UNIVERSIDADE DE LISBOA

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VIDEOGAMES, PERSUASION & DECEIT

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DECLARATION

This dissertation is the result of my own work and includes nothing, which is the outcome of work done in collaboration except where specifically indicated in the text. It has not been previously submitted, in part or whole, to any university of institution for any degree, diploma, or other qualification.

Signed: Luís Duarte

Date: 15th of July, 2014

ABSTRACT

Videogames have grown to be one of the most important forms of entertainment. Designers and developers constantly strive to innovate and include mechanics which provide the best experiences to consumers. Games typically integrate a diversity of instruments and mechanisms (among these, persuasive technology) which attempt to offer players the best experience possible, leading them to a state of optimal experience. The relation between these instruments and their effects on player experience suffer from scarce documentation and empirical sustainment, resulting in a lack of insight regarding how players are affected by them.

This thesis documents how we addressed these research opportunities, tied videogames, persuasive technology and players as well as driven existing knowledge about persuasion forward. This research's goal concerns the gathering of empirical evidence showing that different types of persuasive instruments can be employed in videogames to steer players towards a state of optimal experience. Our analysis focuses exclusively on how these mechanisms impact on the player's performance and emotional state. In addition to this goal, we explored alternative persuasion strategies which are often disregarded due to existing and preconceived negative coverage – deceit. This effort lead us to cover how deceitful persuasive interventions are designed, in what circumstances they are employed and the relation between them and the videogames domain.

Treading throughout these research goals resulted in a set of theoretical and empirical contributions tying both persuasive technology and videogames. We present player experience data supporting the role of persuasive technology in attaining an optimal experience state, addressing both performance and physiological evidence. We also a model, created with the intent of supporting designers and developers in establishing deceitful persuasive interventions. This model is put into practice, allowing us to test and show that deceitful and real persuasive instruments can have equivalent effects on player experience.

Keywords: Videogames, Flow, Persuasion, Deceit, Placebo, User Experience, Performance, Physiology

RESUMO

Nas últimas décadas, o domínio dos videojogos assumiu um lugar de relevo na indústria do entretenimento. O seu rápido crescimento e expansão muito para além dos dispositivos que eram, tradicionalmente, usados para usufruir deste tipo de entretenimento fizeram deste segmento uma área de negócio extremamente apetecível do ponto de vista do investimento e lucros associados. Para além do factor financeiro, esta área serviu de percussor de tecnologias que hoje em dia encontramos nos mais diversos dispositivos e que melhoraram alguns aspectos do nosso quotidiano. Tal como em muitos outros domínios e, em particular no âmbito de aplicações e sistemas informáticos, o objectivo de um videojogo passa por proporcionar a melhor experiência possível aos jogadores.

O conceito de experiência óptima, quer no mundo dos videojogos, quer noutros domínios, está intimamente ligado a um estado psicológico denominado de *flow*. Baptizado na década de 70, trata-se de um conceito que muitas vezes é estabelecido como sendo uma relação entre o estado emocional de uma pessoa e o seu desempenho, fomentando-se o seu equilíbrio para proporcionar experiências agradáveis. Diversos factores podem fomentar este estado: os desafios inerentes do jogo, a destreza do jogador, o suporte social oferecido ou a existência de recompensas aquando da concretização de determinados objectivos. A forma como estes elementos influenciam um jogador, porém, não é totalmente determinística nem linear. Idealmente, um jogador deveria permanecer num estado de *flow*. No entanto, no decorrer do mesmo existem flutuações e desvios que, potencialmente, podem fazer com que o jogador peca o interesse, se aborreça, ou simplesmente conclua que a dificuldade do jogo eclipsa as suas capacidades. Os criadores de videojogos usam uma panóplia de instrumentos capazes de mitigar estas situações na tentativa de levar os jogadores a um estado de experiência óptima.

O leque de instrumentos disponíveis para potenciar o estado de *flow* pode ser mais ou menos alargado. No entanto, existe um conjunto particular cujas características enfatiza a sua relevância para este tema: os mecanismos de persuasão. O principal objectivo destes mecanismos consiste na alteração de comportamentos e / ou crenças de um público-alvo. Nos videojogos, os mecanismos persuasivos são usados de forma a prolongar (por vezes, artificialmente) o tempo de vida de um jogo ou de forma a motivar um jogador a melhorar o seu desempenho de forma consistente. Desta forma é possível estabelecer uma relação que une os três temas apresentados: os videojogos integram mecanismos persuasivos que,

por sua vez, afectam os jogadores de forma a providenciar uma experiência óptima durante o período de jogo. Apesar de ser possível estabelecer esta relação, o conhecimento existente sobre a forma como alguns destes conceitos se relacionam é escasso. Por exemplo, o impacto que diferentes estratégias ou mecanismos persuasivos têm nos jogadores (quer a nível comportamental, quer a nível emocional) não é documentado na literatura existente. Uma análise superficial sobre as características do estado de experiência óptima sugere que este é, tipicamente, atingido a partir de dois estados emocionais distintos:

- Estado de excitação – caracterizado por uma batida cardíaca acelerada. Tal efeito pode provir da ansiedade gerada por um grau de dificuldade inerente ao desafio imposto pelo jogo que ultrapassa as capacidades do jogador, fazendo-o(a) sentir-se frustrado(a) por não atingir os seus objectivos. O desempenho também reflecte este mesmo estado, dado que nestas situações este fica aquém do que seria realmente esperado.
- Estado de relaxamento – o oposto do estado anterior é caracterizado por uma batida cardíaca mais relaxada, também gerada por uma discrepância entre a dificuldade do jogo e as capacidades do jogador. Porém, neste caso, a dificuldade é suficientemente reduzida para que o indivíduo se sinta em pleno controlo dos desafios que lhe são propostos. Reflectindo esta tendência, o desempenho do jogador pode assim ultrapassar aquilo que seria normalmente esperado.

Ainda que existam modelos cujo objectivo se centra em identificar que tipo de mecanismos e instrumentos podem ser utilizados para promover um estado de experiência óptima, o verdadeiro impacto que estes exercem na experiência dos utilizadores ainda está por desvendar. Em particular, o efeito da utilização de mecanismos persuasivos que são encontrados em qualquer videojogo não está documentado, dificultando assim não só a compreensão dos mesmos, mas também o desenho adequado de videojogos. Adicionalmente, o tipo de estratégias utilizadas no domínio dos videojogos pode ser considerado algo estanque. As abordagens mais populares envolvem a utilização de mecanismos de retorno, recompensas ou reforço de modo a transmitir um sentimento de progresso aos jogadores. No entanto, existem outras estratégias que foram utilizadas noutros domínios com sucesso. Entre as quais, surge uma que, nos últimos anos, tem gerado algum interesse por parte da comunidade académica: a dissimulação ou engodo.

Trata-se de uma técnica em que o alvo da persuasão é levado a acreditar num conjunto de conceitos que não são verdadeiros, mas que produzem um efeito persuasivo suficientemente forte para que a pessoa altere o seu comportamento e / ou crenças. Esta abordagem é tipicamente associada a esquemas perversos nos quais os alvos são notoriamente prejudicados. Com o intuito de desmistificar esta conotação negativa, alguns investigadores começaram a explorar a potencialidade desta estratégia ser utilizada com objectivos benevolentes. A dissimulação benevolente mostrou já ter sido bem-sucedida, sendo usada em aplicações online, em procedimentos terapêuticos ou no tratamento de condições de foro psicológico através da administração de medicamentos placebo. A validação se esta estratégia constitui alternativa para o domínio dos videojogos é uma tarefa que ainda se encontra por cumprir.

Com base neste panorama, os principais objectivos deste trabalho foram delineados com o intuito de:

- Obter um conjunto de provas empíricas relacionando o impacto de diferentes mecanismos persuasivos e o comportamento dos jogadores.
- Obter um conjunto de dados empíricos que consigam relacionar o impacto de diferentes tipos de mecanismos persuasivos e o seu estado emocional.
- Averiguar a viabilidade de utilização de estratégias persuasivas baseadas em dissimulação no domínio dos videojogos. Em caso de sucesso, deve-se estabelecer um conjunto de comparações com outras estratégias, focando no impacto comportamental e emocional dos jogadores.
- Estabelecimento de um modelo teórico capaz de caracterizar intervenções persuasivas no domínio dos videojogos, capitalizando na literatura existente, na análise de intervenções existentes e nos resultados obtidos no decorrer do trabalho.

Naturalmente, existem desafios que se revelam, em parte devido à existência de algumas lacunas na literatura actual. Entre os desafios que enfrentamos destacam-se:

- Estabelecimento de uma relação entre o estado de *flow* e a reposta emocional dos jogadores – embora a literatura sobre o conceito de *flow* ofereça algum detalhe sobre os estados emocionais associados ao mesmo, as provas empíricas que corroborem os efeitos de mecanismos externos na experiência dos utilizadores e de que forma estes os afectam do ponto de vista emocional são praticamente inexistentes.

- Estabelecimento de uma relação entre o estado de *flow* e a reposta do desempenho dos jogadores – por razões similares às apresentadas imediatamente acima, não existe conhecimento científico vasto que permita retirar conclusões sobre como se interligam videojogos, mecanismos persuasivos e o efeito destes no desempenho dos jogadores.
- Contextualização e enquadramento da persuasão no domínio dos videojogos – as lacunas acima apresentadas podem ser agregadas de forma a discutir a falta de investigação sobre os efeitos de mecanismos persuasivos em videojogos. Apesar do variado leque de intervenções persuasivas no âmbito dos chamados jogos sérios, pouca ênfase se deu ao impacto dos mesmos instrumentos em videojogos para entretenimento. Tal deve-se à falta de estudos capazes de identificar os instrumentos persuasivos mais comuns neste domínio, a sua relação com a experiência dos jogadores e, finalmente, o seu impacto nos mesmos.
- Enquadrar o conceito de dissimulação no domínio dos videojogos – a escassa cobertura dada à conexão entre videojogos e instrumentos de persuasão afecta, consequentemente, o conhecimento existente sobre técnicas persuasivas de dissimulação em videojogos. Dois importantes desafios surgem neste caso: por um lado lidar com a mistificação que se dá à dissimulação e a toda a sua conotação negativa e, por outro lado, a falta de modelos capazes de caracterizar integralmente uma intervenção persuasiva deste tipo no domínio dos videojogos.

Nesta dissertação apresentamos um extenso estudo sobre o impacto de diferentes tipos de mecanismos persuasivos na experiência dos jogadores, no âmbito dos videojogos. Numa primeira fase centramo-nos na relação entre o estado de *flow*, os videojogos e as tecnologias de persuasão. Aqui se identificaram os instrumentos mais frequentemente encontrados neste tipo de entretenimento, de forma a criar a base sobre a qual os nossos esforços são canalizados. Daqui se extraiu, ainda, a influência esperada que estes mecanismos exercem na experiência dos jogadores, abordando este tópico de forma objectiva e contemplando tanto respostas emocionais como ao nível do desempenho. De forma a reduzir o espaço de estudo, centrámos o trabalho em mecanismos persuasivos baseados em retorno e recompensa, explorando variantes em cada tipo, tais como o uso de mensagens de congratulação ou a disponibilização de métricas de desempenho.

A componente experimental deste trabalho fornece os seus mais importantes contributos. De forma a explorar o impacto dos referidos mecanismos na experiência dos jogadores, foram desenvolvidos dois jogos para plataformas distintas e pertencendo a géneros diferentes, garantindo assim um grau de variedade adequado à validação das nossas hipóteses. Os períodos experimentais contaram com uma adesão respeitável de participantes, contribuindo assim para a obtenção de resultados que são estatisticamente significativos. As contribuições destas experiências dividem-se em duas categorias. A primeira diz respeito ao impacto que diferentes tipos de mecanismos persuasivos têm na experiência dos jogadores, da qual se destaca:

- Impacto de mecanismos persuasivos baseados em retorno – durante as sessões experimentais focámo-nos na influência que determinados instrumentos persuasivos baseados em retorno poderiam exercer nos jogadores. Os principais resultados obtidos apontam em duas direcções distintas: o retorno que encoraja o jogador tem simultaneamente um efeito imediato no desempenho e também uma componente relaxante; o retorno baseado apenas em métricas de desempenho mostrou ter o efeito contrário, levando a um aumento do stress do jogador e a uma deterioração do desempenho do mesmo.
- Impacto de mecanismos persuasivos baseados em recompensas – nas mesmas sessões foi ainda testado um conjunto de abordagens persuasivas baseadas na oferta de recompensas. Os resultados favoreceram as nossas hipóteses, revelando que este tipo de estratégia é capaz de afectar a experiência dos jogadores dado o aumento significativo do desempenho dos mesmos e a redução da sua batida cardíaca ao longo do período de jogo.

A segunda categoria de contribuições concerne o estudo das flutuações da experiência dos jogadores de forma a conduzi-los a um estado de *flow*. Assim, destacam-se algumas transições encontradas, nomeadamente:

- De um estado de ansiedade para um estado de *flow* – uma das transições possíveis para o estado de *flow* advém de um estado de ritmo cardíaco elevado e de fraco desempenho, tipicamente associados a situações de excitação ou ansiedade. Nestas experiências mostrámos empiricamente que conseguimos, através da inclusão de mecanismos persuasivos, reduzir o ritmo cardíaco dos jogadores enquanto aumentavam o seu desempenho, podendo assim atingir o estado de *flow*.

- De um estado de relaxamento ao estado de *flow* – um segundo tipo de transição está relacionado com a passagem ao estado de *flow* proveniente de um estado de relaxamento ou tédio, caracterizados por um ritmo cardíaco reduzido e alto desempenho. Através dos nossos períodos experimentais foi possível mostrar que alguns mecanismos persuasivos revelam uma tendência para potenciar a deterioração do desempenho dos jogadores, enquanto aumentam o seu ritmo cardíaco. Assim, foi possível cobrir os principais tipos de transições possíveis para o estado de experiência óptima.

No âmbito destas experiências surgiu um resultado que, inesperadamente, se adequa a técnicas de persuasão baseadas em dissimulação. À luz deste cenário, elaborou-se um plano que teve como ponto de partida a validação dos resultados parciais obtidos até ao momento para este tipo de mecanismo. O terceiro período experimental reportado nesta dissertação teve como objectivo averiguar o impacto de estratégias persuasivas baseadas em dissimulação. Em particular, restringimos o tipo de mecanismos usados para recompensas do tipo placebo. Os resultados empíricos obtidos revelaram que:

- Instrumentos persuasivos baseados em placebos podem afectar a experiência dos jogadores. Tal como as suas versões reais, estes instrumentos foram capazes de não só exercer um efeito relaxante, reduzindo progressivamente o ritmo cardíaco, mas também produzir um aumento significativo no desempenho dos jogadores. Com estes resultados, conseguimos mostrar que é possível recorrer a estratégias que, tipicamente, possuem uma conotação negativa junto da população e orientá-las de forma a serem benéficas para os utilizadores.
- Existe uma relação de proximidade relativamente ao impacto que mecanismos persuasivos baseados em placebos e as suas versões reais têm na experiência dos jogadores. Apesar de numa abordagem céptica se poder pensar que a ausência de qualquer comportamento num mecanismo baseado em placebo não terá qualquer efeito num jogador, os resultados obtidos neste trabalho mostram o contrário. Embora a influência na componente emocional da experiência do jogador pudesse ser esperada, dados os exemplos oriundos da área da medicina, a extensão deste impacto ao desempenho dos jogadores não era de todo expectável. Ainda assim, os

resultados revelam que não existem diferenças significativas entre o aumento do desempenho nas versões reais e placebo dos instrumentos persuasivos usados.

O último passo deste trabalho de investigação consistiu na elaboração de um modelo de persuasão que fosse não só capaz de caracterizar intervenções persuasivas em videojogos, mas que também tivesse em conta estratégias alternativas tais como as que foram abordadas neste trabalho. Dadas as limitações existentes na investigação nesta área em particular, elaborou-se um plano que teve como ponto de partida o levantamento do trabalho relacionado mais relevante na área da dissimulação, pesquisando a forma como esta é usada no quotidiano e mediada através de tecnologia. De forma a garantir uma contribuição sólida no domínio dos videojogos, analisámos também a forma como o engodo e a dissimulação estão presentes nos mesmos. Para além destes aspectos, direccionámos parte desta pesquisa para a compreensão de mecanismos dissimulativos com efeito benevolente nos jogadores, tentando assim desmistificar os preconceitos existentes relativamente a esta área da persuasão. Como principais contribuições deste exercício, destacamos:

- Desenho de um modelo de caracterização para intervenções persuasivas com recurso à dissimulação no âmbito dos videojogos – com base na literatura existente, foi possível elaborar um modelo que tem com objectivo dar suporte ao desenho de intervenções persuasivas com recurso à dissimulação em videojogos. Este modelo tem como base um conjunto de conceitos inerentes ao uso de dissimulação em variados cenários totalmente adaptados aos requisitos dos videojogos, limitando assim o leque de características e focando nas estratégias que potencialmente têm mais sucesso em atingir os objectivos propostos. Existem vários factores que podem contribuir para o desenho de um instrumento deste tipo. Entre eles, destacam-se as entidades envolvidas no processo (autor e alvo(s) da persuasão), o impacto esperado que o processo tenha ou a estratégia envolvida.
- Extensão do mesmo modelo para contemplar instrumentos persuasivos com recurso à dissimulação benevolente – considerado no âmbito desta investigação como um sub-domínio da dissimulação, o uso da mesma para fins benevolentes foi investigada de forma a reunir um conjunto de características encontradas em alguns exemplos presentes na literatura. Este exercício teve como resultado uma extensão de forma a contemplar o desenho de instrumentos persuasivos baseados

em dissimulação mas cujo objectivo seja benéfico para os jogadores. Esta extensão contempla outras características para além das estipuladas no modelo original, atendendo, entre outros, ao tipo de instrumentos utilizados, motivação por trás da intervenção ou o tipo de oportunidade explorado para atingir o fim pretendido.

Este exercício teórico foi validado em três frentes distintas:

- Validação com os jogos experimentais criados no âmbito desta investigação – dado que cada jogo possuia um conjunto diversificado de mecanismos persuasivos tradicionais e baseados em dissimulação, foi realizada uma caracterização dos mesmos baseado no modelo proposto.
- Validação com um conjunto de videojogos disponíveis no mercado e que contemplem conceitos de dissimulação – com o intuito de responder à realidade do mercado de videojogos, foi realizado um mapeamento das características das intervenções persuasivas presentes num grupo de videojogos que contemplem dissimulação. A selecção foi criteriosa de forma a contemplar diferentes géneros e estratégias persuasivas.
- Validação com um conjunto de videojogos disponívei no mercado sem necessariamente recorrerem à dissimulação – de forma a validar totalmente o modelo proposto, procedeu-se à caracterização de videojogos cujos mecanismos persuasivos não estivessem relacionados com estratégias de dissimulação.

Este processo de validação foi concluido com sucesso em todas as fases, demonstrando que o modelo proposto é uma mais-valia para este tipo de caracterização, oferencendo um notável contributo sobre os modelos existentes na literatura actual. Com esta contribuição obteve-se um equilíbrio entre os resultados empíricos e teóricos que foram originados no âmbito deste trabalho de investigação.

Palavras-Chave: Videojogos, Flow, Persuasão, Dissimulação, Placebo, Experiência de Utilização, Desempenho, Fisiologia

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GLOSSARY

Action Games – videogames where players participate in events which are often packed with stimulating sequences, often indulging in midly violence themes, in order to surpass the challenges issued by the game.

Arcade Games – a coin-operated entertainment machine, usually installed in public businesses, such as restaurants, bars, and particularly amusement arcades. Most arcade games are video games, pinball machines, electro-mechanical games, redemption games, and merchandisers (such as claw cranes).

BCI (Brain Computer Interface) – a direct pathway between an individual's brain and an external device.

ECG (Electrocardiogram) – a test that records the electrical activity of the heart. It shows how fast a heart is beating, whether the rhythm of the heartbeat is steady or irregular and the strength and timing of electrical signals as they pass through each part of the heart.

EMG (Electromyogram) – a test that measures the electrical activity of muscles at rest and during contraction. Signal retrieval is typically ensured by an eletromyograph, an instrument that converts the electrical activity associated with functioning skeletal muscle into a visual record or into sound.

EOG (Electrooculugram) – a record of the difference in electrical charge between the front and back of the eye that is correlated with eyeball movement and obtained by electrodesplaced on the skin near the eye.

Boss Battle / Final Boss – a boss is an enemy-based challenge (and a computer-controlled opponent in such a challenge). A fight with a boss character is commonly referred to as a boss battle or boss fight. Boss battles are generally seen at the climax of a particular section of the game, usually at the end of a stage or level, or guarding a specific objective, and the boss enemy is generally far stronger than the opponents the player has faced up to that point.

FPS (First-Person Shooter) – videogames in which players control their character through his / her eyes, providing an experience that attempts to simulate being the character him / herself. FPS games are mostly connotated with military shooters in which players adopt the role of a soldier fighting in diverse conflict zones.

GSR (Galvanic Skin Response) – a change in the electrical resistance of the skin that is a physiochemical response to emotional arousal which increases sympathetic nervous system activity.

HBR (Heartbeat Rate) – the number of times the heart beats per minute (the recording of a single heartbeat which corresponds to the depolarization of the right and left ventricles).

HRV (Heart Rate Variance) – the time gap between the heart beats that varies as individuals breathe in and out. It is measured by the variation in the beat-to-beat interval.

MMORPG (Massive Multiplayer Online Role-Playing Game) – videogames played exclusively online in which players engage in a vast virtual world and are required to play with several other human players in order to surpass the challenges issued to them. A MMORPG often includes their own economical ecossystem.

Platforming – videogames in which players controls characters traverssing levels which are comprised of a set of platforms and inhabitting by a diversity of enemies, creating artificial challenges and puzzles.

Racing Games – videogames where players engage in races, either in tracks or in scenic courses, against human or artificially controlled opponents. The degree to which vehicles can be customized differs greatly, creating a broad spectrum of games in this genre and spawning a couple of noteworthy sub-genres: arcade racing games and racing simulators.

Rhythm Games – videogames in which players are required to quickly respond to commands issued to them. Music rhythm games are one of the most popular examples, allowing players to mimic playing guitars, drums, bass or mixing tables.

RPG (Role-Playing Game) – videogames in which players are typicaly allowed to create or customize their own character to a great extent in order to embark on a journey during which they find other characters, allies and enemies.

RTS (Real-Time Strategy) – videogames in which players are required to employ management skills in real-time to overcome the challenges issued to them. Sub-genres greatly vary from city management, life management or military control.

Simulation Games – videogames which comprise an above average sense of realism in determined areas. Racing games typically include advanced physics engines and vehicle configuration options, whereas strategy games may include advance financial models capable of mimicking real-world market fluctuations.

Stealth-Based Games – videogames in which players are encouraged to recur to trickery and deceit to surpass challenges, instead of brute-force via, more traditional, direct conflict.

TPS (Third-Person Shooter) – videogames in which players control their avatar using a perspective which allows them to see their character partially (common in over-the-shoulder perspectives) or in its entirety from their back.

1 INTRODUCTION

Videogames are currently one of the most important segments within the entertainment industry. Annual ESA reports shows a growth tendency from 2007 to 2010, where revenues have gone up from US$9.5 billion to US$25.1 billion, respectively. As of 2011, the videogame industry was valued at US$65 billion (Reuters, 2011). According to Gartner Inc., this value is rapidly growing, having surpassed the US$90 billion mark in 2013 and estimated in breaking the US$110 billion milestone by 2015 (Gartner, 2013). Over the years, both developers and consumers started to view videogames as being useful for more than just pure entertainment. Games have since been deployed for benevolent causes. For instance, they have been used as the driving force behind behavior changes for promoting a less sedentary life (Yim & Graham, 2007), improving personal well-being (de Oliveira, Cherubini, & Oliver, 2010; Jung, Li, Janissa, Gladys, & Lee, 2009) or increasing healthy behavior awareness (Chiu et al., 2009). The areas of intervention are as diverse as therapy (Bartle et al., 2010), rehabilitation (Gouaïch, Hocine, Van Dokkum, & Mottet, 2012) and sports (Selvadurai, 2010). Whether the game's purpose is related with purely entertaining people or it is connected with a nobler goal, videogames typically entice players to: perform adequately and steadily increase their skill-set within it; enjoy the experience; if possible, have fun. These factors are intrinsically related and have been subject of research by Csíkszentmihályi when coining the concept of flow (Csíkszentmihályi, 1975).

Flow is a mental state related to how a person is immersed, enjoys and is involved in the process of carrying out a specific task (M. Csikszentmihalyi, 1990) – a state which is also referred to as the optimal experience. Even though the concept was not originally defined specifically for the videogames domain, over the years researchers noticed the similarities between the characteristics of both flow and games (Sherry, 2004). Models and frameworks have emerged (Jones, 1998) detailing what is commonly denominated as the dimensions of flow (i.e. concepts which are defined as contributors to the process of attaining the flow state) and the requirements for their presence in videogames. In spite of these research efforts, little relevance has been given to the catalysts and vehicles used in videogames to drive players into that optimal experience state. Using a theoretical perspective, some researchers have explored how designers should accommodate the aforementioned catalysts within a game (Cowley, Charles, Black, & Hickey, 2008). However, the actual effect that those catalysts exert on a player remains shrouded in mystery.

Understanding the impact that the referred vehicles and catalysts of flow have on players is paramount for a diversity of reasons. First, both designers and researchers would have rich information addressing how each vehicle influences players as a far as achieving their flow state is concerned. Such expertise paves the way for the creation of well-thought experiences capable of providing a pleasant time to the player. This benefit can be extended towards mitigating the chance of a player growing tired of a videogame. Lastly, this knowledge can benefit amateur videogame designers. During the past decade several games have encouraged players to go beyond their consumer role and explore their abilities as content creators. “Minecraft” (Mojang, 2011), “Little Big Planet” (Molecule, 2008) and “Modnation Racers” (U. F. Games, 2010) are quintessential videogame examples which popularized this strategy. The emergence of easy-to-use game development tools and frameworks such as Game Maker (Y. Games, 1999), XNA (Microsoft, 2004) and Unity (Technologies, 2005) also broadened the spectrum of potential game creators around the globe. While this openness brings added value to this segment of the entertainment industry, it can also generate content which does not abide to existing game design guidelines. Furthermore, users may create games / levels which are designed in a way that steers players away from an enjoyable experience, leading them to forfeit their interest in it. Being knowledgeable about what mechanisms can lead a player towards the optimal experience and how they affect players can help in circumventing these issues.

1.1 Motivation

We introduced the importance of addressing the process of driving players towards a state of optimal experience in order to provide them with a pleasant, fun and enjoyable gameplay period. We also mentioned that certain catalysts or instruments can be deployed to fuel this process. However we are yet to elaborate on what these instruments are, how they materialize themselves in videogames and how they are characterized.

Existing literature suggests that some elements within a videogame can foster the optimal experience. These may include the usage of compelling storytelling, the inclusion of rich and informative feedback elements, collectible items, puzzle solving challenges and rewarding players for their accomplishments. If we look at these examples, we can elaborate on how they can potentially steer players towards a flow state using different strategies. However, they also possess some common points. For instance, the usage of feedback to praise the players' performance or warn them to improve their focus can act as a motivator for better performance and experience. Likewise, the inclusion of collectible items can entice players to keep playing the game and extend their experience until they have collected everything. Rewarding players for their achievements is another form of motivation, as players can feel the urge to surpass determined challenges to gain access to specific rewards. Even storytelling can produce a motivational effect in order for the player to keep playing and witness the story unfold. Videogames, players and the aforementioned instruments to attain flow are intrinsically tied to each other. Figure 1.1 displays our vision of how this concept triad is organized.

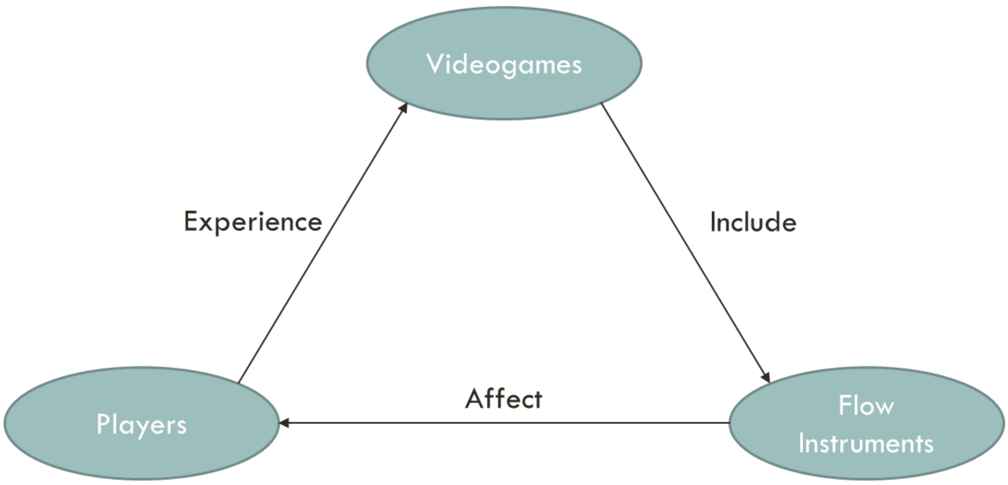


Figure 1.1 – Relating Players, games and the Instruments of Flow

Videogames include certain “flow instruments” which are able to affect players during gameplay period. As previously hinted, these instruments may assume different forms, despite sharing common traits. They are present to lead the players to adopt certain behaviors or attitudes within the game; their presence also acts as a vehicle to compare one’s performance to another, motivating players into excelling against their opponent(s), whether they are human or artificially controlled. This motivational nature is linked with a category of technological features which are present in everyday applications: persuasive technology.

Persuasive technology consists in a set of instruments which, according to existing definitions, attempt to:

- “change attitudes or behaviors or both without using coercion or deception”

This definition, by B. J. Fogg (Fogg, 2002), is used for software applications in general and thus can be extended to videogames in particular. Existing literature suggests that persuasive strategies can impact on a player’s health (Soler, Zacarías, & Lucero, 2009). Other examples show how other peers intervening in the play experience can exert some influence on the players’ enjoyment of the activity. Unfortunately, there is no evidence addressing how specific persuasive strategies and instruments can steer players towards the optimal experience state. In particular, there was no attempt to identify potential relations between those strategies / instruments and their impact on the players’ experience and behavior during the gameplay period. Can these mechanisms improve a player’s performance? Can they stress players? Can they be used to actively decrease the player’s performance? These are some of the questions currently unanswered by existing literature and which we want to provide closure to by the end of this document.

1.1.1 Exploring Persuasive Technology in Videogames

Persuasion is omnipresent in our lives. Product placement (Ip, 2009), advertisements (Saari, Ravaja, Laarni, Turpeinen, & Kallinen, 2004), politics discourses (Mutz, 1996) or corporate performance benchmarks (Bogan & English, 1994) are some of the existing approaches to (de)motivate an individual into adopting determined behaviors and / or creeds. Technology has contributed towards the advancement of these techniques. Its mediation has propelled interesting changes advocated by examples which depict large displays showing advertisements tailored to the interests of a specific individuals when they stroll near that equipment or directly sending those adverts to their smart-phones (Narayanaswami et al., 2008).

Videogames are no exception. Recent developments have garnered the media's attention not only due to product placement strategies (Durrani, 2009; Rio, 2013), but also due to their usage as a vehicle for political campaigns (Sinclair, 2008). Persuasive technology's momentum in the videogame domain increased in recent years with the advent of serious games. Designers and experts from different domains explored the virtues of videogames (e.g. fun and enjoyment) as a way to motivate individuals into carrying out otherwise dull tasks. A quick glance at existing literature clearly shows a considerable amount of successful serious games deployments in which there were noticeable changes in the target demographics' behaviors (Wouters, van Oostendorp, & van der Spek, 2010). These results testify that the power and potential of persuasive technology can go way beyond what a product / service original intentions.

Regardless of the game's nature, players have been confronted with the broadest variety of persuasive cues, ever since their introduction in the popular arcade saloons in the 80s. High-score charts, collectible items or power-ups are all persuasive strategies deployed to entice players into dedicating themselves even more to the game, and thus spend more time (and coins) playing it. Pinpointing the relation between the existing persuasive cues and their actual impact on the target user(s) remains unexplored territory. This type of data can be pivotal in game design: human beings are complex creatures whose behavior and psyche may be influenced by a myriad of factors. Understanding which particular persuasive strategies (e.g. whether feedback, rewards or social pressure is being used) are more prone to alter the users' behavior, those which are more effective at impacting on their emotional state or those which may be used to regulate their performance is an exercise yet to be conducted and whose impact on existing expertise on videogames and persuasive technology can be defined as a step forward to create content with higher odds of being enjoyed.

1.1.2 Beyond Traditional Persuasion

The persuasive strategies examples depicted in this motivation are those which are mostly connected with the act improving certain aspects of a target user's performance and / or quality of life. In short, those are examples of persuasive strategies linked with good-deeds. Nevertheless, documented History is full of examples of shady persuasive interventions whose nature is not as positive as the previously mentioned ones. For instance, deception has played a major role throughout times: the success of major military operations depended on it (ComNavEu, 1946) and it is also behind some of the great propellers of the economic crisis lived since 2008 (Shedlock, 2008). These and other established examples have generated a tendency to give deception a negative connotation and typically use it as a strategy which relies on someone taking advantage of another.

The second half of this research's motivation builds on the work carried out by a few researchers in recent years within this particular field. They began assessing the potential of deceit as a plausible strategy to benefit users. Instead of using deceit to capitalize on a person or entity's naivety to hamper them, the goal is to use it for the user's own benefit. Existing literature testifies that technology mediated deception can be applied to improve one's experience with a product or service (Wang & Zhao, 2011) or quality of life (Quetteville, 2008). Driven by these examples, we aimed at exploring how deceit can be a viable option as a persuasive approach in videogames. Our analysis suggests that some endeavors are tied with clever usage of storytelling mechanics. Other examples use deceit as a core gameplay mechanic, detracting from established and more traditional gameplay approaches to provide different experiences to players. Little to no attention has been given to deceit in slightly different settings: for instance, masquerading players' performance in order to motivate them to excel on future play periods.

Whether these approaches are possible, plausible and more importantly, effective in impacting on player experience remains unanswered. Breaking new ground in this theme not only introduces novel design approaches to the videogames domain, but also helps in reshaping an established definition of persuasion, broadening its scope and renewing the spectrum of possible strategies, at the least, for the videogames domain.

1.2 Challenges

The path to collect evidence regarding the impact of different instruments of flow on player experience is sinuous to the point of constantly challenging us as researchers to find the best approaches to tackle the research's objectives.

1.2.1 Tying the Optimal Experience to Performance and Emotional Responses

As hinted, one of our goals consists in steering players into a state of optimal experience where their performance potential is stimulated while having some consideration for how the user responds emotionally to the triggers of that change. While we have referred to the optimal experience, player performance and affective response throughout this motivation, it is still unclear whether or not they are linked with each other. There is evidence that performance is tied with the flow state and that it is also connected with the way users react emotionally. However, little to no relevance has been given to how the three elements factor into each other, with the possibility of creating a triad establishing cause and effect events.

1.2.2 Framing Persuasive Technology within the Videogames Domain

Despite centering our motivation within the videogames domain, the concept of flow was originally introduced to support everyday tasks. Over the years, researchers noticed an almost perfect overlapping of flow theory to the reality of videogames, devising models and frameworks to support the exploration of ideas related with these two concepts. While there are some exercises addressing the potential strategies used to reach that optimal state, poor focus has been given on how those strategies are actually materialized in videogame features or functionalities. One of the challenges ahead of us lies in exploring how persuasive instruments materialize themselves in videogames. This effort builds on existing literature in the area and our analysis of existing and representative videogames from multiple genres.

1.2.3 Defining Deceitful Persuasion in Videogames

Research addressing technology mediated deceitful persuasion is still coming out of its embryo" status and taking some steps into being a recognized field. Still, there is a significant amount of ground to cover, ranging from defining foundation-worthy concepts to the establishment of models, taxonomies and / or frameworks capable of better describing these strategies. The inexistence of a formal way to describe technology mediated persuasion in existing literature is a significant hindrance to those willing to drive existing knowledge further.

Our overview of the literature on the area allowed us to identify a set of authors who have strived to define deceit in the context of general persuasive strategies (Mechner, 2010) and establish how technology can play any role in improving these approaches (Adar, Tan, & Teevan, 2013). Tying these concepts to the reality of videogames is an effort which, to our knowledge, is yet to be tackled. One of the challenges we faced concerned the comprehension of how videogames, persuasion and deceit connected with each other and whether or not they produced any impact on player experience. The lack of expertise in this field was further aggravated when extending our work towards benevolent deception – an area of research even less exploited by researchers and designers alike.

1.2.4 Designing for Deceit

The absence of frameworks for the design and establishment of deceitful persuasion interventions is a caveat present existing research in this domain. Its impact is felt in the lack of conformity and harmony of existing research as well as in the relatively simplistic (albeit sometimes detached) way in which deceit is applied in videogames. As mentioned before, most videogames utilize deceit intermingled with either its storyline or the core gameplay mechanics. Other persuasive approaches are often not depicted as having deceitful counterparts, and much less benefitting from a benevolent nature.

Designing technology mediated deceitful persuasive interventions is thus a non-standardized process which relies solely on the designers' ability to create meaningful, purposeful and adequate pieces. Our interest in assessing the impact of deceitful persuasive instruments on player experience faces this hindrance, as there is no reference point which describes what is a proper deceitful persuasive intervention or instrument.

This challenge can obviously be turned into an enticing research opportunity, allowing us to build on existing literature in the area and formulate a set of guidelines and design directives for the creation of deceitful persuasive interventions and instruments.

1.2.5 Summary

The definition of these challenges serves two purposes: on the one hand it identifies current caveats within the domains tackled in this research; on the other hand it allows us to establish potentially interesting contributions for these domains. The presented challenges are divided in two categories: the first duo pertains to the establishment of meaningful relations between player performance, emotional response and the optimal experience; the second pair addresses relevant caveats which characterize existing research on deceit. Throughout this document we will tackle each these challenges, sometimes implicitly in the review of existing work while in other occasions they will be fully examined as part of our contributions.

1.3 Research Goals

Existing literature in relevant areas for this research displays some noticeable caveats concerning the impact of persuasive instruments on player experience and how the optimal experience can be attained via the materialization of flow-related mechanics within a game. While a certain degree of convergence was witnessed in the way player experience can be assessed, the actual process of accounting the influence of specific instruments on that experience is virtually inexistent. If we extend this panoramic towards the current expertise on the usage of technology mediated deceit in the videogames domain (or other fields as well), even more research opportunities emerge.

Faced with a somewhat grim scenario and building on both the motivation provided as well as on the existing challenges, we established the following objectives for this research:

- Gather empirical evidence which shows that persuasive instruments can be used to steer players towards an optimal experience state.
  - Show that persuasive instruments are capable of significantly impacting on the players' emotional response.
  - Show that persuasive instruments are capable of significantly impacting on the players' performance figures.

The challenges awaiting us concerning the usage of deceitful persuasive interventions are even more daunting. Unlike the previous goals, literature within this domain is relatively scarce, a fact further aggravated if we take into account how technology is tied to it. Still, and based on the identified challenges, there are very interesting opportunities which can be materialized as research goals. The following describe our intentions within this specific field:

- Establish a model addressing the interventions in videogames.
  - Guarantee that the model is capable of covering deceitful instruments for videogames.
- Collect empirical evidence showing that deceitful persuasive instruments can steer players towards an optimal experience state.
  - Show that deceitful and real persuasive instruments have no significant differences between each other on player experience.
  - Show that deceitful persuasive instruments can be used benevolently to benefit a player.

1.4 Research Audience

Ultimately who can really benefit from the knowledge produced from this research? In the context of today's world and existing trends within consumer applications and videogames, we envision that the following stakeholders can gain valuable expertise from the findings reported in this document:

- **Professional Researchers and Videogame Designers** – some videogame software houses are known to hire and maintain user research teams encompassing highly specialized individuals in understanding player experience. For instance, Valve has given a glimpse of their evaluation methods in a presentation at the Games Developers Conference in 2011 (Ambinder, 2011). However, these studios typically do not release user research data, keeping those records for internal usage. In the end, this can lead to different studios repeating experiments which may be similar in their procedure and goals. The evidence extracted from this research can reduce some of that effort by immediately pointing the expected impact that particular instruments of flow have on user experience.
- **Amateur Videogame Designers** – throughout the last decade we have witnessed a significant growth in what is labeled as user generated content. Videogames like "Minecraft" (Mojang, 2011) and "Little Big Planet" (Molecule, 2008) offer individuals with no programming skills and with no training in videogame design with the tools to create their own worlds, characters and levels and then share them with the community. This phenomenon is being further emphasized via the availability of some tools and frameworks which ease the burden of creating fully functional games. Microsoft's XNA framework (Microsoft, 2004) and Game Maker (Y. Games, 1999) are examples of this approach. Given the potentially low level of expertise of this population, the findings collected within the context of this work may be of relevance towards the creation of improved games by amateur designers.
- **Domain Experts** – the design of a serious game for a specific end is typically a multidisciplinary exercise which capitalizes on the expertise of videogame designers (those with the actual skill to design the game) and domain experts (those with the knowledge about the problem being addressed). With this knowledge, domain experts can increase their participation in the design process, knowing in advance the expected outcome of specific design choices allowing them to consider the adequacy for the issues being addressed.

1.5 Contributions

This work's contributions were divided among three categories. Scientific contributions were collected as a vehicle to enrich and advance existing knowledge in the domains of videogames and persuasive technology. Theoretical contributions encompass the conceptual frameworks envisioned in the context of this research. Finally, software contributions include all tools and applications implemented to support the experiments and allow us to achieve the appointed research goals.

1.5.1 Scientific Contributions

Scientific contributions encompass the most important, impacting and relevant results which emerged during the course of this research. As a work centered in human factors, it comes naturally that the main outcome is tied with the advancement and introduction of new knowledge concerning the videogames and persuasion domains. We were able to retrieve empirical evidence showing that:

- Persuasive instruments can be used as driving factors to lead a player into a state of optimal experience.
- Different persuasive approaches can actively influence a player's emotional response.
- Persuasive strategies are able to significantly impact on a player's performance.
- User behavior during gameplay period can be affected by persuasive cues.
- In a videogame, persuasive instruments can overlap each other's influence on player experience.
- Placebo persuasive instruments produce equivalent effects on player experience as their real counterparts, indicating they can act as full replacements to the latter.

1.5.2 Theoretical Contributions

The following theoretical contributions were also derived from this research:

- A unified persuasion model capable of covering both traditional persuasive interventions and deceitful ones.
- A revised definition of persuasive interventions.

1.5.3 Software Contributions

Some development work was necessary to mostly respond to the requirements assessing the effects of a variety of persuasive strategies. As such, two games were created:

- **Wrong Lane Chase** – an arcade racing game developed for Windows PC platforms.
- **Ctrl-Mole-Del** – a rhythm game developed for Windows PC and Windows Mobile 6.0 platforms.

1.6 Publications

This research originated the following publications, organized by publication year:

2013

- Luís Duarte and Luís Carriço. 2013. The cake can be a lie: placebos as persuasive videogame elements. In CHI '13 Extended Abstracts on Human Factors in Computing Systems (CHI EA '13). ACM, New York, NY, USA, 1113-1118.

2012

- Luís Duarte, Luís Carriço. ""Blue pill or red pill?" Placebo Effect and the Outcome on Physiological & Player Performance Metrics". In Proceedings of Fun & Games 2012, Toulouse, France, 2012.

- Luís Duarte, Luís Carriço. "Power me Up! An Interactive and Physiological Perspective on Videogames' Temporary Bonus Rewards". In Proceedings of Fun & Games 2012, Toulouse, France, 2012.
- Luís Duarte, Tiago Antunes, Luís Carriço. "Can you feel it? Sharing heart beats with Augmento". In Proceedings of Augmented Human 2012, Megève, France, 2012.
- Luís Duarte, Luís Carriço. "User Performance Tweaking in Videogames - a Physiological Perspective of Player Reactions". In Proceedings of Augmented Human 2012, Megève, France, 2012.

2011

- Luís Duarte, Luís Carriço. "The Influence of Performance-Oriented Widgets on Interactive Behavior while playing Videogames". In Proceedings of ACE 2011, Lisbon, Portugal, 2011.
- Luís Duarte, Luís Carriço. "Coupling Interaction & Physiological Metrics for Interaction Adaptation". In Proceedings of Interact 2011, Lisbon, Portugal, 2011.

2010

- Luís Duarte, Marco de Sá, Luís Carriço. "Utilização de Dados Fisiológicos na Avaliação de Aplicações Móveis". In Proceedings of Interacção 2010, 4th National Conference in Human Computer Interaction, Aveiro, Portugal, 2010.
- Luís Duarte, Marco de Sá, Luís Carriço. "Physiological Data Gathering in Mobile Environments". In Extended Abstracts of UBICOMP 2010, Copenhagen, Denmark, 2010.
- Luís Duarte. "Interaction Assessment through Physiological Interfaces in Collaborative & Mobile Environments". In Proceedings of the 12th International Conference on Human Computer Interaction with Mobile Devices, MobileHCI 2010, Lisbon, Portugal, 2010.
- Inês Oliveira, Ovidiu Grigore, Nuno Guimarães, Luís Duarte. "Relevance of EEG Input Signals in the Augmented Human Reader". In Proceedings of the First Augment Human International Conference, ISBN: 978-1-60558-825-4, Megève, France, 2010.

- Luís Duarte, Luís Carriço. “The Unconventional Interaction Library: Tackling the Use of Physiological Interaction Modalities”. In Proceedings of C5, Conference on Creating, Connecting and Collaborating through Computing, San Diego, CA, USA, 2010.

2009

- Inês Oliveira, Luís Duarte, Nuno Guimarães, Luís Carriço, Ovidiu Grigore. “Towards Coupled Interaction – Practical Integration of Physiological Signals”. Berliner Werkstatt Mensch-Maschine-Systeme, 2009.

1.7 Legacy

The work (and respective results) described in this thesis has served as the inspiration for other research projects carried out at the University of Lisbon. Two MSc theses have benefitted from the methodology and rationale behind this research, capitalizing on a set of characteristics which improved their analysis processes and subsequent result examination. One other project in which the knowledge generated by this thesis was influent concerns the envisioning and creation of Augmento – a platform for sharing

emotions in location-based experiences. This thesis’ influence on each of these endeavors was as follows:

- **MEGA (Mobile Multimodal Extended Games)** – this work encompassed the creation of multimodal mobile puzzle games, exploring this genre beyond the usual visual jigsaw version. Among the contributions of this work we emphasize the analysis of player performance and puzzle solving strategies in both visual and audio puzzles. The approach followed to achieve those contributions was similar to the performance analysis employed in this research, aiding in the comprehension of not only the metrics involved, but also on the human factors tied with the act of playing videogames. This research was performed by Jaime Carvalho and supervised by Prof. Luís Carriço, attaining a final grade of 18 out of 20.

- **ExodUS (Exergames for Ubiquitous Scenarios)** – the focus of this work resided in investigating the influence that specific types of persuasive mechanisms have on amateur athletes which utilize mobile exertion applications. Besides an application which features numerous persuasive approaches to accompany individuals in their exercise activities, the contributions also encompass a subjective analysis concerning how individuals perceive those instruments to impact on their performance and on their motivational levels. ExodUS capitalized on this thesis' work on two fronts: the design of the persuasive instruments and on identifying the relevant variables and metrics for the final evaluation of the developed system. This research was performed by Paulo Ribeiro, supervised by Prof. Luís Carriço and co-supervised by myself, attaining a final grade of 16 out of 20.
- **Augmento (Reinforcing Bonds with Augmented Mementos)** – this was a system that capitalized on the expertise gained while working with physiological sensors. The rationale behind it involved people sharing experience with each other. However, more than sharing words, pictures, sounds or videos we designed the system to also share an individual's heart rate. In the proof-of-concept prototype we utilized an ECG sensors (the same used in this research) to retrieve data and smart-phone vibration to replicate the patterns to other users. This system was proposed and presented at the 13th IFIP TC13 Conference on Human-Computer Interaction (Interact 2011) Student Design Competition, achieving the second place prize.

1.7.1 Related Publications

These works spawned some publications in national and international peer-reviewed conferences. The list is catalogued according to the presented research:

MEGA:

- Jaime Carvalho, Luís Duarte, Diogo Marques, Luis Carriço. "Puzzles: Explorando Designs Multimodais". In Proceedings of Inforum 2012, Almada, Portugal, 2012.

- Jaime Carvalho, Luís Duarte, Luís Carriço. "Puzzle Games: Player Strategies across Different Interaction Modalities". In Proceedings of Fun & Games 2012, Toulouse, France, 2012.
- Jaime Carvalho, Luís Duarte, Luís Carriço. "An Analysis of Player Strategies and Performance in Audio Puzzles". In Proceedings of the International Conference on Entertainment Computing 2012 (ICEC), Bremen, Germany, 2012.

ExodUS:

- Luís Duarte, Paulo Ribeiro, Tiago Guerreiro and Luis Carriço. A Preliminary Assessment of Physical & Virtual Presence in Exergames. In Proceedings of the 28th British HCI Conference, Southport, United Kingdom, 2014.
- Luís Duarte, Paulo Ribeiro, Tiago Guerreiro and Luis Carriço. Defining a Design Space for Persuasive Cooperative Interactions in Mobile Exertion Applications. In Proceedings of the 20th Conference on Collaboration and Technology (CRIWG 2014), Santiago, Chile, 2014.

Augmento:

- Luís Duarte, Tiago Antunes, Luís Carriço. "Can you feel it? Sharing heart beats with Augmento". In Proceedings of Augmented Human 2012, Megève, France, 2012.

Other:

- Luís Duarte, Luís Carriço. "The Collaboration Platform: a Cooperative Work Case-Study". In Proceedings of C5, Conference on Creating, Connecting and Collaborating through Computing, San Diego, CA, USA, 2010.
- Luís Duarte, Marco de Sá, Luís Carriço (2009). "Exploring Multimodal Interaction in Collaborative Settings". In Proceedings of the 13th International Conference, HCI International 2009, San Diego, California, USA, 19-24 July, Lecture Notes in Computer Science, vol. 5611 /2009, pp. 19-28, Springer-Verlag: Berlin/Heidelberg, July 2009. ISBN: 978-3-642-02884-7.

- Luís Carriço, Luís Duarte, Marco de Sá, Rogério Bandeira, Pedro Antunes (2009). "Tackling Collaborative-Design of Mobile Prototypes". The 13th International Conference on Computer Supported Cooperative Work in Design (CSCWD'09), Santiago, Chile, April 22-24, IEEE Press, April, 2009. BEST PAPER AWARD.
- Luís Duarte, Luís Carriço. "A Session Engine Approach for Synchronous Collaborative Environments". In Proceedings of C5, Conference on Creating, Connecting and Collaborating through Computing, ISBN: 978-0-7695-3620-0, pp. 144-150, Kyoto, Japan, 2009.
- Luís Duarte, Marco de Sá, Luís Carriço (2008). "Collaborative and Comparative Analysis of Mobile Artefact Usage". In Proceedings of ICPCA'08, 3rd International Conference on Pervasive Computing and Applications, Alexandria, Egypt, October 06-08, pp. 429-441. Marwan Al-Akaidi, Lizhen Cui, Bin Hu, Bo Hu, Zongkai Lin, Yong Zhang (Eds.), IEEE Press, October 2008. ISBN: 978-1-4244-2020-9.
- Luís Duarte, Luís Carriço, Marco de Sá. "Análise Comparativa e Colaborativa para Artefactos Móveis". In Proceedings of Interacção 2008, 3rd National Conference in Human Computer Interaction, Évora, Portugal, October 15-17, pp. 55-65. José Creissac Campos, Daniel Gonçalves, Teresa Romão and Luís Rato (Eds.), GPCG, October 2008. ISBN: 972-98464-9-9.

1.8 Document Structure

The remainder of this document is organized as follows:

- **Chapter 2** – provides a review of existing literature addressing videogames in general, the concept of flow and derivative models which has been proposed over the years. At the end of this chapter we define our object of study within the videogames domain.
- **Chapter 3** – gives an overview regarding the concept of persuasion, persuasive technology and technologically mediated persuasive interventions. We analyze which persuasive strategies are most commonly encountered within the videogames domain. At the end we establish in which types of persuasive approaches we will primarily focus in order to link them with the process of attaining the state of optimal experience, resulting in a model which builds on

existing literature and offers a robust instrument to characterize persuasive interventions in videogames.

- **Chapter 4** – addresses existing user experience analysis methodologies, covering subjective, objective and physiological assessment. We examine which ones are most adequate for the videogames domain, ending up with the identification of the most adequate methodology for our research.
- **Chapter 5** – presents the first full experimental period of this research in which we assessed the impact of specific types of persuasive instruments on player experience. We also provide a description of the game specifically developed to be employed in these trials as well as how the persuasive instruments were designed. We finalize by discussing the main findings and establishing what were the next steps to finalize this research.
- **Chapter 6** – gives continuity to the research by presenting the second full experimental period in which we aimed not only at testing unaddressed variants of persuasive instruments but also at validating the findings retrieved in Chapter V. we followed the same approach employed in the previous chapter, opting to describe the new game used to validate our results, experimental settings and finally discussing the results. The outcome of this chapter created a new research opportunity which we immediately sought, establishing here the next (and unexpected) direction of this research.
- **Chapter 7** – elaborates on the final experimental period which capitalized on the games already developed and described in Chapter V and Chapter VI. This trial's purpose addressed the assessment of whether deceitful persuasive instruments could act as a replacement of real ones. We ended up obtaining the necessary empirical evidence to support our hypothesis and contribute with new expertise in all domains addressed by this research.
- **Chapter 8** – we review existing literature concerning deceit, deceitful persuasive interventions and the role of technology within this field. We explore how deceit is present in modern videogames and utilize that expertise to improve the model proposed in Chapter 3, accomodating the necessary mechanisms to allow for the characterization of deceitful interventions in videogames. We conclude by validating this model with a mapping exercise contemplating the games developed within the context of this research and other commercially available games which include any kind of deceit in their core mechanics.
- **Chapter 9 –** finalizes this document by showing the main conclusions we drew from the course of this research. We also present what we envision to be the most

promising and challenging research directions to give continuity and improve the findings discussed in this document.

2 FLOW & VIDEOGAMES

Human beings are confronted with a diversity of tasks throughout their daily lives. While the difficulty associated with these may differ and self-motivation may play an important part, individuals strive to have the most pleasant experience while performing the said tasks. The psychology revolving these concepts has been exhaustively researched since Csikszentmihalyi coined the flow concept. While the basic concept suffered little to no changes, the theory has been in constant evolution for the past four decades. The following are testimonials from Csikszentmihalyi's work:

- "**the holistic experience that people feel when they act with total involvement**" (Csíkszentmihályi, 1975) – this definition emphasizes the importance of all components of an individual (e.g. psychological, biological, physical, chemical, etc.) harmoniously working in consonance when performing a task in which he / she is absorbed.
- "**Optimal experience**" (M. Csikszentmihalyi, 1990) – while this is one of the quintessential definitions of flow, when isolated it provides a somewhat vague perspective of the concept. The intrinsic subjective nature of this sentence emphasizes the individuality of flow. For some individuals an experience may be optimal due to the rewards emerging from it; for others, the challenge is what drives them to pursue their goals. The variety of contexts to which this passage related is vast, and using it as the primary definition of the flow concept may be risky in some situations.

- "… flow – the state in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it." (M. Csikszentmihalyi, 1990) – this definition expands the rationale of the first one by emphasizing user involvement. It introduces another facet pertaining to the stakes of performing a task. In short, the price an individual has to pay (i.e. not necessarily related to the financial aspect of the word, but to the physical or cognitive effort required) pales in comparison with the experience of carrying it out.
- "A sense of that one's skills are adequate to cope with the challenges at hand in a goal directed, rule bound action system that provides clear clues as to how one is performing. Concentration is so intense that there is no attention left over to think about anything irrelevant or to worry about problems. Self-consciousness disappears, and the sense of time becomes distorted. An activity that produces such experiences is so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous." (M. Csikszentmihalyi, 1990) – the final quote we selected depicts a more thorough and broad definition of flow. Several new ideas are introduced here. First and foremost, the importance given to the individual skills required to carry out a given task. Second, the rules and goals defining each task and the clearness with which these should be presented to the users. Finally, Csikszentmihalyi again emphasizes the selfless and almost altruistic nature of performing a task just for the sheer pleasure of doing it, regardless of associated rewards or costs for the individual responsible by it.

These passages aggregate a set of ideas which were often reinforced multiple times. These facets of flow theory can be ruled as components which support the necessary requirements to attain that state.

2.1 The Original Four Components

The previous definitions point towards flow being a state of concentration which builds, among other, on the relation between a task's difficulty level and the individual's skill set's adequateness to accomplish it. Some of these aspects were the result of several years of research which ended in providing a more detailed definition for the concept. Originally, Csikszentmihalyi identified four key aspects contributing to flow (Table 2.1).

Table 2.1 – Components of flow according to Csikszentmihalyi (circa 1975).

Component	**Highlights**
Control	Individual steering the task and not the other way around
Attention	Awareness, abstracting from external influences
Curiosity	Sympathetic evolution towards the task
Intrinsic Interest	Self-motivation regardless of rewards

The first component pertains to the requirement of the user being in full control of performing the task by him / herself and not the other way around, through explicit or automated guided processes. Attention is related with a reduction in user awareness, abstracting him / herself from events surrounding him / her and focusing completely on the task being carried out. Curiosity is connected with the experience provided by the task itself and how the individual should pursue the development of a positive attitude towards a task or thematic which may not be pleasant from his / her perspective. Intrinsic interest is linked with the voluntary urge to accomplish the task despite potentially not providing any reward other than self-satisfaction.

2.2 The Eight Dimensions of Flow

In 1993, Csikszentmihalyi (Mihaly Csikszentmihalyi, 1993) reinforced the definitions of flow and presented a new set of components which expand some existing ones and introduced new elements.

Table 2.2 – Dimensions of Flow according to Csikszentmihalyi (circa 1993).

Dimension	**Highlights**
Clear goal & immediate feedback	Well stipulated rules & knowledge of the effects of any action
Equilibrium between challenge & skill	Adequate difficulty for user
Merging of action & awareness	Harmony in task perception & execution
Focused concentration	User's attention is focused on the execution and not secondary aspects
Sense of potential control	User drives task completion forward, not the other way around
Loss of self-consciousness	High involvement leads to loss of context awareness of the user him / herself and his / her surroundings
Time distortion	
Autotelic or self-rewarding experience	Self-motivation regardless of rewards

The first dimension dictates that a task must have clearly defined goals – the main objectives which are expected to be accomplished by the user. At the same time, any action users takes or any change in the environment produced from the users' actions should be instantly communicated to them so that they are aware of the effects of their actions.

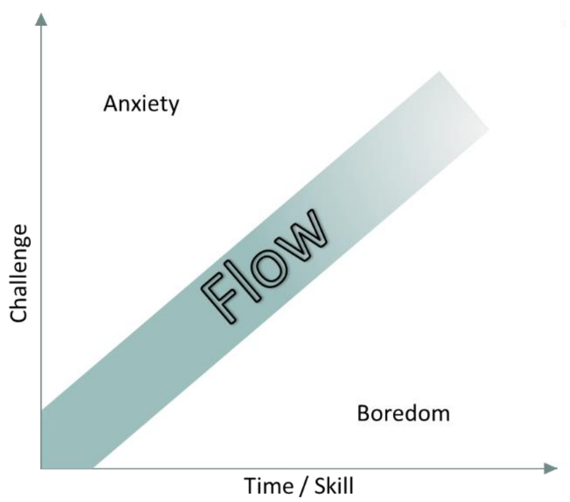


Figure 2.1 – Relation between player skill and task challenge.

Balancing a task's difficulty in light of the performer's skill set is a pivotal aspect of the flow state – failing to do so may overwhelm the individual and lead to a state of anxiety or, oppositely, provoke a feeling of boredom (Csíkszentmihályi, 1975). Figure 2.1 illustrates this relation.

Task performance plays a central role as far as flow, skill and challenge are concerned. As stated by Engeser (Engeser & Rheinberg, 2008), there are two reasons for this relation:

- Flow being a high functional state, forcing it to promote better performance by itself.
- Individuals who experience this state often procure it in other occasions, forming almost an addiction to it. However, as they attempt to achieve that state repeatedly, they often find themselves in setting more challenging goals, thus balancing the inherent task difficulty to their improved skill-set.

It comes as no surprise that a closely coupled relation emerges between the will to improve oneself and the difficulty barrier that same task poses to the player.

The merging of action and awareness is best explained with elucidative examples. For instance, in sports, athletes often mention that they are one with a tool they utilize in that particular sport (e.g. a racquet being an extension of a tennis player body, a car being a natural extension of a racing driver's mind and body). This dimension states that there is perfect harmony between the actions being carried out and how the individual perceives them as being executed.

The remaining dimensions are intrinsically connected to each other, with some of these relations being reminiscent of a causal-effect event. While performing a task, users should be fully focused on it. The existence of clear goals is the catalyst for this dimension, so that an individual is driven towards pursuing the primary goal and not secondary objectives. External variables disruption should be avoided in order to maintain that state of concentration. As state by Csikszentmihalyi, if the user is experiencing the state of flow, then his / her:

- "concentration is so intense that there is no attention left over to think about anything irrelevant or to worry about problems."

Such state of concentration paves the way to another dimension – the loss of self-consciousness. When a user enters a state of mind where external influences no longer trigger any response and do not disrupt his / her performance, then that individual may be losing any sensitivity towards the real world. Phenomena such as suspension of disbelief may be related with this dimension. Note that these states may not be pejorative, but rather an amalgamation of pleasant experiences for the user who is fulfilled by his / her accomplishments.

The immediate consequence of this state of self-absorption and loss of self-consciousness is the process of fuzzing the passage of time. When a user is so absorbed by the task at hand, he / she may start having a different perception of how quickly time is passing, indulging in the pleasure of the task being performed.

For the introduction of another dimension we shall pick the loss of self-consciousness and the merging of action and awareness. Recalling, these two dimensions deal with an absorption state and the harmonious perception of actions being carried out and their execution, respectively. In order to achieve both states and to ensure the user's complete focus on a task, some control on the latter's part is required. For instance, external variables being manipulated by a third party may be detrimental for the overall experience of an individual. As such, giving as much control as possible to a user over a given task is desirable as defended by Csikszentmihalyi.

The last dimension entering the equation concerns the value of performing a determined task while attaining a flow state. Instead of expecting a reward for the conclusion of a task, the experience of carrying it out, regardless of any profit being involved is the ultimate reward itself. This dimension favors the process of performing a task rather than the reward (if any) expecting the user at the end, evoking a state of self-rewarding education.

2.3 Applications of Flow Theory

The potential of flow theory as a psychological approach to motivate individuals excel in their areas has since been explored by researchers. Throughout life, human beings are confronted with a series of activities which they are required to successfully surpass, as a benchmark for self-satisfaction or professional accomplishment. While some of these activities may be triggered due to personal interest, others may be defined as a burden, due to lack of any motivation apart from the fact of them being mandatory.

2.3.1 Education

This cumbersome experience is prone to begin at tender ages during school but may span throughout the entire academic career. Some individuals do not develop the necessary aptitude and skills to lead a successful student life. Such special cases require precise interventions to motivate these students, allowing them to grow interest in some (if not all) of the themes being approached. In other cases, fostering the flow state aims at improving further the abilities of some individuals, making them pursue even more demanding challenges and, ultimately, develop their skill-set.

Existing research on the area of flow theory in education is diverse, covering both theoretical and empirical approaches. Throughout his research, Zarb et al (Zarb & Hughes, 2011) has procured the most adequate methods to measure flow in learning environments, elaborating on experience sampling methods, retrieval of psychophysiological signals or using report flow-scales. He has also given focus on the tools which are more convenient and effective for promoting a flow state (e.g. using tablets or other types of learning devices). Although results are not available at the time of this thesis writing, this work points at the existing link between flow theory and education.

Musical education has also capitalized on flow theory to assess the students' success rates. Bakker (Bakker, 2005) has investigated the role of job resources in achieving a flow state. Results showed that students who had developed more of these resources were able to achieve a flow state more often and make it last longer. This research had a second goal which consisted in determining whether the flow state could fall under the emotional contagion theory – in short, if teachers in a flow state could be capable of positively impact on their students' psyche and make them enter the flow state as well more rapidly. Results also showed a positive influence, suggesting flow is prone to a contagion effect between peers.

Malone et al (Malone & Lepper, 1987) created a taxonomy based on flow theory which aimed at understanding how intrinsic motivation for learning works and at circumventing a dampening effect which often occurs in schools. Four categories emerged from this categorization:

- **Challenge** – Malone viewed this category as more than steadily providing increasingly demanding challenges in order for students to improve by themselves. The objective was to provide a constructive way to develop student's skills, matching the challenge to their needs as necessary.
- **Curiosity** – this category was divided in two more detailed ones. Sensory curiosity deals with the novelty factor intrinsic to the introduction of a new tool, theme or device into the student's learning process. The second one is denominated cognitive curiosisty and concerns the urge students feel to consolidate and organize all knowledge they recently acquired, creating constructs which may be later applied as required.
- **Control** – similarly to the original depiction of the control category, the learner should not be overwhelmed with large amounts of information to retain. He / she should acquire his / her own pace to assimilate all concepts being channeled. Furthermore, teacher should avoid any random learning effects which sometimes may emerge from less controlled learning environments.
- **Fantasy** – a division in two categories was also performed for fantasy. Malone describes some as being dependent on the skill being learned. The example given is the creation of a fantasy game like the Hangman to learn new words and spelling. Other types of fantasies maintain a relation of dependency in both directions: role-playing games and simulations fall into this category. Studies show that the latter approach is richer and more effective as a learning option.

As a final note, Malone inherited some of these concepts from games – control and fantasy are the most prominent ones. In short, he hypothesized that player and learner behavior converge in some scenarios, leading to a better performance and more enjoyable experience.

Habgood (Habgood, 2005, 2007) further explored this relation between the flow theory and games suggesting that learning material should be presented during the most fun to play sections of a game in order to maximize knowledge retain ratio. He also suggested some design approaches capitalizing on the merging between the game's world, core mechanics and learning material. The intent is to make the learning process as smooth and as flowingly as possible.

2.3.2 Instructional Design

Instructional design is a discipline which aims at researching the best practices for an optimized learning experience. In the last decade, focus has been steered towards e-learning strategies, capable of covering a broad number of topics and reaching remote learners as well. This approach gathered even more followers since it is a very effective way of giving training to groups in companies. Ho et al (Ho & Kuo, 2010) has studied the latter, examining how the provision of different attitudes towards technology can impact on the learners' flow and retained knowledge. The research encompassed 50 companies in which employees were constantly alerted towards positive aspects of computers (e.g. common functions, useful shortcuts, interesting applications, etc.). The goal was to assess if this positive thinking philosophy had any impact in the learning outcome of these trainees. Results showed that individuals who had been subject to nudges towards positive computer attitudes were able to attain better results in the learning activities.

Liao (Liao, 2006) assessed the effectiveness of flow theory for long distance learning environments. Results not only confirmed this hypothesis, they also explored the most suitable interaction approach between teacher and learner in such environments. The learner-instructor (fostering the relation between these two entities) and learner-interface (promoting better interactions between the trainee and the available tools) had the most impact of experiencing flow.

One interesting research was performed by Pearce et al (Pearce, Ainley, & Howard, 2005). While the methodology and goals did not entirely differ from previous examples, one of the main contributions was summarized as flow being understood as a process rather than as a goal. Other results pertain some specificities of the research such as the usage of flow-paths to identify a user's proximity to a flow state.

2.3.3 Web Design & Online Environments

Flow theory has also been researched in other domains, among which web marketing. Hoffman et al (Hoffman & Novak, 1996) proposed a model for hypermedia computer-mediated environments which integrated the flow concept. The goal was to analyze any potential implications of flow theory from a marketing perspective. Results were positive in pointing towards the importance of some flow-related notions in marketing. First, the authors found hints for an improved quality time with hypermedia computer-mediated environments. From a design point-of-view this opens new perspectives as avoiding apathy or anxiousness becomes pivotal for the success of such environments. The second major contribution is the identification of different consumer profiles, as these groups tend to develop the flow state at different paces. Designing for heterogenic groups thus faces new challenges as the identification of which variables are more prone to trigger / forfeit the flow state emerge.

This example shows the importance of flow theory in yet another domain. Here, user-centered design and the importance of the consumer was demonstrated to be of the utmost importance within the context of this theory.

2.4 Flow & Videogames

The psychology behind performing a task and achieving optimal experience has been thoroughly linked with videogames. As stated by Sherry (Sherry, 2004) and later by Gackenbach (Gackenbach, 2008), Csikszentmihalyi's initial depiction of flow theory seemed to have videogames as its main inspiration. The easiness to which each flow dimension can be mapped with the experience of playing a videogame is one of the catalysts for this belief. The basic purpose of a game (including videogames) is to provide a pleasant experience to the player. This often leads the player to be immersed in virtual worlds (Seah & Cairns, 2008), losing consciousness of the world around him / her and deeply experience the activities within the game world. As the players progress throughout the game and their skills develop, they are typically confronted with greater challenges, requiring some effort on their part to overcome them (Cox, Cairns, Shah, & Carroll, 2012). However, apart from the e-sports community, players typically do not receive any real incentive (e.g. tangible or financial) for spending time playing those games or tackling these challenges. They do it for the sheer pleasure of experiencing it.

Ever since, multiple researchers have further explored how videogames relate to flow theory. Identifying how each flow dimension relates to particular elements of gameplay and / or interaction (Jones, 1998) as well as the potential definition of new dimensions (Sweetser & Wyeth, 2005) has been a steady goal for the past decades. The result of this effort consists in the formalization of the findings into complex models capable of describing the relations between videogames and flow theory.

2.4.1 Models

The growing interest surrounding videogames paved the way for a more serious and scientific approach towards understanding this entertainment medium. Researchers started assessing how flow theory models could be reviewed or re-applied to the videogames domain to better suit the latter's requirements and intrinsic characteristics. Some deviations of the initial flow model were considered not only in an attempt to explain the rationale behind the "optimal experience", but also to elaborate on why individuals play games (Jansz, 2005) or why some of these games are able to achieve general acceptance and others fail to capture the players' attention (Kultima & Stenros, 2010). Still, several authors took inspiration from Csikszentmihalyi's 8 dimension flow model (Mihaly Csikszentmihalyi, 1993) and presented how these dimension are mapped into videogame elements and features.

2.4.1.1 Matching Flow Dimensions and Gameplay Attributes

While Jones' original intention encompassed the creation of improved electronic learning environments (Jones, 1998), he took inspiration from flow theory and in particular how games are structured. The rationale consisted in employing some of these techniques in the design of learning environments, thus incorporating fun and pleasure into this type of tools. To come to fruition, the author explored how the eight components of flow appear in videogames. Table 2.3 showcases the results of this exercise. This table summarizes how flow's dimensions surge in videogames. By capitalizing on these characteristics, learning environment designers would be able to improve the latter, boosting trainees' knowledge retain and achieving better learning results.

Table 2.3 – Jones' mapping between dimensions of flow and how they manifest themselves in a game.

Dimension of Flow	**Manifestation in a Game**
Task that we can complete	The use of levels in games provides small

	sections that lead to the completion of the entire task.
Ability to concentrate on task	Creation of convincing worlds that draw users in.
Task has clear goals	Survival, collection of points, gathering of objects and artefacts, solving the puzzle.
Task provides immediate feedback	Shoot people and they die. Find a clue, and you can put it in your bag.
Deep but effortless involvement (losing awareness of worry and frustration of everyday)	The creation of environments far removed from what we know to be real helps suspend belief systems and takes us away from the ordinary.
Exercising a sense of control over their actions	Mastering controls of the game, such as a mouse movement or keyboard combinations.
Concern for self disappears during flow, but sense of self is stronger after flow activity	Many games provide for an environment that is a simulation of life and death. One can cheat death and not really die. It is the creation of an integration of representation, problem, and control over systems that promotes this.
Sense of duration of time is altered.	Years can be played out in hours; battles can be conducted in minutes. The key point is that people continue playing these games.

A few years later, Cowley et al (Cowley et al., 2008) reviewed this mapping. They showed it possessed some structural flaws as there are some discrepancies between the expectations provided by the model and the player's expectations: for instance, and quoting Cowley, a task that can be completed should be a product of the player's desire to pursue his / her goals and not a product of the way the game is structured (for instance, by levels), as defended by Jones (Jones, 1998). The author also states that players should immediately be informed of any action or change produced within the game. Despite this criticism, this research still managed to provide a straightforward relation between games and flow.

2.4.1.2 Game Flow Model

Jones tackled the relation between flow and videogames by observing the latter and identifying how each dimension surges as a gameplay element or mechanic (Jones, 1998). While it shed some light as far as this mapping is concerned, it failed to enlighten the scientific community in regards to the vehicles that can be employed to foster the flow state according to each dimension.

Sweetser's game flow model (Sweetser & Wyeth, 2005) tackles this problematic by associating each dimension of flow with a set of criteria. The majority of these can be classified as design guidelines for videogames. However, they summarize a set of good practices capable of promoting an optimal experience while playing a videogame. Table 2.4 presents the matching of each dimension of flow to the criteria which potentially promotes the optimal experience.

Table 2.4 – Sweetser's game flow model.

Element	**Criteria**
Concentration - Games should require concentration and the player should be able to concentrate on the game	▪ provide stimuli from different sources ▪ provide stimuli that are worth attending ▪ grab the players' attention and maintain their focus throughout the game ▪ players shouldn't be burdened with tasks that don't feel important ▪ high workload while still being appropriate for the players' perceptual, cognitive and memory limits ▪ players should not be distracted from tasks that they want or need to concentrate on
Challenge - Games should be sufficiently challenging and match the player's skill level	▪ must match the players' skill levels ▪ provide different levels of challenge for different players ▪ the level of challenge should increase

	as the player progresses through the game and increases their skill level ▪ provide new challenges at an appropriate pace
Player skills - Games must support player skill development and mastery	▪ players should be able to start playing the game without reading the manual ▪ learning the game should not be boring ▪ games should include online help so players don't need to exit the game ▪ players should be taught to play the game through tutorials or initial levels that feel like playing the game ▪ games should increase the players' skills at an appropriate pace as they progress ▪ players should be rewarded appropriately for their effort and skill development ▪ game interfaces and mechanics should be easy to learn and use
Control - Players should feel a sense of control over their actions in the game	▪ feel a sense of control over the game interface and input devices ▪ feel a sense of control over the game shell (starting, stopping, saving, etc.) ▪ players should not be able to make errors that are detrimental to the game and be supported in recovering from errors ▪ feel a sense of control and impact onto the game world (like their actions matter and they are shaping the game world) ▪ feel a sense of control over the actions that they take and the strategies that they use and that they are free to play the game the way that they want
Clear goals - Games should provide the player with clear goals at appropriate times	▪ overriding goals should be clear and presented early

	▪ intermediate goals should be clear and presented at appropriate times
Feedback - Players must receive appropriate feedback at appropriate times	▪ players should receive feedback on progress toward their goals ▪ receive immediate feedback on their actions ▪ always know current status or score
Immersion - Players should experience deep but effortless involvement in the game	▪ players should become less aware of their surroundings ▪ players should become less self-aware and less worried about everyday life or self ▪ experience an altered sense of time ▪ feel emotionally involved in the game ▪ feel viscerally involved in the game
Social Interaction – games should support and create opportunities for social interaction	▪ games should support competition and cooperation between players ▪ support social interaction between players (chat, etc.) ▪ support social communities inside and outside the game

Some of the criteria here presented were partially expected from earlier research in the flow theory. For instance, matching the game's challenges to the players' skill level was an expected criteria; error recovery support is another guideline which was more or less evident judging previous work. Yet, the relevance of this work also concerns the discrepancies between itself and Csikszentmihalyi's work.

The most immediate one is the merging of two categories: less of self-consciousness and time distortion. Sweetser opted to aggregate these in a single dimension denominated immersion. Our analysis of Csikszentmihalyi's dimensions already pointed towards the similarity between these two categories. As stated here, immersion deals with the game's ability to make the player forget where he / she is, flow of time, and to attach the players to the game world by making them feel emotionally connected to it.

Another difference resides in the introduction of the social interaction dimension. While activities in general may broadly be aimed at a single person or require the joint effort of multiple entities, videogames have always promoted interactions with peers. Sweetser adds that both competitive and cooperative gameplay are beneficial to achieve an optimal experience. Furthermore, games should provide the necessary channels for players to communicate with each other during gameplay (e.g. chat support) and outside the game world (e.g. forum support).

Our final analysis focuses on two connected aspects of this model. Throughout his research, Csikszentmihalyi repeatedly states that in a flow state, individuals perform activities for the sheer pleasure of doing it, regardless of being provided with rewards or the activity itself having an associated cost (e.g. cognitive, physical or financial). The absence of the "autotelic or self-rewarding experience" dimension emerged as striking for us. However, a closer look into the criteria shows that the thematic of rewards was still approached in this model: in the player skills dimension, one of the criteria states that "the player should be rewarded appropriately for their effort and skill development". While the provision of rewards to match skill development is common in videogames (e.g. battle titles in "Street Fighter 4" (Capcom, 2008), new skills in "Diablo 3" (B. Entertainment, 2012)), this is a narrow view on all the possibilities available for videogame designers. For instance, games such as "Super Mario" (Nintendo, 1985), "Wipeout" (Psygnosis, 1996) or "World of Warcraft" (B. Entertainment, 2004) provide players with temporary rewards for the sake of introducing new gameplay elements and as part of the game's core mechanics. Yet, no skill development is associated with retrieving these rewards nor any effort as they are typically handed over to the player without restrictions. Such caveat leaves an interesting space for questions and challenges regarding this thematic.

2.4.1.3 Pervasive Game Flow Model

As technology moves forward, new opportunities emerge for designers and developers alike to present new applications for end-users. Videogames are no exception to this. The advent of smart-phones and the steady popularity of portable dedicated videogame consoles offer new interaction and game design possibilities to developers. The pervasive nature of these devices and associated services is a clear contributor for this new paradigm – one in which the user is able to play anytime and anywhere capitalizing on the device's sensors to improve gameplay. It comes to no surprise that researchers attempted to connect flow theory to pervasive games.

Based on Sweetser's game flow model, Jegers' (Jegers, 2007) presents the pervasive game flow model. Jegers respected the dimensions present in Sweetser's model. For the sake of readability we only refer to the criteria introduced in this new model, as it respects every single one already present in the original one. Table 2.5 showcases the new criteria.

Table 2.5 – Jegers' pervasive game flow model.

Element	**Criteria**
Concentration - Games should require concentration and the player should be able to concentrate on the game	▪ Pervasive games should support the player in the process of switching concentration between in-game tasks and surrounding factors of importance
Challenge - Games should be sufficiently challenging and match the player's skill level	▪ Pervasive games should stimulate and support the players in their own creation of game scenarios and pacing ▪ Pervasive games should help the players in keeping a balance in the creation of paths and developments in the game world, but not put too much control or constraints on the pacing and challenge evolving
Player skills - Games must support player skill development and mastery	▪ Pervasive games should be very flexible and enable the players' skills to be developed in a pace set by the players
Control - Players should feel a sense of control over their actions in the game	▪ Pervasive games should enable the players to easily pickup game play in a constantly ongoing game and quickly get a picture of the current status in the game world (in order to assess how the state of the game has evolved since the player last visited the game world)
Clear goals - Games should provide the player with clear goals at appropriate times	▪ Pervasive games should support the players in forming and communicating their own intermediate goals
Feedback - Players must receive appropriate feedback at appropriate times	▪ N/A

Immersion - Players should experience deep but effortless involvement in the game	▪ Pervasive games should support a seamless transition between different everyday contexts, and not imply or require player actions that might result in a violation of social norms in everyday contexts ▪ Pervasive games should enable the player to shift focus between the virtual and physical parts of the game world without losing too much of the feeling of immersion
Social Interaction - Games should support and create opportunities for social interaction	▪ Pervasive games should support and enable possibilities for game oriented, meaningful and purposeful social interaction within the gaming system ▪ Pervasive games should incorporate triggers and structures (e.g. quests and events, factions, guilds or gangs) that motivate the players to communicate and interact socially

Most of the criteria introduced by Jegers shares a common theme: user empowerment. This reflects not only the characteristics of pervasive games, but also the way videogames have been steered in the last years. Instead of being passive consumers, players are now often encouraged to produce their own content and share it within the game's community. The increase of the players' age is also determinant towards the design of adequate content for individuals who enjoy these games but may no longer have the available time to commit to it.

The criteria introduced here reflect some of these shifts. For instance, instead of the game being responsible for constantly presenting new challenges, Jegers defends that players should be able to create their own challenge paths at a desired pace. Consequentially, skill development should also be prone to control by the player and not "enforced" as in Sweetser's model.

2.4.1.4 Summary of Flow Models

More than providing an extensive coverage of every model conceived to couple videogames and flow, the aim of this section was to enlighten the type of assessment researchers perform regarding the flow state. There are a few trends concerning how flow is addressed in existing literature. Rather than identifying whether or not a user is experiencing flow, exercises relating this concept to videogames attempt to:

- Map how each flow dimension is mapped in specific videogame features.
- Establish a set of criteria that games should include in order to promote the optimal experience.

Note that while these authors encourage the usage of the said instruments to steer players into a flow state, almost no evidence was provided to justify those claims. Given that flow addresses various aspects of an individual's characteristics (namely performance, behavior and physiology) (Ravaja et al., 2006; Schneider, 2004), one can how the different instruments affect a player. Effectively, these caveats allow us to pose one of the primary questions of this work:

- How do different flow promotion instruments / strategies affect the players' traits (e.g. physiology, behavior, performance)?

This question will be further revisited and reinforced throughout the following sections and chapters, building up to the main goals of this thesis.

2.4.2 Impact on Videogame Design

The relation between flow and videogames has altered how designers and developers alike treat the latter. Fueled by some of the presented research on models mapping dimensions of flow into elements of gameplay, new design opportunities surfaces, broadening the available spectrum of creativity. However, flow theory is not exclusively used to improve game design.

2.4.2.1 Consumer Adoption

Zhou (Zhou, 2012) investigated how flow is able to influence the adoption of mobile games and player behavior. The author was able to pinpoint a set of dimensions which are determinant for consumers. For this type of games, flow is mostly affected by how easy the game is to interact with, the quality of the provided content and how good the connection is. As far as adoption is concerned, peer influence and the associated cost to enjoy the game are the main contributors. Despite the study's limitations – being focused on a particular region of the globe – it shows the diversity of subjects to which flow theory can be tied.

2.4.2.2 Meeting Player Expectations

Cowley et al (Cowley et al., 2008) on the other hand elaborated on how feedback and user expectations are tightly linked. Through various simple examples, they were able to explain that players are capable of adapting their play style and the level of challenge they tackle based on visual feedback, among other cues. The scenario involved players growing expectations as they face different enemies in a certain zone or level. If they were confronted with an enemy who visually appears as bulkier and carrying heavier equipment, they assumed that the challenge to defeat that particular enemy would be more enticing than the previous ones. Obviously this chain of events has repercussions on game development. Designers need to be aware of this player behavior to accommodate such expectations, attempting to provide the best experience possible.

The same author explores yet another facet of videogames – the ability to quickly jump in and earn immediate satisfaction. The comparison is done between carrying tasks within a game and in the real world. In the latter an individual is expected to steadily train and commit him / herself to develop his / her skills and excel at a given task. Videogames, on the other hand, do not require a huge investment on that sense. Users can typically engage in playing a game and have at their disposal a respectable number of abilities which they can explore and utilize for their own enjoyment.

2.4.2.3 Ensuring the Optimal Experience

In his research, Jenova Chen (Chen, 2007) delved into how the dimensions of flow can be combined to provide an enjoyable experience to players. Keeping an isolated perspective of each dimension can be beneficial to understand their implications within the game and for the player. However, some advantages may sprout from their intermingling as well. Joining dimensions of flow opens new possibilities – among these, Chen emphasizes their combination to keep the player within the flow state. This approach ultimately leads to the provision of adaptive content, allowing players to attain the optimal experience state through their own choices and from different angles. Another design approach which emerged from this research was the integration of flow promoting features into the game's core activities and not as appendixes or secondary objectives. This strategy potentiates immersion and complete focus while mitigating possible distractions introduced by accessory activities.

Chen's work shares some interest points with our own research: the exploration of how specific instruments that promote flow impact on player experience is the main common point. There is however a substantial difference in the type of instruments addressed in both works. While Chen opted to primarily focus on difficulty adaptation mechanisms, effectively changing the core mechanics of a game to affect a player's flow and, ultimately, their experience, we deviated from that philosophy. Instead, we opted to study instruments and strategies which may not effectively have an impact in the game's mechanics, but impact on the players' behavior and perceptions regarding the game. In the next sections we will explore this idea in more detail.

2.4.3 Prominent Ideas

The relation between flow theory and videogames encompasses a variety of ideas which have, to a certain extent, been researched by the scientific community. Some of these concepts are prone to more frequently capture the researcher's attention, particularly when there are "backstage" driving factors involved (e.g. new interaction paradigms). Immersion is one particularly elucidative example (Seah & Cairns, 2008). Hardware and software designers strive to keep players engaged as much as possible, spending most of their time in the game world.

Nevertheless, there are other relations which spark the researchers' curiosity. This short review of existing literature in the area showed that one of the most popular links is established by the "challenge" and "player skill" dimension (Basawapatna, Repenning, Koh, & Nickerson, 2013). Players should face increasingly challenging activities as their skills and expertise with the game develop. Balancing this duo is paramount for player enjoyment – too demanding challenges may lead the player to a state of arousal (Gilroy, Cavazza, & Benayoun, 2009); on the other hand, if the player's skills are far more developed than the activity requires, then the player may enter a state of boredom (L. Nacke & Lindley, 2008). Achieving an equilibrium between these dimensions ensures the player keeps interested in the game (Cox et al., 2012) and, more importantly contribute to a heightened state of performance.

Performance becomes, thus, a central aspect of player enjoyment. While the flow state may not guarantee the best performance attainable by the player (we believe that situation is more prone to occur when the player's skills far outmatch the challenge being issued), existing literature labels this as a state of high performance capable of maintaining player enjoyment (Engeser & Rheinberg, 2008). The cognitive and (in more recent times) physical effort required to keep this high performance state and reach good performance numbers is often signalized with the provision of rewards to players. Despite being one of Csikszentmihalyi's dimensions of flow (M. Csikszentmihalyi, 1990), recently proposed models ignore this step of the flow process. The absence of the meaning of rewards in flow theory and, in particular, player performance leaves some open opportunities and challenges which we are keen on exploring throughout this document.

2.5 Players & Flow

The relation between players and the flow state is a constantly evolving one. Maintaining the equilibrium between player skill and the game's inherent challenge often results in achieving a smooth performance. Existing research considers this performance to not correspond, occasionally, to the best performance possible, but rather representing an optimal compromise for the player (Engeser & Rheinberg, 2008) (Engeser & Rheinberg, 2008). Nevertheless, the players' ability to maintain these performance values is still regarded as high level of play. Over extended periods of play (and even in short ones, if prone for it) it is often difficult to retain the flow state and the high performance values. Several factors related with flow theory may account for this phenomena (Chen, 2006):

- Players gradually gains a certain level of expertise which far surpasses the challenge they are confronted with, leading to state of boredom or apathy.
- The game confronts players with a challenge which overwhelms their skill set, leading to a state of anxiousness and / or arousal in the process.
- Gameplay mechanics become overly repetitive and dull, forcing players to rapidly lose interest and self-motivation to pursue their goals.

While there are certainly other justifications for straying outside high levels of play, the reasons we cited are elucidative to understand the complexity of this issue.

2.5.1 Challenges

In an ideal scenario, players are capable of maintaining a flow state during the entire gameplay period (Falstein, 2005) and / or as their skill level increases in face of the challenge being issued (Mihaly Csikszentmihalyi, 1993). Even though certain events may slightly affect the experience, players are capable of steadily holding to the state of optimal experience without faltering, as depicted in Figure 2.2 (left).

The situation illustrated in Figure 2.2 (right) contrasts with the previous one but showcases a more realistic depiction of how players may deviate from the flow spectrum during gameplay period. Games can confront the players with a variety of events: these may encompass emotionally engaging story developments or the appearance of demanding gameplay mechanics.

We believe that the extent to which these instruments impact on a player's experience vary from person to person. As previously hinted, the efect that these instruments have on the players' experience is currently not well documented, leaving a hole in existing literature regarding such an important theme for videogame design and analysis.

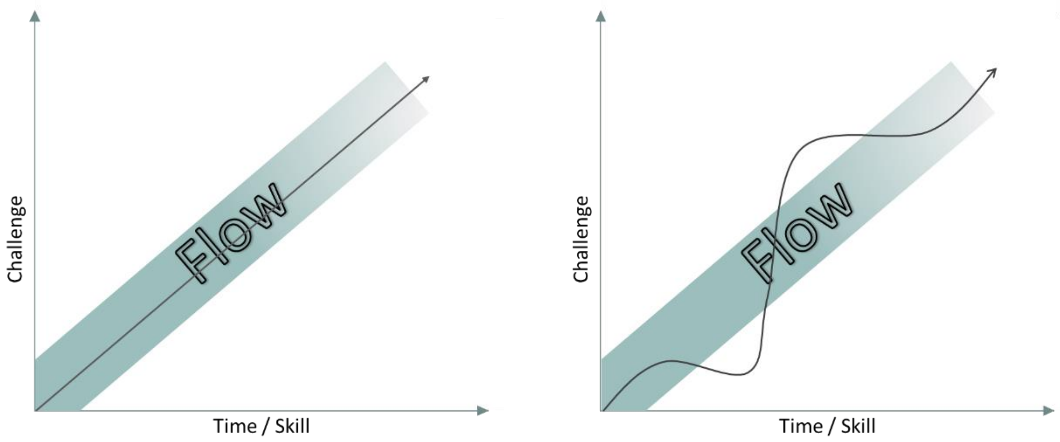


Figure 2.2 – Optimal flow behavior (left); fluctuations during gameplay period bringing players outside high levels of play (right).

Careless and reckless usage of these mechanics may result in players often falling outside their optimal experience spectrum. This result can be pivotal to affect players:

- From a performance perspective.
- From an emotional state angle.

We will now delve on how existing literature tackles these effects on the player's optimal experience.

2.5.1.1 Addressing Performance Fluctuations

Performance plays a pivotal role in videogames. The gameplay period encompasses a series of events which may interfere with player performance. Story related cut-scenes, voluntary breaks performed by the player or sudden difficulty spikes are but a few of the reasons accounting for this phenomena. Delivering a pleasant experience for the players is fundamental in videogames. This experience may cover a broad range of concepts. Among these, flow theory often ties-in the players' performance with the optimal experience, suggesting that bringing players to a state of high performance becomes an urgent and critical aspect of design.

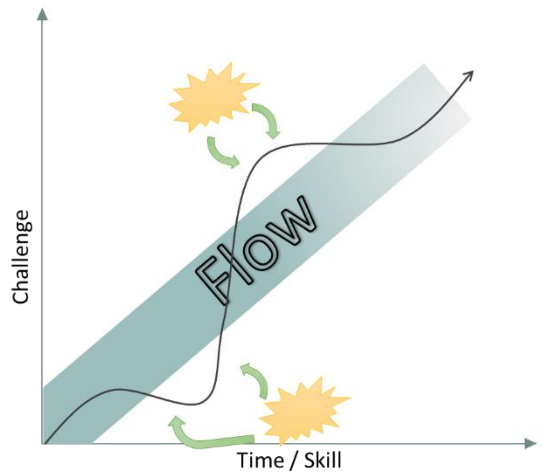


Figure 2.3 – Active flow adjustment (inspired by Chen's depiction).

Figure 2.3 illustrates how designers tackle the event of a player falling outside the flow spectrum and decreasing his / her performance. We took inspiration from Jenova Chen's thesis on "Flow in Games and Everything Else" to enlighten this process. Modern videogames often encompass monitoring components which constantly assess how well the player is performing. For instance, "Kingdoms of Amalur: Reckoning" (38 Studios, 2012) assesses the number of times a player is vanquished in a given area – after some fruitless attempts, the game asks the player whether he / she desires to lower the difficulty level. "World of Warcraft" (B. Entertainment, 2004) implements a similar mechanic in certain game modes, providing groups of players who may be having difficulty in defeating certain enemies with a scalable power up until they are able to overcome the obstacle. Even in research, we can find some elucidative examples of games featuring mechanics of this nature, reducing the difficulty as the player fails to achieve the desired results (Hunicke, 2005).

Chen labels these mechanisms as Dynamic Difficulty Adjustment (DDA), a technique which provides games with the necessary means to analyze player data and adjust the challenges based on user performance (among other data if available). This approach is adequate to a substantial number of situations: the ones illustrated above are particularly representative of this universe. However, narrowing transitions in high levels of play and flow state to a change in task difficulty is misleading and downgrading. Loss of performance may occur due to decrease interest, lack of self-motivation or lack of adequate rewards (even if, according to flow theory, the experience of playing is a reward in itself). Furthermore, this type of adaptation enforces the explicit modification of some of the game's core elements or mechanics. An adjustment to the difficulty level requires even the slightest change in one or more of the game's characteristics to accommodate a lower challenge level. Such modification is obviously dependent on the game's genre, but some review of existing literature or commercially available games suggest that typical approaches rely on increasing / reducing the number of enemies that players have to defeat and / or boosting / hindering the characteristics of those enemies (e.g. number of abilities they can use, health points, magic points, their strength, etc.). While these approaches have successfully been implemented in hugely successful games such as "Diablo 3" (B. Entertainment, 2012), they rely on artificial mechanisms to help players overcome the challenges they face. We believe this design choice can potentially hinder player skill development, as the fact that players get over the said challenges does not necessarily mean that their skills were developed to match those requirements.

2.5.1.2 Tackling Emotional Effects

Falling outside the spectrum of optimal experience leads players into other zones of comfort (or discomfort) with which they are required to cope with. Figure 2.4 displays Csikszentmihalyi's model for the individual's mental state (Mihaly Csikszentmihalyi, 1993). According to this model, the optimal experience (flow state) is achieved when the game's challenge and player skill set are sufficiently high. On the opposite side of the spectrum we can observe an apathy state, where the game is not challenging enough and the player skill set is not sufficiently developed to even tackle an easy challenge.

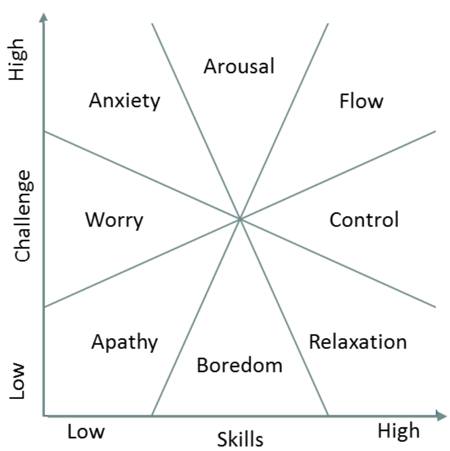


Figure 2.4 – Csikszentmihalyi's mental state model as depicted in The Evolving Self: A Psychology for the Third Millennium (1993).

A change in the player's emotional state may affect his / her behavior or interaction patterns. Furthermore, these can be used to assess when a player transits from state to another. However, the type of information we have about the player does not resume itself to these "visible" manifestations. Some of these emotional states are characterized, among other, by determined shifts on the individual's physiology (Chanel, Rebetez, Bétrancourt, & Pun, 2008). For instance, arousal often is associated with electro-dermal activity and accelerated heart rate; relaxation, on the other, hand typically involves a brief slowdown of the person's heart rate, along more prolonged respiration patterns.

Capturing these subtle changes in a player's physiological state may be determinant for the creation or introduction gameplay mechanics capable of steering the user out of one of these states and pushing him / her closer to his / her optimal experience.

2.5.2 Potential Solutions

A few solutions for the performance fostering problematic exist and are prone to be successful. We already discussed the usage of DDA techniques in previous sections. Challenge is easily one of the most prominent factors for player frustration. Adapting a game's difficulty to address a player's fruitless efforts to overcome a certain challenge has been shown to be a viable approach in the past. However, we find it reducing to pinpoint the sole cause of player frustration or venturing outside their optimal experience state to the task's challenge. Furthermore, the addressed artificiality of the process may retract the feeling of accomplishment from the player: it was the game which adapted itself to cope with the user's abilities and not the other way around. Despite its importance, challenge is merely one of the dimensions which typically comprise flow models.

Building on Chen's multi-path approach towards steering a player into the flow state, we were able to identify some elements in videogames which are recurrently employed to motivate better performances. Furthermore, some of these techniques pertain to distinct dimensions of flow. Among these, we emphasize the usage of feedback messages to inform the player on his / her accomplishments. Videogames often display these type of messages signaling certain achievements or as an acknowledgement of a particularly good performance display on behalf of the player. The type of feedback employed is also diverse, ranging from trivial text messages, to more elaborate metrics display intermingled with the game's world. How these messages are able to affect a player it yet to be assessed as far as the videogame domain is concerned.

Another approach which is commonly encountered in videogames is the provision of some kind of reward to players. Existing flow literature typically addresses rewards as a mechanic which is given to players as their skills develop or as they progress through the game. The appearance of rewards, however, is not tightly mechanized as existing literature suggests. Numerous examples, ranging from older games like "Super Mario" (Nintendo, 1985) to more recent offers such as "Diablo 3" (B. Entertainment, 2012), offer players temporary rewards which bestow them with additional or improved abilities. This is an important aspect of modern game design, yet one which existing flow models and literature appear to oversee.

2.6 Discussion

This chapter allowed us to provide an overview of the flow theory – a concept which originally pertained to everyday tasks and a multitude of domains but which, over the years, gathered a substantial amount of interest from the gaming community. Multiple models emerged tying flow theory to videogames. Nevertheless, some challenges remain. Maintaining high levels of play for (close to) optimal performance is often not feasible over extended periods of play time.

Based on our essay on current challenges regarding flow theory and videogames we conclude this chapter with the following questions:

- If a player faded from a flow state, how can we steer him / her back to it?
- How can we identify that a player is fading away from a flow state?

The first question requires us to assess external mechanisms which may be present in videogames and are capable of steering players into changing their attitudes and behaviors. Ultimately we wish this posture change reflects itself in an improvement of player performance which, as already defended, is tied with becoming closer to a state of flow. This thematic will be reviewed in Chapter III.

To answer the second we need to recur to some flow dimensions. First we must explore the relation between performance and flow state attainment. At the same time, we will delve into emotional states which fall outside the flow spectrum, namely anxiety, boredom, apathy and arousal. We will explore this in Chapter IV.

3 PERSUASIVE TECHNOLOGY

We concluded the previous chapter by transmitting the idea that videogames can include determined instruments with the aim of steering players towards an optimal experience state. We also reinforced the idea that, within the context of this research, we would primarily focus instruments and strategies which might not necessarily alter the game's core mechanics or gameplay style, but rather promote certain changes in the players' behavior which would make them capable of overcoming the game's challenges. Provoking these changes is the goal of a very specific area of research: persuasion.

The domain of persuasion has been discussed throughout history in the context of diverse disciplines – politics (Dourish, 2010), philosophy or marketing to cite a few (Serapio & Fogg, 2009). In its essence, a persuasive intervention typically requires two entities to be involved: the target of the persuasion process (typically an individual or a group of individuals) and the persuader (usually another individual or group of individuals who are intent on changing the target's creeds, behaviors or beliefs) (Fogg, 1998). The intervention process comprises the usage of certain instruments (e.g. discourse, pamphlets, recordings) to persuade the targets into adopting the ideals / behaviors defended by the persuaders (Torning & Oinas-Kukkonen, 2009). This exchange of arguments can be defined as a set of social interactions which aim at changing a set of characteristics of one of the participants. Within the videogames domain, persuasive techniques have been suggested as a potential way to steer players to / from different emotional states and potentially to have some influence on their performance levels (Khaled, Barr, Noble, Fischer, & Biddle, 2007).

3.1 Characterization

Research in the persuasion domain has spanned throughout centuries. We will now briefly address it by characterizing the following themes:

- The origin of the concept.
- The way the intervention process unfolds.
- What instruments are used to ensure the process comes to fruition.

At this initial stage we will provide with broad descriptions of these three aspects of persuasion. Throughout the chapter and as we delve deep into the specificities of certain persuasive models we will analyze address these aspects, particularly the unfolding of the process and the instruments used to reach the final goal.

3.1.1 The Origin

The Greek civilization was the cradle and catalyst of several aspects of modern society. Democracy, novel scientific methods applied to medicine and astronomy, architectural styles and philosophy are all landmark advancements in various areas attributed to it. Greek philosophers often utilized agoras (e.g. central gathering places for people in cities) to share and discuss their ideas and lines of thought with their peers and general population. The art of discourse is labeled as rhetoric. One of its main goals was to persuade and motivate listeners into changing their opinions or behaviors towards determined matters (Parlor & Johnstone, 1996). Over the years, persuasion assumed an increasingly relevant role in society: politicians recur to it; marketing specialists use it to seduce consumers; even computers capitalize on this concept to approach their users.

3.1.2 The Process

Persuasion is a social process in its essence (Fogg, 2002). The process typically involves two actors, consisting in one entity, the persuader, which aims at motivating, persuading or changing the behavior of another entity. To accomplish this mission, the persuader recurs to different tools to transmit his / her message, often involving and array of strategies of varying complexity which are adequate to a multitude of scenarios. B. J. Fogg (Fogg, 1998) defines persuasion as:

- "an attempt to change attitudes or behaviors or both without using coercion or deception".

Some key concepts are introduced in this definition. It is clearly stated that the agent who is persuading should not recur to instruments of coercion or deception. In our perspective, this inhibits the usage of ethically questionable approaches such as excessive force, torture or submission strategies to effectively oblige a determined target to change his / her behavior / beliefs. It also impedes the utilization of deceit to persuade: explicit lies or mischievous schemes (e.g. phishing) are also discarded in this definition.

3.1.3 The Technology

As technology and society evolved, so did the channels through which persuasion can be conveyed. The radio, television and the internet assumed the role which was once carried out by oral discourse in public spaces, manuscripts and pamphlets. Nowadays, computer systems are empowered with a set of intelligent features capable of challenging a person's behavior and beliefs. Persuasion has been adopted in IT all around (Torning & Oinas-Kukkonen, 2009). Computer systems have absorbed these concepts, effectively aiding users in changing their behavior and, in some cases, improve their quality of life. The strategies used in persuasive interventions utilize instruments as diverse as natural speech, rewards, the antropomorphization of machines and psychology cues to reach their targets and steadily alter their behaviors and / or creeds. Every day, users are confronted with persuasive instruments even if they do not recognize them as such. E-commerce and home-banking websites utilize a myriad of natural language techniques and crowd profiling to entice users into purchasing products that suit their characteristics. Rewards are also used in videogames and e-commerce sites to foster the players' and the users' fidelity towards the brand. There are various example of instruments being used to convey persuasion. Over the next sections we will explore how particular persuasion frameworks accommodate different types of channels and instruments to reach users.

3.2 Persuasion Frameworks

Over the years, researchers have strived to formalize persuasion concepts into frameworks (Saari et al., 2004), models (Oinas-Kukkonen & Harjumaa, 2009) or theories (Fogg, 1997) which provide a broad enough coverage to summarize the strategies and instruments employed in persuasion. Providing a broad overview about the domain may emerge as the best solution but it comes at the expense of potentially overlooking some details which may be important within the context and framing of our work – videogames. In light of this restriction, we opted to pick a set of theories and models from a few select authors and thoroughly present and discuss the details of their work:

- Fogg's theory of computers as social actors.
- Oinas-Kukkonen's et al Persuasive System Design model.
- King and Tester's environment of discovery.

We later build on this analysis to elaborate how the presented persuasive technologies and strategies are employed in videogames, bridging some of the previous chapter's content with this chapter's topics and, ultimately, framing our research goals.

3.2.1 Fogg's Computers as Persuasive Social Actors

B.J. Fogg investigated how technology can mediate the social dynamics of a persuasive intervention process, contemplating the participating actors, technology involved and the characteristics that each of these can potentially impact on the process' outcome. The author discusses characteristics which persuasive actors (persuaders) often possess or employ to successfully achieve their goals:

- Physical
- Psychological
- Language
- Social Dynamics
- Social Rules

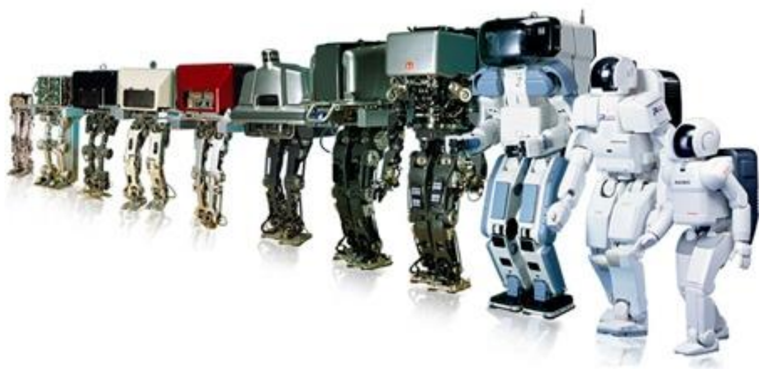


Figure 3.1 – Honda's Asimo design evolution towards more human-like appearance.

3.2.1.1 Physical Characteristics

According to Fogg, technology's visual appeal may impact on a user's decision and behavior (Berscheid, Dion, Walster, & Walster, 1971; Chaiken, 1979). Adding human-like features to a machine or system (e.g. a mouth that moves when a sound is played or eyes that randomly look at the user) can improve its likeliness and empathy developed by the target user. In addition, a system's attractiveness may pertain to several factors: its visual attractiveness, audio charm or the appeal of virtual elements within the system (e.g. user interface design, appealing human avatars, etc.). Individuals assume certain qualities when they are confronted with a certain degree of attractiveness on another person (Dion, Berscheid, & Walster, 1972). As such, when transitioning to a system or a virtual character this assumption should still hold true. Parise et al reached that result (Parise, Kiesler, Sproull, & Waters, 1999). In their research, they concluded that individuals were more sympathetic towards a virtual avatar who was more aesthetically pleasing rather than a creepier and not as pleasant version of it. The antropomorphization of systems (Figure 3.1) is a common approach towards creating feelings of empathy between user and machine.

3.2.1.2 Psychological Characteristics

This “humanization” of a system or a virtual character can involve more than tweaking its physical appearance. Certain traits such as its motions, its sounds, the way it communicates with the user and the perception of intelligence can also be paramount to tighten the emotional link between the users and the system (R. W. Picard, 1998). This leads us to the second approach which consists in using psychological cues to persuade a target individual. One of the goals of the artificial intelligence domain has consisted in providing machines with human-like behavior and intelligence, making them as indistinguishable from human beings as possible. Persuasion designers utilize this rationale in the creation of applications within various domains: they empower computer systems with features which narrow the gap between machine and human-like behavior (R. W. Picard, 2000; Reynolds & Picard, 2001). Expressing emotions through comments or via animations (if applicable) is one of the approaches typically encountered in persuasive applications. Other strategies involve the usage of clever script construction (R. W Picard, 1997). Instead of responding to a user’s request with telegraphic sentences (e.g. “yes”, “no”, etc.) designers recur to language tips reminiscent of dialogues between humans (e.g. “I agree with you”, “I apologize, but I can’t perform that operation”, etc.) in the attempt of bonding user and machine / system. Existing studies within this field suggest that humans are more likely to feel closer to machines which show some similarities to them. The Stanford’s personality study aimed to assess whether users would feel closer to a machine which expressed characteristics and emotions close to their own (Nass, Moon, Fogg, Reeves, & Dryer, 1995). Results showed that those users paired with computers tailored to their emotions felt more empathy with the system than the others whose emotions did not resonate with the computer’s own. A second study (the affiliation study) was designed to build on the results of the former and enrich existing knowledge in the domain. The goal consisted in assessing how individuals perceived their emotional connection to a machine which was introduced to them as being part of a group formed to solve a known problem. Users felt more attached to the machines which were presented to them as an integral part of the group than those who were briefed that the machine was present as an independent entity which could be used to help in the problem solving task (Nass, Fogg, & Moon, 1996).

3.2.1.3 Language Characteristics

The usage of language traits in machines and systems is a common approach towards creating empathy with a user, as testified by some examples cited above. Many companies recur to clever messages to get closer to their customers and even tailor their products and services to them. Fogg labels this strategy as "influencing through language". Amazon is an example of a company which uses language to persuade its customers extensively. From the welcoming message addressing the user's name, to the suggestion of products based on user preferences or hinting at potentially interesting items using an almost seductive language, it attempts at maximizing the number of purchases a user performs while navigating in the website (Figure 3.2).

Figure 3.2 – Amazon's usage of language to empathize with customers.

Some particular language strategies venture beyond the construction of sentences to mimic human speech. Persuasion designers also employ cues which acknowledge simple or complex feats that users accomplish. This explicit act of praise aims at making users feel better about themselves and their progress through the presentation of sentences which encourage them to further pursue their goals (Pandey & Singh, 1987). There are various examples of these strategies throughout computer systems and applications. Figure 3.3 depicts an example showcasing a user being praised for abiding to licensed software practices (left) and another being congratulated for successfully completing the process of registering in a specific service by a software company (right). Existing studies show that praise is a very strong and impactful instrument in persuasive interventions, with users perceiving as clearly being affected by these messages when they accomplished determined tasks (Fogg & Nass, 1997; Fogg, 1997).

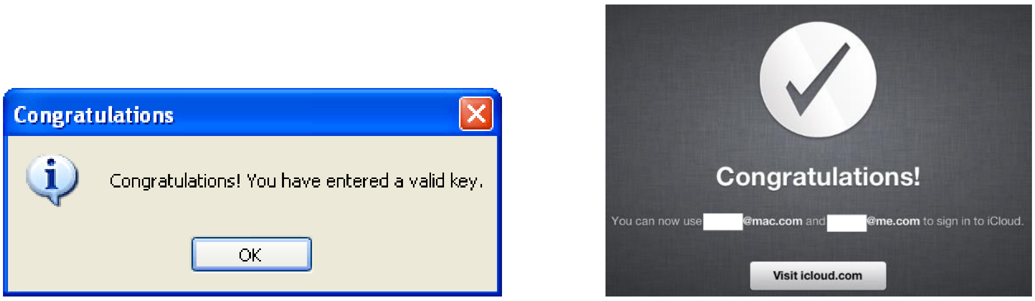


Figure 3.3 – Examples of praise in computer systems and applications.

3.2.1.4 Social Dynamics

All prior strategies have relied on the creativity of the persuasion designers to convey engaging and emotionally connecting messages to influence a user. However, in the domain of persuasion, other variables may be accounted for concerning the pressure exerted on individuals towards modifying their habits. Among these is social dynamics. Social interactions play a pivotal role in the current world. Not only humans were, since the beginning of recorded history, societal beings (Buss & Malamuth, 1996; Leakey, 1993), cultures have been influenced through knowledge exchange (Argote, Ingram, Levine, & Moreland, 2000) or imitation (Kaye & Marcus, 1981). Peer pressure is a form of social interaction, albeit sometimes not explicit, in which individuals make decisions not only based on their personal interests, but also on what their friends and / or relatives opted for. Such behavior is notorious in marketing, where users often purchase items from brands which are also preferred by their peers. Persuasive cues recurring to language influence approaches have also incorporated social dynamics. Examples range from toys which emit sounds asking children to "play with them" as if the inanimate toy had a soul of its own and could engage in play-making autonomously. As suggested by Fogg, e-commerce sites capitalize on societal rules and protocols in order to seduce their costumers, creating an empathetic environment as if they were being assisted by a shop-owner in the real world. Figure 3.4 depicts Amazon's product recommendation system based on what other customers bought. This is an example of using social pressure to induce the user to purchase products based on what everyone else is also acquiring.

Figure 3.4 – Amazon's product suggestions based on other people's trends.

Reciprocity is a persuasive strategy related with social dynamics. The theory states that users respond to positive actions with another positive action (Falk & Fischbacher, 2006; Gouldner, 1960). A typical example consists in gift exchange: people tend to respond by giving gifts of similar value as the ones they received from their acquaintances. Fogg performed a study to assess whether the reciprocity theory had an impact on user task performance (Fogg, 1997). The methodology consisted in assigning users to two computers – one which actively assisted them in performing a task and another which provided minimal assistance. Participants were then asked to perform a second task where half of the participants remained in the same computer while the other half switched to the other. Results showed that those who worked with the helpful computer in both tasks performed twice as much as other subjects in the second task. This experiment is a testament to the potential behind social dynamics in persuasion.

3.2.1.5 Adopting Social Roles

The last strategy as proposed by Fogg, builds on the societal aspect of persuasion, pushing it further into machines assuming roles of personas and / or roles of authority. The adoption of social roles on behalf of a machine is a persuasive approach which can impact of a user's decisions. Weizenbaum (Weizenbaum, 1976) reflected upon the power that a virtual therapist (ELIZA) had on influencing patients towards adopting determined postures (Figure 3.5 – left). The adoption of social roles strategy emulates this experiment, by creating virtual personas, with a certain authority degree (e.g. therapists, doctors, physicists, teachers, etc.), capable of counselling or even dictating orders to users. As the original author had discussed, people adhere to such type of approach, often obeying these virtual entities, despite having full knowledge that it is just a piece of software. There are other examples which do not assume such pivotal commanding roles, but adopt the form of a helping character available to provide support to a user's shortcomings. Microsoft has employed such characters in its Office Suite (Figure 3.5 – right) (Microsoft, 2014); Jeeves is another well-known example of a virtual persona employed in the Ask Jeeves (Media, 2014) search engine.

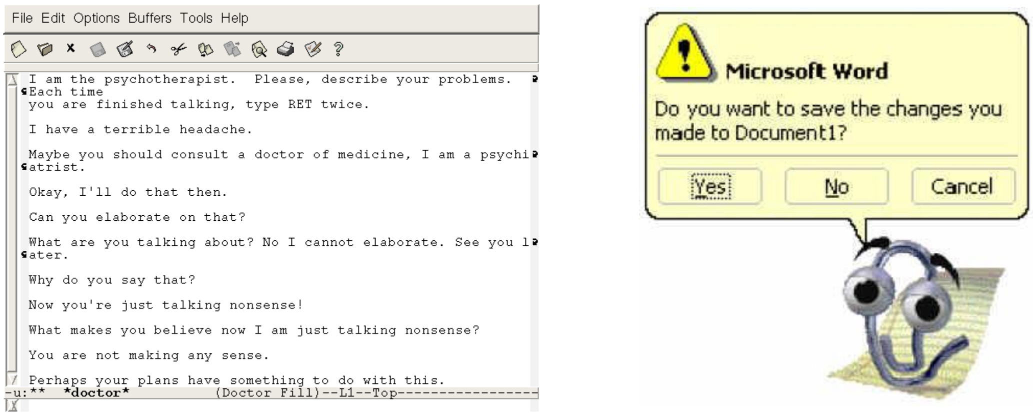


Figure 3.5 – Roles of authority: ELIZA's Emacs interface (left); Microsoft Office clip assistant (right).

3.2.1.6 Summary of Computers as Persuasive Social Actors

B.J. Fogg's theories on persuasion have been extensively used as a source of inspiration for research within this domain. In the context of this thesis, we opted to explore in detail the role of computers as persuasive social actors. As the genesis of a persuasive process often involves two entities which engage in an exchange of arguments to change the other's opinions, beliefs or behaviors on a determined topic, we considered this view of the author to be adequate to our goals.

The presented theory focuses on how designers imbue systems with certain characteristics which lead users to create empathy with them and thus be more susceptible to persuasive interventions. Discussed strategies are as diverse as "humanizing" a computer through the inclusion of language or aesthetically pleasing physical qualities or relying on social dynamics and the adoption of roles of authority to persuade individuals. A broad analysis of the discussed characteristics suggests that one of them assumes a pivotal role and is present (sometimes in a dissimulated way) in most strategies: the inclusion of language. Regardless of the usage of social dynamics, a virtual character in a role of authority or using praise to convey persuasive cues, language assumes a leading role in these strategies. Feedback messages and praise cues are fundamental to keep the users up to date regarding their progress or their achievements. It is a centerpiece of the communication process between man and machine intent on altering the creeds or behavior of the target user.

For the context of our thesis, we will pay special attention to the usage of feedback messages and, in particular, praise as a way to persuade users into improving their performance or changing their behavior patterns.

3.2.2 Persuasive System Design Model

One of the most well-known models in this domain is the Persuasive System Design Model as proposed by Oinas-Kukkonen et al (Oinas-Kukkonen & Harjumaa, 2009). The model details a step driven process which can be applied in the development of computer systems addressing two facets of the persuasion task: the process of persuading a target itself and the intrinsic qualities which a system capable of persuading should possess. The provision of a harmonious balance between these two aspects can greatly contribute to the success of the persuasive intervention. Figure 3.6 depicts the full process as envisioned by Oinas-Kukkonen.

Figure 3.6 – Persuasive System Design Model process depiction.

The proposed process comprises two steps which are commonly found in traditional system development: the requirements elicitation and definition along with the implementation of the software itself. There are two steps particularly related with the design of persuasive systems which are inserted. The first emerges at the forefront of the process and pertains not only to the analysis of the context of persuasion but also to the selection of adequate persuasive design principles to support the effectiveness of the process. Ultimately, the conjunction of these steps leads to the end result of a change of behavior and / or attitude in the target user(s).

3.2.2.1 Persuasion Context

In the model proposed by Oinas-Kukkonen, the first step of the persuasion process concerns the characterization of the context in which the intervention will take place. Accordingly, there are three elements which can summarize this context:

- Intent
- Event
- Strategy

The intent is what the persuasive technology designer aims at changing in the target user(s). This typically refers to the targets' behavior, ideals and / or creeds. A sub-component of the intent concept, entitled change type, is responsible for addressing which particular facet(s) should be targeted by the intervention.

The event component pertains to the instruments used to persuade the target(s) and is further divided in three sub-components. The first, denominated usage context, describes the characteristics and contingencies of the environment and domain in which the persuasive instruments will be employed. For instance, entertainment applications (in particular, videogames) should account for the prevention of player addiction; health domain applications must abide to the existing medical laws and existing procedures in order to avoid aggravating the patients' health condition. Complementing the context of the domain, the event component also accounts for the context of the target(s) of the persuasive intervention. This includes the daily environment in which the intervention will take place, lifestyle, personal commitment to the process and other relevant information at the personal level. The last sub-component concerns the technology involved in the process. This may include the type of device (e.g. specialized hardware, smart-phone, etc.) and the characteristics of the device or application (e.g. native app, web-app, mobile device, etc.).

The strategy is composed by two sub-elements – the message and the route. The message is the medium selected to deliver the persuasive cues intended to produce some changes.

The route dictates whether a direct (presentation of undisputed arguments), indirect (presentation of set of data indicating benefits due to changed behavior) or a mix of both is employed.

A macro level analysis of this step of the persuasion process reveals that its main intervenients are accounted for and characterized. Designers are able to define the behaviors which are the target of the intervention, how they will be changed and under which circumstances this will be achieved. The only noteworthy absence of this characterization is the definition of the specific cues, strategies and technology which are used to convey the persuasive messages – the qualities of the persuasive system.

3.2.2.2 Qualities of Persuasive System Design

The Persuasive System Design model introduces a set of qualities which a persuasive system should aim to include. The selection of these qualities is often tightly connected with the definition of the context of persuasion, as suggested in Figure 3.6. The authors propose four qualities which add to the persuasive intervention:

- **Primary Task Support** – the degree to which the system provides support and assistance to the users while carrying out the main tasks assign to them. The proposed qualities include reduction, tunneling, tailoring, personalization, self-monitoring, simulation and rehearsal.
- **Dialogue Support** – the qualities required to provide feedback to the users while progressing throughout their tasks. Ultimately the system should keep the users informed and steer them towards their goal. The instruments / qualities used to convey this type of information often include praise, rewards, reminders, suggestions, similarity, liking and social role.
- **System Credibility Support** – a set of qualities which improve the system's legitimacy for the user and hence can be more effective as far as persuasion is concerned. Properties include trustworthiness, expertise, surface credibility, real-world feel, authority, third-party endorsements and verifiability.
- **Social Support** – the authors of the PSD model inspired in Fogg's own theories revolving persuasion and its social aspect. These include social learning, social comparison, normative influence, social facilitation, cooperation, competition and recognition.

Primary task support comprises a set of characteristics which offer support to the user while performing the tasks assigned to him / her during the persuasive intervention (Figure 3.7). These include the minimization of possible activities to those which are essential (reduction), focus on the goals at hand (tunneling), providing a process which addresses the intrinsic characteristics of the user and environment (tailoring and personalization) as well as being able to track progress (self-monitoring) or investigate the cause-effect relations or potential outcome of the intervention (simulation and rehearsal).

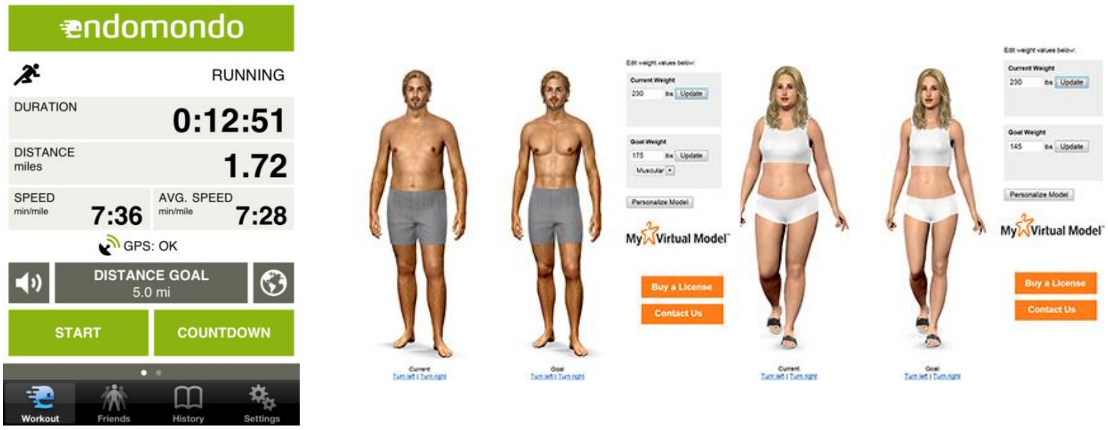


Figure 3.7 – Primary Task Support examples: progress tracking (left); simulation (right).

Ensuring users are aware of their own progress and status amidst a persuasive intervention can be pivotal towards achieving success. The dialogue support qualities capitalize not only in clever ways to convey this information but also take inspiration from Fogg's facets of persuasion. Some of the instruments used to inform users about their progress include praising them, offering rewards for manifesting the target behaviors, recall them to abide to the target behaviors or even are capable of offering suggestions to steer the users towards the desired behaviors (Figure 3.8). Some feedback approaches capitalize on the proximity between user and system as a way to approach the latter to the former, creating relations of affect or empathy which ultimately lead to users abiding to the target behaviors due to similarity between each other. Attractiveness and aesthetics can also perform a pivotal role since users are more readily attracted towards beings, objects or systems which have an appealing look to them.

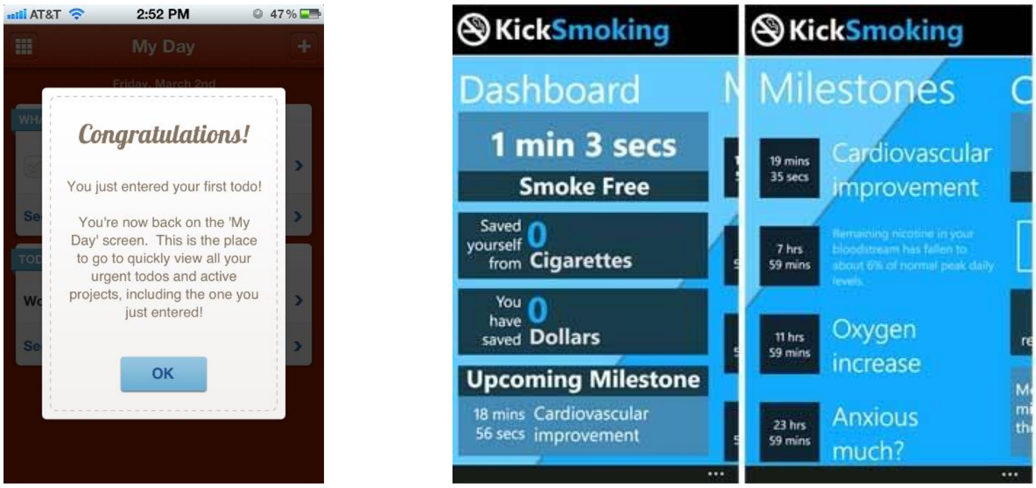


Figure 3.8 – Dialogue Support examples: offering praise (left); provision of rewards (right).

A key point in any system design is the credibility it conveys to its potential users. An application developed by a reputable software developer is likely to garner the trust of consumers more rapidly than if it was developed by an unknown entity. Furthermore, trust is an important aspect of today's cyberspace (Figure 3.9): people expect the presence of certain cues in critical websites such as home-banking (e.g. certificates, secure connection) or health related websites (third-party endorsements).

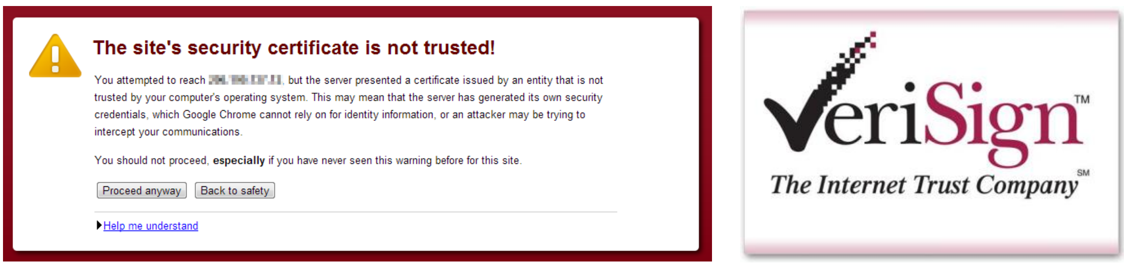


Figure 3.9 – Credibility Support examples: untrusted certificate (left); verified authority (right).

It comes to no surprise that persuasive system design is also connected with credibility. Some of the qualities suggest how the available information should be unbiased, fair and truthful (trustworthiness). It should also be viewed as originating from a competent, knowledgeable and experienced source (expertise) and should also appear serious in both look and feel in the first contact with the user (surface credibility and real-world feel).

Systems which capitalize on third-parties or authorities to support the claims they state are often viewed as being more credible as well (authority). This feeling of trust can be further enhanced if the website provides links to the source of the information there displayed (verifiability).

The last set of qualities concerns social support. While some differences can be noticed, most facets of these qualities take inspiration from Fogg's theories regarding the role of social cues in persuasion. Providing support for groups may be done addressing both a cooperative and competitive nature. Allowing users to compare results (social comparison), promoting and recognizing those who abide and achieve the target behaviors (social facilitation and recognition respectively) as well as grouping those who currently share the same goals (normative influence) can be paramount to the success of the persuasive system. The observation of other users who are going through the same kind of interventions can also result in being a catalyst to improve motivation across the board (social learning).

3.2.2.3 PSD Model Summary

Oinas-Kukkonen's Persuasive System Design Model derives some concepts from B. J. Fogg's work on persuasion in computing systems. The model provides a broad coverage regarding how the persuasion process unfolds itself when targeting a user or group of users. Additionally, it also discusses how this process can be supported via the inclusion of specific instruments which aim at improving the relation between the target user and the persuasive system. These instruments comprise features related with the support given to perform specific tasks, quality and type of feedback provided to the user, the credibility of the system or how it is endorsed by third-party entities.

The analysis of these characteristics starts suggesting a confluence of ideas regarding multiple models or theories concerning persuasive technology. The connection between some features of the PSD model and Fogg's theories are evident and testify the effectiveness of this technology. The inclusion of feedback messages, praise and social aspects in the PSD model can be viewed as partially taking inspiration from previous work by Fogg.

There are, however, other instruments which deserve our full attention, especially within the context of this research. The PSD model suggests the inclusion of rewards as a mean to motivate users and to show recognition for their feats and achievements. The extent to which these rewards go (whether real rewards or virtual ones) is not thoroughly discussed, a matter which is therefore subject to discussion and exploration, potentially in other models. Nevertheless, in light of this work's framing around videogames, we identify the employment of rewards as a potentially enticing and interesting object of study which joins the usage of feedback messages and praise as our targets as far as persuasive instruments in videogames is concerned.

3.2.3 King & Tester's Persuasive Strategies

Phillip King and Jason Tester (King & Tester, 1999) elaborated on other strategies which, in some cases, may have a more relevant role in non-technological environments. They capitalize on existing motivational approaches and discuss how systems can employ them successfully to persuade a user or group of users. The following are the approaches as discussed by King and Tester:

- Simulating Experiences
- Surveillance via Monitoring & Tracking
- Providing an Environment to Discover
- Creating Virtual Groups
- Personalizing Content

In critical settings, persuasion can lead users towards altering their behavior indefinitely, having short or long term consequences on that person's quality of life. The decisions one takes while under a persuasive intervention may, therefore, have a lasting and profound impact. However, in some cases, such abrupt and disruptive "changes of heart" may not be desirable or even the ultimate goal of the process. Raising awareness towards a specific thematic may be sufficient. The simulated experiences approach aims at providing a decision environment, sharing similarities with the real world, and showcasing the consequences of adopting determined decisions. If the persuasive process is successful the impact is more limited than in other scenarios where the user is under a continuous and stressful stream of persuasive elements. One such example is RealityWorks' Real Care Baby which is a simulator to practice parental skills and child-caring procedures.

Another approach pertains to the usage of surveillance tactics such as constant monitoring and tracking of users. This strategy is often employed continuously until the target user(s) change a determined behavior. However, this practice is known to be controversial as the boundary between persuasion and coercion or manipulation is sufficiently thin to raise ethical questions (Berdichevsky & Neuenschwander, 1999). Nevertheless, one may interpret the usage of monitoring and tracking as reminiscent of both what B. J. Fogg and Oinas-Kukkonen propose as far as keeping users up to date about their progress is concerned. In this case, ethical concerns are mitigated since the information is displayed to the users themselves for their own benefit during a persuasive intervention.

Not all persuasive approaches are as forceful as the ones depicted yet. While narrowing the user towards a determined goal has its benefits, as testified by the diversity of strategies discussed here, King and Tester proposes a tactic which capitalizes on the freedom given to the target user(s). The environment of discovery is a strategy which enables users to explore a determined setting. The process of exploration is accompanied by smaller and feasible goals which, upon completion may provide the user(s) with rewards. In addition, this strategy intermingles the persuasion by praise approach, in which encouraging feedback is provided to motivate the subjects. In this tactic, the user has the freedom to explore an environment and determine which of his / her actions resulted in positive reinforcement. This identification of what elements are beneficial to the participant is the core of the persuasive experience, leading the users to assimilate what is positive and / or negative to their welfare. Even though the authors do not attempt to bridge this approach towards specific domain, we believe the environment of discovery approach is a constant presence in videogames, as players are prompted to explore virtual worlds, make decisions with certain repercussions and explore which features can be beneficial for their performance.

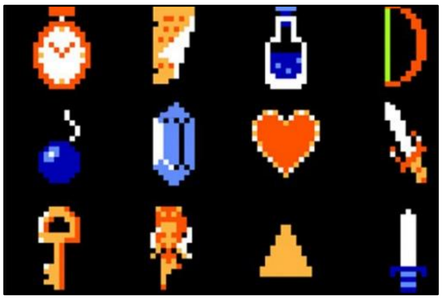


Figure 3.10 – The Legend of Zelda item list: the game's environment of discovery.

The first entry in the "Legend of Zelda" (Nintendo, 1986) series is a fine example of such tactic: players are presented with a set of icons at the beginning of the game which represent the items which can be discovered throughout the adventure. Players are then responsible for using the items and choosing the ones they prefer based on their abilities, preferences and perceptions (Figure 3.10).

The author discusses another strategy which resonates with Fogg's social dynamics approach. The establishment of virtual groups is a way to motivate and persuade users into adopting determined postures and behaviors. Similarly to Fogg's approach, these groups work as catalysts for the user to participate and indulge in certain activities which, in the end, may impact on the user's psyche and behavior. However, while Fogg focuses on the potential of cooperation, King and Tester delve into the power of competition, in which individuals belonging to virtual groups are persuaded to perform above and win over other participants. This has been a recurrent practice in auction houses. In this scenario, an individual is constantly in pressure and being persuaded to spend more for the sheer purpose of winning the item at stake from the other bidders. The creation of empathic relations between stakeholders is another divergence point between this and other socially enhanced persuasive strategies: the focus of competitiveness may downplay the role that others have in the process from a purely sympathetic perspective.

The last strategy concerns the personalization of content for a particular user and having the modification of a determined characteristic in mind. The adaptation of content to a person in particular is a valid starting point towards a completely tailored persuasive experience. As the target users' needs evolve so does the persuasive environment surrounding them. King and Tester, on the other hand, denote not only the usage of personalization as a support mechanism, but also using tactics which involve striking fear or concern on the user. Such approach is stated to have a deeper emotional impact, forcing users to embrace the persuasive cues and ultimately adopt the behaviors these aim to impose on them.

3.2.3.1 King & Tester's Research Summary

Philip King and Jason Tester's view on persuasive strategies presents a few common traits concerning the theories of Oinans-Kukkonen and B. J. Fogg. Content personalization, the advantages of social dynamics, the ability to monitor or track progress as well as the provision of a simulation space in which users can preview the benefits / drawbacks of their behavior had already been presented with minor differences in some characteristics. King and Tester, however, reinforce an important issue in some of these approaches which is present in B. J. Fogg's definition of persuasion: while changing the ideals, creeds or behaviors of an individual may be beneficial to him / her, one must take into account the means to accomplish it. Fogg defends that neither deception nor coercion should be employed to reach that goal. King and Tester emphasize the ethical problems which arise from constantly monitoring or tracking the users.

There is one other persuasive strategy proposed by King and Tester which, albeit capitalizes on existing expertise regarding the existence of rewards for accomplishing certain tasks, possesses its own unique features which diverge from previous design exercises. The environment of discovery proposes a space in which users are free to experiment and explore which behaviors, interactions and attitudes are most beneficial to them. The goal here is to replace a certain sense of spoon-feeding the users and allow them to experience and explore which features can be beneficial to change their behavior and / or creeds using technology.

Our emphasis in the environment of discovery approach is not unpremeditated. As pointed by the example we gave, the usage of an environment of discovery is relatively common in modern videogames. While some rewards are given for accomplishing certain feats, players are also confronted with a spectrum of features, abilities and rewards they must opt for and optimize in order to pursue their goals, preferably with a high approval rating / performance. In sum, in the context of this document we will also take particular attention to this kind of approaches.

3.3 Unifying Persuasion Frameworks

B.J. Fogg's view on the role of persuasion in technology along with King and Tester's theories both explore strategies for persuasive interventions at a macro level. Additionally, there are common points between them: the usage of simulation and social dynamics emerge as the most obvious ones. Oinas-Kukkonen, on the other hand, delivers a model which touches a couple of ideas which are noteworthy for persuasion interventions. The usage of specific instruments and the characterization of supporting pillars to aid the intervention throughout its process provide an added-value over the previous authors' offerings. Apart from sporadic common points between these three perspectives, no effort was channeled towards unifying these ideas into a single model with the intent of better describing persuasive interventions.

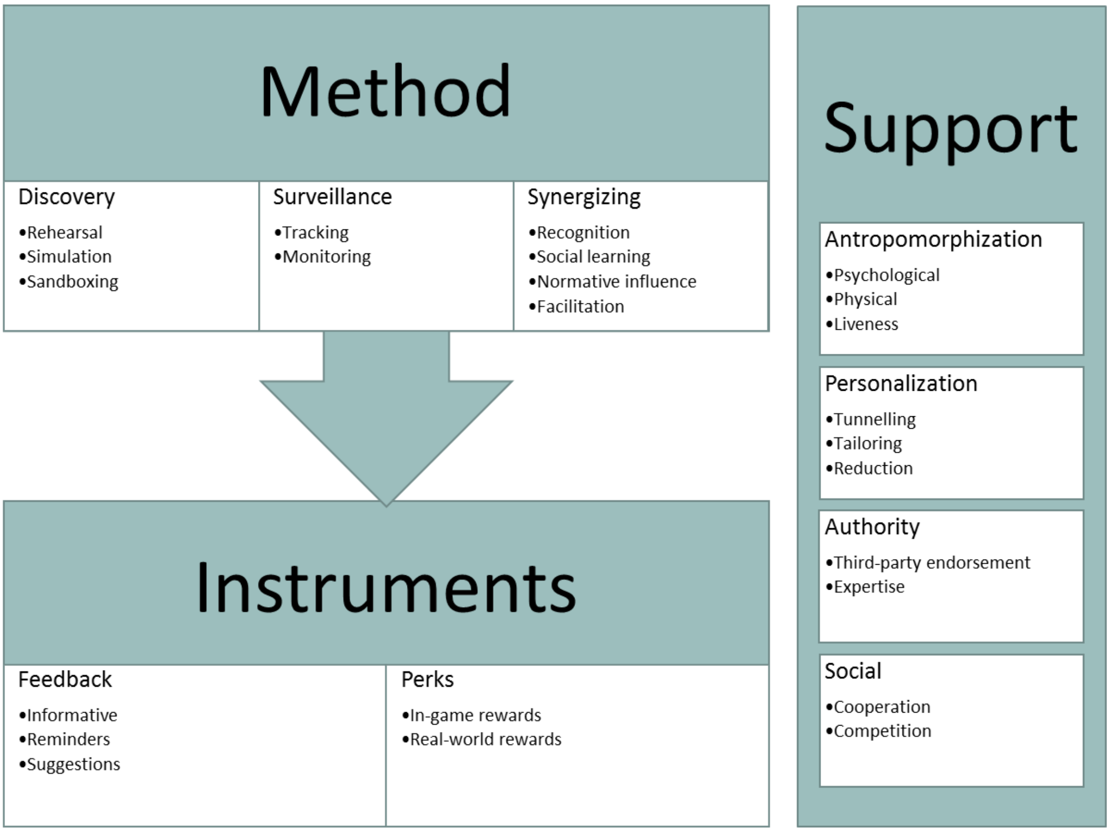


Figure 3.11 – MSI persuasion model depiction.

3.3.1 The MSI Persuasion Model

The Method-Support-Instrument persuasion model is the result of an abstraction exercise stemming from the confluence of the ideas present in the approaches persuasion theories. We closely followed the division we presented at the beginning of this chapter in which persuasion was referred to as having a process and some king of technology involved. We also built on the studied models and frameworks' strengths and weaknesses to deliver a unified view of how a persuasive intervention for videogames can be defined. The model's graphical representation can be observed in Figure 3.11. Unlike the PSD model, in the MSI persuasion model we refrain from accounting for the target behaviors' we want to address with the intervention. Instead, the framework focuses on describing the existing infrastructure to support those behavior changes (whichever they are). Note that, for each category, we merely provide examples of methods, support strategies and instruments based on the analyzed frameworks. We do not discard the possibility of extending these categories with further approaches, provided there is strong evidence supporting it.

The model encompasses a trio of categories: the method, the supporting structure and the instruments. While most persuasive interventions recur to these three categories, in the context of our framework, only the method and the instruments used are mandatory. The support category can be used to enhance the intervention but are in no way a required presence for it to take place. We will now address each category and intrinsic dimensions in detail.

3.3.1.1 Method

The method defines the major guidelines and the grand strategy concerning how the intervention will be approached. The inspiration for this stems from the PSD model's requirement elicitation and context definition prior to the beginning of the intervention. At that stage, designers merely retrieved a general perspective of the target and the modifications they wish to provoke. The method category in the MSI model acts as the base upon which more detailed strategies will be built, steering the general directions in which the persuasive intervention will be based upon. The inspection of the analyzed persuasion frameworks allowed us to pinpoint a set of strategies which are typically encountered in videogames. We aggregated these into logical dimensions which define the type of method available for designers:

- **Discovery** – pertains to the usage of exploration as a motivational process, ensuring the onus is on the players and not on the technology surrounding them. Both Oinas-Kukkonen and King and Tester stated that simulation and rehearsal can be viable ways for users to change their behavior when facing real challenges: the opportunity to preemptively experiment and have a clear preview of the outcome of their decisions may foster / detract them from following the same path in the future. King and Tester, in particular, go beyond this paradigm and defend the usage of an environment of discovery, providing users with a sandbox environment in which they are free to fully interact with the elements populating it and experience their effects. The discovery category addresses these three particular methods for persuasive interventions. In addition, there is a metacomponent for discovery which is related with modern integration in videogames. In an era where information is widespread and easily accessible, discovery processes may be severely hindered by what is commonly denominated by "flavors of the month" or "cookie-cutter builds" – in short, a compilation of the best choices a player can make to maximize their performance. Instead of letting the environment of discovery quickly dry, developers periodically force changes in the characteristics of the environment in order to renew the players' interest and self-discovery acts.

- **Surveillance** – this method relies on closely following the targets' progress during the intervention to ensure they are aware of their own improvements / fallbacks. The approaches mentioned are based on King and Tester's monitoring and surveillance and Oinas-Kukkonen's self-monitoring method. While outside the scope of this research, surveillance methods have been questioned as ethics and morality may interfere with their deployment (Vasalou, Oostveen, & Joinson, 2012).
- **Synergizing** – the last method we identified and unified aggregates strategies which base themselves on the power of social dynamics to ensure players are motivated. Using B. J. Fogg's and Oinas-Kukkonen's works as the primary sources of inspiration, we were able to identify a set of strategies which fall under this category and are suited for the videogames domain. Since some of the previously analyzed approaches overlapped each other, we reduced the spectrum of strategies to a select few. As such, recognition emerged as one, alongside social learning, normative influence and facilitation. Note that while many pinpointed recognition, social learning, normative influence and facilitation as the main strategies within this particular method.

3.3.1.2 Support

This category defines a set of facultative dimensions which may be used to improve and provide added layers of detail to the persuasive intervention. The MSI model does not mandate the inclusion of support methods. Still, based on existing literature and our own experience, we believe they strengthen the process. As of this moment, the following categories were identified:

- **Antropomorphization** – Fogg's theories explored how computers can be social actors for facilitating the persuasion process. Among the approaches discussed, imbuing the computer with psychological or physical traits which can make people feel more connected to them. In short, this consists in giving computers human-like characteristics to approach users more effectively. In the MSI framework we maintained these two aspects – the psychological and the physical facets – and added a third one which consists in how lively the persuading agent is. Since videogames often employ characters to act as companions guiding players throughout the experience. The character's liveliness indicated whether it is an inanimate object of a lively humanoid character supporting the player.
- **Personalization** – similarly to the theories approached, the personalization category comprises support strategies that each method can capitalize on in order to tailor the persuasive intervention. Among these, we included tunneling, tailoring and reduction as the support approaches available, each of them maintaining the same goal as in their original description.
- **Authority** – the intervention may also rely on the support of entities whose knowledge and presence strengthens the effect trying to be produced by it. This category considers two strategies. Third-party endorsement, as its name implies, consists in having an independent entity supporting the claims defended by the intervention with the intent of convincing the target player to abide to those procedures. The alternative strategy consists in the game itself delivering tools which give no margin for questioning. For instance, the usage of game masters in various online games is an example of this approach.
- **Social** – the social category requires some discussion, as the reader may question why its approaches are not an integral part of the synergizing method. The main reason is straightforward: there are single-player games which do not take into account the dynamics of groups and do not require those rules to actually operate harmoniously. Even games where users may be connected with each other, but do not directly influence one another within the game fall into this category (e.g. the usage of leader boards). For this category, we envisioned two possible ways to support the persuasive method in use: create an environment capable of fostering a sense of competition between players, or one where cooperation dictates how users may reach success.

3.3.1.3 Instruments

The last category present in the model concerns the actual catalysts of the persuasion intervention and the mechanics used to convey persuasive cues to the targets of the process. We were able to identify two subcategories in which these instruments may materialize themselves in videogames:

- **Feedback** – one of the most popular and recurrent ways to persuade players utilizes feedback to transmit the necessary information for the process to occur. Based on existing literature and our knowledge of this entertainment medium, we identified the usage of reminders, suggestions and information as the pillars of feedback. The first is typically used whenever the player is confronted with a challenge that he / she has overcome previously, but for an unknown reason is unable to repeat that feat. Alternatively it is also used as a hint to explore different approaches to tackle in-game challenges. Suggestions have been especially popular in the past years and typically appear whenever the player fails to overcome an obstacle in a plausible time frame. Informative feedback is often issued when players successfully accomplish determined feats, acknowledging their prowess (or lack of it) in doing so.
- **Perks** – the usage of rewards in videogames is a common practice. Players are offered new items, skills and cosmetic apparel as a token for their efforts in reaching a determined milestone in a game (e.g. levelling up a character, finishing a challenge). Currently, there are two trends: players receive rewards which can be utilized within the game, as exemplified via the offering of items and / or skills; players receive rewards outside the game which they can use to display their skill level. For instance, achievements and wallpapers (e.g. "Final Fantasy XIII" (Square-Enix, 2009) unlocks wallpapers for the Playstation 3 system (Sony, 2006) for accomplishing determined feats).

3.3.2 Validating the MSI Persuasion Model

To conclude this chapter and to provide closure to the first contribution of this document, we will now explore how the proposed persuasion model is able to provide coverage to persuasion in videogames. To do so, we selected a set of commercially available videogames and mapped the game's persuasive mechanics into the proposed framework.

3.3.2.1 Videogame Pool

Although performing an exhaustive review of how persuasive technology is present in videogames would be the ideal route, such study possesses a magnitude which far outreaches the scope of this document. As such, we opted to select a small set of videogames, representative of different genres and contemplating a period which spans from roughly 1985 to 2013. Table 3.1 lists the selected games, respective genres and a brief description of the players' goals and game modes.

Table 3.1 – Selected videogames for the analysis of the presence of persuasive technology.

Title	Genre	Description
Burnout Paradise	Racing	Racing game in which players do not only race but need to make opponents crash
Call of Duty: Modern Warfare	FPS	Single and multiplayer game which puts the player in various theatres of war
Dead Nation	Action	Single and multiplayer game in which players need to fend off a zombie invasion
Diablo 3	Action RPG	Action and story based game in which players progress through various difficulties to rid the world of a powerful enemy
Final Fantasy XIII	RPG	Role-Playing Game in which the player progresses through the story, meeting new characters and striving to rid the world of a powerful villain
Gran Turismo	Racing	Simulation game in which players build a racing career spanning throughout various categories and vehicle types
Guitar Hero	Music / Rhythm	Music rhythm game in which players need to accurately hit the correct notes to stay in tune

Sim City	Strategy	Simulation game in which the player acts as the mayor of a city, controlling buildings and taxes over his / her citizens
Sonic the Hedgehog	Platforming	Platform game in which the player needs to collect as many rings as possible each level and as rapidly as possible
Starcraft 2	Strategy	Single and multiplayer strategy game in which the player controls different races which battle each other for victory in different missions and skirmish battles
Super Mario	Platforming	Platform game in which the player progresses through different levels in the attempt to save a princess
Uncharted	TPS	Action game in which the player must defeat waves of enemies and solve puzzles to uncover the mystery of an ancient civilization or legend
Unreal Tournament	FPS	Single and multiplayer first-person shooter in which players battle against each other (or bots) in arenas
World of Warcraft	MMORPG	Online and multiplayer role-playing game which provides players with multiple activities (killing monsters or battling each other in arenas)

The list comprises a set of games which are typically given as examples of their own genres. We covered the classic platforming genre with popular franchises such as “Super Mario” (Nintendo, 1985) or “Sonic the Hedgehog” (Sega, 1991), up to more recent venture such as MMORPGs with “World of Warcraft” (B. Entertainment, 2004) or the music genre with “Guitar Hero” (Harmonix, 2005). With this set we hoped to strike a balance across the genres analyzed, platforms covered and period to which the games belong to.

3.3.2.2 Mapping Videogames into the MSI Persuasion Model

Table 3.2 presents how each videogame’s persuasive content is mapped into the MSI persuasion model. In this table we opted to display which dimensions of the method-support-instrument trio are invoked in the game. The presentation of this table is complemented with an overview and discussion of the most prominent strategies according to each concept in the MSI model and across the assessed games, rather than extensively dissecting each one.

Table 3.2 – Videogame mapping in the MSI persuasion model.

Title	**Method**	**Support**	**Instruments**
Burnout Paradise	Discovery ▪ Rehearsal Synergizing ▪ Recognition	Social ▪ Competition	Feedback ▪ Informative Perks ▪ In-game rewards
Call of Duty: Modern Warfare	Surveillance ▪ Tracking Discovery ▪ Sandboxing Synergizing ▪ Recognition	Social ▪ Competition	Feedback ▪ Informative Perks ▪ In-game rewards
Dead Nation	Discovery ▪ Sandboxing	Social ▪ Cooperation ▪ Competition	Perks ▪ In-game rewards
Diablo 3	Discovery ▪ Sandboxing Synergizing ▪ Facilitation	Social ▪ Cooperation Personalization ▪ Tailoring ▪ Tunneling	Feedback ▪ Informative Perks ▪ In-game rewards
Final Fantasy XIII	Discovery ▪ Sandboxing	Personalization ▪ Tailoring	Feedback ▪ Informative Perks ▪ In-game rewards ▪ Real-world rewards
Gran Turismo	Discovery ▪ Sandboxing	Authority ▪ Third-party endorsement	Perks ▪ In-game rewards
Guitar Hero	Surveillance ▪ Tracking	Authority ▪ Third-party endorsement	Feedback ▪ Informative
Sim City	Discovery ▪ Rehearsal	Antropomorphization ▪ Psychological	Feedback ▪ Informative

	▪ Sandboxing ▪ Simulation		▪ Suggestions Perks ▪ In-game rewards
Sonic the Hedgehog	Discovery ▪ Sandboxing		Feedback ▪ Informative
Starcraft 2	Discovery ▪ Rehearsal ▪ Sandboxing	Social ▪ Competition ▪ Cooperation Antropomorphization ▪ Psychological	Perks ▪ In-game rewards
Super Mario	Discovery ▪ Sandboxing		Feedback ▪ Informative
Uncharted	Discovery ▪ Sandboxing	Personalization ▪ Tunneling	Feedback ▪ Suggestions
Unreal Tournament	Discovery ▪ Rehearsal ▪ Sandboxing Synergizing ▪ Recognition	Social ▪ Cooperation ▪ Competition	Feedback ▪ Informative
World of Warcraft	Discovery ▪ Rehearsal ▪ Sandboxing Surveillance ▪ Tracking ▪ Monitoring Synergizing ▪ Learning ▪ Recognition	Social ▪ Cooperation ▪ Competition Authority ▪ Expertise	Feedback ▪ Informative Perks ▪ In-game rewards

3.3.2.3 Dominating Persuasion Methods

A quick glance at the table allows us to extract a basic conclusion: sandboxing is a highly popular persuasive method. Any game which provides the player with a set of options in a controlled environment and with which the player may interact with and experiment to determine what best suits his / her playing style is bound to fall into this method. For instance, “Call of Duty” (I. Ward, 2007), “Uncharted” (Dog, 2007) and “Unreal Tournament” (E. Games, 1999)offer players an arsenal of weapons which they are free to explore and to select based on their prowess with them. “Diablo 3” (B. Entertainment, 2012) (Figure 3.12 – left), “Final Fantasy XIII” (Square-Enix, 2009) and “World of Warcraft” (B. Entertainment, 2004) (Figure 3.12 – right) give players the ability to experiment with different skills and abilities, potentiating a full customization of their play style.

Figure 3.12 – Diablo 3 skill configuration (left); World of Warcraft skill configuration (right).

Platforming games such as “Sonic the Hedgehog” (Sega, 1991) and “Super Mario” (Nintendo, 1985) also provide players with an environment of discovery. While in the first installments of both series it can be difficult to assess this approach (given how linear those games were), advancements throughout the years allowed players to explore the best tactics to overcome certain obstacles and challenges. “Gran Turismo” (Digital, 1997) offers players an extensive and rich environment in which they can customize their vehicles and experiment on with those alterations. The range of customization covers engine output, suspension, clutch characteristics, tires, transmission type and response times, among a myriad other characteristics. The impact spectrum stemming from the combination of these characteristics is broad enough to require the players’ commitment for considerable amounts of time until they are comfortable with their setup, thus inviting them back to the game and spend more time with it. Strategy games rely on environments of discovery and sandboxing methods using a straightforward approach: they provide players with a variety of options with which they can accomplish the challenges imposed upon them. For instance, in "SimCity" (Maxis, 1989) players have different types of buildings and facilities to reach their population and to increase the likeliness of migrating to the player's town. On the other hand, "Starcraft 2" (B. Entertainment, 2010) gives players a tiered technology tree (Figure 3.13) which unlocks powerful units to battle their foes. Unit combination and rapid adaptation to what the adversary relies upon (countering each other's strategies) is a key element for achieving success in this game. Both "Starcraft 2" (B. Entertainment, 2010) and "World of Warcraft" (B. Entertainment, 2004) also employ rehearsal strategies as they use specially created content (often denominated Proving Grounds) in which players can practice before engaging in real confrontation scenarios.

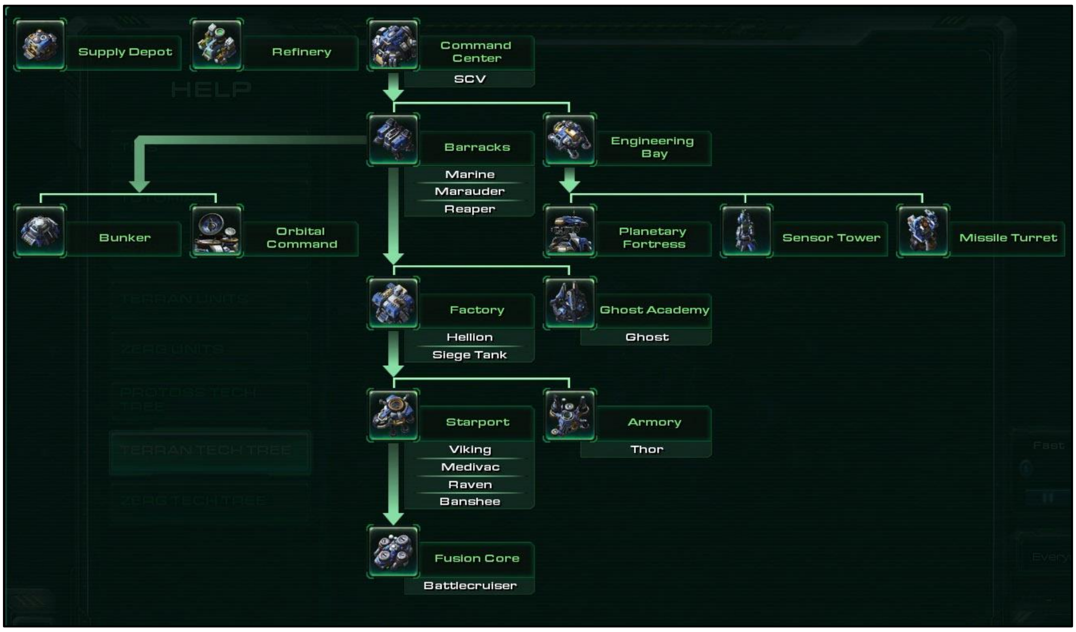


Figure 3.13 – Starcraft 2's Terran race technology tree.

The other two methods are less represented, but still deserve our attention. Persuading through surveillance occurs in "Call of Duty" (I. Ward, 2007), "Guitar Hero" (Harmonix, 2005) and "World of Warcraft" (B. Entertainment, 2004). The first allows players to constantly keep track of their statistics (e.g. kill / death ratio, accuracy, etc.) and thus promote improved performances by maintaining that knowledge. "Guitar Hero" (Harmonix, 2005) utilizes a similar approach, with the player having constant awareness of their skill within the game by inspecting different cues across the game environment. "World of Warcraft" (B. Entertainment, 2004) does not natively provide monitoring and tracking features but, with the addition of extensions to the player's user interface, it is possible to not only track his / her own performance, but also their partners'.

Persuasion based on synergies created between players is also accounted for in a few videogames. Shooting games such as "Call of Duty" (I. Ward, 2007) and "Unreal Tournament" (E. Games, 1999) rely on synergies created among players to have them coming back for more matches and potentially create bonds between them. "Diablo 3" (B. Entertainment, 2012) and "World of Warcraft" (B. Entertainment, 2004) rely on facilitation techniques to provide players with some bonuses for grouping up and building those ties between them.

3.3.2.4 Supporting Persuasion Strategies

We were not able to encounter a single dominating approach for the support category in the MSI model's mapping. Antropomorphization is probably the least present support variant. "SimCity" (Maxis, 1989) uses its psychological facet as a way to approach players and entice them to take certain decisions: they are typically informed about the discontent of the town's population via direct complaints of its citizens (Figure 3.14). "Starcraft 2" (B. Entertainment, 2010) uses a very similar approach in briefings prior to each mission (during which the player is exposed to determined causes in an attempt to make them feel more connected to the storyline's development) and during missions via the counselling and informing voice of their supporters in the battlefield.

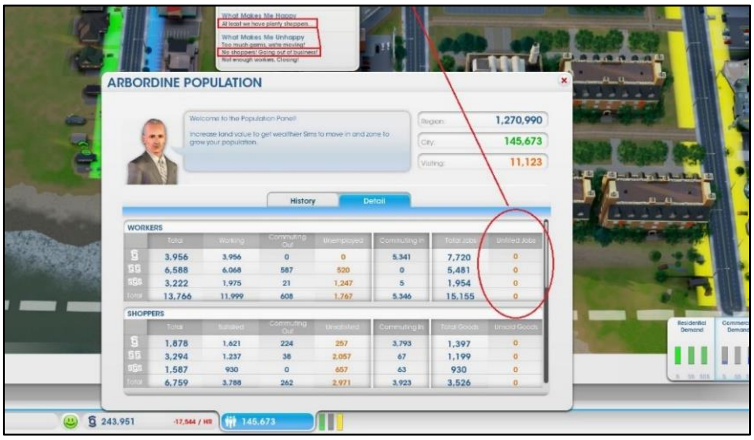


Figure 3.14 – SimCity's usage of psychological cues to approach the players via discontent reports.

Support to personalization is present in a few role-playing games along with the isolated case of "Uncharted" (Dog, 2007). In both "Diablo 3" (B. Entertainment, 2012) and "Final Fantasy XIII" (Square-Enix, 2009), personalization recurs to tailoring strategies to persuade players. This is achieved by effectively implementing dynamic difficulty adaptation techniques, as the challenges issued by the game accompany the development of the players' characters. In "Uncharted" (Dog, 2007) we can witness a tunnelling approach as players are often explicitly steered towards their goals when the game determines they have been unsuccessfully looking for the objectives for a predetermined time frame. The game also uses a clever colour palette for the surrounding building architecture with specific colours (e.g. yellow, red) suggesting that certain areas can be interacted with (Figure 3.15).

Figure 3.15 – Uncharted's usage of tunneling techniques to steer players during wall climbing sections.

Supporting system credibility is highly dependent on the external features available for the game is another way to improve the persuasion process. In our videogame pool, both "Gran Turismo" (Digital, 1997) and "Guitar Hero" (Harmonix, 2005) utilize third-party endorsement in the same way. The game includes special segments in which the player is tutored by known racing drivers (e.g. World Rally Championship's nine time winner Sébastien Loeb, Formula 1 three times champion Sebastian Vettel, etc,) and guitarists (e.g. Tom Morello from Rage Against the Machine and Slash from Guns 'N Roses fame), respectively for each game. "Gran Turismo" (Digital, 1997) also recurs to some safety messages endorsed by the appropriate authorities to promote safe behavior while driving on the road (e.g. always use safety belt, always use turn signal). "World of Warcraft"'s (B. Entertainment, 2004) approach slightly differs from these two other games as it includes entities within the game to give players the support they need. These entities are the game-masters: especially hired individuals who have knowledge about the game surpassing the average players' and have a set of powers and abilities at their disposal which can typically solve situations beyond the player's reach. For these reasons, players look to them as authorities which are present to support and punish them whenever some behaviors go against the rules of the environment. We couldn't let a very famous type of endorsement during the 90s go unnoticed. A significant number of games used to present a message in their loading screen encouraging players to stay away from drugs. The message was endorsed by the FBI, increasing the impact of the message on its audience (Figure 3.16).

Figure 3.16 – The "Winners don't use drugs" endorsement splash screen.

Social support is mostly divided among the two approaches we listed in our framework. Competition is a highly popular way to promote social dynamics between players and improve their engagement with the product. Virtually all examples listed in this mapping exercise include some type of leaderboards with which players can compare with each other. The layers of these leaderboards is where the approach can be differentiated. While games like "Unreal Tournament" (E. Games, 1999) and "Call of Duty" (I. Ward, 2007) utilize these mechanisms on a match basis to showcase the prowess of each player for that particular encounter, other games rely on more established track records to make player compete between them. "World of Warcraft" (B. Entertainment, 2004), for instance, offers a complex achievement system which is available within the game and using the game's official website. Players are able to compare between them. The usage of seasonal player-vs-player arena tournaments adds to the competitiveness of the game, engaging players in exchange for exclusive rewards. Finally, “Dead Nation” (Housemarque, 2010) adds another interesting twist, as the competition layer takes into account the contributions of each player on a per country basis. This means that players can observe how much their country has contributed to overcoming the zombie invasion that is present in the game. Cooperation approaches in our mapping fall into a few distinct categories. The first also relies on the concept of leaderboards, having spate ranks for players who opt to play solo or cooperatively. “Starcraft 2” (B. Entertainment, 2010) is an example that testifies this strategy. Other games have cooperation rooted in their own design, allowing players to tackle tougher challenges or mandating that those same challenges should be done in a group. “Dead Nation” (Housemarque, 2010), “Diablo 3” (B. Entertainment, 2012), “Unreal Tournament” (E. Games, 1999) and “World of Warcraft” (B. Entertainment, 2004) fall into this category.

3.3.2.5 Popular Persuasion Instruments

The way persuasion is truly conveyed to the player is dominated by the usage of in-game rewards and the informative feedback approach. In-game rewards can be offered due to a few different reasons. The typical method is to provide players with new rewards as part of their natural progress in the game. Role-playing games often award players with new items and skills when their character levels up or when they defeat a powerful enemy. First-person shooter games like “Call of Duty” (I. Ward, 2007) include perks which are unlocked as players’ progress through the multiplayer ladder – as the player progresses further, more options become available to customize their character (Figure 3.17).

Figure 3.17 – Call of Duty’s unlockable perks through multiplayer matches.

Strategy games also unlock new units in single-player campaigns as players progress through it. “Starcraft 2” (B. Entertainment, 2010) goes beyond this traditional approach and also awards players with unique skins and textures for their units based on their skill in multiplayer matches (Figure 3.18). This type of reward’s goal is two-folded: on the one hand it fosters the players’ curiosity and commitment to unlock those rewards; on the other hand it acts as a tool of social recognition as opponents will immediately identify those skins as a token of skill and accomplishment. The same strategy is present in “World of Warcraft” (B. Entertainment, 2004) with exclusive rewards being available to those players who excel in certain areas of the game (e.g. raiding, player-versus-player, etc.).

Figure 3.18 – Unique unit skins use to fuel social recognition in Starcraft 2.

Other games in our list offer players rewards as they progress: vehicles in “Burnout Paradise” (C. Games, 2008) and “Gran Turismo” (Digital, 1997); weapons and armor in “Dead Nation” (Housemarque, 2010). We are required to especially mention “Final Fantasy XIII” (Square-Enix, 2009). The game also rewards players with wallpapers in the Playstation 3 system (Sony, 2006) for accomplishing determined achievements (e.g. finish the game, beat the final boss with an S rank, etc.). This type of rewards goes beyond the boundaries of the game, expanding towards the system the game is played on. On the same note, “Tearaway” (Molecule, 2013) (not analyzed in this exercise) also provides players with rewards in their personal website: by collecting schematics within the game, players are then able to print and use them to create paper representations of the inhabitants of the game’s world.

Feedback is also a constant presence in videogames and a very effective instrument to convey persuasive cues. We already discussed the only example which recurs to suggestion cues: “Uncharted” (Dog, 2007). Other games utilize informative feedback as their primary way to transmit messages to players. This informative feedback is often tied with the support strategy utilized by the game. As an example, "Starcraft 2" (B. Entertainment, 2010) uses psychological cues extensively. While the players' units are being attacked or the player attempts to produce a unit when he / she does not possess the necessary materials for it, an advisor contacts the player giving valuable suggestions concerning how to circumvent the issue at hand. For instance, when low on certain materials, the advisor promptly informs that:

- "We require more minerals"

Also, when the player's infrastructures are under harass, the advisor communicates:

- "Our base is under attack"

The usage of clever language traits is more common. First-person shooters typically recur to this strategy to instantly communicate quick facts to players: kill streaks (Figure 3.19 – left), whether the player did a particular skill shot (e.g. killing an enemy while jumping) or who killed the player. Racing games such as "Burnout Paradise" (C. Games, 2008) also utilize praise messages to express high-risk maneuvers or quick accomplishments by the players (Figure 3.19 – right). We already discussed how "SimCity" (Maxis, 1989) uses periodic reports (often dissimulated as in-game newspapers or financial reports) in which the denizens of the player's city express their opinions about how the player is faring.

Figure 3.19 – Unreal Tournament feedback messages (left); Burnout praise message (right).

While there are certainly more ways to reward and convey information to players, we delivered an overview of how representative games of various genres materialize those instruments within them.

3.3.3 Discussion

This exercise served two purposes. The first and the most immediate one was validating the MSI persuasion model. We were able to aggregate three theories which failed to unify important aspects of a persuasive process such as the method and the instruments used to reach the targets of the persuasion in a single model and delivered on that vision. The MSI model characterizes persuasive interventions according to a trio of concepts – the method, the support and the instrument. Validating this model encompassed selecting a representative set of videogames and map their primary persuasive strategies into the model's concepts. We showed that our model is sufficiently broad to give coverage to the disjunctive concepts as they were present in the analyzed theories, but at the same time attains the necessary level of detail to fully disclose the idiosyncrasies of the persuasive processes present in videogames. In addition, we believe the model is easily extendible with added concepts and approaches for each dimension.

The second purpose allowed us to explicitly reinforce our research track by identifying the most popular persuasion strategies and instruments. We observed that, as far as the actual instruments are concerned, feedback and the usage of in-game rewards assume a pivotal role. Given the inexistence of literature regarding the particular effects of persuasive strategies on player experience and how they can be used to steer players into a flow state, it becomes natural that our endeavor will begin by studying the most regularly used approaches – the usage of in-game perks / rewards and the conveyance of feedback to players.

3.4 Assessing Persuasion

Until this moment we have been focused on the existing persuasive approaches, how they can be mediated through technology and how these are mapped in videogames.

Nevertheless, the goal of this research encompasses assessing how persuasive technology affects a player's experience during a game. In light of this scenario a question is naturally imposed: how do we assess the effect of persuasive technology?

Existing research with persuasive technology often analyzes the effects of the imposed strategies addressing any effective changes (e.g. behavioral, creeds, etc.) which occurred on the target users. Such evaluation process usually requires users to be exposed to and interact with the mediating technology for extended periods of time. While the ultimate goal of persuasive technology is for those behavioral or ideological changes to come to fruition, other information can be lost in the process. Amidst this is the expertise concerning the effectiveness and impact of determined persuasive approaches on the users' experience, on an instant basis (i.e. immediately after exposure and only not at the end of the process).

This type of immediate assessment cannot be performed using traditional impact assessment techniques. Instead, we argue that since this is related with user experience, we are able to recur to experience sampling methods to analyze the impact on each user. On the next chapter, we will present a set of techniques usually deployed to address user experience and discuss which ones are most adequate to pursue the goals of this research.

3.5 Discussion

Persuasive technology is a strong instrument that designers have at their disposal to effectively steer users into adopting certain behaviors, ideals or creeds. This chapter provided a broad overview addressing existing persuasive approaches, how they can be mediated through technology and how they are mapped in modern videogames.

We analyzed and discussed the theories proposed by three authors within this domain. Despite notable differences in some details of each approach, in the end most of the persuasive instruments available to designers share a significant number of common traits. Fogg's (Fogg, 2002) theories addressing the usage of computers as persuasive social actors highly emphasize the importance of the usage of language and, in particular, praise to create empathy with users and further motivate them to pursue the desired goals. Oinas-Kukkonen (Oinas-Kukkonen & Harjumaa, 2009) propose the Persuasive System Design model which encompasses a full design process for persuasive applications. Additionally, the authors discuss a set of characteristics which support the persuasion process and which systems should strive to include in order to potentiate their success. Among these, the usage of appropriate feedback, praise and rewards emerge as some of the strongest choices available to designers and developers alike. Finally, the work of King and Tester (King & Tester, 1999) addresses how existing persuasive approaches are adapted into the modern age of computer systems. Among the proposed strategies, the provision of vast environments in which users can explore the various elements to discover which characteristics / features suit them the best to accomplish their goals appears as the most unique approach. All these theories, however, fail to merge two important aspects of the persuasion process – the methods and the instruments.

Based on these three research works, we proposed the MSI persuasion model for videogames in an attempt to unify all components of the persuasive process. The model is composed by a set of concepts (the method, the support and the instruments) which are fully capable of describing a persuasive intervention. The support concept is a facultative aspect of the process, enabling designers to enrich their interventions with a myriad options capable of improving the motivational aspect of their strategies.

We concluded this chapter with an analysis addressing whether the MSI model was sufficiently broad and capable of characterizing in detail persuasion in videogames. We opted to assess a restricted list of games spanning across different platforms, eras and genres to account for some diversity. The mapping's results indicated some interesting trends:

- The usage of feedback and praise is highly present in modern videogames.
- Deploying rewards for players as part of an environment of discovery for players to explore is also a popular approach towards promoting player motivation.

The first is self-explanatory and is an omnipresent feature in videogames. Players need to be informed about their progress, goals, achievements and every important aspect of the game's experience. The inclusion of rewards acts as a motivator for players: sometimes these can be paramount to surpass certain challenges; in other approaches they act as an instrument of recognition for the players' feats. The usage of an environment of discovery can provide an element of surprise and self-learning for players. Instead of expecting a reward at the end of a level, they may be presented with a set of them which they can opt for to tailor their play experience to what suits them the best.

In the context of this research we will build on these particular persuasive strategies and assess how they are able to affect a user's experience while playing different videogames. Complementing the literature we reviewed in the previous chapter, we are now in possession of:

- Knowledge regarding which behavioral and emotional traits can potentially be affected during gameplay.
- Expertise regarding which persuasive instruments and strategies are most commonly used in modern videogames.

The choice we made concerning the persuasive instruments we opted to analyze was not arbitrary. The presence of feedback and rewards was already mentioned in the previous chapter as potential characteristics of a state of optimal experience. In sum, we have tied-in a theory uniting flow and persuasion backgrounds regarding how persuasive instruments can steer players into an optimal experience state. The missing puzzle piece concerns how we can assess the effects of these instruments on the mentioned experience. We will delve into player experience assessment techniques in the next chapter, focusing on approaches particularly suited for the study of videogames.

4 MEASURES OF PLAYER EXPERIENCE

Chapter II allowed us to analyze how flow theory is linked with the videogames domain. Along with the theory's original dimensions we explored some models which emerged alongside the combination of this discipline with the videogames domain. These models focus on a few aspects of flow:

- How each flow dimension manifests itself within a videogame?
- Which features should a videogame encompass to promote each flow dimension?
- The emotional states associated with the transition towards the flow state.

In Chapter III we explored the possibility of using persuasive instruments as catalysts to achieve a flow state. After delving into existing literature, creating a persuasion model and mapping existing and commercially available videogames' features into it we were able to conclude the following:

- The usage of perks and rewards to motivate players is a common trend in videogames.
- Providing players with informative feedback, praise or suggestions is often associated with the intent to motivate players to improve themselves in the videogame.

These two set of questions complement each other as the latter identifies the most popular persuasive instruments and the former suggests potential player characteristics that may be affected when transitioning to a flow state. Still, there is a missing link between them which was still left unaddressed:

- How do specific instruments affect player experience with the intent of steering him / her towards the flow state?

To answer this question we are required to present our view on what constitutes player experience. Videogames are applications created with the purpose of entertaining the consumer (Malone, 1981). Despite the introduction of new types of games with a more serious nature (Michael & Chen, 2005), the entertainment facet is still present. As such, player experience is prone to be evaluated using similar metrics as any other application would. While some adjustment may be required to encompass some specificities of the domain, in general we are able to treat it as part of the broader user experience (UX) area of research. The accepted definition of user experience (UX), as stated in ISO 9241-210 (ISO, 2010), asserts it as:

- "a person's perceptions and responses that result from the use or anticipated use of a product, system or service".

The referred perception and responses encompass the user’s emotions, beliefs, preferences as well as physical, physiological and behavioral responses. The metrics here presented can be labelled and assessed according to a couple of distinct categories. The first pertains to user / player behavior. We expect that persuasive instruments impact on the players’ behavior, in particular on their performance figures and, potentially, some interaction choices. To assess these changes we are required to delve into the methodologies used to assess user behavior change and which are particularly adequate for the videogames domain. The second category addresses the emotional facet of flow and how the persuasive instruments are capable of influencing it. These changes should, preferably, be addressed state-of-the-art assessment techniques such as physiological analysis to determine reactions to certain features and events.

In sum, there is some variety on the assessment methodologies available for videogames. In this chapter we will present a brief analysis of some of the most prominent ones, discussing the advantages and disadvantages of their usage according to the perspective they are bound to.

4.1 Behavioural Assessment Methodologies

Users are capable of changing behavior when faced with determined events and situations. This statement also applies to HCI and, in particular, to interacting with videogames. Players often adjust their behavior when faced with particular challenges: an easy challenge may not capture the player's attention and commitment, while a more demanding one will force the player to attentively look at ways to overcome it. When considering applications and videogames, these behavior shifts may be also reflected by other assessable alterations. For instance, the number of input actions may increase in response to a certain event. Player performance may also fluctuate as the player is confronted with a diversity of occurrences. Determining whether any behavior was altered and / or assumed as well as the impact of those changes is the goal of behavioral assessment methodologies. Note that we also include performance assessment (as a result of behavior change) in this analysis category.

Existing literature suggests a myriad of methodologies which can be deployed according to the users involved, type of the applications being assessed and other experimental settings. Literature also suggests two major groups one can delineate when analyzing behavioral assessment methodologies. The first addresses methods which put the onus on the users' opinions (analyst and experimental subject alike) and feedback to extract their perceptions while / after they interact with the system / application. These are denominate qualitative assessment methods. The second group relies on more automated procedures in which user interaction data is typically recorded without the need for the user to express themselves. These are denominated quantitative assessment methods. We will now discuss each type in particular, presenting different approaches, their caveats and virtues and justify which are more adequate for the research are being carried out in the context of this thesis.

4.1.1 Qualitative Approaches

User perceptions and beliefs are prone to be influenced by the quality of the applications or services they interact with. The appeal of these products is bound to what the users think about them and how they experience them. Despite being able to successfully carry out certain tasks with an applications, users may not feel well about it, thinking ill of its design or the way it guides the user towards the completion process. These opinions can then be fed to designers and developers alike in order to rapidly assess any potential issues and improve them on the next revisions of the application / service (Klausner & Konchan, 1982; Medlock, Wixon, Terrano, Romero, & Fulton, 2002; J. Nielsen, 1993).

Designers and researchers value this type of feedback for various reasons. First, the methodologies used to assess this data are inexpensive from both a financial and human resources perspective (Jakob Nielsen, 1989). Second, gathering of this data can be done immediately after the interaction period (e.g. using questionnaires) or as the users interact with the application / service (e.g. using thinking aloud or self-report methodologies). This may potentially reduce the entropy introduced by performing untimely reports of user perceptions.

The application of these methodologies to videogames research is also not novel. Most methods have been employed with success (Pagulayan, Keeker, Wixon, Romero, & Fuller, 2002). However, existing literature suggests that there is a small set of methodologies which are often seen being utilized (Fulton & Medlock, 2003; Fulton, 2002; Medlock et al., 2002). The intrinsic requirements and variation of videogames and their genre often mandates researchers to adapt existing formal methodologies to better accommodate their needs. It is therefore common to witness small variations of some assessment methods.

4.1.1.1 Standardized Questionnaires

The usage of questionnaires is a widely adopted procedure to rapidly assess the users' feelings and opinions immediately after they conclude a trial with an application / service. Unstructured questionnaires are sometimes deployed by researchers in an attempt to obtain quick and easy to grasp data on the subjects' perceptions. However, the absence of a foundation from which the questionnaire is derived often impacts on the validity, coverage and scope of the results. Hence, the provision of questionnaire templates from which small variations can be introduced becomes a viable option to ensure a certain confluence and harmony as far as this approach is concerned.

Standardized questionnaires offer analysts a more structured way to assess user perceptions for different systems. The possibility of deploying the same questionnaire to evaluate different applications / services is one of the advantages of standard questionnaires. NASA's Task Load Index (TLX) is one of the most well-known examples of standardized questionnaires and surfaced in 1986 (NASA, 1986), with some of the first deployment results being published a couple of years later (Hart & Staveland, 1988). TLX allows analysts to determine a system's or team's different performance related variables. For instance, it assesses frustration levels, cognitive workload or physical demand. This questionnaire has been utilized throughout history (Denford, Steele, Roy, & Kalantzis, 2004; Park, Harada, & Igarashi, 2006), maintaining its popularity even in current research (Regal et al., 2013).

Usability and user experience are two concepts which are pivotal for the success of an application / service. Among the variety of techniques used to assess these aspects of interaction, standardized questionnaires are usually a common practice. Examples include the System Usability Scale (Brooke, 1996), WAMMI (WAMMI, 2013), User Experience Questionnaire (Laugwitz, Held, & Schrepp, 2008) or AttrakDiff (Hassenzahl, Burmester, & Koller, 2008). These questionnaires may vary in complexity, providing coverage to a multitude of variables related with usability and UX. However, according to Fierley et al (Fierley & Engl, 2010) this coverage is often not sufficient to address the dimensions of a videogame. As stated by the authors, excitement, immersion and flow are elements of the gameplay experience which are not contemplated by recurrently used standardized questionnaires.

Questionnaires related to game experiences have since emerged to mitigate these deficiencies in videogame analysis. The most widely adopted is the in-Game Experience Questionnaire (iGEQ) (Ijsselsteijn, De Kort, & Poels, 2007). Developed by Ijsselsteijn et al, it assesses a set of components of gameplay experience, including competence, sensory immersion, imaginative immersion and challenge, among other. The questionnaire contemplates multi-player settings as well as providing a solid foundation from which extensions can be created. Unfortunately, it is often dismissed as being too long for short surveys on post-experimental settings, requiring subjects to spend a significant amount of time in mindfully responding to all items.

Brockmyer et al (Brockmyer et al., 2009) developed the Game Engagement Questionnaire, an instrument aimed at assessing the levels of engagement a player is able to attain with a videogame. One of the applications proposed by the authors was the usage of GEQ to predict engagement with violent games. Results were positive as far as this connection is concerned: the GEQ is capable of pointing at user tendencies to prefer violent videogames. The authors defend that this is an important step towards behavior control in order to steer potentially problematic users away from this type of entertainment.

Overall, standardized questionnaires provide a solid contribution towards UX assessment, given the low cost, light effort in terms of resources spent and the proximity between questionnaire reporting and the experiments. The ability to distribute these questionnaires online increases their reach from merely a dozen subjects to potentially thousands, making this an ideal strategy to reach the masses and obtain large amounts of data effortlessly.

4.1.1.2 Thinking Aloud

Thinking aloud techniques are often employed by analysts to assess the subjects' opinions as they performed tasks associated with the application / service being evaluated (Ericsson & Simon, 1984). Users are often required to verbalize their opinions, perceptions, expectations, difficulties and enthusiasm as they explore the target of evaluation. Besides its utilization in system design and evaluation, the method has been applied in peculiar situations such as web navigation experience research (Olmsted-Hawala, Murphy, Hawala, & Ashenfelter, 2010), usage of digital libraries (Makri, Blandford, & Cox, 2011) and even as a teaching instrument for programming (Arshad, 2009). Despite being a well-established approach since its initial discussions by Nielsen, researchers still seek to enrich it with extra data, often recurring to other data gathering mechanisms (Elling, Lentz, & de Jong, 2011).

However, as stated by Mandryk et al (Mandryk, Inkpen, & Calvert, 2006), thinking aloud approaches are not entirely suited to assess UX in entertainment applications / services / technology. The verbalization process introduces disruptions which affect the subject's interaction process with the system. This disturbance obviously affects the quality of the results, not only due to the disruption, but also due to the rationalization of the experience, a limitation also present in poorly designed questionnaires. Due to these caveats, the same authors introduced a variant denominated retrospective think aloud. In this case, subjects are retold their experience and they are asked to verbalize their perceptions, feelings and expectations as they recall the events. While we agree that the experience disruption component is removed, new liabilities are introduced such as requiring the analysts to produce faithful recreations of the player experience and the temporal discrepancy between the actual trial and its retelling which may introduce inconsistencies.

Instead of verbalizing their experience, some approaches rely on a providing users with applications and / or specialized modules to report their emotions and perceptions. Denominated self-report tools, they allow subjects to typically express their feelings amidst an experiment. Successful examples include eMoto (Sundström, Ståhl, & Höök, 2007) and Babylon (Waern, Ahmet, & Sundström, 2009). The first allows users to express their feelings by performing subtle gestures with their smart-phone. The second, took inspiration from the former and is aimed at self-reporting amidst pervasive games. Still, the same type of interruptions are present when considering the videogames domain.

4.1.1.3 Video Recording

Video recording is an approach in which, given the appropriate consent, users are filmed during the entire trial. The goal is to later analyze these recordings and identify potential behaviors, interaction patterns and hesitations expressed by users, preferably with synchronized interaction event data (Badre, Hudson, & Santos, 1994). As stated by Mandryk et al, video recording requires the analysts to pinpoint verbal and non-verbal data (e.g. body language) (Mandryk, Inkpen, et al., 2006). There is a multitude of tools which address video analysis, enabling analysts to annotate specific segments (B. L. Harrison & Baecker, 1992) or even to collaboratively analyze the recordings (Cockburn & Dale, 1997; Ellis & Groth, 2004). The technique has been utilized in various works, including behavioral analysis (Maly, Mikovec, Vystrcil, Franc, & Slavik, 2011) and usability studies (Kennedy, 1989).

The usage of video recording as an experience assessment methodology in its essence belongs to the subjective family of methodologies. Any results stemming from it are bound to the observational power, perceptions and opinions of the researcher(s) performing the analysis. Consequentially, each researchers possesses his / her own set of criteria which ultimately dictates the results reported for the experiment.

Recently, technological advances, have the emergence of advanced recording mechanisms, including automated facial expression detection software. The inclusion of these specialized detection suites attempts to mitigate the subjective and qualitative nature of this approach. The process typically involves the full recording of a trial. Once concluded, the video is fed to the facial expression detection software which produces a set of reports based on the recorded data. Tan et al (Tan, Rosser, Bakkes, & Pisan, 2012) have employed this approach to assess user experience from facial recognition. Their particular goal was to assess the facial expressions manifested by users while playing different games. Results point towards the possibility of using this method to identify games and / or genres which are more prone to stimulate emotions from players. Another interesting detail was that users showed more varied expressions when playing against human opponents than when facing the computer AI.

4.1.1.4 Limitations

As discussed, subjective assessment methodologies can provide analysts and researchers with valuable input on their subject's experience while interacting with a system. Strategies are varied, allowing for analysts to retrieve data either at the end of the experiments or during their execution by enabling participants to verbalize their experience or report it using specialized tools.

Nevertheless, the investigated approaches possess some liabilities which not only impact on the quality of the results but also ignore a large chunk of data produced by users during experimental periods. Marshall and Rossman (Marshall & Rossman, 2006) suggest the inability of questionnaires to encounter complex patterns, their poor support for user privacy and the potential discrepancy between subject responses and their experience. While we generally agree with this view, we argue that some of these limitations are mostly related with ad-hoc questionnaires, given standardized questionnaires often allow for complex analysis. The privacy statement is more dependent on the ability of the experiments' supervisors to provide adequate consent forms and ensure data is strictly anonymous for experimental purposes. Wilson and Sasse (Gillian M. Wilson, 2000) extend their criticism even further, suggesting participants may be influenced by the experimental setting, expressing what they believe the analysts desire to hear instead of their true experiences.

Think aloud methods also possess their own share of limitations. The most striking one pertains to the disruption introduced when interrupting the flow of the experience to verbalize their opinions. This impacts profoundly in trials with entertainment technology since the users' immersion can be clearly affected via the interruptions, resulting in not so favorable experiences. As defended by Fierley (Fierley & Engl, 2010), think aloud approaches are definitely not suited for time-consuming games and especially long trials. Its utilization in shorter experiments involving small and quick casual games or to test determined game mechanics in particular is not as negative.

Video recording is also not exempt from issues which limit its applicability in the addressed domain. In its original conception, video recording is subject to all limitations of subjective assessment methods, since it is the responsibility of a human observer to identify verbal and non-verbal manifestations performed by users interacting with the system. The alternative strategies in which video recording is employed (e.g. automatic facial expression recognition) mitigate the subjectivity inherent to the former. The detection of user emotions via facial expressions allows researchers to assess a type of data which is commonly linked with subjective measures. Nevertheless, these algorithms often required optimal experimental conditions which can be difficult to ensure.

Our last critique to these methods concerns their inability to address an important part of the user's experience, particularly in the videogame domain: player performance. As discussed in the previous chapters, user satisfaction and optimal experience is also connected with how well they perform. Even if it does not translate in the best attainable performance, the optimal experience is coupled with a high state of play during which players excel in the tasks at hand. Subjective assessment mechanisms tend to ignore this type of data. The amount of errors performed, obtained score and time spent to complete the proposed objectives are some of the metrics discarded. The inclusion of objective assessment strategies emerges as a possible solution for these issues.

4.1.2 Quantitative Approaches

Researchers often enrich their analyses with objective data, in addition to potential subjective measures as detailed in the previous section. Objectiveness stems from quantifiable and measurable data, as opposed to the utilization of fuzzy scales to describe a determined phenomenon (e.g. using the exact temperature instead of classifying as being "cold" or "hot"). While qualitative metrics are concerned with user perceptions, such as ease of use or satisfaction, quantifiable metrics deal with objective variables which relate with the interaction experience. As stated by Nielsen (Jakob Nielsen, 2008), objectiveness in usability and UX is mostly coupled with user performance. Typically, the metrics retrieved concern task completion time, number of erroneous actions or success rate. Objective metrics are, thus, a powerful instrument in understanding a system's issues and potential, according to how well users perform while interacting with them. While the immediate tendency would be to prioritize this type of assessment over subjective strategies, Nielsen, argues that the two must co-exist and researchers must strive to bring out the best of both worlds. A good performance does not imply the user is satisfied. The two approaches are valid and can co-exist and complement each other for a richer assessment of a system.

The nature of the methodologies used to gather objective data slightly differs from qualitative approaches. While in the latter the users explicitly manifest their experience by either filling-in a questionnaire or verbalizing their perceptions, quantitative assessment often relies on specialized software and hardware modules capable of recording user data as they interact with the system.

4.1.2.1 Metrics Logging

A typical philosophy when it comes to objective assessment of usability or user experience is to record all possible data (Kim et al., 2008) – not only recording through video, but, more explicitly, storing all interaction events performed by the users (de Sá, Carriço, Duarte, & Reis, 2008; Hilbert & Redmiles, 2000). This process is often denominated interaction logging and encompasses specialized software or features capable of storing time-stamped interaction events (Guzdial, Santos, Badre, Hudson, & Gray, 1994). The granularity level of these events determine the richness of the posterior analysis: researchers may desire to store all interactions including mouse clicks, key presses, mouse movements, or just major application events such as opening a new window and accessing determined functionalities.

While this methodology has always been popular among usability evaluations, it gained a new momentum with the advent of mobile devices. Multiple strategies and specialized logging systems have been developed to tackle automatic data gathering in the wild. We believe this particular utilization of the technique is suited for the evaluation of mobile games, a significant portion of the videogame market with a strong momentum currently.

As far as videogames are concerned, one of the most interesting applications of interaction logging was performed by Kim et al (Kim et al., 2008). Idealized at Microsoft Game Studios, TRUE (Tracking Real-Time Experience) is a solution to assess gameplay experience. The rationale behind it is to record all interaction and in-game event data in order to identify all possible relations between the game's variables. The methodology was tested with two commercially available games: "Halo 2" (Bungie, 2004) and "Shadowrun" (F. Interactive, 2007). The method allowed the authors to fine-tweak several game features and mechanics through gameplay analysis. For instance, in "Halo 2" (Bungie, 2004) they were able to track weapon effectiveness as far as their range is concerned, based on the players' death locations and the source location of the shooting. In "Shadowrun" (F. Interactive, 2007), the metrics assessment allowed the designers to balance different character classes as the evidence obtained pointed towards players favoring one particular class due to possessing some abilities which gave it an edge over the others. The authors end their introduction to the method by stating one of its main advantages: it allows the gathering of player experience and performance data in a naturalistic setting, without disrupting the players' flow.

4.1.2.2 Limitations

Despite the potential shown by objective UX assessment methodologies, they also possess a fair share of limitations which inhibit them from being the perfect choice for all situations. The recording of interaction metrics possesses a few drawbacks:

- **Inadequate granularity level** – logging strategies allow for the definition of different granularity levels. Finer grain analysis provides researchers with more detail and richness in the analysis; on the other hand, the varied analysis vectors may deteriorate targeting the goals of the analysis. In a macro level analysis the level of detail is reduced, but the analysis are provided with the major interaction events produced; however, the loss of detail implies the inability to potentially address certain interaction or behavioral patterns. Depending on the goal of the analysis, the definition of an adequate granularity level for the retrieved data is paramount to perform good usability and UX assessment.
- **Overwhelming amount of gathered data** – this issue is partially dependent of the granularity level. Nevertheless, examples such as the TRUE solution show that an extremely large amount of data is gathered when recording interaction / play metrics. Considering the relations between the variables obtained, some

interesting relations may be overlooked amidst all the information available, a problem which leads us to the third issue.

- **Misconceived assessment goals** – like in all other methodologies, a good experimental period should have its goals clearly defined. The definition of fuzzy goals as far as interaction logging is concerned may be especially problematic considering the sum of the previous issues: one may define a granularity level which does not comply with the kind of results expected to be obtained; quality results may be overshadowed by "satellite" data or relations between variables due to the immense amount of information retrieved.

Still, both qualitative and quantitative methods fail to grasp another subset of relevant information which is typically difficult to grasp without deploying specialized hardware. There are determined patterns in the human body which are the result of a reaction towards external events. Muscle contraction, accelerated heart rate or increased sweating are some of the phenomena often associated with emotional states such as stress, arousal or anxiety. None of the previously analyzed methodologies can naturally reach any of this data. As such, there is room for improvement when it comes to emotional assessment in the context of studying flow in videogames.

4.2 Emotional Assessment Methodologies

We have briefly tackled how subjective behavioral assessment approaches are capable of generating an emotional profile based on the user's perceptions. However, this methodology carries some limitations. First they are based on user reports, which may not be accurate and may also not reflect their actual experience. Second, users typically provide those reports after their experience takes place, allowing some time for rationalization and potentiating the skewing of those results. Finally, the exclusive usage of questionnaires for emotional assessment ignores and important set of concealed cues manifested by the human body: heart rate, respiration, blood pressure, galvanic skin response, among other. Physiological signals can, thus, be a valuable source of data capable of improving the level of detail and accuracy of the players' emotional response. To understand the usage of physiological signals in an application or as a source of information during the evaluation stage of a system it is important to address certain questions such as:

- Which signals are we interested on?
- Why are those signals important?
- Where do those signals come from?
- What can these signals tell us?

To properly address these questions, we are required to provide a short summary concerning the human body and, in particular, the nervous system. We remind that we are interested on exploring physiological responses typically concerning emotional states such as arousal (typically tied with demanding challenges in games in relation to the player's skill) or relaxation (the opposite situation – player skill surpassing the issuing challenge). Particularly, identifying potentially interesting metrics connected with the transition from an arousal state to the optimal experience is a significant step towards the development of this research.

4.2.1 The Nervous System

One of the most important parts of human physiology is the nervous system. It is typically responsible for the coordination of all voluntary and involuntary signals transmitted between different body parts. Physiological metrics such as the heartbeat rate, galvanic skin response and muscle tension are associated with the nervous system (R. D. Ward, Marsden, Cahill, & Johnson, 2002; Wastell & Newman, 1996). Figure 4.1 presents a schema elucidating how the system is divided, based on Goldstein's depiction (Goldstein, 2009).

The nervous system is comprised by two subsystems (Goldstein, 2009): the Central Nervous System (CNS) – which includes the brain and spinal cord; the Peripheral Nervous System (PNS) – consisting of nerves that carry impulses to / from the spinal cord. The CNS can be considered the primary processor in our body as it is responsible for the coordination of our body parts and for the integration and processing of the information it receives from those parts.

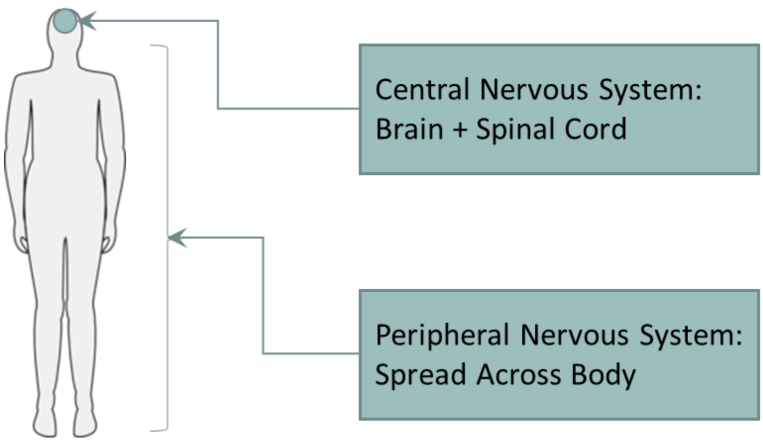


Figure 4.1 – Human central nervous system main divisions (based on Goldstein's depiction).

The PNS is composed by nerves and glandules outside the brain and spinal cord, responsible for carrying electric signals do these two (Marieb & Hoehn, 2007). The PNS may also be partitioned into two divisions: the sensory and motor divisions (Figure 4.2), as depicted in Beckhaus work (Beckhaus & Kruijff, 2004).

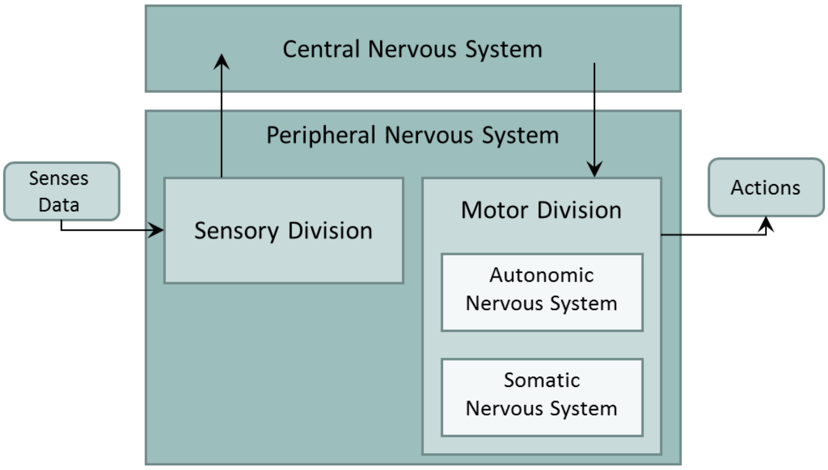


Figure 4.2 – The central and peripheral nervous systems (according to Beckhaus).

The first is responsible for carrying electric impulses from our senses (e.g. vision, olfactory, hearing, touch and taste) to the brain and spinal cord. The motor division transports electric impulses from the brain and spinal cord to other organs such as muscles and glands and is comprised by the Somatic Nervous System (SNS) and the Autonomic Nervous System (ANS):

- **Somatic Nervous System** – often denominated voluntary nervous system, it allows a human being to consciously control their muscles through a special type of nerves capable of stimulating muscle contraction. Our whole body movement is controlled by this system.
- **Autonomic Nervous System** – similarly to the SNS, experts often recur to a different denomination for the ANS: the involuntary nervous system. The reason for this is connected with the fact that the main actions it performs – muscle regulation – are not consciously controlled. Among the muscles regulated by this system, we emphasize those connected with the heart beat process.

We need to partially frame this research's intentions at this point of the analysis of the nervous system. Relaxation and arousal states are often associated with particular phenomena in an individual's physiology. Among these, literature often mentions alterations in the breathing patterns, acceleration / deceleration of the user's heart rate and increased electrical activity as far as skin conductance is concerned. These symptoms happen within the context of the motor division of the peripheral nervous system. In more detail, the regulation of some muscles (e.g. heart) is the responsibility of the autonomic nervous system. In light of this evidence, the focus of this analysis will be steered towards the motor division's autonomic nervous system.

4.2.2 Autonomic Nervous System

The autonomic nervous system is comprised by sensory and motor neurons. These connect the central nervous system to organs such as the lungs or the heart. The ANS acts as a regulator, effectively monitoring our body's internal state and bringing any changes it considers necessary to ensure its correct functioning (Ekman, Levenson, & Friesen, 1983; Levenson, 1992). The ANS is divided in two complementary subsystems (Brodal, 2004):

- **Sympathetic Nervous System** – is related with emergency actions, more particularly in using different body systems to attend to those emergencies. Specialists call these situations the "fight or flight mode" and encompass scenarios involving physiological responses (e.g. heart rate acceleration, faster breathing patterns) to specific events (e.g. life threatening situations, uncomfortable actions). For instance, pupil dilation, heartbeat stimulation or a sudden increase in the blood pressure can be the result of the sympathetic nervous system stimulation.

- **Parasympathetic Nervous System** – where the sympathetic nervous system is concerned with the body's reaction to emergencies, the parasympathetic deals with non-emergency situations, mainly promoting energy conservation. Actions such as the relaxation of the heartbeat, decrease of blood pressure or pupil contraction are elucidative examples of what happens when we stimulate the parasympathetic nervous system.

4.2.3 Physiological Metrics Assessment

Both sympathetic and parasympathetic nervous systems are related with some of the most popular physiological manifestations: the galvanic skin response, the contraction of the heart's muscles or the activation of other muscles in the body. All these phenomena result in determined manifestations throughout our body, including shifts in some physiological metrics.

Physiological metric assessment is a quantitative user experience evaluation methodology. We opted to dedicate a full section instead of grouping it with interaction metrics due to its sheer complexity and the fact that it is more closely related with the emotional side of UX than with its behavioral and performance counterparts. We will now address a set of representative metrics which are typically sought when using physiological assessment mechanisms.

4.2.3.1 Galvanic Skin Response

Galvanic skin response (GSR) or electro dermal response is a highly responsive body signal used to measure changes in skin conductance due to stress or other emotional states. In more detail, GSR measures the electrical conductance of the skin, a value that fluctuates due to the skin's moisture level. This moisture changes due to sweat glands activity, controlled by the sympathetic nervous system. Unlike the majority of physiological signals in which the sensors directly measure the data they are supposed to capture, in this technique a stimulus is applied to the skin, and the collected data is the response to that stimulus (Shi, Ruiz, Taib, Choi, & Chen, 2007). The setup needed to perform these measurements typically comprises a pair of silver chloride electrodes which can be applied anywhere in the body, but tests recommend the hand palm or the tip of the fingers as the best measurement points (Laufer & Németh, 2008). Finally a small voltage should be applied so that the response can be acquired. After setting up the equipment needed, it is recommended that some calibration is performed, as the baseline signal is changed according to gender, diet or skin type (Meehan, Insko, Whitton, & Brooks, 2002). While there is little knowledge to the real meaning of the measured data, it is known that peaks happen after emotional arousal happens – this can be a cause of fear, anger or sexual feelings, among other (Sakurazawa, Yoshida, & Munekata, 2004) - this connection between sympathetic nervous system activity and changes in the skin's moisture levels, allows researchers to use GSR as an indicator of emotional arousal.

Besides the use as a polygraph, this technique has been applied to aid users with Amyotrophic Lateral Sclerosis in controlling simple interfaces, assisting in their everyday lives (Meehan et al., 2002). In the technology domain, there are a few examples of the use of GSR in videogames for two distinct ends: on the one hand the data has been collected to be used in adaptive game mechanics (Sykes & Brown, 2003), in which stressful states increase the difficulty of the game, while more relaxed states have the opposite effect; on the other hand it has been used to provide feedback through small electrical discharges on players' limbs whenever they get hit by enemies (Kruijff, Schmalstieg, & Beckhaus, 2006). While the ethics behind the latter research is highly questionable, GSR has shown to be one of the most useful promising physiological modalities available.

4.2.3.2 Heart Related Metrics

The heart is an extremely rich source of information. Kramer (Kramer, 1990) compiled information regarding how the human heart works and how it can be utilized for physiological assessment. He states that "the mechanical contractions of the heart are produced by electrical impulses generated by the pacemaker cells in the sinoatrial and artioventricular nodes of the heart. This electrical activity can be measured in the form of the ECG". The most familiar representation of an ECG can be visualized in Figure 4.3. The R wave (the most prominent spike) is preceded by a small Q wave and followed by another small S wave. According to Kramer, the "P wave is produced by the depolarization of the atrial muscles, the QRS complex is the result of a depolarization of the ventricles, and the T wave is produced by a repolarization of the ventricles".

Unlike GSR, there are multiple metrics associated with it, such as the average heartbeat rate, heart rate variability or blood pressure volume, leaving researchers and analysts alike with a selection of metrics to choose from:

- **Heartbeat Rate (HBR)** – the HBR is the time between two QRS complexes (the recording of a single heartbeat which corresponds to the depolarization of the right and left ventricles) (Tokui, Kuroda, Kuroda, & Oshiro, 2009). The HBR is then calculated by measuring the time between each R peak (referred to as an NN interval). Increase in the HBR is typically associated with frightening, stressful, anxiety or arousal situations, while positive feelings such as happiness or relaxation typically decrease the HBR values (Rainville, Bechara, Naqvi, & Damasio, 2006). Akin to the GSR, the HBR can give us some insight on emotional changes – however, accurate identification of the emotion is not performed at this level.

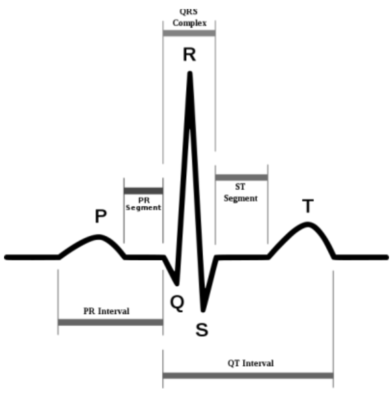


Figure 4.3 – QRS wave (from Wikipedia).

- **Heart Rate Variability (HRV)** – as its name implies, HRV consists of noticeable fluctuations of the intervals between heart beats (Malik, 1996). These fluctuations are the result of sympathetic and parasympathetic influence on the individual's heart rate process. HRV has been linked with several emotional or pathological states: anxiety and post-traumatic stress disorder often leads to low HRV values (Middleton & Ashby, 1995). High HRV values have been linked with task disengagement due to its difficulty (Aasman, Mulder, & Mulder, 1987). HRV can be calculated using different methods (Malik, 1996) (e.g. time-based, frequencybased, non-linear, long term duration, etc.). While critical domains such as clinical scenarios recur to the most advanced forms of calculating the HRV, we observe that, in HCI research, less robust methods can be applied, such as the time-based SDNN, which consists of calculating the standard deviation of NN intervals.

- **Blood Pressure Volume (BPV)** – a decrease in an individual's sympathetic arousal leads to an increase in blood pressure volume (James, Yee, Harshfield, Blank, & Pickering, 1986). This signal is obtained by using a photosensor near the skin (for instance in the individual's ear or fingertip) and retrieving the amount of light that is reflected (Beckhaus & Kruijff, 2004). Variations of blood pressure may result from the so called "fight or flight mode". For instance, frightful situations may increase blood pressure values, while happiness is typically prone to lower them (James et al., 1986).

4.2.3.3 Electromyography

This modality is related with measuring electromyographic activity generated by the firing of motor neurons – the electrical activity generated by a muscle when contracted (R.W. Picard, Vyzas, & Healey, 2001). The two main data gathering methods consist in either using a needle EMG which is inserted through the skin into the muscle tissue or using an external bio-feedback device with sensors attached to key points in the skin's surface. The differences between both methods are obvious as, typically, the quality of the gathered signal is lower in the second case but, on the other hand, the first method is considered highly intrusive to be used in some contexts.

The first examples of the use of the EMG originate in therapy procedures, namely in the control of prosthetic devices or as a mean to detect subtle movements which fall into the category of motionless gestures (Hefftner, Zucchini, & Jaros, 1988; Swindells, MacLean, Booth, & Meitner, 2007). There are also a significant number of experiments on user interfaces for users with disabilities: one example is a system that makes use of muscle contraction to slide scrollbars and identifies simple gestures for activation commands (Putnam & Knapp, 1993); Barreto proposes a system in which it is possible to control a desktop interface with facial muscles (Barreto, Scargle, & Adjouadi, 1999). However, as stated by Costanza, one of the most prominent features of the EMG signal is the ability to differentiate between muscular activity originating from movement and from other type of physiological responses (Costanza, Inverso, & Allen, 2005). This ability allows for the definition of "motionless" gestures, ideal for determined environments, such as mobile ones, in which users may perform these to interact with their devices without being hindered socially for practicing such gestures in public spaces.

4.2.3.4 Summary

In this section we provided a concise view on how the human nervous system works. As it is responsible for the regulation of voluntary and involuntary reactions in our body, we aimed at exploring its relation with specific physiological metrics. Among the available ones, we faced those which are recurrently linked with arousal and relaxation – two key states as far as videogames and the flow theory are concerned. Table 4.1 depicts determined manifestations associated with the metrics analyzed in this section.

Table 4.1 – Mapping between physiological metrics and emotional states.

Metric	Manifestation
Galvanic Skin Response	▪ Arousal is connected with increased electro-dermal activity ▪ Low electro-dermal activity linked with relaxation states
Heartbeat Rate	▪ Accelerated heart rate linked with arousal ▪ Decrease in heartbeat rate coupled with relaxation
Heart Rate Variability	▪ High activity related with user disengagement due to task difficulty
Electromyography	▪ Activation of specific muscles according to the emotions triggered (especially relevant for facial expression detection (Antonio Fratini, 2012))

Based on this summary, we point three metrics of potential interest: galvanic skin response, heartbeat rate and heart rate variability. While electromyography is capable of discerning between different emotions, the strong coupling between all other metrics and the states which we seek to address in this research – arousal and relaxation – make them invaluable to forfeit their usage. Henceforth throughout this document, our focus will be on those specific metrics.

4.3 Physiological Metrics in HCI & Videogames

We covered a small selection of physiological metrics, how they are related with the human nervous system, how they can be stimulated and basic correlations between them and emotional states. Now we will address why and how these metrics have been applied in HCI studies, with particular focus on how HCI and videogame researchers capitalize on them for various ends.

As an introductory note, physiological interaction is a trend within the broader unconventional human-computer interaction domain, which focuses on the use of the body's biological signals and stimuli as an alternative or complement to traditional interaction mechanisms (Anttonen & Surakka, 2005). This interaction paradigm can provide information which is paramount to determine user satisfaction and usability issues in different settings (Kivikangas et al., 2011). In recent years, physiological interaction modalities started to appear more frequently in projects covering distinct domains such as arts, entertainment or medicine (Aylward & Paradiso, 2007; Knight et al., 2004; Nijholt & Tan, 2007). These interfaces are mainly used to determine motion (Kwon & Gross, 2005) (through muscle tension detection, video capture or accelerometers) or emotion (through skin conductivity or heart rate variance) (Shi et al., 2007). But what are the advantages of these mechanisms as a complement or alternative to existing assessment techniques?

4.3.1 The Rationale behind Physiological Metrics

Traditional assessment approaches in HCI (e.g. post-experiment questionnaires, observation, video recording, interviewing) are considered highly subjective and possess an interesting set of drawbacks (Meehan et al., 2002). Failure to address complex interaction patterns as well as a frequent discrepancy between questionnaire responses and the actual user experience are among the cited reasons. In fact, Wilson and Sasse (G. M. Wilson & Angela Sasse, 2004) state in their research that results stemming from subjective and physiological measurements are sometimes conflicting, as users may not be aware of (or try to hide) their true feelings or simply are not able to recall their experience in post-interviews. Rowe (Rowe, Sibert, & Irwin, 1998) also provides a report on the advantages of physiological assessment mechanisms. For him, the majority of the capturing devices are unobtrusive, which emphasizes the complementary value this interaction type may provide to traditional assessment techniques. Second, physiological measures are considered multi-dimensional, being able to provide different views on different issues, such as user mental workload. Lastly, physiological signals are typically continuously gathered, enabling a faster and more accurate detection of emotional or workload shifts.

The possibility of coupling physiological metrics with subjective or objective assessment methodologies weights in favor of its inclusion. Nacke's (L. Nacke, 2009) work on affective ludology is a testament to this. The intermingling of physiological metrics with other objective variables allows for a much more powerful analysis environment capable of better describing the players' experiences.

4.3.2 Physiological Metrics as an Analysis Instrument

Physiological metrics can improve the objectivity of an individual's emotional assessment. Instead of relying on rationalized reports and methods which can interrupt the experimental flow, analysts can continuously retrieve this type of data and analyze it in a post-experiment setting. Deployment reports and the domains in which this approach has been utilized are varied. In the next subsections we will delve into the most prominent ones, with special emphasis to those works that tackle physiological assessment in the videogames domain.

4.3.2.1 Emotion, Usability and User Experience Assessment

Some of the first widespread examples of researchers utilizing physiological metrics pertain to the assessment of task load index (Tattersall & Hockey, 1995; G F Wilson, 1993) and cognitive effort (Hess & Polt, 1964; Kramer, 1990) required to perform a determined task (Aasman et al., 1987). Wilson pursued the cognitive effort research line. First they combined heart rate and respiration data with brain activity signals to characterize the mental workload of an operator being aided by automated processes (Hockey, 2003). Later, they improved the operator's task performance, by linking the automated processes triggers with physiological data (G. F. Wilson, Lambert, & Russell, 2000). He (G F Wilson, 1993) also attested to the sensitivity of physiological signals when responding to variations in task difficulty. The research involved analyzing the workload of a specific military aircraft's pilots and its weapon system officers during training missions and laboratorial tasks. Periods with the most prominent physiological activity were associated with high-risk missions (e.g. bombing range missions for pilots and piloting for weapon system officers). In the end, the author concludes that the participants' physiological signals showed a high level of adaptability to the requirements of each task. Tattersall et al (Tattersall & Hockey, 1995) assessed how trainee flight engineers reacted from a physiological point-of-view to determined faults and incidents which were purposely introduced into everyday tasks of their specific domain. The authors recurred to a mix of physiological data gathering (using ECGs) and video recording to analyze user behavior. Results showed that both heart rate and heart rate variability and sensible to the unpredicted events introduced amidst the trials and that the periods encompassing elevated heart rate values were associated with the most stressful tasks (typically take-off and landing aircraft).

Fridlund et al (Cacioppo & Petty, 1983) can also be considered precursors of this assessment methodology. They utilized EMG signals in different zones of the human body to identify the emotions expressed. At that time, the success of the recognition algorithm peaked at 51%. The classification and recognition of these emotions is also the motivation behind Cacioppo's research (Cacioppo, Tassinary, & Berntson, 2007). The goal here was to induce certain emotions on participants in order to obtain their physiological responses and be able to identify different emotions.

As far as usability and UX is concerned, Wilson et al (Gillian M Wilson, 2002) attested how users experienced degradation of video quality in teleconference systems. Results showed a significant increase in the participants' heart rate and sweat levels. Ward et al (R. Ward, 2003) performed an assessment of potential correlations between recorded metrics and reported data in web usability studies. While no significant correlations were encountered between the analyzed groups, the authors found some confluence when assessing participants in an individual basis. Still in the web usability and UX field, Foglia et al

(Foglia, Prete, & Zanda, 2008) performed the same type of evaluation, comparing how users reacted to the navigation process of a specific webpage when supported by a virtual assistant. Results indicated that, although navigation speed did not diminish, the cognitive effort required to perform the task was lower. Finally, Alexandros et al (Alexandros & Michalis, 2013) propose a system to address emotional responses based on the tracking of physiological signals. The system encompasses not only the gathering of this type of data, but also video recordings and logging of interaction events. The advantage lies in the highlighting of key segments in the recordings where emotional activity was intense.

Several indications emerge from this short overview. First, physiological metrics are seldom used in isolation: researchers typically pair them with subjective metrics (e.g. to correlate and validate the reported perceptions with factual data), objective metrics (e.g. to complement with insight on interaction patterns) or a combination of both. Second, emotion identification is not entirely accurate. If we observe the examples provided, we can conclude that there is a handful of emotions which are typically tracked and sought after. Coincidentally, most of these are present in Csikszentmihalyi's mental state model.

4.3.2.2 Game Experience Assessment

In the particular case of videogames, there is a significant set of research which contemplates the usage of physiological signals. These are often divided in three groups: those who use physiological signals as a mean to understand user experience; those who capitalize on these metrics as a mean to adapt the game's mechanics (i.e. typically involving dynamic difficulty adaptation procedures); and those who utilize these signals as an input modality. In the context of this thesis, we are exclusively interested in the first group. Recurrent topics include immersion assessment, analysis of player arousal, emotional levels when facing specific types of opponents and general experience assessment.

4.3.2.3 Intertwining Physiological Measures and Subjective Analysis

Nacke et al (L. Nacke & Lindley, 2008) measured players' gameplay experience in first-person shooter games. The goal was to assess its effect on valence and arousal. The methodology involved the administration of a GEQ questionnaire and the assessment of physiological metrics (e.g. EMG and GSR signals). Players were required to play three levels designed to evoke boredom, flow and immersion. The authors concluded that EMG responses were determinant to address positive valence as expressed by muscle contraction and that the GSR metric showed statistically significant differences for the distinct level conditions.

Drachen et al (Drachen, Nacke, Yannakakis, & Pedersen, 2010) procured potential correlations between heart rate and electro-dermal activity and subjective gameplay experience reports. The procedure involved subjects playing three commercially available games while their physiological data was being retrieved. At the end, they reported their experience using a GEQ form. The authors found a significant correlation between heart rate, electro-dermal response and the self-reported GEQ results. These results were consistent across the assessed games. However, the covariance between physiological measures and questionnaire reports varied between the two measures (e.g. HR and EDA).

One of the current pivots of game experience assessment was proposed by Nacke as part of his doctoral dissertation [ref]. Affective Ludology, as coined by the author, is:

- "(…) the field of research, which investigates the affective interaction of players and games (with the goal of understanding emotional and cognitive experiences created by this interaction) (…)"

The author states that the scientific study of games (ludology) should also encompass the understanding of the affective and biological reactions of the entities playing them – the players. The dissertation comprises a thorough review of gameplay experience assessment methodologies, along with a set of experiments which aimed at attesting the validity of the proposed methodology, combining objective physiological data and subjective measures of experience.

4.3.2.4 Correlating Physiological Patterns & Emotions / Behaviors

This section is dedicated to a set of works in which the authors aimed at correlating physiological metrics with the emotions reported or behaviors pinpointed during interaction period. Maartje Polman et al (Polman, Calvi, & Janssen, 2011) presented a study which aimed at detecting facial expressions while users played casual games. The authors recurred to a facial expression detection program and to a method based on EMG which detected subtle muscle activation across an individual's face. Results are not clear to pinpoint the best approach for facial expression detection. However, the authors do state that both approaches can be intertwined to increase the accuracy and robustness of facial expression detection algorithms.

Shi (Shi et al., 2007) has also performed a correlation between galvanic skin response and the cognitive load associated with interacting with an application. In particular, the purpose of this research was adapting a game's difficulty according to variations in the skin conductance level. Results showed that higher peaks in the skin conductance were related with situations of high frustration or major events taking place in the interface.

Tadeusz Stach (Stach, Graham, Yim, & Rhodes, 2009) performed a study which addressed a couple of different hypothesis. One of the goals built on the fact that different individuals possess distinct heart rate patterns – the intent was to verify if it was possible to achieve some consensus in the generation of a handicap algorithm which recurred to each individual's heart rate patterns. The second goal was to assess if the usage of those handicaps resulted in a more engaging and competitive playing experience for both players. Results showed that the heart rate patterns based handicap was viable. The player engagement and fun factor were both at least as good when they played with the heart rate handicap approach.

Lin et al (Lin, Omata, Hu, & Imamiya, 2005) aimed at showing potential correlations between physiological data and more traditional usability metrics. The experimental procedure encompassed having subjects playing a game divided in multiple segments (each with a different level of difficulty associated) as quick as they could, while avoiding to incur in erroneous actions. Results were straightforward: stress levels and the challenge provided were positively correlated.

4.3.2.5 Societal Influences

As addressed in the previous chapter regarding persuasion, society can play a pivotal role in everyday decisions. The impact may be so intense that an individual may change his / her behavior due to social pressure. From an affective point-of-view it is natural that there are some challenges and emerging questions – for instance, how different types of acquaintances may affect us emotionally. Some research regarding gameplay experience addresses the role of different types of adversaries and how they impact on our own experience.

Mandryk et al (Mandryk & Inkpen, 2004) assessed players' experience from a societal perspective. The goal was to compare player metrics when facing AI controlled opponents against facing human-controlled opponents. The authors' hypothesis consisted in assuming that GSR would reflect preference for playing against human opponents (due to high arousal) and that EMG values around the participants' jaw would also reflect that tendency (due to competition purposes). Results corroborated the two proposed hypothesis. However, the authors denote that EMG activity was also related with player laughter and smiles, making it difficult to distinguish between those expressions and muscle activity due to a state of concentration.

Mandryk also proposed a method for modelling user emotional states based on physiological metrics (Mandryk, Atkins, & Inkpen, 2006). A confluence of physiological metrics (e.g. ECG, EMG, and GSR) is used to determine the emotions being expressed. A dedicated system is then used to obtain an emotional representation (e.g. arousal, valence) from the physiological data. An experimental period was designed to assess the validity of the system as well as to explore user experience traits when playing against three different types of opponents: co-located friends, co-located strangers and AI opponents. As far as the procedure is concerned, results showed that the emotions modelled by the system roughly corresponded to the ones reported by the users at the end of the trial. Concerning player experience, players reported having more fun when playing against friends. Non-acquaintances also provided them with a more pleasant time than computer AI adversaries.

4.3.3 Limitations

In the last sections we showed the potential of physiological metrics. Whether they are employed in isolation or coupled with other objective metrics or subjective measures, they can enrich the analysts' understanding of user / player experience. The applications of this type of assessment are also varied, ranging from utilizing the data to feed the applications themselves, to the identification of correlations between interaction patterns and behaviors and physiological data.

Despite these strong aspects favoring the usage of physiological data, several authors have denoted a consistent set of shortcomings which affects its utilization. Alexandros and

Michalis provide a list of the disadvantages of physiological measurements (Alexandros & Michalis, 2013). Acquisition cost is pointed as one of the reasons – not only the financial aspect associated with often costly devices, but also the requirement of having specialized staff to operate them and interpret that data. Signal quality is pointed as an often present limitation which can hinder the value of the results. Physiological measurements typically involve the measurement of electrical signals. These are vulnerable to some external variables, such as skin cleanness, humidity levels and room temperature, among other. The capturing devices need to be thoroughly prepared and the experimental settings carefully planned in order to mitigate the disturbances introduced by the enumerated factors. The last limitation mentioned by Alexandros concerns to the conditions under which subjects are required to perform. Physiological data gathering devices are complex: they typically do not possess the sleek design of a modern smart-phone and require the subject to be wired via a set of cables in order for the signals to be captured. This technological paraphernalia may cause discomfort on some users, affecting their emotional state and interaction experience due to the unnatural work circumstances.

Kramer (Kramer, 1990) presents an even more detailed depiction of the limitations of physiological data, taking into account particular signals. The existence of disturbances in the gathering of electrical signals is also present in the author's review. Interference due to body movement is a possibility, a scenario which required subjects to be attentive to their posture. This is a limitation with impact on the retrieval of heart related metrics and skin conductance values. Regarding the collection of skin conductance levels, Kramer mentions that the typical electrode positioning (hand palms) limits the type of tasks which can be performed while the signal is being gathered.

While some of these limitations are detrimental for the gathering process, most can be solved with careful experimental planning and adequate briefing periods in order to mitigate the impact on the subjects' experience. Recent advances in the signal acquisition area also suggest that some equipment may tend to fade from this type of experiments (MobiHealthNews, 2013). Advanced image retrieval techniques are able to detect heart rate using video recording, removing the requirement to have electrodes attached to each participant.

4.4 Discussion

This chapter presented an overview on existing user experience assessment methodologies. Researchers are able to opt for the most adequate strategies for the experimental setup and the goals they intend to pursue. Table 4.2 presents a summary of the methodologies analyzed in this chapter, depicting also their main contributions and disadvantages in an experiment.

Table 4.2 – Player experience assessment strategies summary.

Family	**Methodology**	**What can we know from them?**	**Disadvantages**
Qualitative	Standardized Questionnaires	Insight regarding the user's experience and emotional state	Results may not reflect actual player experience
	Thinking Aloud	Timely verbalizations of their experience	Player flow disruption
	Video Recording	Body language	Knowledge of being filmed may affect experience
Quantitative	Metrics Logging	Player performance	Overload of recorded data
Physiological	Galvanic Skin Response	Increased activity related with arousal Low activity related with relaxation	Equipment paraphernalia may affect experience
	Heart Rate	High values relate to arousal Low values relate to relaxation	Equipment paraphernalia may affect experience
	Heart Rate Variability	High activity related with task disengagement	Equipment paraphernalia may affect experience

Qualitative assessment methodologies are advantageous since they mostly require expertise in designing proper questionnaires, or at least adapt standardized ones to the demands of the experiment at hand. Unfortunately, they possess a set of liabilities, particularly relevant to the videogames domain. While the fact that the data is heavily linked to the perceptions of participants is a detrimental factor per se, the disruption of player flow in particular assessment strategies is paramount to influence the way users interact and, ultimately, the results obtained. Quantitative metrics rely on the actual data produced by the users: ranging from interaction metrics, to their behavior and, in the end, their physiological reactions. The set of disadvantages associated with quantitative assessment methods is of different nature: typically it falls on the technical expertise required to operate the devices capable of gathering this data and to interpret it. Physiological assessment methodologies can potentially have some impact during the experiment and limit the type of tasks that can be performed. The devices and electrodes required to retrieve physiological data may influence the subjects' experience, especially if they are not used to that type of paraphernalia. The way and locations in which these sensors are placed on the human body (e.g. chest, hand palms, fingers, etc.) may also limit the type of tasks possible of being executed. A careful consideration regarding the methodologies used for this research is required.

In the context of this research, we opted for a hybrid approach comprised exclusively by quantitative behavioral assessment mechanisms and physiological ones. Our research goals involve the understanding of how players can be steered towards a state of optimal experience, a compromise between performance and emotional state. The review of existing literature in the area revealed the following characterization of this optimal state:

- It is a state of high performance, although not necessarily the best attainable. It relies on the balance between the player's skill set and the task's challenge.
- Sudden performance decreases are typically linked with the tackling of a challenge too demanding for the player's current skills.
- The transition outside this optimal experience state may lead to two adjacent states:
    - A state of relaxation, due to possessing a skill set which far surpasses the demands of the challenge at hand. This state is also characterized by lower heart rate values, lower heart rate variability and lower electro-dermal activity.

- A state of arousal when the skill set does not match the requirements of the challenged being issued. The increase of heart rate, higher heart rate variability and increased electro-dermal activity.

Figure 4.4 depicts the transitions we want to study in this research. Considering this set of phenomena, we opted to include a mix of objective metrics, encompassing player performance assessment (via metrics logging) and the analysis of the players' physiological state.

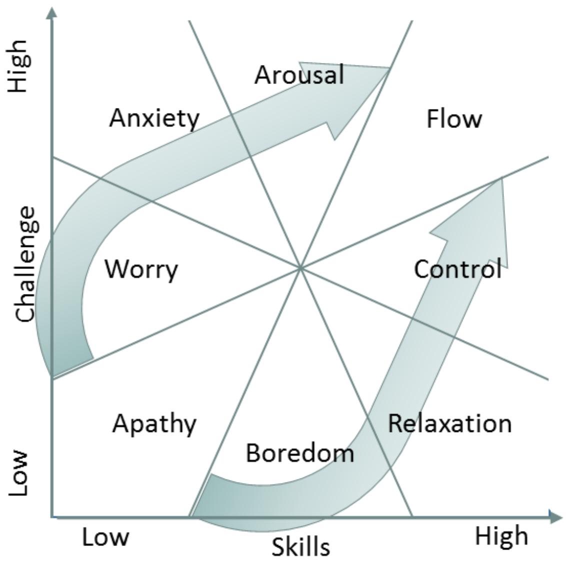


Figure 4.4 – Steering the player towards a state of optimal experience.

One of the deciding factors was the need to actively assess the player's emotional state without recurring neither to their perceptions nor to thinking aloud methods, since these are often considered inadequate for videogame experience assessment. Due to constraints in the available equipment, we used an ECG device to retrieve heart related metrics. Despite this hindrance, we believe that the complementarity of both assessment strategies will result in a compelling and rich set of data capable of supporting our analysis of how persuasive mechanics are able to affect a player and steer him / her to a state of optimal experience.

5 Impact of Persuasion on Player Experience

Persuasive technology is a powerful instrument capable of changing the way individuals address certain issues and even their behaviors. With a long record of successful deployments (Berscheid et al., 1971; Dion et al., 1972; Serapio & Fogg, 2009), it is a well-established research domain capable of being adapted to different contexts. The videogames domain is no exception. Multiple approaches can be observed in this entertainment format, ranging from clever messages, to anthropomorphic characters or even items which provide temporary or persistent boost in the players' abilities.

However, data regarding how these strategies affect the players is scarce. While the inability to release this type of information by major developers is comprehensible from a business standpoint, videogames have evolved from being exclusive to the mass consumer market and are now subject for indie development and for deployments in critical contexts as serious games. These developers are prone to benefit from this type of expertise, leading to better designed products and ultimately games which are able to motivate the players in an improved way as a result of a more clever way to employ persuasive technology.

5.1 Focus of Research

Designers conceive a diversity of strategies to convey persuasion to their target users. From the anthropomorphization of virtual characters to the provision of psychologically enticing messages, the approaches employed are able to cope with the requirements of the environment they are inserted on. While the videogame domain possesses its own set of challenges as far as design is concerned, most persuasive strategies can be adapted into game mechanics or instruments upon which designers can capitalize.

In the previous chapters we provided a detailed view on existing persuasive approaches, how they fare within the videogames domain and what instruments are utilized to convey persuasive cues to players. We narrowed our object of study to focus on three particular types of instruments:

- Feedback and / or praise.
- Usage of rewards.
- Provision of an environment of discovery.

This selection is the result of an analysis contemplating representative games across different genres. They reflect the persuasive instruments with which players are more frequently confronted with. These vehicles of persuasion will be the subject of analysis throughout this chapter.

5.1.1 Research Questions

This research has been framed according to three domains: flow & videogames, persuasive technology and experience assessment methods. As summarized in the previous chapter, the broad objective of this research is the study of how determined persuasive instruments can steer players towards a state of optimal experience, where there is a balance between their performance, affective state and the challenge being issued.

Given that we have narrowed and identified the persuasive vehicles we wish to address, we are now able to objectively state the research questions of this first experimental period:

- In a videogame, can feedback / praise persuasive instruments steer a player to an optimal experience by effectively lowering their heart rate / increasing their performance or increasing their heart rate / decreasing their performance?
- In a videogame, can the inclusion of rewards steer a player to an optimal experience by effectively lowering their heart rate / increasing their performance or increasing their heart rate / decreasing their performance?

Note that the denoted variations on player experience (pertaining to physiological and / or performance changes) reflect the possible directions in which the player can be steered according to the *flow* graph presented in last chapter's summary.

5.1.2 Methodology

We designed an experimental period to address the formulated research questions. The scientific method serves as the foundation for our approach, reflecting our interest in measurable and objective data retrieved directly from our participants and their interaction logs.

Since we wish to compare how determined types of persuasive instruments influence the players' experience, an intra-subject analysis emerges as the most adequate approach to tackle this trial. To do so, we developed various prototypes of a game, each sporting one of the persuasive mechanics being addressed by this study. The objective comprises establishing a baseline trial (preferably with none of the above mentioned persuasive instruments) to which all other game variants are compared.

The game's design and development process should adhere to well-known methods in which we are able to rapidly deliver a functional prototype, test it and iterate on the encountered faults. The rapid prototyping development process (Klausner & Konchan, 1982) coupled with a RITE (Rapid Iterative Testing & Evaluation) methodology (Medlock et al., 2002) surfaced as adequate strategies. During the experimental period we gathered all necessary data according to our own goals for player experience analysis (heart rate and performance data, as established in the previous chapter). We took inspiration from Microsoft Studios' TRUE (Tracking Real-time User Experience) (Kim et al., 2008) approach in which all data related to the variables at stake is retrieved, even if only a sub-set of it is utilized in the analysis.

5.2 Experimental Game – Wrong Lane Chase

For the first experimental period we developed Wrong Lane Chase, an arcade racing game which took its main inspiration from Chase H.Q. The player controls a police car in pursuit of an automobile driven by robbers. The chase forces the player to drive in the opposite direction to incoming traffic, generating dangerous situations. While doing so, the player must also retrieve gold coins being unintentionally dropped by the robbers. After collecting enough coins, the player enters a final confrontation to stop the robber's vehicle, having to shoot them until they pull over. However, since the robbers are focused on accomplishing their mission, the player needs to avoid various hazards, such as spike traps while shooting the enemy.

5.2.1 Design & Implementation

Wrong Lane Chase was designed for Windows PC platforms. The game's architecture follows basic software design principles aiming to be as modular as possible for potential future upgrades and to provide a clear separation between the game's logic and presentation to the players. As previously hinted, we adhered to a mix of rapid prototyping and RITE methodology for the development process. This mixture ensured the quality of the final prototypes, a result of the constantly iterating over new prototypes to correct significant architectural inconsistencies or gameplay balance issues. Wrong Lane Chase's architecture can be observed in Figure 5.1.

The game possesses six main components comprising functionalities related to the game's logic, drawing game elements, user interface management and data persistence. We will now address these components individually:

- **Event Manager** – serves as a facilitator between all other components, providing the necessary separation between what is the game's logic and the presentation to users. Modules are able to generate events which are dispatched by the event handler and then attended by the components to which those events are addressed to.

- **Persistence** – the storage and retrieval of relevant game data is the responsibility of the persistence component. Player data such as high scores are locally stored on XML files which are updated after each gaming session and loaded when the player initiates Wrong Lane Chase. Additionally, the persistence component is also responsible for storing any interaction data generated by the player for posterior analysis.

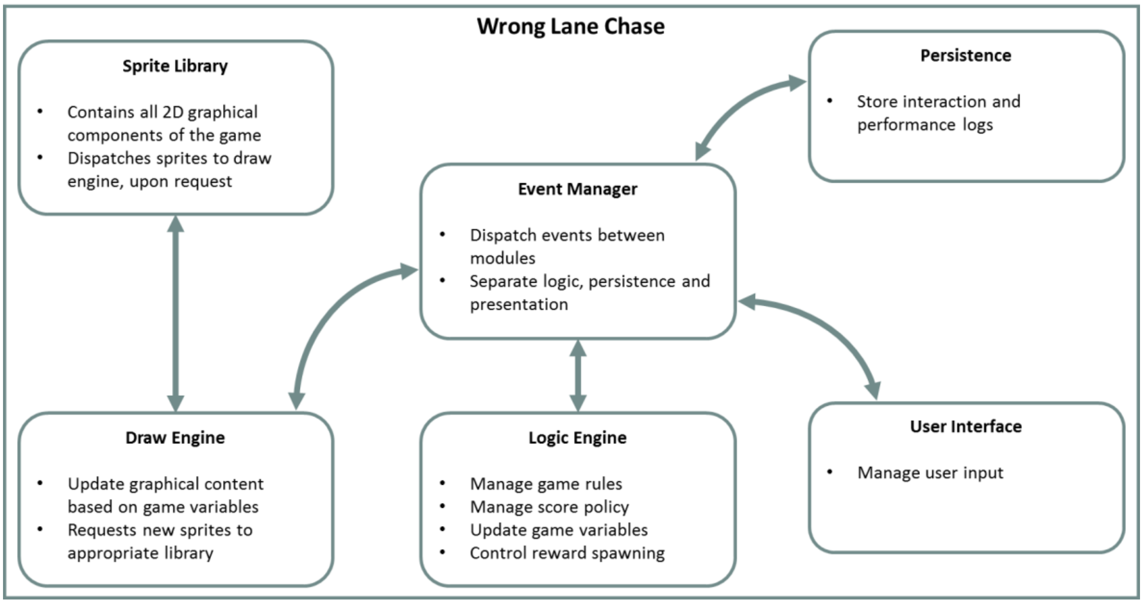


Figure 5.1 – Wrong Lane Chase's component diagram.

- **Logic Engine** – the logic engine is responsible for maintaining the game's variables and settings updated, addressing features such as obstacle and reward spawning rate or updating the score table. Each modification generates an event which is then dispatched to the appropriate components (typically the draw engine and the persistence component).
- **Draw Engine** – the draw engine is addresses the graphical content being displayed to the player. Functionalities include the process of updating the background images used in the game or the position of the player's vehicle. All necessary information is typically fed to it via the event manager.
- **Sprite Library** – the sprite library is a collection of images used by Wrong Lane Chase to represent, among other, the player's vehicle, the game's obstacles,

scenery and some of the midgame incentive mechanisms. The draw engine and the sprite library are closely linked since particular sprites may be loaded depending on the current game state (e.g. some animated elements require different sprites to be loaded according to the current game instant).

- **User Interface** – all user input commands are subject to be treated by the user interface component and then relayed to other appropriate components through the event manager.

The game was implemented for Windows PC platforms using the .NET framework 3.0 and also using XNA 3.0 toolset for facilitating and managing the development process.

5.2.2 Rules & Gameplay

Wrong Lane Chase is a two phase game: during the first, the player needs to avoid incoming traffic and collect gold coins; during the second phase, the player is required to pull over the robbers' vehicle by shooting it, while avoiding hazards created by the enemy. Both phases require a set of rules and scoring policies adequate for the objectives of each phase. Table 5.1 and Table 5.2 present the policies for phase 1 and phase 2, respectively.

Table 5.1 – Wrong Lane Chase phase 1 scoring policy.

Action	**Score Modifier**
Collect gold coin	200 points
Collect 5 coins in a row	400 points
Hit incoming vehicle	-40 points
Avoid an incoming vehicle	2 points
Avoid a streak of 40 incoming vehicles	100 points

During phase 1, the player earns points for collecting gold coins and avoiding the incoming traffic. Performing certain achievements such as collecting 10 coins in a row without missing any in between or avoiding a streak of 40 vehicles in a row awards the player with bonus points. Penalties are given for hitting an incoming vehicle. Traffic is generated at certain intervals which are determined by the lane in which the vehicle will appear. Certain lanes have a spawn timer of 5 seconds while others can reach a 7 second interval between each spawn. Since the game does not impose a time limit, we opted to restrict the amount of points a player can obtain. Players could, hypothetically, fail to pick up coins in order to amass points by avoiding incoming traffic. As such, traffic only awards points while less than 20 coins were spawned. From the moment the player had the chance to finish the first phase (when the 20th coin is spawned), incoming vehicles cease to award any point.

In Wrong Lane Chase's second phase, the player is awarded points for shooting the enemy vehicle (the player has an infinite amount of bullets) which spawns at the beginning of this stage. The enemy vehicle moves randomly from lane to lane and, while doing so, spawns spike strips which the player needs to avoid. Similarly to phase 1, the player is rewarded when dodging incoming obstacles (spike strips in this case) and is also given bonus points when he / she performs unique feats such as hitting 3 bullets in a row or avoiding 40 obstacles in a row. The player is penalized each time he / she hits an obstacle. Obstacles are generated at a rate of one each 5 seconds.

Table 5.2 – Wrong Lane Chase phase 2 scoring policy.

Action	**Score Modifier**
Bullet hit	10 points
Hit 3 bullets in a row	250 points
Hit spike strip	-40 points
Avoid spike strip	2 points
Avoid a streak of 40 spike strips	100 points

Regarding the player's controls, the police vehicle is steered using the keyboard's arrow keys during both phase 1 and phase 2. A new command is introduced in phase 2 – shooting a bullet – which is triggered by pressing the Z key. The full list of controls is available in Table 5.3.

Table 5.3 – Wrong Lane Chase control scheme.

Command	Action
Press ↑ key	Moves police car upwards
Press ↓ key	Moves police car downwards
Press ← key	Moves police car to the left
Press → key	Moves police car to the right
Press ‘Z’ key	Shoots a bullet

5.2.3 Interface

Wrong Lane Chase is a vertical scroll-down game, akin to popular games using the same top-down view such as “Xenon 2” (Line, 1989). We wanted to provide the player with a large gaming area, complemented by two smaller panels which could feature basic feedback such as current score or the progress of the player in each phase. Figure 5.2 shows the interface’s low (left) and hi-fidelity prototypes (right). The playing area occupies the vast majority of the game’s screen, with the aforementioned panels embracing it on the topmost and on the lowermost section. These panels showcase the game’s title and the player’s score and progress, respectively. All action takes place between the two continuous lines delimiting the boundaries of the highway (and the player’s action range as well). The player’s police vehicle can be observed in the lower part of the screen as the dark blue vehicle. All other vehicles move from top to bottom and act as obstacles for the player (incoming traffic).

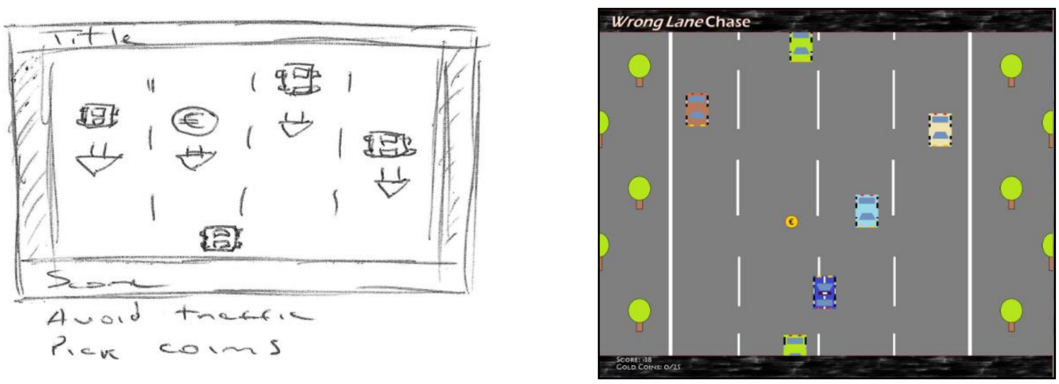


Figure 5.2 – Wrong Lane Chase phase 1 low-fi (left) and hi-fi prototype (right).

The player is free to move the police car across all four lanes. In each side of the road we can observe the existence of some scenery not only to improve the game's aesthetic component, but also to give the player a sense of travelling speed. In Figure 5.2 (right) we can also observe a small gold coin in the center of the screen – the goal of the first phase.

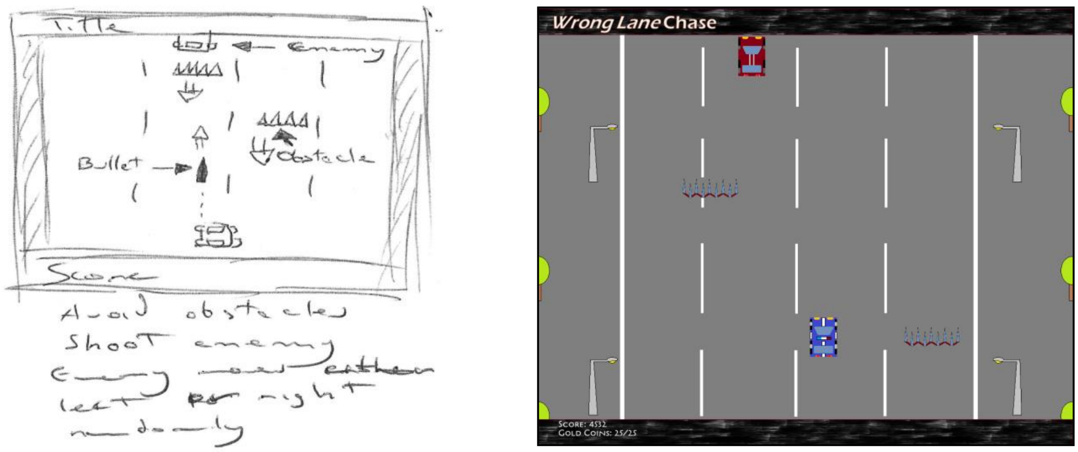


Figure 5.3 – Wrong Lane Chase phase 2 low-fi (left) and hi-fi prototype (right).

Figure 5.3 presents Wrong Lane Chase during the game's second phase. In order to provide players with a sense of advancement, we replaced the trees in the scenery with streetlights. The other changes in the playing area are related with the game's mechanics themselves. First, we can observe the enemy vehicle at the top center of the screen as a red vehicle. Near the player's vehicle we can also visualize a spike strip (represented by blue tinted metalic strip).

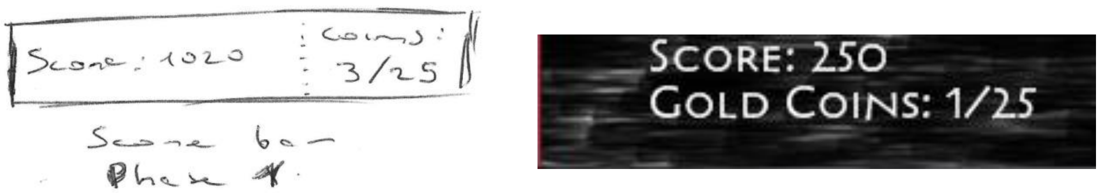


Figure 5.4 – Wrong Lane Chase coin collection feedback low-fi (left) and hi-fi prototype (right).

During the game, the player has access to his / her progress in the lowermost panel. Figure 5.4 shows the low and hi-fidelity prototypes for the score presentation during phase 1. In this case, the score appears on the left side of the lowermost panel. Below the score information, the player can visualize the progress for the coins he / she has collected during phase 1.

Figure 5.5 – Wrong Lane Chase enemy hit points low-fi (left) and hi-fi prototype (right).

In Figure 5.5 we can observe the information displayed pertaining phase 2. Here, in addition to the aspects already detailed, we also add the enemy vehicle's remaining hit points. This information is placed on the right side of the topmost panel. The reason for this is that during the second phase, the player focus will mostly be directed at the top area of the screen, since that is the zone where the enemy vehicle will be positioned.

The design and positioning of all these interface features stemmed from our own design expectations which were progressively iterated over based on user feedback. These feedback elements are present in all versions of the game. Despite the fact that one of the research's goals addresses the usage of feedback as a persuasive mechanic, we opted to include this information in all prototypes since it conveys basic player data that is typically available in most commercially available games. As such, we will be addressing another type of feedback as a vehicle for persuasion during these trials.

5.2.4 Persuasive Strategies & Respective Prototypes

To pursue our agenda, we developed a set of prototypes pertaining to each of the persuasive strategies we had intent in evaluating. Additionally, we developed a prototype deprived of any persuasive features (apart from the previously detailed score and progress panels) to act as the baseline for the experimental period. Since the basic version of Wrong Lane Chase does not add anything new to the features already described, we will retract from detailing it further and focus our attention in the two other prototypes. The first prototype we envisioned addressed the usage of feedback features as a vehicle to convey persuasion. In particular, we wanted to experiment with the inclusion of praise messages which are issued each time the player achieves a remarkable feat. The second prototype concerns the inclusion of reward mechanics. In this particular case, rewards are not issued when the players reach a determined goal, but are rather part of the gameplay mechanics. They provide the players with a temporary ability which may benefit them during that limited period.

5.2.4.1 Inclusion of Praise

The usage of feedback as a vehicle to convey persuasion cues in Wrong Lane Chase was locked, by our own design choices, to encompass the inclusion of praise. Showcasing the players' score and progress in all of the game's prototypes inhibits us from assessing those specific instruments in an isolated way. In light of this limitation, we explored alternative ways to use feedback and, in particular, praise in Wrong Lane Chase. For this game, we wanted to pop praise messages whenever the player achieved an important feat. Looking back at the game's rules, we can observe that there are a few events in which, upon occurring, can benefit from the inclusion of praise messages to inform the player that he / she has performed that feat. Those events are:

- Collect 5 coins in a row.
- Avoid 10 vehicles in a row.
- Avoid 10 spike strips in a row.

To design this prototype and the persuasive instruments we revisited Chapter 3's Table 3.1 in search for examples of games that have utilized praise. A quick glance allows us to identify "Burnout 3: Takedown" (C. Games, 2008), "Diablo 3" (B. Entertainment, 2012), "Final Fantasy XIII" (Square-Enix, 2009), "Guitar Hero" (Harmonix, 2005), "SimCity" (Maxis, 1989), "Sonic the Hedgehog" (Sega, 1991), "Super Mario" (Nintendo, 1985) and "Unreal Tournament" (E. Games, 1999) as games which fall into the category we are seeking. However, not all of these recur to praise messages in the same way we desire for Wrong Lane Chase. "Final Fantasy XIII" (Square-Enix, 2009), "Sonic the Hedgehog" (Sega, 1991) and "Super Mario" (Nintendo, 1985) deliver praise only at the end of a fight (for

"Final Fantasy XIII") or at the end of each level (for the other two games). In all the other games, praise messages are spawned during gameplay whenever an important event takes place. This is precisely the type of approach we require for Wrong Lane Chase. The way those games display praise is also similar across each other: typically a toast message (a sentence which appears for brief moments) appears approximately in the middle of the screen. In some cases, designers opt to include other effects such as blinking, sounds or additional art to emphasize that message.

In the particular case of Wrong Lane Chase, a blinking toast message appears momentarily (approximately for 3 seconds) to the player in the center of the screen congratulating him / her each time he / she performs an achievement (e.g. the traffic avoidance and coin collection streaks). This situation is depicted in Figure 5.6: in this example the player is being informed that he / she has collected 5 coins in a row and that he has surpassed the 4000 points threshold. These examples occur during the game's first phase. During phase 2, the presented messages concern the goals for this stage, namely avoiding a certain number of spike strips in a row.

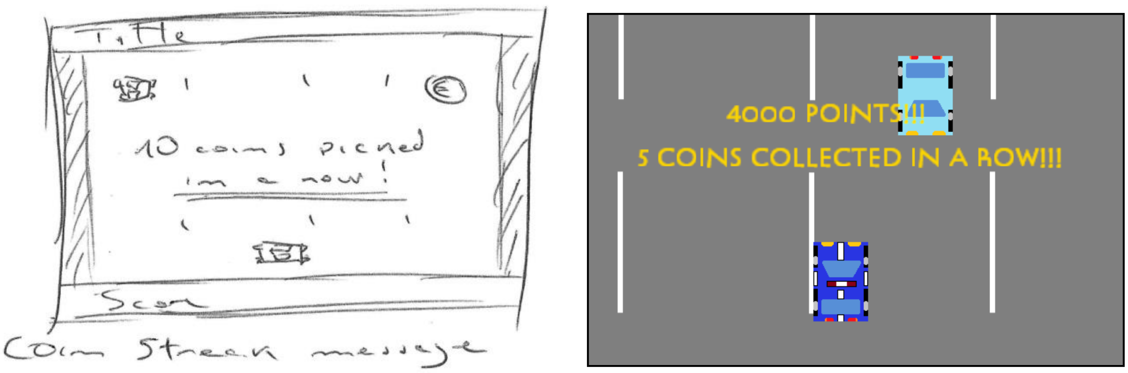


Figure 5.6 – Wrong Lane Chase coin collection streak message low-fi (left) and hi-fi prototype (right).

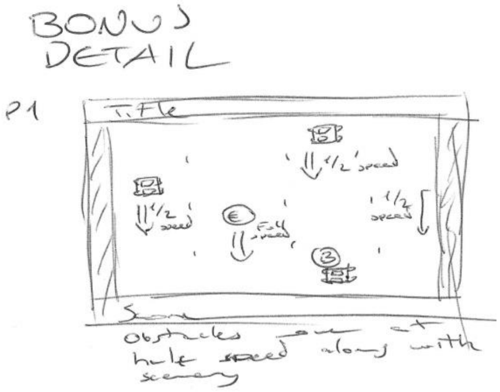
5.2.4.2 Addition of Rewards

The second envisioned prototype addressed the usage of rewards as vehicles of persuasion. We took a similar approach as we did for the first prototype, by analyzing Chapter 3's Table 3.1 and elaborating on the different strategies used when rewards are involved. Rewards are almost omnipresent in our list: only "SimCity" (Maxis, 1989), "Uncharted" (Dog, 2007) and "Unreal Tournament" (E. Games, 1999) do not extensively use this approach. Virtually all other examples offer players with rewards upon completion of a certain task (e.g. at the end of a level, when their character levels up, etc.). However, there are some specific games which go beyond this traditional way of designing rewards. In "Diablo 3" (B. Entertainment, 2012), "Sonic the Hedgehog" (Sega, 1991), "Super Mario" (Nintendo, 1985) and "World of Warcraft" (B. Entertainment, 2004), rewards can be encountered throughout the levels and typically provide a temporary boost to the players' abilities, instead of acting as a sign of achievement. Let us now analyze these particular cases in more detail.

In "Diablo 3" (B. Entertainment, 2012), players encounter diverse shrines in the world map. Upon activating them, they gain a two minute aura which can increase their attack speed, experience gained or gold retrieved from monsters. "Sonic the Hedgehog" (Sega, 1991) and "Super Mario" (Nintendo, 1985) utilize similar approaches. In both games, players can pick up rewards spread throughout the levels which augment their character's abilities: temporary invincibility, shields, bonus points, etc. In "World of Warcraft" (B. Entertainment, 2004), players can pick up temporary rewards in battlegrounds (venues where groups of players fight against each other) which provide them with a boost on their damage output or gradually heal them for that specific time period. Since the goal of this research is to assess the effects of persuasive instrument on player experience during gameplay period, we obviously are interested in the approach depicted by these four particular examples.

The reward mechanic we opted for takes inspiration from "Max Payne"'s (R. Entertainment, 2001) bullet time mode. When the player picks up the reward, the speed of the incoming traffic is reduced in half for 10 seconds. The coins still spawn at the same rate, in order to not hinder the player's final performance, leading to lowering the difficulty temporarily. The mechanic is also present in phase 2. Here, it not only reduces the obstacles' speed, but also the enemy vehicle, giving the player a higher chance to successfully hit it. This incentive is also active for 10 seconds in phase 2. On both phases, we were particularly careful with the player's sense of immersion. As such, the scenery speed is also reduced to provide a slowdown perception to the players across the entire game.

In both phases the reward items assume the form of a green bubble depicting the letter 'B' (for Bonus). The player needs to pick this item (as he / she would do with a coin) to activate it. These items appear in random intervals which go from 22 to 26 seconds between each spawn. An example of the reward item can be observed in Figure 5.7.



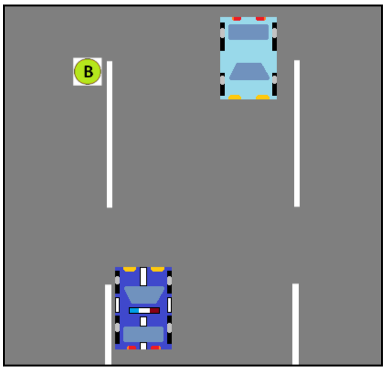


Figure 5.7 – Wrong Lane Chase midgame incentive low-fi (left) and hi-fi prototype (right).

5.2.4.3 MSI Model Mapping

We only miss one step in order to close the persuasive strategies design exercise here presented: mapping the proposed approaches into our own MSI model. The mapping can be observed in Table 5.4, including the method, support approach and instruments used for both Wrong Lane Chase's persuasive strategies and prototypes.

Table 5.4 – Wrong Lane Chase's persuasive strategies' mapping on MSI model.

Method	**Support**	**Instruments**

▪ Discovery
  ○ Sandboxing
	▪ Personalization
	  ○ Tunneling
	  ○ Reduction
		▪ Feedback
		  ○ Informative
		▪ Perks
		  ○ In-Game Rewards

The method employed is tied with the discovery strategy and, in particular, sandboxing justified by the fact that players engage in a setting where they need to explore a few game mechanics (name the rewards' effects and when praise appears). This method received the support of some minor personalization as some hints of tunneling and reduction are present to guide players towards their main goal and impede them from deviating towards secondary objectives. Finally, the instruments are representative of the previously described game elements: players are confronted with informative feedback on one of the prototypes, while the other encompasses offering perks in the form of in-game rewards.

5.3 Experiment

We envisioned an experimental period whose goal was to address the research questions raised at the beginning of this chapter. In sum, we want to analyze whether it is possible to utilize persuasive instruments to regulate (e.g. increase or decrease) a subset of a player's physiological signals and / or performance to steer him / her to a state of optimal experience. Persuasive technology has been studied for a myriad of domains. However, the videogame domain has been constantly neglected, leaving many unexplored research opportunities open for analysis.

Throughout this section we will establish our hypothesis, detail the experimental settings, participants, procedure, assessed variables and finally present the obtained results.

5.3.1 Hypothesis

The following hypotheses were identified in light of existing literature in the area and our goals with this research:

- **H1** – persuasive technology in videogames can be used to effectively improve or deteriorate the players' performance during the play process.
- **H2** – persuasive technology in videogames can be used to effectively increase or decrease the values of a subset of the players' physiological signals during the play activity.

5.3.2 Tools & Equipment

Subjects were provided with a Sony Vaio VPCS13S9E laptop model connected to a Dell 27'' 2709W monitor. Three Wrong Lane Chase prototypes were previously installed on the laptop: i) one containing the basic version of the game; ii) another containing the prototype featuring praise messages; iii) a final prototype which contemplated the delivery of rewards. Participants were also handed an AliveTec Heart Monitor sensor, previously prepared with electro-gel for better signal acquisition.

5.3.3 Participants

30 individuals volunteered to participate on our test sessions (25 male, 5 female; M = 25.5; SD = 6.1). Approximately 90% of our subjects played videogames regularly and all were proficient users of computers and modern smart-phones. This profile allowed us to discard any disruption stemming from novelty factors concerning the technology involved.

Subjects were briefed they would be playing different versions of the same game and that some features could be introduced / removed between each trial. The effects of each one of these features were not disclosed prior to the experiment. They were not only informed about the game's core mechanics (e.g. how different elements are visually represented, controls or score policy) but also allowed to have a trial period to get used to the controls' responsiveness. We did not detail the persuasive elements they would be dealing with.

5.3.4 Metrics

We concentrated on a select set of metrics representative for the conclusions we intend to draw from the study. During the trial, we accounted for the subjects' physiological metrics. In particular, we recorded the participants' average heartbeat rate values and from it we derived the heart rate variance:

- **Average Heartbeat Rate (HBR)** – this metric is capable of quickly reflecting changes due to stress or anxiety. We considered it as relevant to be one of the measures recorded for this testing period (L. E. Nacke, Kalyn, Lough, & Mandryk, 2011).
- **Heart Rate Variability (HRV)** – heart rate variability offers further insight of a user's emotional status (Rowe et al., 1998). By calculating the standard deviation of the heart beat rate, we are able to achieve this measure.

The players' score was the primary source of data concerning their performance. We complemented this metric with the average number of obstacles they were able to avoid in a row. This is a metric which may indicate how reckless players are when playing the game – favoring the end-goal or attempting to obtain a clean play-through:

- **Score** – we retrieved the final score obtained by the players in all prototypes. In general, the player's score should reflect his / her proficiency during that time period and should suffer alterations if determined instruments are able to affect the player at that level.
- **Average Obstacle Avoidance Streak** – this game's mechanics allowed for the assessment of a metric related with the average number of obstacles a player was able to avoid in a row without crashing.

5.3.5 Variables

Based on existing literature and our own assumptions, our analysis was focused on a small set of variables which may be good indicators of both physiological and performance fluctuations during gameplay period.

5.3.5.1 Independent Variables

The following is the independent variable we accounted for in these trials:

- **Persuasive Elements** – subjects were required to play three different prototypes of Wrong Lane Chase. They only differed among themselves according to the persuasive instruments being employed: on one of them no persuasive technology was present; on another prototype players were confronted with praise messages; on the last prototype the players were provided with rewards to check if they were able to increase their performance. By keeping all other features unchanged, we were able to assess whether a player's physiological state or performance were changed due to any alteration in the persuasive strategy being analyzed.

5.3.5.2 Dependent Variables

We considered the next variables as dependent for these studies:

- **Physiological Metrics** – respecting the research goals in sight we aimed at retrieving the players' average HBR and HRV in both experimental periods.
- **Performance Metrics** – during this experiment, we addressed the players' score performance and their average obstacle avoidance streak, assuming these variables would potentially be modified due to the players' interaction with the game's different prototypes.

5.3.6 Procedure

The trial required participants to carry out a total of three tasks using Wrong Lane Chase's prototypes. Before beginning we asked for each subject's consent to retrieve their average HBR, stating that their individual data would never become publicly available, would only be used for academic research and their identities would remain anonymous. After signing this agreement we asked each participant to wear the AliveTec Heart Monitor sensor, placing the electrodes according to Figure 5.8. We assisted subjects by providing them with an indication sheet they could read in a secluded area of the room to correctly place the electrodes. We analyzed the signal after the electrodes were set up to assess its quality as acceptable for proceeding forward with the trial.

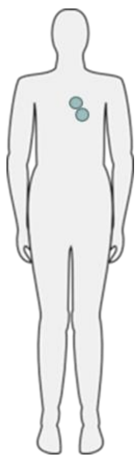


Figure 5.8 – AliveTec Heart Monitor electrode placement depiction.

Testing took place in a well lit room (natural lighting) at ambient temperature. In both trials, all subjects sit in a chair which they could regulate according to their needs and make themselves as comfortable as possible. Each subject's trial lasted for approximately 40 minutes.

We allowed for a 60 second acquaintance period with the game's controls and core mechanics using the game's first prototype (no persuasive instruments included). After engaging in the pre-task to inform the players about the game's rules and objectives, all subjects were required to carry out three tasks in a random order to avoid training bias. A 5 minute rest period was introduced between each task for physiological signals to return to their regular values (Mandryk & Inkpen, 2004). Wrong Lane Chase's trial was organized as follows:

- **Pre-Task** – players were informed they were participating on a series of trials in which they had to play videogames, without disclosing particular information about each task. They were briefed about Wrong Lane Chase's rules and were allowed a 60 second trial to get acquainted with the game's controls, responsiveness and the smart-phone's responsiveness and form factor.
- **Task 1** – participants were required to interact with the basic version of Wrong Lane Chase, stripped of any persuasive instruments. Players were briefed on the game's objectives (finish the two available levels with the highest score possible) and having no time limit to do so. This task was selected as the baseline of comparison to all others in this trial.
- **Task 2** – subjects were required to play a Wrong Lane Chase prototype contemplating the presence of a reward mechanism which momentarily delayed obstacle speed. Each time the players collected the reward item, all obstacle's speed along with the background's scenery (for the sake of realism and immersion) was slowed down for a limited time frame. Players were not informed about the presence of the reward, leaving them with the onus of discovering the effects.
- **Task 3** – users were requested to interact with a prototype of Wrong Lane Chase which contemplated the usage of praise feedback. They were presented to players each time they met certain conditions (e.g. avoid a certain number of obstacles in a row, picking a determined number of coins in a row without hitting any obstacle).

- **Post-Task** – after finishing all trials we attempted to obtain some subjective feedback from the participants addressing each task. After finishing this informal interview period we debriefed all players, clarifying what was being assessed in each task and the goals of the experiment.

After ending the sessions we debriefed all players on our intentions with our research. It is important to emphasize one detail in Wrong Lane Chase's tests: participants were not briefed about all game rules. In particular, we intentionally omitted the existence of a score bonus for avoiding a determined number of obstacles in a row. No reward was provided to any participant at the end of the trial.

5.3.7 Results

The analysis of this trial's results followed the following process:

- We assessed our physiological and interaction logs for each player, calculating some metrics such as the average heartbeat rate values or average score.
- We used this data to test whether our data followed a normal distribution and to test for equal variances (homoscedasticity).
- We used the results of the previous assessments to carry out a set of adequate statistical tests to validate our findings.
- Finally, we attempted to find any correlations between physiological and player performance metrics to address the influence of specific types of PT on players.

This procedure covers the main aspects of our results analysis, effectively building the momentum for a thorough discussion of our findings.

5.3.7.1 Descriptive Analysis

Table 5.5, Figure 5.9, Figure 5.10 and Figure 5.11 compile the descriptive results for this experimental period. A quick glance at the results allows us to conclude that:

- Players presented lower average heartbeat rate values when in the presence of different persuasive elements.
- Players were able to present better performances in the tasks which featured some type of persuasive instrument.

In sum, these results appear to support the two hypotheses we proposed for this experiment. We will now address each metric in detail.

Table 5.5 – Descriptive statistics for Wrong Lane Chase trials

		N	Mean	Std.	Min	Max
Average HBR	Task 1	30	83.98	11.33	63.89	105.69
	Task 2	30	80.17	10.60	59.58	102.00
	Task 3	30	79.38	10.54	59.46	98.62
Score	Task 1	30	4262.86	827.21	2172.00	5360.00
	Task 2	30	4628.60	728.60	2390.00	5458.00
	Task 3	30	5259.33	1333.31	1836.00	6848.00
Average Obstacle Avoidance	Task 1	30	68.53	22.44	34.00	118.00
	Task 2	30	81.93	26.39	38.00	119.00
	Task 3	30	134.86	24.10	91.00	169.00

Using Task 1 – absence of any persuasive instrument in the game – as the baseline task (M = 83.98; SD = 11.33) to which every other will be compared, we can observe from both Table 5.5 and Figure 5.9 that the persuasive instruments had a noticeable effect on players, leading to a reduction on their average HBR values throughout the gameplay period. This decrease is evident in both Task 2 (M = 80.17; SD = 10.60) and Task 3 (M = 79.38; SD = 10.54). Initially, we believed that the introduction of praise messages could potentially disrupt a player's flow. The act of reading the message itself may lead players to distraction, reducing their performance and ultimately feel more stressed. The obtained results, however, challenged our expectations, since players show noticeably lower average HBR values.

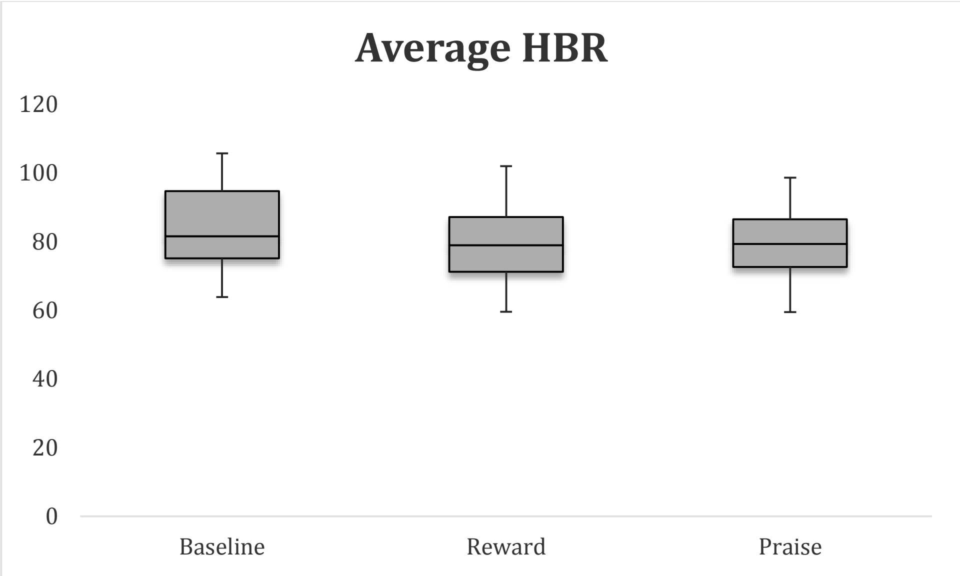


Figure 5.9 – Wrong Lane Chase average HBR boxplot.

Player score results continued the same trend found on the average HBR metric. Task 2 (M = 4628.60; SD = 728.60) presented a striking increase in player score when compared to Task 1 (M = 4262.86; SD = 827.21). Surprisingly, the average score obtained by players in Task 3 (M = 5259.33; SD = 1333.31) eclipsed the other tasks, displaying remarkably higher values than on either Task 1 or Task 2. We believe the reason for this phenomenon can be explained by the rules of the game – in particular, a scoring policy which we kept concealed from players intentionally. Wrong Lane Chase awarded points for players avoiding a determined number of obstacles in a row without hitting one of them – a fact we omitted from players. Nevertheless, the introduction of praise messages signaling each time the player was able to accomplish one of these feats was given enough relevance for players to alter their behavior to a certain extent. This behavior change encompassed prioritizing avoiding the obstacles rather than pick the gold coins whenever they appeared – ultimately this decision led to this abrupt increase in their score.

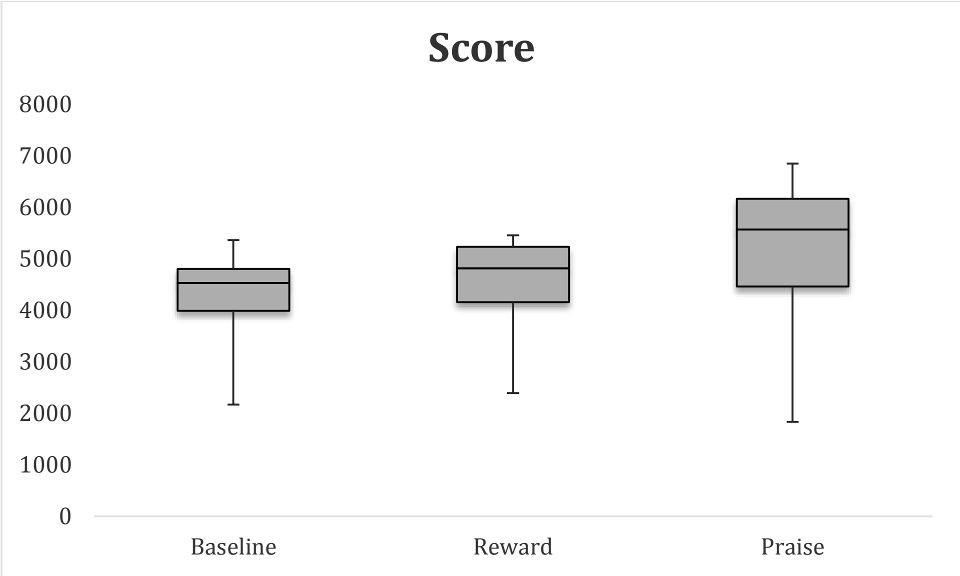


Figure 5.10 – Wrong Lane Chase score boxplot.

The results for the average number of obstacles avoided in a row metric are reminiscent of those found for the average player score. Task 2 (M = 81.93; SD = 26.39) presented a moderate increase when compared to Task 1 (M = 68.53; SD = 22.44). Again, Task 3 (M = 134.86; SD = 24.10) displayed the clearest gain in performance for players, stretching the average number of obstacles avoided above any other trial. These results strengthen the presented hypotheses and the outcome of the score metric analysis. Now we will proceed to assess the statistical relevance of these results.

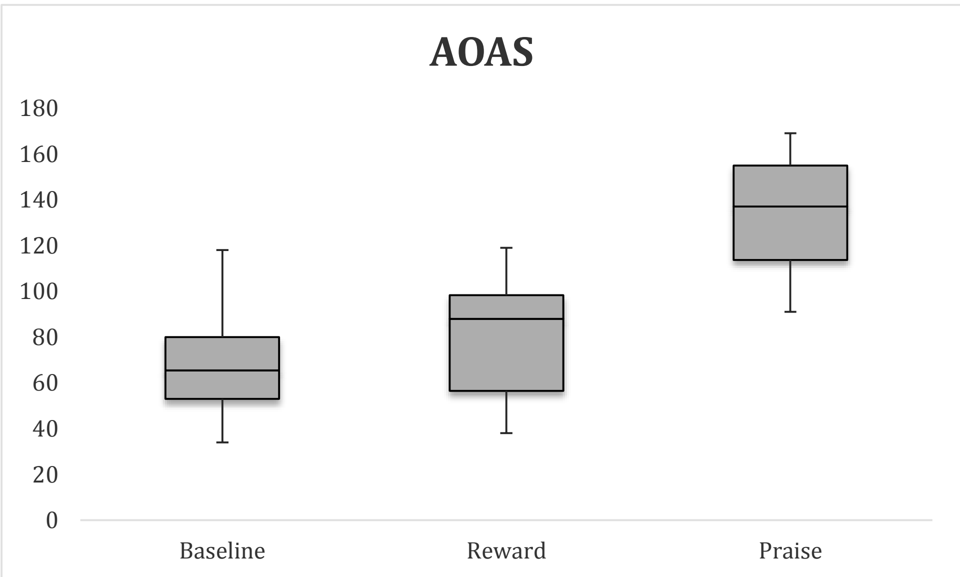


Figure 5.11 – Wrong Lane Chase average obstacle avoidance streak boxplot.

5.3.7.2 Statistical Analysis

We began the Wrong Lane Chase statistical assessment by checking whether the data respected the conditions to conduct analysis of variance testing. To do so, we started by performing a Shapiro-Wilk normality test. Results can be observed in Table 7.2. As emphasized by the light gray shading, those tests failed to comply with the normality test requirement ($p > 0.05$). Given this result and in light of both the nature of our data and of the tests already performed for the previous game we proceeded to carry out a set of non-parametric Friedman tests.

Table 5.6 – Shapiro-Wilk normality test results for Wrong Lane Chase trials.

		Shapiro-Wilk		
		Statistic	**df**	**Sig.**
	Task 1	0.956	30	0.246
Average HBR	Task 2	0.963	30	0.377
	Task 3	0.966	30	0.433
	Task 1	0.897	30	0.007
Score	Task 2	0.892	30	0.005
	Task 3	0.862	30	0.001
Average obstacle avoidance streak	Task 1	0.955	30	0.231
	Task 2	0.924	30	0.034
	Task 3	0.938	30	0.078

The non-parametric Friedman test results can be consulted in Table 7.3. All metrics yielded statistically significant differences in the performed tasks (light-gray shading indication in Table 7.3) at the 95% confidence interval.

Table 5.7 – Friedman test results for Wrong Lane Chase Trials.

	Average HBR	**Score**	**AOAS**
N	30	30	30

Chi-Square	36.92	50.04	42.19
df	2	2	2
Asymp. Sig.	0.000	0.000	0.000

With the intent of identifying which tasks produced statistically significant differences between each other, we performed a series of non-parametric Wilcoxon Signed Rank tests. Results can be observed in Table 7.4, with statistically significant pair comparisons being highlighted using a light-gray shade. We used a Bonferroni correction (Šidák, 1967) to avoid type-I errors (this means statistical significance is achieved when $p < 0.016$.

Table 5.8 – Wilcoxon Signed Rank test results for Wrong Lane Chase Trials.

		Task 1 – Task 2	Task 1 – Task 3	Task 2 – Task 3
Average HBR	Z	4.783	3.785	0.761
	Asymp. Sig. (2-tailed)	0.000	0.000	0.447
Score	Z	4.207	4.186	3.322
	Asymp. Sig. (2-tailed)	0.000	0.000	0.001
AOAS	Z	1.996	4.721	4.506
	Asymp. Sig. (2-tailed)	0.046	0.000	0.000

By starting with the analysis of Task 1 and Task 2, we can observe the results are in favor of our hypothesis. Both the differences between the players' average HBR ($Z = 4.783$; $p < 0.01$) and the differences between the players' average score ($Z = 4.207$; $p < 0.01$) are statistically significant. The same result was found for the case of the average number of obstacles avoided in a row metric ($Z = 1.996$; $p < 0.05$). Albeit the Wilcoxon result for the average number of obstacles avoided in a row can be questioned for being close to the boundary of statistical significance (further aggravated if we take the Bonferroni correction into account), existing literature states that the tests we performed are known to be highly conservative in nature (Narum, 2006). This leads us to believe that with a broader population we could achieve statistical significance in this test, given the tendency that is already identifiable here.

When compared to Task 1, the presentation of praise messages (Task 3) significantly reduced the players' average HBR ($Z = 3.785$; $p < 0.01$). We also found statistically significant differences between the average score metric ($Z = 4.186$; $p < 0.01$) and the average number of obstacles avoided by players in a row without hitting any other hazard (Z = 4.721; p < 0.01). This is one of the remarkable finding in the trials since there was no added mechanic actually benefitting the player – all changes in their performance and physiological state are the result of effective persuasion instruments in the form of praise messages for attaining certain achievements.

Although the object of our study consists in analyzing how different persuasion techniques can affect a player in a videogame compared to the absence of such mechanics, we still addressed the comparison between Wrong Lane Chase's Task 2 and Task 3. No statistically significant differences were found between the players' average HBR in both tasks (Z = 0.761; p = 0.447). The same does not apply to the remaining metrics: the obtained score in Task 3 was significantly higher than in Task 2 (Z = 3.322; p = 0.001). Players also were able to achieve much higher obstacle avoidance streaks in Task 3 when compared to Task 2 (Z = 4.506; p < 0.01).

5.4 Discussion

The presented results favor our hypothesis. Not only did the players respond physiologically to the introduction of persuasive mechanisms in the assessed videogame, but they were also able to improve their performance amidst the gameplay period. Regarding the research questions posed at the beginning of this chapter we can also state that the assessed persuasive strategies have similar effects on players, although with some differences between them as far as the impact is concerned. In light of these findings, we can safely assume that the persuasive strategies identified with help of related literature in the area were successful in changing at least two aspects of the player experience: their performance and their emotional response.

We will now delve in detail into the most interesting aspects of this initial trial, assessing the reasoning behind the witnessed alterations on player physiology and performance.

5.4.1 Praising the Player

Fogg presented empirical evidence in other domains of application which showed that praising a user can effectively persuade him / her into having a more positive posture (Fogg, 2002). We wanted to assess if such approach was also valid for the videogame domain. This trial's third task was utilized as a mean to analyze such effects. The usage of praise messages which appear to inform players about reaching certain feats provided us with unexpected results. Initially, we envisioned that these messages would be disruptive for the experience, distracting players from their tasks and ultimately lead to provoking errors in their actions. However, what we witnessed could not have been farther away from that scenario: players capitalized on those persuasive cues to improve themselves and attain higher scores. Participants provided some anecdotal feedback stating:

- "I enjoyed the popping motivation messages".
- "This type of feats always leads me to want to improve more".

Testimonials of this nature are elucidative on how these messages are capable of changing the playing behavior of a user. Results for Task 3 were fairly straightforward: not only players had a lower average heartbeat rate throughout the test, they also had a significantly higher score and, more importantly, presented longer obstacle avoidance streaks. The presence of the messages provided players with a relaxation symptom, leading to lower heart rate values through the gameplay period. Simultaneously, players were also able to boost their performance. Interestingly, there was no mechanism which could aid them in any form. We believe that the increased performance is a direct result of a behavior shift during gameplay: since players generated interest in witnessing the appearance of the praise messages, they unknowingly triggered the concealed score policies which awarded them with bonus points for attaining certain feats. When talking about the basic version of the game (Task 1), participants commented:

- "I felt no obligation to completely avoid all obstacles that appeared".
- "I just went for the coins despite crashing into the cars. The score they gave was sufficient to cover the crash deduction".

With the addition of the praise messages, we witnessed that players often preferred to skip a gold coin to avoid an incoming obstacle than collecting all coins as fast as possible. Such behavioral change resulted in them attaining multiple avoidance streaks which ultimately awarded them with even more points. In summary, displaying these praise messages was a catalyst for players to map their own objectives on-the-fly without prior information that they would be rewarded for it. This particular result goes well beyond our expectations, since it shows that persuasive instruments were capable of not only affect the players' physiological signals and performance, but also completely alter their behavior in a short time frame. Based on these results, we argue that the usage of particularly tailored feedback messages is able to not only prompt users to pursue different ways of playing the same game, but also to excel and overcome their own limits as players.

Concluding, the existence of a persuasive strategy involving praise was capable of not only motivating players to excel themselves and attain better performances, but also in reducing a subset of their physiological signals, suggesting a more relaxed gameplay experience. The H1 and H2 hypothesis are, therefore, covered by the usage of praise strategies as a persuasive mechanism.

5.4.2 Rewards as a Motivational Catalyst

Existing literature summarizes the utilization of rewards in the following fashion: players should be rewarded when they achieve a certain milestone (Cowley et al., 2008; Sweetser & Wyeth, 2005). Although we agree with this sentence and it holds true for a diversity of games, there are numerous cases in which players are able to benefit from reinforcement mechanics which are not related with any accomplishment at all. Developers populate games with multiple ephemeral rewards which, although not game-breaking, can temporarily alter the player's abilities and introduce brief changes in gameplay. During the debriefing period of our experiments, our subjects provided us with statements elaborating on the motivation to go beyond one's skills:

- "They (the rewards) interrupt the game's monotony".
- "They give me a confidence boost to go further".

The addition of reinforcements produced less physiological strain on our subjects. The improvement observed regarding the performance metrics should be carefully dissected. The nature of the reinforcement suggests that, while the mechanic is in play, players perform erroneous actions less frequently, due to a decreased speed related to the obstacles and subsequent increase of the reaction time to avoid them. While the mechanic does not directly contribute to a better performance regarding the process of collecting coins, it may influence the players' score on two fronts:

- Generate longer obstacle avoidance streaks.
- Generate less score penalties due to hitting obstacles.

The coupling of these two reasoning lines justifies the performance increase present in our experiment. It is important to note that, even though the reinforcement positively contributed to a potential performance boost, the game's core mechanics were in no way modified during Task 2. Coupled with the fact that the players' average heartbeat rate was also altered, we believe that the usage of reinforcement mechanisms as persuasive elements is a valid strategy to keep players engaged in the activity.

As a concluding remark, the inclusion of a persuasive strategy based off of rewards also corroborates our hypothesis. Both in this case and in the inclusion of praise messages, the usage of persuasive technology provided a less stressful play experience. At the same time, the coupling of these persuasive instruments with rules of play allowed players to achieve higher performance marks when compared with the absence of any of these mechanics.

5.4.3 Framing Results in our Goals

How do these results fit in our research plan? The contextual framing of this work as presented at the end of Chapter 4 states that the main goal is to steer players into a state of optimal experience while playing videogames. To attain that goal, we hypothesized that persuasive instruments can be employed in order to motivate / demotivate players during gameplay period and adjust their experience on-the-fly. Two particular strategies emerged based on a set of states we identified from existing literature:

- If the player is in a state of anxiety or arousal, then the game should try to relax him / her and, preferably, attempt to boost his / her performance accordingly.
- If the player is in a state of relaxation or boredom, then the game should try to entice him / her by promoting more stressful gameplay segments and, preferably, challenge the player's performance.

In this chapter we were able to show that certain types of persuasive instruments can equivalently be employed to not only give provide users with more relaxed playing periods, but also to improve their own performance during that time frame. These findings cover the first of the previously mentioned strategies to steer players towards an optimal experience state, allowing us to partially cover some of this research's goals, as depicted in Figure 5.12.

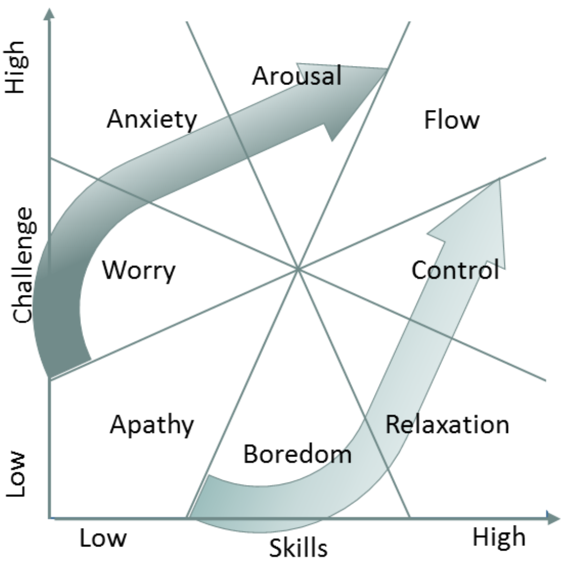


Figure 5.12 – Framing Chapter 5's results into the research's goals.

Succeeding the successful framing of the obtained results in this research's context, we can now address the research questions posed at the beginning of the chapter and answer them accordingly:

- In a videogame, can feedback / praise persuasive instruments steer a player to an optimal experience by effectively lowering their heart rate / increasing their performance or increasing their heart rate / decreasing their performance?
    - **Answer** – Yes. Results showed that praise messages can simultaneously lower the players' heart rate values and increase their performance level.
- In a videogame, can the inclusion of rewards steer a player to an optimal experience by effectively lowering their heart rate / increasing their performance or increasing their heart rate / decreasing their performance?

- **Answer** – Yes. The obtained results also confirmed that the usage of rewards in a videogame can decrease the players' average heart rate while at the same time increase their performance.

5.4.4 Study Limitations

Despite the favorable results, we have to still look at them adopting an independent and unbiased posture. While we encountered no hiccups or severe issues during the trials, the study itself does have its limitations. The most striking one is the lack of validation with a second game. While we put effort into the development process of Wrong Lane Chase and, particularly, to the persuasion instruments utilized in the different prototypes, at most it is still only representative of a single genre.

The validation of these findings with a second game becomes paramount to strengthen and solidify this research. Preferably, the complementary experimental period should:

- Contemplate a different genre.
- The game should feature different types of feedback / praise to the ones used in Wrong Lane Chase.
- If impossible to try out different persuasive methods, then it should strive to utilize a different type of reward policy and / or feedback.

Altering all these variables can incur in us obtaining a set of results which challenge the ones obtained in this chapter. However, we do still have a major objective to complete – showing that it is possible to steer players from states of boredom towards the optimal experience.

5.5 Summary

Persuasive technology is a powerful instrument in steering a user's opinions or behaviors, without recurring to coercion or deception, towards a predefined ideal. While a diversity of domains have capitalized on this technology, empirical data concerning its usage on the videogames domain is virtually non-existent. The third chapter of this document possessed the following intents:

- Empirically show that well-studied persuasive strategies have an influence on player experience.
- Provide evidence that designers can capitalize on determined persuasive strategies to provoke different physiological responses by a player.
- Provide evidence that designers can leverage on determined persuasive strategies to improve a player's performance while playing a videogame.

To address these, we developed an arcade racing game, Wrong Lane Chase, which comprises a set of persuasive mechanisms reminiscent of existing literature in the area: i) providing praise to the player; ii) providing rewards. We adopted an A/B testing methodology to assess whether these persuasive mechanisms had any effect on a subset of the players' physiological signals and on their performance during the gameplay period.

The experimental results corroborated the hypothesis we set: not only did the players' heartbeat rate decreased, on average, over the course of the gameplay but also their performance was significantly higher when they were confronted with the two persuasive strategies we devised. We complemented our analysis with a set of statistical tests which testified the significance of our findings. Contrary to our initial expectations, the persuasive strategy with the most noticeable effect was the praise feedback. We justified this via a change in player behavior within the game: instead of pursuing the main goal they were briefed to pursue, players devised their own set of alternative / secondary goals on-the-fly in order to pop those praise messages. Inadvertently, this behavior resulted in attaining a series of feats which rewarded them with more points, thus resulting in a significantly higher score. In sum, the persuasive strategies employed in the Wrong Lane Chase experiment allowed players to relax their physiological signals and improve their performance. These two findings are in complete harmony with the goals of this research.

6 Validating the Influence of Persuasive Technology

Last chapter's experimental period was successful in showing the impact of specific persuasive instruments on users during gameplay period. So far, players have demonstrated to be positively influenced as far as their performance is concerned: they were able to considerably improve when confronted with both praise messages and the inclusion of rewards. Simultaneously, we witnessed a tendency for a substantial decrease of the players' average heartbeat rate. The results obtained so far support the goals we established at the beginning of this research. However, their impact is conditioned by the experimental settings in which we conducted the trials.

To retrieve a solid and impactful contribution from this work we are required to expand the horizons of the experimental periods. We should not restrict ourselves to a single game with limited characteristics and opportunities to convey persuasive cues. A new experimental period in a different context is therefore pivotal to strengthen this research's findings.

6.1 Validation Approach

In the last chapter we briefly hinted at the limitations of our findings. Despite promising results, their generalization could not be carried out, primarily due to the nature of the experimental period itself. The impeding factors were:

- Testing with a single game.
- Analysing only the effects on a single game genre.
- Assessing only a couple of persuasive instrument types.

These three factors are an obvious hindrance to this research. In order to circumvent these limitations, we envisioned a second experimental period. Some disparity is necessary between the new trials and the ones reported in Chapter 5. However, the experimental design should be carefully planned to avoid incurring in some basic errors. For instance, creating total disruption between the old and new experiments could potentially inhibit the comparison between their respective results. As such, the next experimental period should:

- **Contemplate a new game** – like Wrong Lane Chase, this game should also have simple interaction mechanisms and avoid flashy graphics or sounds effects to minimize the influence factors other than the persuasive instruments at play. We do not consider the game's platform to be a deal breaker in this particular case.
- **Tackle a different genre** – the game should not belong to the arcade racing genre. It should reflect an existing genre and, preferably, also be reminiscent of current trends in gaming as far as popularity is concerned. The interaction mechanics, rules and scoring policy should also the properly accommodated to reflect these changes.
- **Balance the assessment of new persuasive instruments** – new persuasive instruments should be introduced to broaden the spectrum of strategies for which we analyze their impact. However, the experiment should also include variations of the persuasive instruments utilized in Wrong Lane Chase's trials in order to have a term of comparison between both trials.

Ensuring these experimental requirements are followed will potentiate a stronger discussion and results' validation. If the obtained results corroborate our hypothesis, then we may state that the foundations of this research are verified.

6.1.1 Research Questions

This new experimental period accommodates an update to the research questions presented in Chapter 5. They now reflect not only the validation of our previous results, but also the intent on finding persuasive instruments capable of producing an impact which is the opposite of the one encountered in those findings. In light of these research lines, the update research questions are:

- In a videogame, can feedback / praise persuasive instruments steer players towards a state of optimal experience by affecting their emotional and / or performance response?
- In a videogame, can the inclusion of rewards steer players to an optimal experience state by effectively affecting their emotional response and / or performance?
- Can similar persuasive instruments produce the same impact on player experience (regarding physiological state and performance) across different games and genres?

6.1.2 Methodology

We adopted the same methodology we had for Wrong Lane Chase's experimental period. The approach consisted in an intra-subject analysis where multiple prototypes sporting different persuasive instruments were assessed. The game's development process followed existing and well-known methodologies such as rapid prototyping (Klausner & Konchan, 1982) and the RITE methodology (Randolph G. Bias, 2005). Data retrieval and evaluation abided to the principles exposed in Microsoft Studios' TRUE methodology (Kim et al., 2008).

6.2 Experimental Game – Ctrl-Mole-Del

The game envisioned for the second experimental period is the fruit of a step of reflection regarding current trends in videogames capable of harnessing this research's goals and requirements. Since casual mobile games have gained a respectable momentum in the last decade, we opted to create a game reminiscent of this trend. The result was Ctrl-Mole-Del, a very simplistic and straightforward game which has Whack-a-Mole as its main inspiration. Whac-A-Mole (Racers, 1976) has proven to be a popular game throughout the years since its beginnings in arcade saloons and the later versions for mobile devices (Miyoshi, 2012). The goal of the game is to disrupt an invasion of moles in an open field. The gaming area is typically populated by various holes from which the moles emerge for a brief period of time. The players need to hit them using a plastic tool (arcade version) or clicking / tapping over the mole (in recent digital versions).

6.2.1 Design & Implementation

Ctrl-Mole-Del was developed for the Windows Mobile 6.0 platform. We followed the same software design principles we had applied during Wrong Lane Chase's development period. The game's architecture can be observed in Figure 6.1. The game was implemented using the .NET framework 3.0.

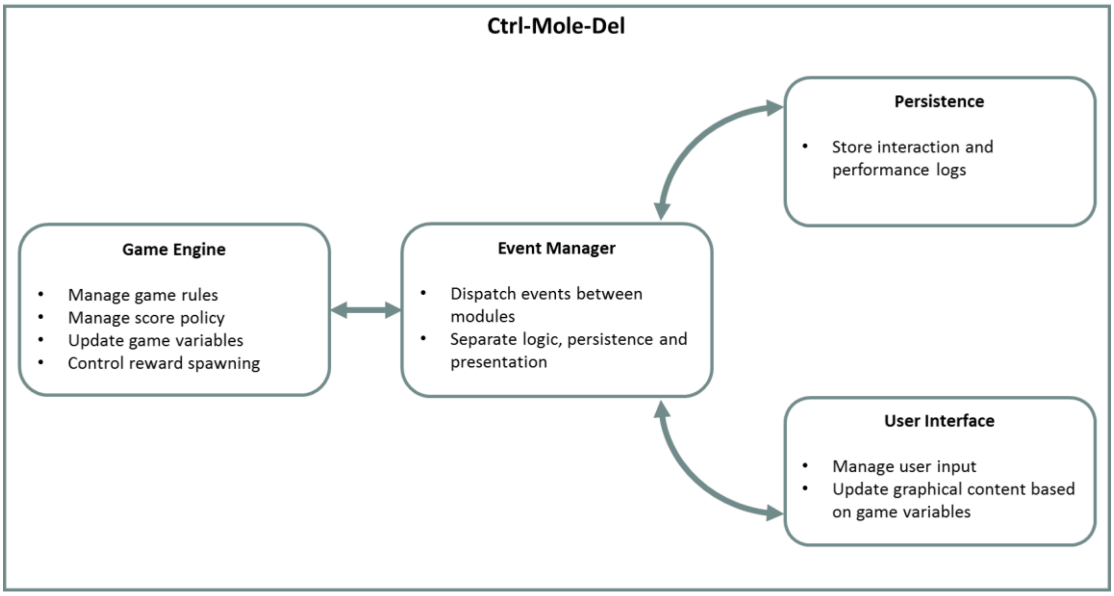


Figure 6.1 – Ctrl-Mole-Del's architecture.

Ctrl-Mole-Del sports four main components, each one of them designed with modularity in mind and aiming at a clear separation between the game's logic and its presentation:

- **Event Manager** – the event manager is a facilitator which sends and receives calls to / from all other components. The intent is to provide a complete separation between the game's logic, interaction components and game presentation to the player. For instance, when a mole appears somewhere in the gaming area, the game engine invokes a call from the event manager, which is then responsible to forward it to the user interface component in order to update the player's view of the game.
- **Persistence** – the persistence component is responsible for storing and loading data for the game's interaction logs. It constantly saves player performance statistics and interaction behavior for posterior analysis.
- **Game Engine** – the game engine is responsible for all of the game's logic, ranging from the generation of moles, to the update the player score, the generation of rewards or checking the game's rules. Any update stemming from the engine is communicated to the user interface component via the event manager and vice-versa.
- **User Interface** – this component manages not only what is presented to the player, but also any player input, communicating it via the event manager to the game engine and to the persistence component to add any new action to the interaction log.

6.2.2 Rules & Gameplay

Contrary to Wrong Lane Chase, Ctrl-Mole-Del is a single phase game. Here, players are rewarded for hitting active moles. On the other hand, they are penalized for missing to hit the moles or idling (i.e. not taking any action for several seconds). The intent of these design options is to keep the users interested in the game. Table 1 contains a summary of the scoring rules for the game.

Table 6.1 – Ctrl-Mole-Del's actions and respective score modifiers.

Action	**Score Modifier**
Successfully hit a target	2 points

Failing to hit a target	-1 point
Idling	-1 point per second after 3 seconds without taking any action

Table 6.2 presents the duration and spawning interval of several game entities. Ctrl-Mole-Del features not only the moles that players are required to target, but also some reward items which are only available in specific versions of the game (this will be fully disclosed in the next sections). Each of these entities have a spawning interval between them and also a time frame during which they are active and, thus, players can hit them.

The goal of the game is to score as many points as possible in a 240 second time window. When the player reaches that milestone, the game ends and displays the final score to the player. Since the game runs on the Windows Mobile 6.0 platform it features touch based interaction. To hit the moles, players need only to tap the targets on the screen.

Table 6.2 – Ctrl-Mole-Del's key event timings and duration.

Event	**Timing / Duration**
Mole Spawning	Random interval (1.5 to 3 seconds) between each mole
Mole Active	0.8 seconds (1.3 seconds with reward active) duration
Reward Spawning	Random interval (20 to 25 seconds) between each reward
Reward Active	1.6 seconds duration

6.2.3 Interface

While designing Ctrl-Mole-Del we decided to follow the original version of the game as closely as possible. Our first batch of low-fidelity prototypes reflects this design option. Figure 6.2 presents both early and late prototypes for the mobile device version of Ctrl-Mole-Del. As observed, the interface closely mimics the original Whack-a-Mole arcade game, providing a gaming area filled with holes from which the moles emerge.

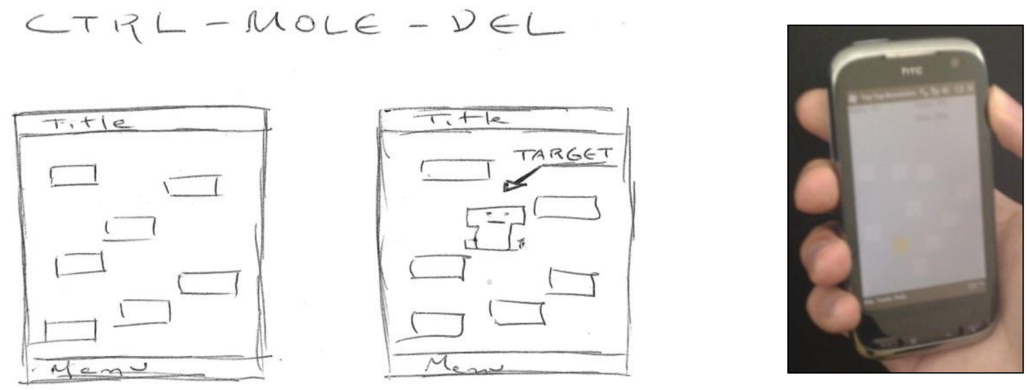


Figure 6.2 – Ctrl-Mole-Del initial low-fidelity prototypes (left) and hi-fi prototype (right).

The game's interface includes a title area (as displayed in the top area of the prototype and a menu area (positioned at the lowermost section of the interface). This panel displays valuable information to the player, such as the player's score (available in all prototypes). The menu area contains the game options along with the possibility to initiate a new game and exit the current one.

As far as the gaming area is concerned, empty mole holes are represented in white and an active mole is represented by a yellow square. When the player successfully hits a mole, the square's color is changed to green for a brief period (precisely 0.3 seconds). If the player hits a hole without an active mole, it is momentarily tinted in red (again, for 0.3 seconds). If a mole spawns at that location during this short period, then it replaces the visual feedback which indicated the erroneous action.

6.2.4 Persuasive Strategies & Respective Prototypes

Similarly to our design and development process for Wrong Lane Chase, we developed a set of Ctrl-Mole-Del prototypes to accommodate different persuasive instruments. As previously defended, here we want to not only provide continuity to the findings obtained in the last experimental period but also venture in exploring new persuasive strategies. Again, we created a prototype to act as the baseline to which all others would be compared. This prototype was deprived of any persuasive instruments. The only information conveyed to players was their score which we assume, when observed in an isolated way, to have no influence in their experience since there is no baseline for comparison.

The new prototypes had to address two types of persuasive strategies: i) one strategy related to the inclusion of feedback messages / cues; ii) the other pertaining the usage of rewards during gameplay period. In the end we envisioned a total of 6 prototypes (including one deprived of persuasive instruments) for this experimental period. We will now address the design rationale and process in detail for each one of them.

6.2.4.1 Adding Feedback

Ctrl-Mole-Del was designed for mobile devices, a design option which led us to take extra care as far the game's controls and feedback panels' position in the user interface is concerned. For instance, cluttering the gameplay area too much may be detrimental for the player and insert a bias in the experimental results (Pombinho, Carmo, & Afonso, 2009). Ctrl-Mole-Del was originally designed to account for these limitations. The upper panel, where the game's title and player score are displayed, was defined with the appropriate size to also contemplate additional feedback.

The information passible of being displayed to the users is limited by the existence of panel conveying score data. While at first glance there is not much room to include another interesting metric, we can capitalize on the rule-set in an attempt to identify possible information which may be of use as feedback. A couple of game characteristics immediately emerge as candidates:

- The first pertains to the way the game unfolds. Players have a limited time frame to achieve the maximum number of points possible. This information is not conveyed to the player in the basic prototype. As such, the first feedback alternative contemplates the usage of an informative panel which displays the time available to complete the game. This timer starts at the 240 second mark and steadily decreases until the player runs out of time.
- While the score metric does not provide any valuable information without a term of comparison, the game's mechanics allow for players to be informed about another performance metric which is independent of any referential. Since the players' goal is to hit active moles, we can calculate their accuracy from their actions. Hence, another prototype contemplates an alternative panel which displays the player's accuracy.

These variants were designated the timer display and accuracy display prototypes, respectively. The envisioned low-fidelity mock-ups and implemented interface can be observed in Figure 6.3. We utilized the feedback panel's right side to display the players' accuracy or the time remaining to finish the game, with the score metric present in the left side of the panel. The reasoning behind the inclusion of the accuracy feedback stems from existing and commercially available games. For instance, games like "Call of Duty: Modern Warfare" or "Grand Theft Auto 4" provide players with performance data such as number of shots fired, total accuracy or how much time the player has passed riding a determined vehicle. In Ctrl-Mole-Del's case we decided to inform the player about his / her accuracy (number of correctly hit moles over the total number of hit attempts). Unlike Wrong Lane Chase's praise messages, this information is always present on the screen for the player to visualize.

The time indicator, on the other hand, takes inspiration from games such as "Final Fight" or "Sega Rally", in which the player had to perform certain tasks within a limited time frame. We expect that the existence of such a feature may have a double sided effect: on the one hand it may influence users to perform better to accomplish the task in time; on the other hand it may induce stress and anxiety and lead to a loss of performance.

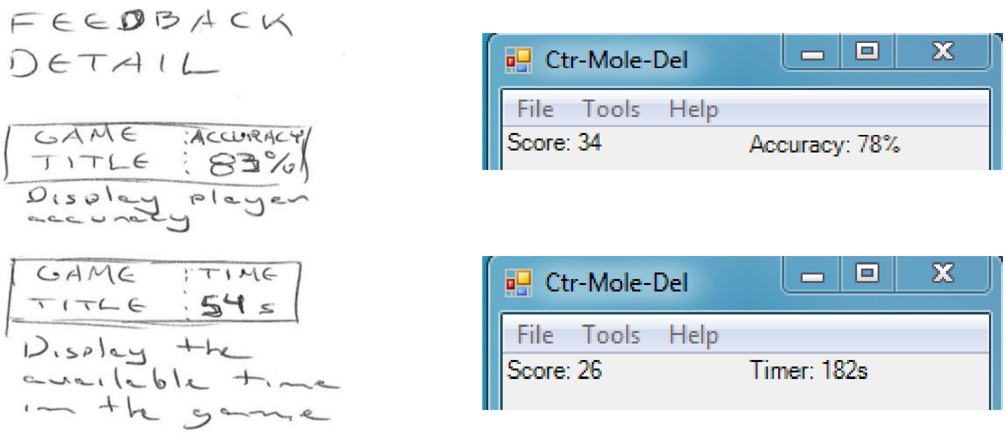


Figure 6.3 – Ctrl-Mole-Del's feedback panels low-fi prototypes (left) and hi-fi prototypes (right).

A potential point of criticism to these design choices concerns the lack of a praise variant to which its Wrong Lane Chase's counterpart can be compared to. We purposely left that variant out of this experiment. The rationale behind that decision is supported via:

- **Inadequateness for mobile screens** – the usage of a toast message similar to the one utilized in Wrong Lane Chase's prototype would not be entirely welcome for Ctrl-Mole-Del. The message would most likely spawn on top of the gaming area which, unlike in the previous game, is severely limited as far as its size is concerned. The available space on the uppermost feedback panel would also not be able to accommodate the type of praise messages that could be conveyed to the player.
- **Broadening the spectrum of analysis** – channeling our attention towards a single type of feedback would end up in providing a narrow and biased perspective (and consequent analysis) of this persuasive instrument in videogames. While praise is, indeed, present in a variety of products, performance feedback is an historical inclusion which rightfully deserves an analysis capable of assessing whether it severely affects player experience or not according to our criteria.

In the end, we want to utilize these feedback variants to check if they can produce an effect which is the opposite of the one found during Wrong Lane Chase's trial.

6.2.4.2 Inclusion of Rewards

If we consider the Ctrl-Mole-Del's genre and gameplay style, the spectrum of potential rewards is rapidly reduced to a just a handful of types. Nevertheless, there are two metrics which are present throughout the game and are related to how the player fares in it: the player's accuracy and the time he / she has to finish the game. Based on this fact, we envisioned two types of rewards:

- **Temporary Accuracy Boost** – following a similar approach to the reward included in Wrong Lane Chase, the accuracy boost temporarily increases the time frame that players have to hit their targets. Ultimately, we expect players to be able to successfully hit more targets, leading to an overall increase of their accuracy level.
- **Time Extension** – Ctrl-Mole-Del's goal comprises the acquisition of the maximum number of points in a limited time period. The time extension mechanic, upon

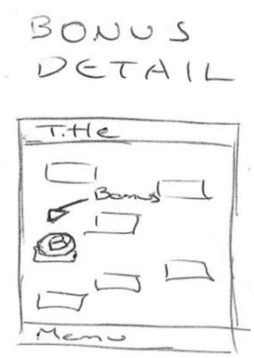
being picked up by the player, adds time to his / her chronometer. This potentially increases the maximum score attained by the players at the end of the play-through.

The rationale behind the design of these two rewards mechanics is also inspired by popular and commercially successful videogames. Capitalizing on design approaches present in “Max Payne” (R. Entertainment, 2001) or “Red Dead Redemption” (R. Games, 2010), the accuracy booster increases, for 10 seconds, the time frame users have to hit their targets from 0.8 seconds to 1.3 seconds (as mentioned in Table 6.2). During the design process and the rapid evaluation process we were confronted with a design issue in this particular reward. An unforeseen detail caused not only the hit window to be extended, but also the spawning interval between moles. This would potentially lead to fewer moles being created during the game’s 240 seconds gameplay period and ultimately to players attaining lower scores. Instead of scrapping the idea and creating a prototype with no secondary effects on the mole spawning intervals, we decided to intentionally create include a prototype addressing each variation of this reward. As such, two accuracy booster prototypes were created:

- **Accuracy Booster I (affects spawning interval)** – activating the reward (achieved by tapping it) increases the time frame that players have to hit moles from 0.8 seconds (s) to 1.3s for a period of 10s. Simultaneously, it also increases the time interval between each mole spawn, from the 1.5s to 3s range to the 3s to 4.5s range.
- **Accuracy Booster II (no secondary effects)** – in this prototype, activating the reward only increases the hit-window duration from 0.8s to 1.3s. This effect lasts for 10 seconds. No other side effects occur in this prototype.

The second reinforcement takes inspiration from arcade games in which players’ actions were limited by time. “Outrun” (Sega, 1986) and “Final Fight” (Capcom, 1989) are quintessential examples. In the particular case of Ctrl-Mole-Del, the reward spawns at random intervals separated by 20 to 25 seconds. Upon picking the reward, the player obtains 5 more seconds in his / her chronometer to play the game. Once a reward spawns, the player has 1.6 seconds to successfully hit it before disappearing.

Figure 6.4 presents the low and high-fidelity prototypes for the reward mechanics. While the low-fidelity prototype showcases a special symbol containing the 'B' letter to differentiate the target instrument from the moles, in the high-fidelity prototype we opted for a color representation. The reward items are represented by a turquoise square. If the player correctly hits them, the square is highlighted in green for a brief period. Note that, for the Time Extension mechanic, the interface displays the time available to finish the game. Both prototypes addressing the Accuracy Booster instrument are devoid of this type of feedback.



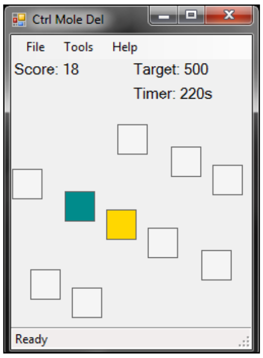


Figure 6.4 – Ctrl-Mole-Del's midgame incentive mechanisms low-fi prototype (left) and hi-fi prototype (right).

How do these two prototypes and respective persuasive instruments fare against Wrong Lane Chase's offering this research's general goals? The accuracy booster mechanic exists to serve as a point of comparison with Wrong Lane Chase's traffic slow down reward. Both are voluntarily activated by the player and temporarily slow down the game's rhythm with the intent of decreasing player errors. The second mechanic introduces different design elements. Although the time concept is still a prominent factor in this instrument, the core game rhythm is not altered. Despite our belief that the time extension mechanic will surely lead to better performances, we are still keen on an analyzing its impact on the players' physiological state.

In sum, if we obtain similar results to the ones stemming from Wrong Lane Chase, then we are able to state that persuasive instruments are capable of steering a player to an optimal experience state, provided they are anxious or in a similar condition. If we retrieve evidence which shows the opposite, then we cover optimal state transitions originating from states of boredom and, therefore, successfully meet the goals of this research.

6.2.4.3 MSI Model Mapping

We concluded this design exercise in the same fashion as we had already done with Wrong Lane Chase in the previous chapter: mapping the persuasive strategies envisioned for Ctrl-Mole-Del into our MSI persuasion model. The outcome can be observed in Table 6.3.

Table 6.3 – Ctrl-Mole-Del's persuasive strategies' mapping on MSI model.

Method	Support	Instruments
▪ Discovery ○ Sandboxing	▪ Personalization ○ Tunneling ○ Reduction	▪ Feedback ○ Informative ▪ Perks ○ In-Game Rewards

The mapping here presented is equivalent to Wrong Lane Chase's, a choice that may raise some arguments as of whether this second experimental period is capable of validating the results obtained thus far. Note that the MSI persuasion model's concepts merely aggregate families of methods, support mechanisms and instruments, allowing for a broad variation among these. In the particular case of Ctrl-Mole-Del, the method is still based on sandboxing as players need to explore the game's concepts to experience and decide for themselves what suits their play style the best. The game was also designed to keep players well focused on their main goal and inhibit them from pursuing other objectives. Tunneling and reduction support approaches guarantee that focus. Unlike Wrong Lane Chase, the type of feedback present in Ctrl-Mole-Del does not possess a "praise nature" but is rather informative in its essence, showing players exact metrics about their performance or other game related variables. The in-game rewards employed provide some diversity over Wrong Lane Chase's while at the same time allowing for a proper validation of the gathered results. On the one hand we have two rewards which appear similar in their nature, but have a minor twist in the way they are capable of affecting the game's pace. On the other hand we added a reward which provides the player with more play time, diverging from the one experimented with in the previous chapter.

6.3 Experiment

Following the trail of the previous experiment, our goal aims at validating the findings encountered until this point of the research. To do so, we developed a new game – Ctrl-Mole-Del – belonging to a different genre from Wrong Lane Chase's and implemented five prototypes, each addressing a persuasive instrument. Besides the basic version of the game, two prototypes address feedback based persuasion, while the other couple concerns the usage of rewards as a persuasive instrument. Our research goals remain generally unchanged, having a few tweaks to reflect the assessment of persuasive instrument impact using games across different genres.

This section contemplated the hypothesis we formulated, described the experimental equipment, participants, assessed metrics and variables, detailed procedure and the retrieved results.

6.3.1 Hypothesis

The hypotheses for this experimental period were updated to reflect the broadened horizons we set to achieve:

- **H3** – persuasive technology in videogames can be used to effectively improve or deteriorate the players' performance during the play process, regardless of game genre.
- **H4** – persuasive technology in videogames can be used to effectively increase or decrease the values of a subset of the players' physiological signals during the play activity, regardless of game genre.

6.3.2 Tools & Equipment

Subjects were handed a Windows Mobile 6.0 phone (HTC HD2), with the five different Ctrl-Mole-Del prototypes installed: i) the basic version of the game; ii) the two versions pertaining to feedback persuasive approaches; iii) two prototypes concerning the addition of rewards. Participants were also handed an AliveTec Heart Monitor sensor, previously prepared with electro-gel for better signal acquisition. Sensors were placed two inches apart over the heart's location on the subject's chest.

6.3.3 Participants

30 individuals (23 male, 7 female; M = 23.3; SD = 5.2) took part in this experimental period. No user had participated in the Wrong Lane Chase trials. Similarly to the previous experiment, the vast majority of the subjects were tech-savvy (93%) and played videogames on a regular basis, allowing us to ignore tech-novelty bias.

A short briefing describing the test's procedure and the game's mechanics was given to elucidate participants on the tasks they would be carrying out. Details concerning the effects of each prototype and the goals of the experimental period were omitted until the end of the experiment.

6.3.4 Metrics

For Ctrl-Mole-Del's trial period, again we retrieved a subset of the subjects' physiological signals, namely:

- **Average Heartbeat Rate (HBR)** – given the promising results from the previous trial we abided to the participants' average HBR.
- **Heart Rate Variability (HRV)** – despite the absence of any significant outcome from this metric, we kept retrieving it for the sake of coherency and in case any interesting finding emerges.

Ctrl-Mole-Del's trial comprised two performance metrics. The player's score presents a general perception of how well the player performed during that segment. By complementing the former with the player's accuracy, we can further explore the play-style, by identifying those who favor a more cautious strategy:

- **Score** – for this experimental period, we normalized the score to the game's duration (240 seconds). This decision is justified by the presence of a reward which increases the play time each time the player picks it. Subjects would potentially present significantly higher scores with that reward in play. We can, however, attempt to distinguish between a score increase which is the result of adding more time to the chronometer, or one which is the result from a motivational boost created by the presence of a persuasive mechanic. The normalization process addresses this effort.

- **Accuracy** – in Ctrl-Mole-Del's context, the accuracy stands for the number of correctly hit targets over the total number of target hitting attempts the player performed. This is a metric which can also complement the normalized score in an attempt to identify performance fluctuations originating from persuasive instruments.

6.3.5 Variables

We narrowed the assessed variables to a selected few, reminiscent of Wrong Lane Chase's experimental period. Again, we divided them considering those upon which we have control and those which will be subject to impactful changes during the experiment.

6.3.5.1 Independent Variables

The following is the independent variable we accounted for in these trials:

- **Persuasive Elements** – participants played five different prototypes of Ctrl-Mole-Del. We controlled the persuasive elements in action for each prototype. One of them had no persuasive mechanics in play; two of them employed a persuasive approach based on feedback provision; the remaining pair addressed a strategy based on the inclusion of rewards.

6.3.5.2 Dependent Variables

The dependent variables we considered for this trial are as follows:

- **Physiological Metrics** – we retrieved the players' average HBR and HRV for the validation of our previous results.
- **Performance Metrics** – we assessed the players' score (normalized to a fixed 240 seconds gameplay period) and their accuracy.

6.3.6 Procedure

The experiment involved carrying out a total of six tasks, comprehended between a briefing and debriefing period. Before starting the trial, we assisted participants in positioning the AliveTec Heart Monitor's electrode's correctly to obtain an acceptable signal quality, following the same directives used in Wrong Lane Chase's trial. The experiment took place in a laboratory at the University of Lisbon – a natural lit room at ambient temperature. Participants were asked to set in a chair (which they could configure to best suit their comfort) while playing the game. Each trial lasted for roughly 70 minutes.

We gave subjects a 60 second time frame to get acquainted with the basic version of the game before initiating the trial. After this period and briefing the game's rules, they initiated the experiment itself. Task order was pseudo-randomized to ensure balance between all tasks and avoid task bias (Cozby, 2008). We inserted a five minutes resting period for physiological signals to return to their baseline values (Mandryk & Inkpen, 2004). All performed tasks' details were as follows:

- **Pre-Task** – players were informed they were participating on an experiment assessing player experience in videogames. No additional details regarding each particular task were disclosed. They were briefed about Ctrl-Mole-Del's rules and were allowed a 60 second trial to get acquainted with the game's controls and the smart-phone's responsiveness and form factor.
- **Task 1** – participants were required to interact with the basic version of Ctrl-Mole-Del, deprived of any persuasive instruments. Players were asked to attain the highest score possible in a 240 time frame. This task was selected as the baseline in this trial.
- **Task 2** – users were requested to interact with a Ctrl-Mole-Del prototype which included the accuracy display panel on the top right corner.

- **Task 3** – participants interacted with yet another form of feedback based persuasion. In this case, the prototype included the chronometer informing the time remaining to finish the game.
- **Task 4** – here we shifted the persuasion paradigm. Players interacted with the first prototype which included the accuracy boost mechanic. As a reminder, this is the version in which both the hit-window and the spawn interval timer were extended.
- **Task 5** – subjects were confronted with a variant of the reward inclusion approach. Here, the reward consisted in providing 7 additional seconds to the chronometer.
- **Task 6** – in this task, participants interacted with the second version of the accuracy booster mechanic. We remind that, in this one, only the moles' hit-window was extended.
- **Post-Task** – after finishing all trials we asked players for anecdotal opinions on each task, attempting to obtain some subjective, yet potentially enticing information about their own perceived experiences. After finishing this informal interview period we debriefed all players, clarifying what was being assessed in each task and the goals of the experiment.

At the end of the experiment we retrieved subjective remarks about the players' experience and debriefed them by revealing the details of each task. No reward was provided for their participation.

6.3.7 Results

The adopted analysis procedure for this experiment followed the same steps utilized during Wrong Lane Chase's trial. The analysis is divided in two segments: first we provide a macroscopic view on the general results; then we proceed towards a detailed analysis where we seek statistical significance in the retrieved data.

6.3.7.1 Descriptive Analysis

Ctrl-Mole-Del's trial results can be observed in Table 6.4, Figure 6.5, Figure 6.6 and Figure 6.7. A first look at these tables and figures pinpoint that:

- Feedback based persuasion had either no effect or marginally increased the players' average heart rate.
- Feedback based persuasion was pejorative as far as the players' performance figures are concerned.
- The inclusion of rewards appears to produce a relaxation effect, leading to a decrease of the players' average heart rate.
- The inclusion of rewards had polarizing effects when addressing the player's performance. While the addition of time noticeably increased the player's score and accuracy, the two versions of the accuracy boosting instrument had opposite effects.

Summarizing this initial overview, some of the results confirm Wrong Lane Chase's findings. Other results, namely the effects of feedback based persuasive instruments, are aligned with the goals established in this chapter concerning the transition towards an optimal experience state stemming from a relaxation condition.

Table 6.4 – Descriptive statistics for Ctrl-Mole-Del trials.

		N	Mean	Std. Deviation	Minimum	Maximum
Average HBR	Task 1	30	83.96	7.60	73.30	97.30
	Task 2	30	83.82	9.65	61.40	97.50
	Task 3	30	86.15	9.00	69.90	100.04
	Task 4	30	78.47	6.43	67.18	89.72
	Task 5	30	77.61	7.52	65.53	90.22
	Task 6	30	76.60	6.32	65.30	87.84
Score	Task 1	30	301.70	28.79	249.00	363.00
	Task 2	30	257.83	34.01	209.00	338.00
	Task 3	30	259.80	22.44	204.00	339.00
	Task 4	30	250.86	30.33	195.00	313.00

	Task 5	30	329.98	20.09	292.00	366.00
	Task 6	30	342.86	30.33	305.00	413.00
Accuracy	Task 1	30	86.92	3.16	82.00	93.00
	Task 2	30	80.90	3.15	75.00	87.00
	Task 3	30	81.56	3.81	72.00	88.00
	Task 4	30	81.92	2.45	77.81	83.32
	Task 5	30	88.61	4.23	82.64	95.53
	Task 6	30	91.91	2.45	87.81	97.31

Starting with the players' average HBR, the baseline values (Task 1) were established with an average of 83.96 bpm and standard deviation of 7.60. Feedback based approaches produced slightly surprising results. On the one hand, displaying the player's accuracy (Task 2) led to a residual decrease of the players' average heart rate (M = 83.82; SD = 9.65). On the other hand, displaying the chronometer (Task 3) had a more noticeable effect in increasing the players' HBR (M = 86.15; SD = 9.00). The provision of rewards appears to confirm the previous experiment's findings. Not only did the accuracy boosting mechanic with secondary effects (Task 4) reduce the players' heart rate (M = 78.47; SD = 6.43), but also its flawless counterpart (Task 6: M = 76.60; SD = 6.32) and the time extension instrument (Task 5: M = 77.61; SD = 7.52) as well.

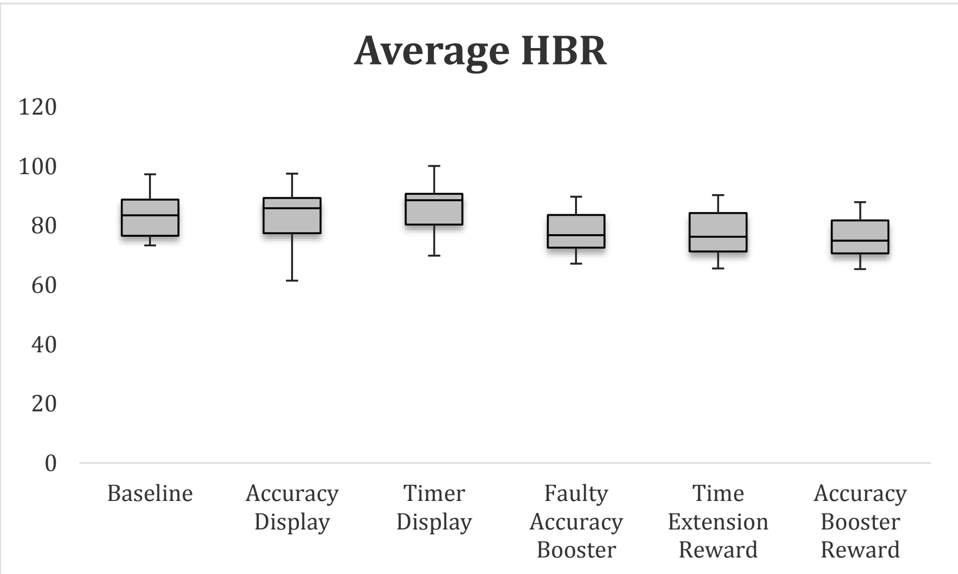


Figure 6.5 – Ctrl-Mole-Del average HBR boxplot.

Score metric results were somewhat polarizing. Feedback based persuasive instruments present a tendency for lower scores when compared to the absence of any persuasive cue in Task 1 (M = 301.70; SD = 28.79). Displaying both the accuracy in Task 2 (M = 257.83; SD = 34.01) and the remaining time to play in Task 3 (M = 259.80; SD = 22.44) had a striking negative impact on the players' performance. The usage of rewards introduced curious and unexpected discrepancies.

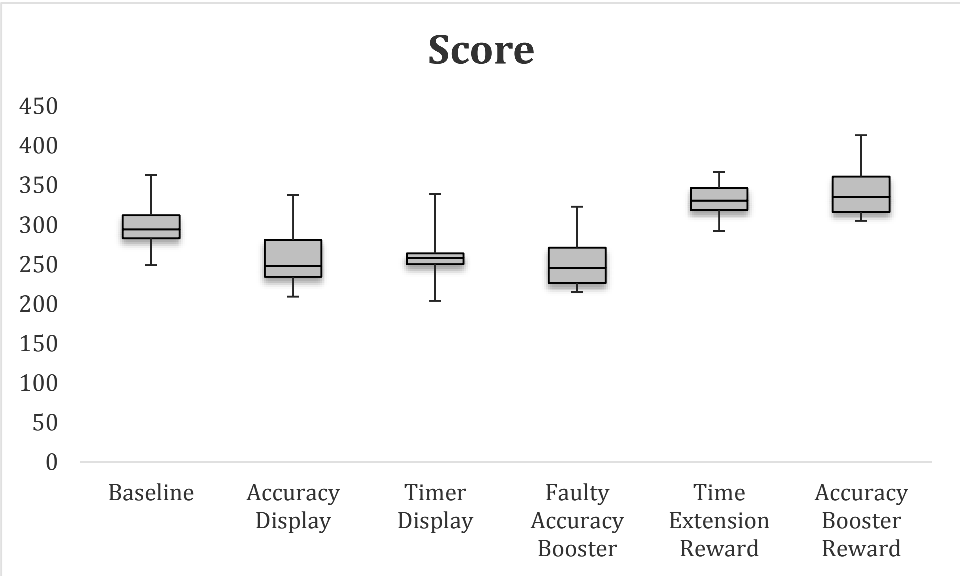


Figure 6.6 – Ctrl-Mole-Del player score boxplot.

The accuracy boosting instrument featured in Task 4 (influencing mole spawn rate) induced a noticeable drop of the players' score (M = 252.86; SD = 29.82), a result which we had not predicted. Oppositely, the accuracy boost mechanic included in Task 6 (no influence on mole spawn rate) resulted in an emphasized score increase (M = 342.86; SD = 30.33). The usage of the time extension mechanic in Task 5 also resulted in a prominent score increase, even when normalized to the 240 seconds playtime (M = 329.98; SD = 19.75).

All these performance results were confirmed in the analysis of the accuracy metric, in which players presented an average of 86.92% hit ratio in Task 1 (SD = 3.16). Again, there was a noticeable decrease of the accuracy metric for both Task 2 (M = 80.90; SD = 3.10) and Task 3 (M = 81.56; SD = 3.74). The results gathered for the persuasive instruments which contemplated rewards also confirm the findings unveiled for the score metric. The accuracy boosting mechanic present in Task 4 had the contrary effect to what we had designed it for (M = 83.92; SD = 2.41). Its variant included in Task 6, on the contrary, induced players to noticeably increase their accuracy rate (M = 91.91; SD = 2.45), a trend also witnessed with the time extension reward in Task 5 (M = 88.61; SD = 4.16).

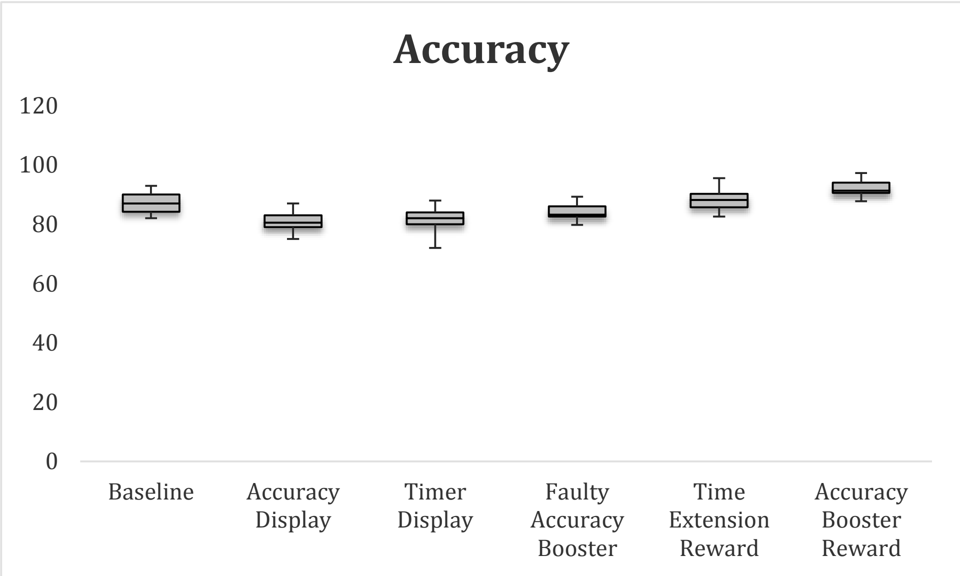


Figure 6.7 – Ctrl-Mole-Del player accuracy boxplot.

Unlike the previous experimental period, Ctrl-Mole-Del's trials showcased some unclear trends. Nevertheless, we have partial confirmation that rewards can, indeed, the used to steer players towards the optimal experience state, given they are in an anxiety posture. The feedback instruments used show the opposite effect that praise had in Wrong Lane Chase. However, this points towards the possibility of using this type of persuasive strategy to steer players towards the optimal experience state when they are bored or in a relaxed status. The next step of the analysis process involves scrutinizing these results in detail and addresses their statistical significance.

6.3.7.2 Statistical Analysis

We began by determining whether our data set respected the conditions to perform analysis of variance testing (commonly referred to as ANOVA). Typically, two tests are performed: i) a normality test; ii) equal variances test (homoscedasticity). Failing to pass either test typically guides the researcher to choose another non-parametric test. Table

6.5 presents the results for a normality test (Shapiro-Wilk) for the Ctrl-Mole-Del data set. Highlighted rows indicate the tasks for which a normal distribution was not found ($p < 0.05$), thus inhibiting us from performing an ANOVA test.

Table 6.5 – Shapiro-Wilk normality test results for Ctrl-Mole-Del trials.

		Shapiro-Wilk		
		Statistic	**df**	**Sig.**
Average HBR	Task 1	0.92	30	0.027
	Task 2	0.92	30	0.031
	Task 3	0.94	30	0.089
	Task 4	0.94	30	0.109
	Task 5	0.92	30	0.034
	Task 6	0.94	30	0.109
Score	Task 1	0.91	30	0.017
	Task 2	0.91	30	0.020
	Task 3	0.86	30	0.001
	Task 4	0.88	30	0.004
	Task 5	0.97	30	0.605
	Task 6	0.88	30	0.004
Accuracy	Task 1	0.94	30	0.135
	Task 2	0.97	30	0.581
	Task 3	0.93	30	0.069
	Task 4	0.95	30	0.192
	Task 5	0.92	30	0.026
	Task 6	0.95	30	0.191

Since our sample failed to pass the Shapiro-Wilk normality test, we opted to run a non-parametric test for related samples known as the Friedman test. Table 7.7 presents the test's results for Ctrl-Mole-Del trials. The results show our data presents statistically significant differences between tasks for all metrics, emphasized in the table as light gray shading.

Table 6.6 – Friedman test results for Ctrl-Mole-Del trials.

	Average HBR	Score	Accuracy
N	30	30	30
Chi-Square	44.824	111.336	112.502
df	5	5	5
Asymp. Sig.	.000	.000	.000

After having identified statistically significant differences in our data, we proceeded to determining which pairs of tasks yielded those discrepancies. Justified by the characteristics of our data set (intra-subject non parametric tests) we opted to carry out a set of Wilcoxon Signed Rank tests. Table 6.7 displays these results (statistically significant differences highlighted in light gray). To avoid family wise error rates we employed a conservative Bonferroni correction. This effectively changes the value at which results are statistically significant to 0.0125 in the following tests.

Table 6.7 – Wilcoxon Signed Rank test results for Ctrl-Mole-Del trials.

		HBR		Score		Accuracy	
		Z	**Asymp. Sig.**	**Z**	**Asymp. Sig.**	**Z**	**Asymp.**
Task 1	Task 2	-0.278	0.781	-4.557	0.000	-4.786	0.000
	Task 3	-1.368	0.171	-4.454	0.000	-4.354	0.000
	Task 4	-3.836	0.000	-4.124	0.000	-4.187	0.000
	Task 5	-3.815	0.000	-3.815	0.000	-1.944	0.052
	Task 6	-4.309	0.000	-3.816	0.000	-4.475	0.000
Task 2	Task 3	-3.838	0.000	-0.576	0.565	-1.086	0.278
	Task 4	-2.993	0.003	-0.267	0.789	-3.861	0.000
	Task 5	-2.993	0.003	-4.782	0.000	-4.741	0.000
	Task 6	-3.898	0.000	-4.659	0.000	-4.783	0.000
Task 3	Task 4	-3.815	0.000	-0.843	0.399	-3.254	0.001
	Task 5	-3.836	0.000	-4.782	0.000	-4.679	0.000
	Task 6	-4.206	0.000	-4.783	0.000	-4.783	0.000
Task 4	Task 5	-0.802	0.422	-4.782	0.000	-4.270	0.000
	Task 6	-5.477	0.000	-5.477	0.000	-4.791	0.000
Task 5	Task 6	-1.563	0.118	-2.273	0.023	-3.735	0.000

Concerning the players' average HBR and having Task 1 as the baseline task, no statistically significant differences were encountered when comparing it to either Task 2 ($Z = -0.278$; $P = 0.781$) or Task 3 ($Z = -1.368$; $p = 0.171$). Contrarily, the existence of rewards was paramount to relax the participants during gameplay period. Task 4 ($Z = -3.836$; $p < 0.01$), Task 5 ($Z = -3.815$; $p < 0.01$) and Task 6 ($Z = -4.309$; $p < 0.01$) displayed statistically significant differences when compared to Task 1.

Statistical results or the score metric confirmed the phenomena already mentioned during the descriptive analysis. Persuasive strategies based on feedback presentation performed poorly when comparing to Task 1: player score for Task 2 ($Z = -4.557$; $p < 0.01$) and for Task 3 ($Z = -4.454$; $p < 0.01$) was significantly lower. The results for persuasion tactics concerning the presence of rewards further confirmed the completely opposite performance impact that our three instruments had. On the one hand, the existence of a reward which extended the gameplay period (Task 5) allowed the players to perform significantly better ($Z = -3.815$; $p < 0.01$). The provision of a mechanic which was designed with the intent of increasing player accuracy (Task 4 and Task 6), however, resulted in diverging tendencies. On the one hand, users displayed a significantly lower score performance ($Z = -4.124$; $p < 0.01$) in Task 4, as the reward also decreased the number of moles spawning during the activation period. On the other hand, the revised version of the same mechanic (Task 6) suggests that players can benefit from this type of reward ($Z = -3.816$; $p < 0.01$). The results for Task 4 appear as strikingly unexpected since subjects presented a lower average HBR during the trial. Still, following the trail of the Wrong Lane Chase findings and what we had witnessed here with both Task 5 and Task 6, we believed players can simultaneously be relaxed and led to achieve improved performance figures given they are confronted with reward mechanisms. Additionally, we showed that rewards which have a similar nature (temporary obstacle slow-down in Wrong Lane Chase and temporary hit-window dilation in Ctrl-Mole-Del) have quite similar effects as far as the steering of the player towards a state of optimal experience is concerned.

The results for the accuracy metric partially mirror the ones observed for the players' score. Accuracy significantly decreased in both prototypes used to represent feedback based persuasion. While the decrease is slightly higher for Task 2 ($Z = -4.786$; $p < 0.01$) than for Task 3 ($Z = -4.354$; $p < 0.01$), we found no statistically significant differences between the two. For the strategies involving reinforcements we found no statistical significance between Task 1 and Task 5 ($Z = -1.944$; $p = 0.052$). The inexistence of statistical significance in this case is explained the by game's rule-set: the game did not immediately penalize idling, allowing players to fail a few targets before incurring in score penalties. This favors the score metric (since it can momentarily remain unchanged), in detriment of the players' accuracy (which is immediately updated for failing to hit targets). Task 4's results reflected the abrupt decrease in player score, with users displaying significantly lower accuracy levels ($Z = -4.187$; $p < 0.01$). In Task 6, players were able to significantly increase their accuracy rate, displaying the highest values across all tasks ($Z = -4.475$; $p < 0.01$).

6.4 Discussion

In light of the outcome of this experimental period we will steer our discussion towards a path which allows us to tackle the most prominent results obtained. First and foremost we will discuss the results obtained in this experiment as an isolated act, commenting on the findings and potential contributions for this research, most notably regarding how different reward and feedback based persuasive strategies are capable of impacting on a player's flow. The second stage involves an analysis which bridges the previous chapter's outcome with the results here presented. In particular, we are interested in observing how these results are capable of validating and / or complementing Wrong Lane Chase's and check whether or not they can support our hypothesis. The last discussion point addresses two particular trials in which we assessed the impact of a faulty reward mechanic against another version of it which had no drawback to the players. This dedicated section is driven by the fact that the results have a polarizing nature in regards to how they influence the players' emotional state and their performance figures.

6.4.1 Persuading Through Feedback

Results for the Ctrl-Mole-Del experiment showed that players increased their average heartbeat rate values over the course of the interaction period when confronted with these elements. Player performance was also significantly penalized with the presence of the feedback mechanisms, both concerning player score and their accuracy rate. Although different in nature, these results are in confrontation with Wrong Lane Chase's, where praise messages produced the opposite effect: players reduced their average heart rate and increased their performance values. A few reasons can be pinpointed for the results obtained in this chapter's experience. Let us analyze each case in isolation.

6.4.1.1 Omnipresent Performance Informative Feedback

Informative feedback in videogames is a relatively common sight. Games such as "Call of Duty" (I. Ward, 2007) (and similar competitive multiplayer first-person-shooters) opt to display performance data at the end of each match or whenever the player's character is killed (there is a respawn period during which this information is conveyed). One other alternative allows players to access this type of information whenever they desire via in-game menus, such as in "Grand Theft Auto IV" (R. Games, 2008).

In the context of this experimental period we adopted one of these approaches with some amendments. Ctrl-Mole-Del's prototype based on displaying performance feedback (Task 2) conveys it by displaying the player's current accuracy in a dedicated panel in the topmost area of the device's screen. For comparison's sake, Wrong Lane Chase's approach is reminiscent of yet another strategy which is commonly encountered in rhythm games such as "Guitar Hero" (Harmonix, 2005), in which the player is praised when achieving determined feats.

Results for each game were polarizing. On the one hand the approach present in Ctrl-Mole-Del resulted in more stressful gameplay periods, with the players showcasing a tendency for higher heart rate values, despite the absence of statistical significance for this outcome. Accompanying this trend, we witnessed a significant decrease in the players' score. Anecdotal evidence uncovers some of the justifications behind the encountered phenomena:

- "(the feedback) distracted me as I was trying to constantly improving my performance and looked at it from time to time (…)".
- "(the feedback) made me miss targets whenever I looked at the accuracy (…)".

In Wrong Lane Chase, feedback was provided for determined accomplishments, representing moments of relinquishing over what the player has achieved. While this may introduce a momentary distraction, players are able to quickly grasp the content of the message and continue pursuing their goal. The approach used in Ctrl-Mole-Del, on the contrary, continually keeps the player up to date on his / her performance levels.

We believe the loss of performance is linked to the distractions introduced via shifting the players' attention from the main gameplay area to the feedback panels. Even if a quick glance does not consume a hefty amount of time, it may prove to be sufficient to miss a couple of targets, leading to a loss of points. The continuous presence and constant updates performed on the feedback panel may also explain the increase of the players' average heartbeat rate, making players feel pressured uninterruptedly. Although this may be a speculative view on this matter, the overloading of information in the user interface may deteriorate performance as seen in research in other domains (Davis, 2011).

In sum, constant informative feedback may be responsible for a loss of performance and increase of heart rate values, a pair of phenomena which can steer players towards the flow state if stemming from states of relaxation. On the other hand, informative feedback disguised as praise was found to have the opposite effect, potentially allowing players to reach the flow state when stemming from states of arousal.

6.4.1.2 Impacting Time Constraints

Task 3's prototype revealed the available time to play the game. Players' average heartbeat rate significantly increased during gameplay period, revealing a more stressed state. Player score was significantly lower than when participants interacted with the game with no persuasive elements in play. The reasons for these findings may be supported by existing literature in the area of how time is used in Human-Computer Interaction. Grosjean (Grosjean & Terrier, 1999) has showed how time can be paramount in task performance: developing time awareness may aid users in obtaining better performances under certain conditions. In our particular case and despite no concrete goal being issued prior to the experiment, we speculate that the players were capable of creating a relation between the elapsed time and the score they had obtained (based on the scoring policy disclosed to them before engaging in the trial). By keeping awareness of these variables, they can create a mental model capable of giving them rough predictions concerning how they are faring within the game. We suspect that this constant awareness and the fact they are confronted with a constantly decreasing chronometer can affect their experience, especially if their current score does not meet their expectations. This result is in line with research in this area which suggests that bounding a task using time constraints is a sensitive matter as far as user performance is concerned (Prabhu, Drury, & Sharit, 1997).

Concluding, informative feedback conveying temporal information can be detrimental for a player's performance and a catalyst for a more stressful gameplay period. Nevertheless, this combination can be used in favor of the player if transitioning from states of relaxation / apathy towards their optimal experience state.

6.4.2 Instigating Players via In-Game Rewards

Mirroring Wrong Lane Chase's experimental period, the usage of in-game rewards in Ctrl-Mole-Del validated the findings we gathered in the previous chapter. The general outcome suggests that this type of rewards is capable of simultaneously relaxing the players' emotional state (by decreasing their heart rate figures) and improving their performance. In one of the trials, this trend was challenged, leading us to a deep investigation in order to identify the reasons behind this discrepancy. We will now address each type of reward used in the Ctrl-Mole-Del's trials, detailing their effects from emotional and behavioral perspectives.

6.4.2.1 Time Extension Reward – Relaxation over Time

The time extension mechanic was envisioned as an alternative persuasive approach for players to achieve better performances. We also expected that the prolongation of the game period would de determinant for a slight relaxation effect to take place. The obtained results (normalized to the game's original gameplay period) confirmed our suspicions. Players displayed significantly lower average heart rate values when confronted with the time extension mechanic than without the presence of any persuasive instrument. In conjunction with the findings stemming from the previous chapter, we can assert that different reward strategies can steer a player from states of anxiety or arousal towards an optimal experience status where the emotional state and performance are in harmony.

6.4.2.2 Time Extension Reward – Performance Catalyst

Besides lowering the players' average heart rate during the gameplay period, the time extension mechanic also had a very positive effect on their performance. Results showed that the inclusion of this reward had a significant effect on the players' score. One can quickly dismiss these results as the addition of more time to complete a task would naturally result in players attaining a higher score. To circumvent this limitation, we looked at two other aspects:

- While the score can introduce a bias, the players' accuracy should still remain true to their performance. As such, that particular metric's adequateness towards assessing player performance suddenly became more inviting.
- In the game's baseline task, play time was fixed at 240 seconds. The inclusion of the time extension mechanic increased this time, on average, by 55 seconds (due to players sometimes missing the activation or due to the variation in the reward spawning interval). By normalizing the extended play period's score to the 240 seconds interval, we were able to obtain an estimate of what would be their performance if abiding to the baseline's play period.

Based on these directives, we pointed the performance analysis to encompass both metrics and to consider the score values normalized to a 240 seconds period instead of the full duration of the trial (the values presented in the previous sections reflect this exercise). The obtained results were promising to support our hypothesis. Despite the normalization process, players showed significantly higher score values when confronted with the time extension mechanic for the same interaction period. While there was also an increase in their accuracy, the difference was not prominent enough to be statistically significant.

If we analyze both Task 1 and Task 5 conditions in detail we can conclude that, despite the difference in the total time spent playing, there were no added effects which boosted player score or tampered with the mole / reward spawning rate. In light of this evidence, we can only point one reason for the performance shift:

- The knowledge of the existence of the reward mechanic is a strong enough persuader / motivator instrument capable of improving the players' performance.

One last observation pertains to the disparity between encountering statistically significant results for the score metric but not for the accuracy metric. As previously hinted this is entirely related with the scoring policy and, in particular, the idling behavior. Players only get points deducted after a certain period. During that interval, they may miss some targets without incurring in any penalty. This means there can be small discrepancies between their score and their accuracy, if they keep interacting with the game but miss a few targets periodically.

6.4.2.3 Accuracy Booster – On-the-Fly Behaviour Adaptation

We will start the discussion of the accuracy booster instrument with the performance results. Both versions of the instrument have the same goal in mind: temporarily improve the players' accuracy rate. However, one of them possesses an undesired side-effect which disrupts the flow of target spawns. The experimental procedure was clear in this matter: players were not disclosed about the specific behavior of each instrument, giving them the onus of discovering the effects and adapting to them. During the design process of these mechanisms, we had foreseen that Task 6's mechanic (accuracy booster with no side-effect) would result in an increased performance over its counterpart. What we did not expect, was the abrupt decrease in player performance in Task 4.

The identification of the causes for this difference can enlighten our knowledge regarding the effects of persuasive technology. Rather than focusing solely on the results we obtained for the score and accuracy metrics, we emphasize a rather important and pivotal development: the behavior players adopted when confronted with these mechanisms. Figure 6.8 shows the percentage of accuracy booster mechanic activations in regards to the total number of spawns for Task 4. An average of 11 accuracy boosters spawned during the 240 seconds gameplay period. The number of activations, though, far from being close to the number of spawns. Players only picked 18% of the rewards in Task 4, suggesting a significantly high abstinence rate.

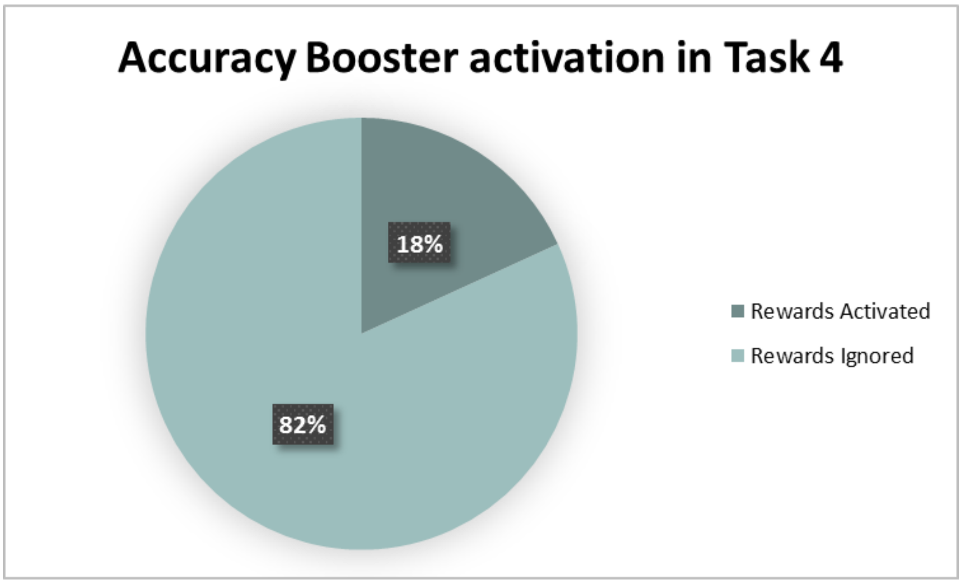


Figure 6.8 – Accuracy Booster mechanic activation in Task 4.

To strengthen this analysis we delved into our interaction logs to assess during which game sections players were more eager to activate the Accuracy Booster mechanic. For this exercise, we considered the average of 11 spawns for each trial and mapped the number of players who activated each mechanic in the order that they appeared. The results can be observed in Figure 6.9.

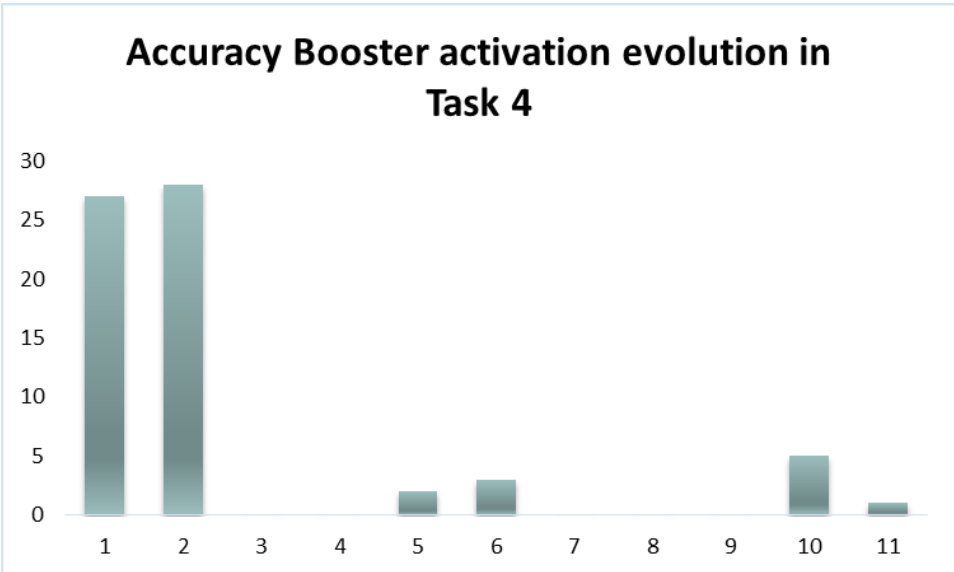


Figure 6.9 – Accuracy Booster's activation evolution during Task 4.

Initial engagement and curiosity prompted players to experiment with the first Accuracy Booster spawns. We believe that the rapid disappointment with its side-effects led them to forfeit activating the reward. There are some occurrences throughout the trial, but the only noteworthy behavior was a small increase in the number of activations in the final stretch of the trial (possibly as a last and desperate resort to increase their score).

We adopted the same procedure for Task 6's analysis. Figure 6.10 displays the percentage of activated Accuracy Booster mechanics in that task. The average number of Accuracy Booster spawns was 11 as well. Contrary to Task 4, here we can observe that players massively adhered to the persuasive instrument with 91% of the rewards being activated. We assume that the absence of any downside for this particular mechanic was a determinant factor for the increased adoption rate.

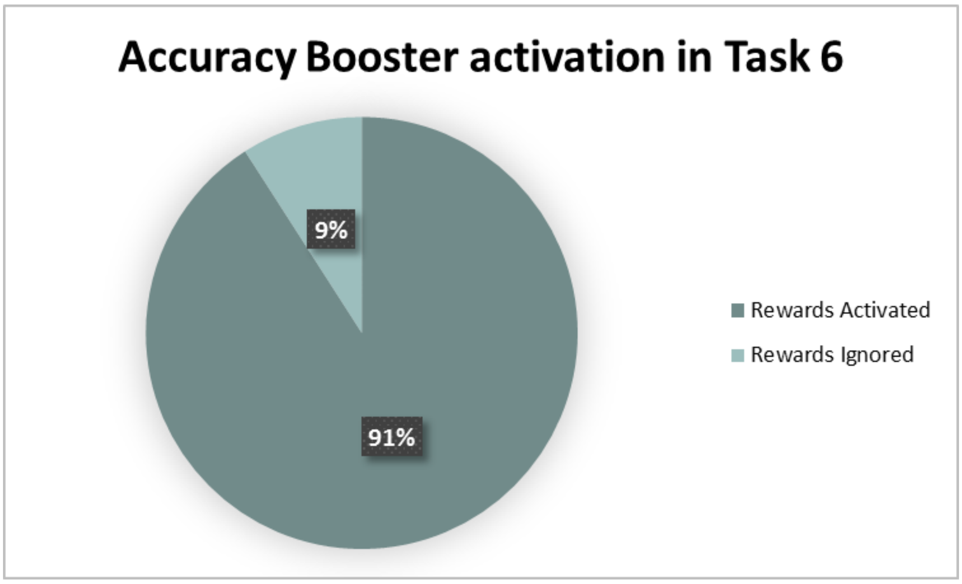


Figure 6.10 – Accuracy Booster mechanic activation in Task 6.

We also looked into how the rewards' activation evolved across the gameplay period. Figure 6.11 display that evolution. Oppositely to Task 4's behavior, here players demonstrated a somewhat stable interest in activating the Accuracy Boosters. The only noticeable decrease occurs at the third spawn. We believe this may relate with the players' eagerness and curiosity to experiment whether the act not activating the reward would be beneficial to them. The number of activations from that moment onwards indicates the importance of the persuasive instrument in increasing player performance.

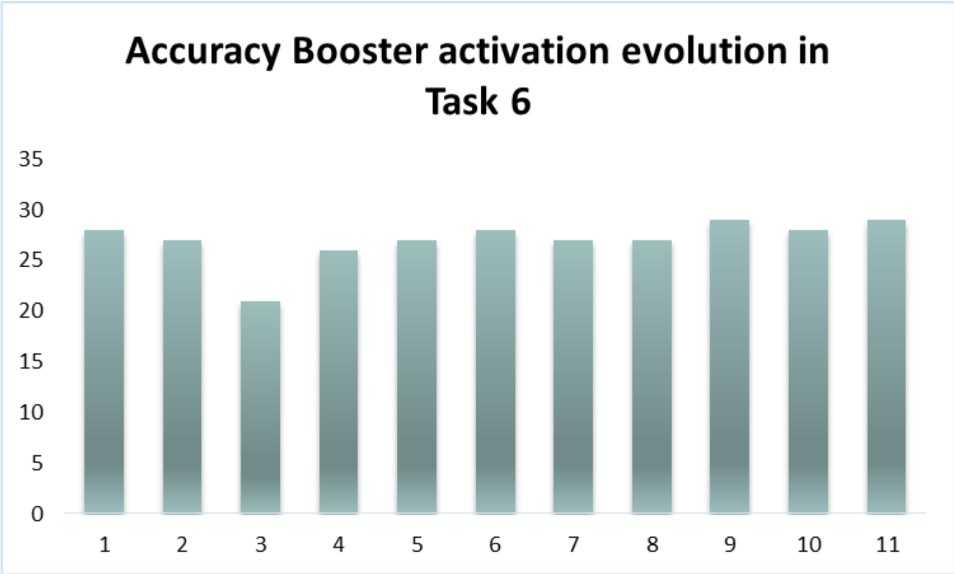


Figure 6.11 – Accuracy Booster's activation evolution during Task 6.

This contradictory behavior in these two tasks paves the way for the definition of what are the main findings in this analysis:

- During gameplay period, players are capable of exploring an "environment of discovery" and experiment with the various mechanics they are confronted with. In this case, they were able to identify the long term impact of activating determined rewards, making them opt for the one which maximized their performance at the end of the task.
- Players are capable of adapting their play-style to fit what they consider to be most beneficial for them. In this experimental period we witnessed that players were more favorably adhering to the Accuracy Booster mechanic present in Task 6, in detriment of that present in Task 4, due to their perception of the return they would get from both.

6.4.2.4 Presence & Relaxation in the Accuracy Booster Mechanic

There is only a missing piece to complete the results' discussion puzzle: players' physiological responses to the two versions of the Accuracy Booster instrument. Revisiting the results for those two tasks shows that players presented lower average heart rate values on both Task 4 and Task 6. This is the most unexpected result we gathered from both experimental periods, as it raises more questions than those it gives closure to. To comprehend this phenomenon, we should list and state all gathered facts:

- Using an Accuracy Booster mechanic with a pejorative side-effect, players significantly decreased their performance a far as their score and accuracy are concerned.
- Using the Accuracy Booster mechanic with no side-effects, players significantly increased their performance as far as the core metric is concerned.
- In both situations, players presented significantly lower average heartbeat rate values.

The straightforward conclusion which we are able to extract from this suggests that the side-effect had no impact in stressing players during gameplay period, allowing them to retain a more relaxed posture when comparing to the baseline task. If the characteristics of the deployed mechanic had no statistically significant differences among themselves regarding the assessed physiological metrics, then the justification for this behavior is related with an independent variable which we did not account for or had even foreseen: the presence factor.

We argue that the belief in the existence of a reward which is in the game to help the player is a sufficiently strong persuading agent to interfere with the players' physiological traits. Indeed, this assumption is the foundation of persuasive technology: the addition of an instrument which is capable of steering users into changing their behavior and / or creeds. In this particular case, however, we witnessed converging emotional responses but opposite performance reactions. We tie the relaxation process to the role of presence of these rewards / persuasive instruments and the performance fluctuations to the discussed side-effects. Furthermore, the emotional response takes an even more prominent role, since in Task 4 few rewards were activated, while in Task 6 the vast majority was. Adding the fact that in both trials participants were briefed using the same information (i.e. they would be playing a version of Ctrl-Mole-Del including a reward, without disclosing the effects of that mechanism), the importance of the knowledge of the presence of those instruments appears as an active influence for these results.

6.4.3 Refuting the Definition of Persuasion

The results obtained for the heart rate metric for the Accuracy Booster mechanic in Ctrl-Mole-Del' experimental period were not completely conclusive as a form of validation for what we had witnessed in Wrong Lane Chase's trials. Additionally, the way players responded emotionally to this particular mechanic inhibits us from elaborating a thoughtful theoretical contribution but also to contribute with guidelines and expertise regarding the usage of these instruments as flow catalysts. Rather than providing closure to this research, these results paved the way to formulate new questions which are pertinent to better understanding how persuasive technology impacts on the path towards the flow state. The first among these addresses a loose end which was unaccounted for:

- We found converging emotional responses to similar persuasive instruments, despite players ignoring one of them during gameplay period. Can we encounter the same impacting result as far as player performance is concerned?

The phenomenon we witnessed dealt exclusively with the players' emotional responses. We question whether it is possible to find a variant of any reward (or other type of persuasive instruments) which is capable of producing a similar effect to this but on the players' performance. Meeting this outcome would open new possibilities for persuasive technology and videogame design. For instance, designers would have new balancing instruments at their disposal, since they could produce similar rewards and other mechanics with different side effects, but whose end performance would be equivalent. However, there is one other design possibility which deserves our utmost attention and is entirely related with the previous question:

- Can a persuasive instrument deprived of any effect still be able to influence a player to improve his / her performance while at the same time relax their emotional state (similarly to a placebo)?

Note that previously we were attentive only to the possibility of affecting either the players' emotional or performance response. Here we are tackling the simultaneous manifestation of the persuasive instrument's impact. Furthermore, since we are suggesting a mechanism which is deprived of any behavior, we are dealing directly with the motivation inherent to the knowledge of the presence of the mechanism or its intended effects. The real meaning of this last question and the concluding point of this line of thought is:

- Can we use deception to effectively persuade a player during gameplay period?

A positive outcome for this new enquiry enables us to refute Fogg's definition of persuasion in which he states that deception or coercion should not be accounted for when attempting to change an individual's behaviors and / or creeds. In order to pursue this new research path and to potentially contribute with new knowledge concerning the usage of deceptive persuasion in the videogames domain, we will dedicate the next chapter towards experimenting with deceptive persuasive instruments with the intent of breaking new ground in this area of expertise and contribute with the introduction of deception as a viable persuasion alternative in videogames.

6.4.4 Framing Results in our Research's goals

To provide some closure to this experimental period, we repeated the process of framing the results obtained during the trials in the general scope of our research. This chapter aimed at validating Chapter 5's findings regarding the usage of feedback and reward based persuasive instruments, while attempting to break new ground with the exploration of the impact of other persuasive approaches in videogames. The main results were:

- Validating that reward based persuasive instruments are capable of steering a player from a state of anxiety or arousal towards the optimal experience state. This is achieved by increasing their performance and lowering their average heart rate values.
- Validation of feedback based rewards as capable of steering players from a state of relaxation or boredom towards the optimal experience state. This is achieved by lowering their performance and increasing their heart rate. We successfully

showed this behavior for the performance metrics but only identified a non-statistically significant trend for the physiological metrics.

This validation is reflected in Figure 6.12. Here we show that the upper quadrants are verified for both physiological and performance metrics. Since the lower quadrants' transition was only partially validated we represented it with a lighter color tone.

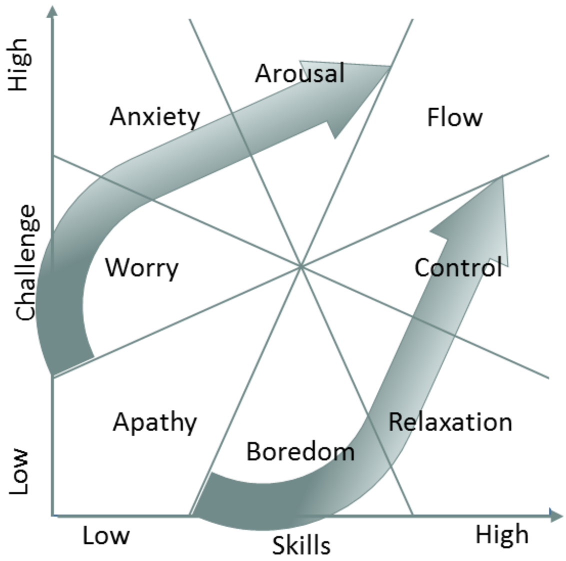


Figure 6.12 – Framing Chapter 6's results into the research's goals.

In possession of these results, we shall now revisit the research questions posed at the beginning of this chapter and provide appropriate answers to them:

- In a videogame, can feedback / praise persuasive instruments steer players towards a state of optimal experience by affecting their emotional and / or performance response?
  - **Answer** – Yes. Albeit we were only able to provide statistically significant empirical evidence for the performance impact, the physiological trend observed suggests that it is possible to increase their heart rate as well.
- In a videogame, can the inclusion of rewards steer players to an optimal experience state by effectively affecting their emotional response and / or performance?

    - **Answer** – Yes. Even though the full set of results was not entirely conclusive, we found enough evidence to validate prior trials and claim that it is possible to steer players towards the flow state via the usage of reward based persuasive instruments.
- Can similar persuasive instruments produce the same impact on player experience (regarding physiological state and performance) across different games and genres?
    - **Answer** – Yes. We tested similar mechanisms addressing reward based persuasive instruments across two different games, showing that similarly designed mechanisms are capable of producing the same type of effects to steer players into the optimal experience state. Informative feedback mechanisms were only tested in the context of the same game but we found a convergence regarding this type of instrument's effect.

In light of these results, we can state that all of the research's hypothesis (including this chapter's H3 and H4) and research questions presented at the beginning of this document were successfully met.

6.5 Summary

This chapter's goal encompassed validating the results encountered during Wrong Lane Chase's trials regarding the usage of specific types of persuasive technology and their effects on players' performance and physiological state. Basing ourselves on the goals established on the previous chapter we sought at:

- Showing that specific types of persuasive elements may affect a player's subset of his / her physiological signals, regardless of game genre.
- Providing empirical evidence that determined persuasive elements can improve / decrease player performance regardless of game genre.

In sum, the goal was to achieve equivalent results for similar persuasive strategies across two different games. To address these goals, we developed a second game entitled Ctrl-Mole-Del. This game took inspiration from Whack-a-Mole, a popular arcade game in which players must stop an invasion of moles in a prairie by hitting them as they pop from their burrows. We followed the previous trial's persuasive strategies by adopting: a couple of mechanics providing feedback to the player; incorporating two persuasive elements which recurred to reinforcement items.

The outcome of the experiment allowed us to fully respond to some of the proposed research questions and provide partial coverage to others. Reward based persuasive strategies were shown to have similar physiological and performance outcomes on players. We were also able to shown approaches capable of being detrimental to the players' performance and have a tendency for increasing their stress levels.

While the bulk of the results of player performance also pointed towards a harmonious confluence of effects regarding the assessed persuasive strategies, one finding demarked itself from all others due to a design flaw in one of the prototypes. What we observed was that, despite the mechanism being pejorative to the players' performance, they still were able to relax when compared to the absence of any persuasive instrument. This unexpected outcome prompted us to analyze the conditions in which it was produced and the potential reasons for such result. We identified the plausible reason behind as being related with the players' knowledge of the existence of a potentially beneficial reward for them and the presence factor of the persuasive instrument. In light of this finding, we elaborated on the possibility of using deception as an alternative approach to persuade players in videogames. To provide closure to our suspicions, we defined a new research direction which will lead us to the understanding of how deception ties with persuasion, videogames and player experience. Since we successfully brought closure to this research's original goals, we are able to pursue this research line, hoping to contribute with novel knowledge regarding this thematic. As such, the next couple of chapters will be fully dedicated towards the designing of a new experiment which will tackle the usage of such deceptive persuasion approaches in videogames and towards the contextualization and framing of deception in persuasion and videogames literature.

7 ASSESSING DECEITFUL PERSUASION IN VIDEOGAMES

Deceit is a fuzzy area of research within the persuasion domain applied to computer systems and applications. One of the main reasons for this is tied with the thin boundaries regarding what is ethically and morally acceptable and what approaches should be condemned to attain determined goals. The outcome of the previous chapter, however, led us to question whether or not deceit can be used as a viable persuasion strategy in videogames. To accomplish this, we envisioned yet another experimental period encompassing the usage of deceitful versions of the persuasive instruments deployed in the experiments reported in the previous chapters. The results will be an invaluable novel contribution not only for the videogame community but also for the persuasive technology one. Additionally, we expect this chapter to demystify some preconceptions regarding deceitful persuasive strategies and aid in mitigating the negative connotation often associated with it.

7.1 Focus of Research

One challenge he had ahead of us concerned how were we going to assess deceitful persuasive instruments in the same way we had carried out for feedback and reward based mechanisms in the previous chapters. In particular, what deceitful persuasive strategies and / or instruments are available and, preferably, appropriate for usage within a videogame?

To address this question we capitalized on the previous chapter's outcome and analyzed the type of results we were confronted with. What we saw was that despite changes in one of the variables being assessed (the players' performance), the other (players' heart rate) showed equivalent variation in regards to what we considered the baseline task. This type of result is similar to the phenomena encountered with a special type of persuasive instrument which is recurrently used in the healthcare domain: placebos.

In the health domain, a placebo is an innocuous pill which is administered to patients suffering from diverse diseases in order to:

- Test new drugs (Ofri, 2013).
- Improve a patient's condition, especially its mental facet (Crow et al., 1999).

One of the keys to a placebo treatment success lies in the omission of the innocuous nature of the pill to the target of the intervention. Typically, this type of treatment is applied to conditions in which both the patient's mental and physical conditions are affected (Crow et al., 1999). While there are no chemical effects and therefore no apparent real benefit for the patient's physical status, most of the times the knowledge of being under a treatment which will improve their health is sufficient to improve their mental condition (Brown, 2006). In various cases, this is enough to conclude the treatment successfully, turning it into a case of benevolent deception. But can healthcare placebos translate into the videogames domain? Let us analyze this transition carefully. The rationale behind the usage of placebos stems from a "false promises" premise based on a mental model built around the effects of a pill. Patients assume that a prescribed pill benefits them with no secondary effects associated with it. The medical doctor's word is taken as a truth and is not challenged. In the end, if the patients improve their health status they attribute it to the pill, solely and without any kind of mistrust being involved since they cannot distinguish a real pill from a placebo one.

If we build on this premise and mirror it in a videogame, we may achieve a placebo within that form of entertainment. For instance, let us think about a reward being offered to a player, similar to the ones present in both Wrong Lane Chase and Ctrl-Mole-Del. Players know that when they activate them, a certain in-game effect is triggered which, potentially, benefits them. If we deprive the reward from having any effect (for instance, inhibit the obstacle slowdown mechanic in Wrong Lane Chase from actually slowing down obstacles) we could achieve an effect which is equivalent to a placebo. Players could, however, notice that an effect is not in place. For the placebo to be successful it should be designed taking into account other game settings revolving it upon its activation time and for its duration.

In the end, the answer is positive – we can potentially and theoretically mirror healthcare placebo mechanisms in videogames. In light of this brief exercise, we can establish a set of research questions which will be addressed during the course of this chapter. For this experimental period we will narrow our focus of research towards experimenting with placebo reward based persuasive instruments, given that we already have a set of experimental results which are capable of fortifying and acting as points of comparison to the results stemming from the experiment reported in this chapter.

7.1.1 Establishing New Research Questions

Considering how placebos are defined, the way they are utilized in their native domain of application and our own research's agenda we defined a set of research questions which attempt to bring closure to the doubts stemming from Chapter 6's findings:

- In a videogame, can placebo rewards affect the players' physiological state in order to steer them towards the optimal experience?
- In a videogame, can placebo rewards produce performance shifts capable of steering players towards the optimal experience state?
- In a videogame, is a placebo reward's impact of player experience significantly different from that of a real reward?

7.1.2 Experimental Approach

In order to gather a resilient set of results to provide closure to the previously appointed research questions we opted to follow a research method similar to the ones employed in all previous experimental periods. The design of these trials was required to accommodate:

- **More Than One Game –** similarly to our course of action in Chapter 6, we need to assess our research questions using at least two games, preferably in different genres. By doing so, we show that any potential findings are not limited to a specific experimental setting.
- **Real VS Placebo Rewards –** the real goal of this chapter is to show whether deceit is a valid and viable approach towards persuasion in videogames. In particular, we narrowed our object of study to compare real and placebo rewards. To achieve this, we analyzed data stemming from both types of persuasive instruments, compare it to a baseline task (similarly to the previous experimental periods) and finally compare between them.
- **Distinct Reward Based Persuasive Instruments –** even though we narrowed our object of research to reward based persuasive instruments, this does not invalidate the need to test different reward designs. As such, we should make an effort to experiment with reward mechanisms which slightly differ from each other as far as the game's mechanics are concerned.

These directives lead to the natural usage of intra-subject analysis to assess differences between each prototype. We continued to support the TRUE methodology as proposed by Microsoft Studios along with the RITE method for the design and preliminary evaluation of the deceitful reward mechanics.

7.2 Designing Deceptive Persuasion Instruments

To carry out the envisioned experimental period we needed to design new material with which we would attempt to pursue our research goals. Instead of creating new content from scratch we decided to capitalize on the available tools and explore the most adequate ways to design and implement deceitful persuasive instruments. As such, we opted to adopt both Wrong Lane Chase and Ctrl-Mole-Del for this chapter's experiments, with the promise that we would create new prototypes to address the deceitful approaches.

The deceitful persuasive instrument design exercise should be tied with how placebos are normally conceived, attempting to mirror those characteristics and mitigate any features which may lead players to detect the absence of any behavior stemming from their activation.

7.2.1 Wrong Lane Chase

The creation of the deceptive reward was subject to the assessment of whether or not we would need a new type of reward within Wrong Lane Chase. To do so, we looked at the existing reward based persuasive instrument and analyzed its features to check if they matched the requirements to design a placebo version out of it.

The only reward instrument present in the game is the obstacle slowdown mechanic, a mechanism which, upon activation, temporarily decreases the speed of incoming obstacles, effectively giving players more time to dodge them. The deceitful alternatives for this reward are not extensive. One of the first approaches envisioned capitalized on two features of this instrument: i) first, the fact that the obstacles slowed down upon activation; ii) second, the fact that the scenery also slowed down to give an overall impression of moving at a lower speed. Based on these characteristics we proposed the usage of visual perception to trick players. This would be achieved by only slowing down the scenery, but maintaining the obstacles speed, hoping that the disguise would go unnoticed.

The placebo version of the obstacle slowdown mechanic builds on a disguise opportunity to trick players into believing a certain event is occurring. A second element factors into the players' belief that something is, indeed, happening: if they are informed that rewards are present in the game then, potentially, they base that information as being truthful (especially when it is conveyed to them by the development team). In sum, disguise and a false promise emerge as key components of a deceitful persuasive mechanic's design process in order to convince the player base that the game's core behavior is working as intended.

7.2.1.1 Design Verdict

In light of the presented rationale, we accepted the placebo obstacle slowdown reward as the candidate for testing deceit within Wrong Lane Chase. To materialize this vision, we built yet another prototype of this game. It is completely based on Wrong Lane Chase's prototype which included the obstacle slowdown reward mechanic. All controls, interface and core gameplay mechanics were kept unchanged for this new prototype. The only mandatory modification addresses the behavior of the reward upon its activation:

- We removed the slowdown effect from all incoming obstacles.
- We maintained the slowdown effect applied to the scenery.

With these small modifications we concluded the development of an experiment-ready Wrong Lane Chase prototype capable of being pitted against its real counterpart.

7.2.2 Ctrl-Mole-Del

We repeated the same design exercise for Ctrl-Mole-Del. In this game's case, there were two reward mechanisms which were candidate towards being included in this chapter's assessment. The first instrument was similar to Wrong Lane Chase's obstacle slowdown mechanic. The Temporary Accuracy Booster increases the amount of time players have to hit their targets for a short period. The second reward mechanic contemplated the extension of the play time by a fixed 7 second period. We will now delve in detail into each of these mechanics and address how suitable they would be to this last stretch of the research.

7.2.2.1 Deceitful Temporary Accuracy Booster

The temporary accuracy booster's natural placebo counterpart follows the same design principles present in Wrong Lane Chase's obstacle slowdown mechanic. The goal is to play with the players' expectations and the image they build of the game and trick them into believing that the game slowed down. In this case, however, the design plan misses a very important factor which Wrong Lane Chase had in its favor. Unlike the previous game, Ctrl-Mole-Del does not have any accessory visual elements in the gameplay area. While Wrong Lane Chase features background scenery which complemented the main playing area, Ctrl-Mole-Del does not have any supporting graphical cues or animations that are used to provide a sense of motion or time passing by. The materialization of this vision, thus, becomes severely limited as far as tricking the players is concerned.

The rationale behind this type of rewards is tied with the knowledge that when the player collects or activates the reward, some changes are witnessed. In the previous game's case, the placebo reward is concealed via our reliance on the ability of the surrounding scenery's slowdown in providing sufficient feedback for players to believe that the reward is being executed. This theory falls short off of success in Ctrl-Mole-Del due to the lack of supporting surrounding elements (e.g. graphical, audio, animations) for the reward triggering event. This reason alone is enough to significantly affect the prospect of using the Accuracy Booster mechanic in a placebo version for these trials.

7.2.2.2 Deceitful Time Extension

The time extension mechanic present in Ctrl-Mole-Del gave players additional play time each time they picked one of those rewards. The mechanisms relied solely on the fact that upon activation, players would get a fixed amount of play time added to their pool. If they were not sure about this information, there was a panel on the upper-right region of the screen which constantly displayed this data. Similarly to the Accuracy Booster, there is not much room for deceit: no animations accompany the triggering of the reward, nor there is any other type of cue, except for the update of the feedback panel.

In face of these limitations, we opted for a slightly different approach for the design of a deceitful instrument. Instead of putting the onus of trickery into the game's environment itself, we opted to capitalize on the game's rules and the presence of the experimenter during the trials to ensure players would rightfully perceive what the reward's activation meant. During the experiment, an expert analyst is present to provide any support and to answer to the participants' questions. In addition, he / she is also responsible for briefing the players about the game's mechanics, controls and rules. We aim at utilizing this last segment to carry out the deception in the particular case of the time extension mechanic.

In its original version, the time extension awarded players with 7 more seconds of play time. For the deceitful version, we assume this value would need to be lowered to roughly 3 seconds. The reasoning behind this is related with both ensuring players would fall for the trick and to be certain that they would not be able to distinguish truth from deceit.

The instrument here envisioned is based on the deception of the players' own mental model. Players create a representation of the game's mechanics within their own mind which, in principle, dictates that the reward activation has an associated behavior. We tackle this perception and play with it in order to trick the users into believing they are still receiving their reward even when it is devoid of any behavior. Finally, the most important aspect, is that this approach is able to ensure that players are not able to discern between truth and deceit. The reason for this is related with the short amount of time promised to them. We assume players are typically focused on the gaming area and, sometimes, check the remaining play time (as testified by anecdotal feedback in the previous chapter). If we gave them a 7 second boost, they would have time to deviate their gaze from the gaming area to the feedback panel, return to the former and conclude that the reward had, indeed, given them extra time. Using a mere 3 seconds boost, we intend to decrease the possibility of identifying the extra seconds gained, since it becomes harder to identify the gain precisely while moving the players' gaze from the game area to the feedback panel.

7.2.2.3 Design Verdict

We identified the placebo time extension as our choice to be included in the experimental period addressing the players' experience when confronted with placebo rewards. Similarly to Wrong Lane Chase's case, the materialization of this vision in a prototype was fairly straightforward. We built on the time extension prototype and removed the behavior associated with picking the reward item. This ensures that the players still observe the reward items, are able to interact with them (picking them triggers the same green tinted feedback as in the original version), but do not gain anything from it. All controls, game pace and visual appearance were maintained in this new prototype.

This choice is reinforced as it gives a certain degree of variation to the experiment, thus providing closure and support to the third experimental design directive we presented earlier in the chapter.

7.3 Experiment

In order to assess the proposed research questions we designed two experimental periods, each concerning one of the games developed within the scope of this research. The experiment followed an A/B intra-subject methodology, as the assessed variables were compared over multiple trials with different conditions. The experimental period comprised two main trials: one to assess Wrong Lane Chase's deceitful persuasive strategies and another for Ctrl-Mole-Del's. We capitalized on the previous chapters' results to perform the necessary comparison between the metrics at stake, while recruiting the exact same subjects.

7.3.1 Hypothesis

Based on the research questions we established, existing literature regarding the usage of deceptive instruments and, in particular, the administration of placebos, we devised the following hypothesis:

- **H5**: Placebo rewards can be used in videogames to steer a player towards a state of optimal experience, providing equivalent emotional and performance shifts as their real counterparts.

If this hypothesis is validated, Fogg's definition of persuasion can be adapted for the videogames domain in order to accommodate the possibility of utilizing deceit as a benevolent instrument of persuasion.

7.3.2 Tools & Equipment

During the Wrong Lane Chase's trial we provided participants with a Sony VAIO VPCS13S9E laptop model connected to a Dell 27" 2709W monitor. For Ctrl-Mole-Del's experimental period, subjects were handed a HTC HD2 Windows Mobile phone. We used the AliveTec Heart Monitor to retrieve the subjects' heart rate during the experiment. The electrode placement and preparation procedure was similar to the one employed in all previous experiments.

For both trials, we used the basic prototype of each game (deprived of any persuasive instrument) as the baseline task. In the context of Wrong Lane Chase we also used the prototype which contemplated the obstacle slowdown reward, along with its placebo counterpart. In Ctrl-Mole-Del's trial we included the time extension prototype and its placebo version as well. For both games we installed and pre-tested each prototype in the devices delivered to the participants before initiating the experimental period.

7.3.3 Participants

Since we were required to perform trials with both games, we kindly asked all participants who had previously carried out experiments within this research to partake in a final experimental period. All agreed to do so. Participants for both groups were characterized as follows:

- **Wrong Lane Chase** – 30 individuals had participated in the first tests (25 male, 5 female; M = 25.5; SD = 6.1). Videogames proficiency was not an issue In general, with roughly 90% of them stating they played videogames with some regularity.
- **Ctrl-Mole-Del** – 30 individuals (23 male, 7 female; M = 23.3; SD = 5.2) took part in this experimental period. No user had participated in the Wrong Lane Chase trials. Similarly to the previous experiments, the vast majority of the subjects were tech-savvy (93%) and played videogames on a regular basis, allowing us to ignore tech-novelty bias.

7.3.4 Metrics

In order to assess the impact of the deceitful persuasive mechanics, we maintained our focus on the same metrics for both games. From a physiological perspective we analyzed the players':

- **Average Heartbeat Rate (HBR)** – an indicator of the players' emotional response.
- **Heart Rate Variance (HRV)** – a complementary indicator of players' emotional state.

As far as performance metrics are concerned, we decided to focus on the ones assessed in our previous trial periods:

- **Score** – the main indicator of performance. The score values were normalized to a 240 second gameplay period in Ctrl-Mole-Del's trial. No modifications were made pertaining to Wrong Lane Chase's results.

- **Average Obstacle Avoidance Streak (AOAS)** – a complementary indicator of the players' performance and behavior during gameplay period. It concerns Wrong Lane Chase's trial only.
- **Accuracy** – another complementary indicator of player performance which is particularly relevant to distinguish those who idle much and those who prioritize perfectly hitting their targets. Assessed exclusively in Ctrl-Mole-Del.

7.3.5 Variables

Our analysis is based on a small set of metrics capable of giving us all data we require to proceed with answering and discussing our research questions. We segmented the assessed variables according to their nature of being control variables or dependent variables.

7.3.5.1 Independent Variables

The following are the control variables used for the ensuing experimental period:

- **Persuasive Instrument Type** – subjects were confronted with three different prototypes for each game. The baseline was established using a prototype devoid of any persuasive instruments, while the other two concerned the usage of real and placebo rewards mechanics, respectively.

7.3.5.2 Dependent Variables

These are the dependent variables which we aimed at addressing:

- **Physiological Metrics** – we gathered the participants' average HBR and HRV.
- **Performance Metrics** – we retrieved the players' score metric as the base performance indicator. The average number of obstacles avoided in a row

complemented that metric in Wrong Lane Chase's trial, while the accuracy metric assumed that same role for Ctrl-Mole-Del's experiment.

7.3.6 Procedure

For both games, participants were initially briefed on some experimental details (any information regarding deceitful persuasive mechanisms was omitted), proceeded to carry out a series of tasks and were finally debriefed on the real purpose of the experiment. Each task lasted for approximately 5 minutes.

The detailed procedure was as follows:

- **Pre-Task –** during this period, players had a one minute (re)acquaintance period with the game they were assigned to, using the basic prototype (stripped of persuasive elements).
- **Task 1 –** this involved interacting with the basic prototype (void of any persuasive elements) of the game the subject was designated to. This task was chosen as the baseline to which all other would be compared.
- **Task 2 –** here, subjects interacted a prototype of the game they were assigned to contemplating a real reward mechanic. As a reminder, Wrong Lane Chase included the temporary obstacle slowdown mechanic, while Ctrl-Mole-Del featured the time extension reward.
- **Task 3 –** for this task, subjects played a prototype featuring a deceitful reward mechanic of the game designated to them. In Wrong Lane Chase we simulated the obstacle delay by capitalizing on the scenery in play which provided an optical illusion that all objects were slowed down. In Ctrl-Mole-Del, players were informed about a time extension of 3 seconds if they hit the reward item, while in reality no time was offered. In any variant, participants were not informed about the existence of the deceitful mechanic.
- **Post-Task –** during this debriefing period, we disclosed all of the experiment's details to the subjects, while simultaneously asking them to comment on the behaviors assumed during the task and their impressions of each prototype.

Task order was randomly assigned to each subject. In our experimental design we assured there was a balanced distribution in task assignment in order to avoid order bias. Participants were sitting in a chair in a well-lit room interacting with the different games (even though Ctrl-Mole-Del was played on a mobile device). Scoring policies were disclosed to players with one exception: in Wrong Lane Chase they were not informed that avoiding a certain number of obstacles in a row awarded more points. Subjects were only informed about the purpose of the experiment upon finishing it.

7.3.7 Results

Yet again, we abided to the same analysis process already employed in Chapter 5 and Chapter 6's experimental periods. For both games, we started off by getting a macroscopic view of the results and proceeded to a finer-grain analysis which encompassed the usage of statistical methods. We divided the results in four sections: the first two address Wrong Lane Chase's descriptive and statistical analysis, respectively; the remaining couple of sections pertains to Ctrl-Mole-Del's descriptive and statistical assessment.

7.3.7.1 Wrong Lane Chase – Descriptive Analysis

Wrong Lane Chase's descriptive results can be observed in Table 7.1. Figure 7.1, Figure 7.2 and Figure 7.3 present the boxplots for the average HBR, score and average number of obstacles avoided in a row metrics, respectively. A quick observation of these results suggests that:

- Placebo rewards were successful in relaxing players
- Placebo rewards were successful in improving the players' performance (both accounting for their score and average obstacle avoidance streak).
- Placebo rewards display no apparent major difference from their real counterpart as far as the effects on player experience are concerned.

Table 7.1 – Wrong Lane Chase's Descriptive Statistics.

		N	Mean	Std. Deviation	Minimum	Maximum
Average HBR	Task 1	30	82.98	11.51	62.89	104.69
	Task 2	30	79.47	10.80	58.88	101.30
	Task 3	30	79.26	11.13	60.05	105.07
Score	Task 1	30	4137.54	824.73	2047.00	5235.00
	Task 2	30	4560.68	730.32	2322.00	5390.00
	Task 3	30	4535.93	774.48	2138.00	5356.00
AOAS	Task 1	30	70.83	21.74	36.00	120.00
	Task 2	30	83.13	26.28	39.00	120.00
	Task 3	30	82.93	25.65	38.00	124.00

The baseline values for this experiment were established using Task 1. The average HBR was set at 82.98 bpm with a standard deviation of 11.51 bpm. The usage of real rewards (Task 2), as witnessed in Chapter 5, resulted in a noticeable decrease of the player's average heart rate (M = 79.47; SD = 10.8). The heart rate behavior for Task 3, appeared to confirm Chapter 6's findings, with users presenting lower figures (M = 79.26; SD = 11.13).

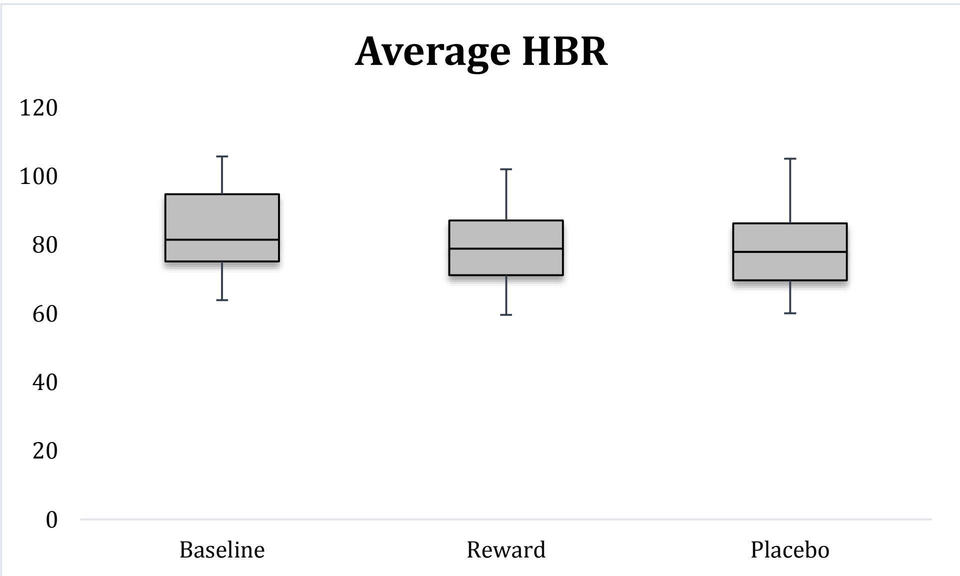


Figure 7.1 – Wrong Lane Chase's average HBR boxplot.

Results concerning the score metric also suggest that our hypothesis is supported: players during Task 1 (M = 4137.54; SD = 824.73) had worse performances than when confronted against real rewards in Task 2 (M = 4560.68; SD = 730.32) or placebo rewards in Task 3 (M = 4535.93; SD = 774.48). While the performance is slightly higher in Task 2, the important fact to retain here is that both real and placebo rewards showcase consistently similar behavior for this game.

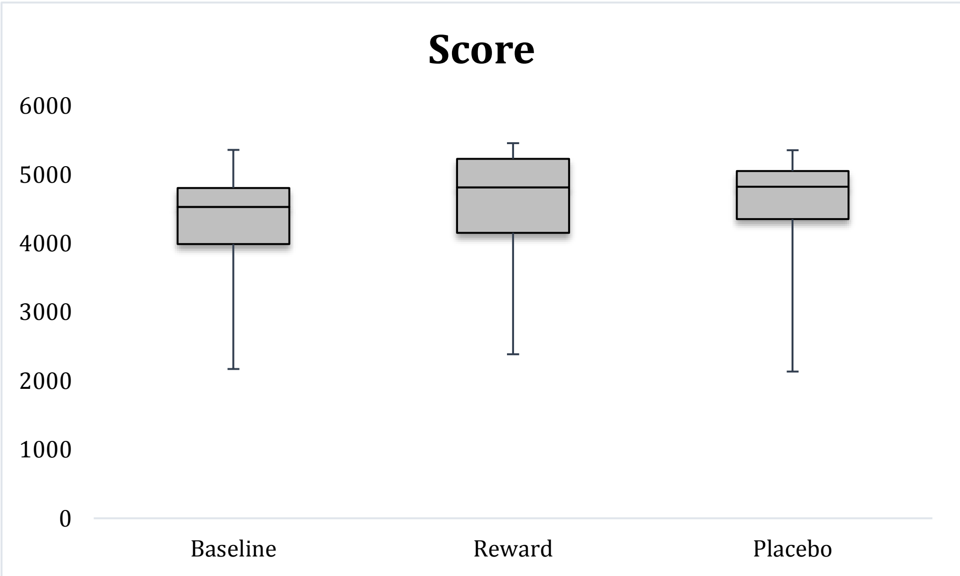


Figure 7.2 – Wrong Lane Chase's score boxplot.

Lastly, the results obtained for the average number of obstacles avoided in a row are also in consonance with our hypothesis: during Task 1 (M = 79.21; SD = 21.74), players' average obstacle avoidance streaks were shorter than in either Task 2 (M = 83.13; SD = 26.28) or Task 3(M = 82.93; SD = 25.65). This metric reflects the findings for the score metric, with real rewards resulting in slightly more avoidances, but still having no apparent major difference from their placebo version.

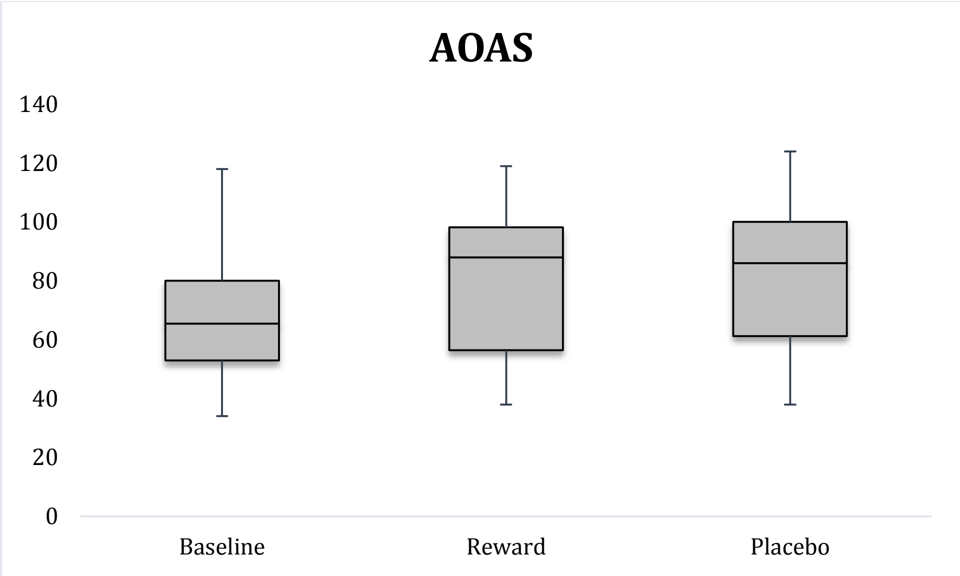


Figure 7.3 – Wrong Lane Chase's average obstacle avoidance streak boxplot.

7.3.7.2 Wrong Lane Chase – Statistical Analysis

For the sake of coherence, we decided to employ the same statistical tests we used for all previous experimental periods. Still, we initially performed the Shapiro-Wilk test to assess whether our data followed a normal distribution. Table 7.2 shows those results. As easily identifiable by the highlighted rows, five tasks pertaining to two different metrics did not pass the normality test ($p < 0.05$ to fail).

Table 7.2 – Shapiro-Wilk normality test results for Wrong Lane Chase trials.

		Shapiro-Wilk		
		Statistic	**df**	**Sig.**
Average HBR	Task 1	.959	30	.243
	Task 2	.954	30	.378
	Task 3	.965	30	.321
Score	Task 1	.894	30	.006
	Task 2	.882	30	.004
	Task 3	.816	30	.000
AOAS	Task 1	.955	30	.231

	Task 2	.924	30	.034
	Task 3	.953	30	.202

Taking into account the non-favorable settings to perform an ANOVA test, we carried out the same procedure we had previously adopted: assess the significance of our results via a non-parametric Friedman test followed by a set of Wilcoxon signed rank post-hoc tests to identify which pairs of tasks yielded statistically significant differences between them. The Friedman test results can be observed in Table 7.3. The result set for all metrics indicated there are statistically significant differences in them ($p < 0.05$). We were required to perform additional tests to assess which tasks displayed these significant differences according to the analyzed dependent variables.

Table 7.3 – Friedman test results for Wrong Lane Chase Trials.

	Average HBR	**Score**	**AOAS**
N	30	30	30
Chi-Square	34.867	29.067	7.267
df	2	2	2
Asymp. Sig.	.000	.000	.026

Table 7.4 presents the results for the Wilcoxon signed rank post-hoc tests: highlighted regions display which tasks possessed statistically significant differences between themselves. As far as the average HBR is concerned and having Task 1 as the baseline, subjects presented significantly lower values when comparing it to Task 2 ($Z = -4.78$; $p < 0.01$) or to Task 3 ($Z = -3.85$; $p < 0.05$). An important result was the comparison between Task 2 and Task 3 ($Z = -0.11$; $p = 0.91$) which did not reveal any significant differences, encouraging a positive answer for the fourth research question posed in this chapter.

Table 7.4 – Wilcoxon Signed Rank test results for Wrong Lane Chase Trials.

		Task 1 – Task 2	**Task 1 – Task 3**	**Task 2 – Task 3**
Average HBR	Z	-4.788	-3.858	-.113

	Asymp. Sig. (2-tailed)	.000	.000	.910
Score	Z	-4.349	-3.754	-.051
	Asymp. Sig. (2-tailed)	.000	.000	.959
AOAS	Z	-1.821	-2.109	-.195
	Asymp. Sig. (2-tailed)	.069	.035	.845

Post-hoc test results for the score metric indicate that Task 1 presented significantly lower values than either Task 2 ($Z = -4.34$; $p < 0.01$) or Task 3 ($Z = -3.75$; $p < 0.01$). Tasks 2 and 3 did not reveal any statistically significant differences between themselves ($Z = -0.051$; $p = 0.95$). Coupled with the outcome for the average HBR metric, this finding further reinforces the response to the fourth research question of this experimental period.

Finally, the average number of obstacles avoided in a row was the last assessed metric in the Wrong Lane Chase experiment. The Wilcoxon post-hoc test result for the comparison between Task 1 and Task 2 shows that no statistically significant difference was present ($Z = -1.82$; $p = 0.06$). Results for the comparison between Task 1 and Task 3 show a moderate difference between the two tasks ($Z = -2.10$; $p = 0.03$). The comparison between the tasks involving real and deceitful rewards (Task 2 and Task 3, respectively) showed no statistically significant differences ($Z = -0.195$; $p = 0.84$). Coupling all these results, we are comfortable in stating there is enough evidence to respond to our research questions.

7.3.7.3 Ctrl-Mole-Del – Descriptive Analysis

The descriptive results for Ctrl-Mole-Del's trial can be observed in Table 7.5 and these are complemented by a set of box-plots pertaining to the players' average HBR (Figure 7.4), score (Figure 7.5) and accuracy (Figure 7.6).

Table 7.5 – Descriptive statistics for Ctrl-Mole-Del trials.

		N	Mean	Std. Deviation	Minimum	Maximum
Average HBR	Task 1	30	99.9260	20.23635	59.76	123.99
	Task 2	30	85.0207	15.08197	60.50	117.89

	Task 3	30	86.8883	14.18306	58.92	114.32
Score	Task 1	30	299.0000	57.25924	155.00	385.00
	Task 2	30	350.1263	32.41103	267.79	382.11
	Task 3	30	339.5333	46.88190	228.00	408.00
Accuracy	Task 1	30	83.6349	8.65033	63.37	94.74
	Task 2	30	85.2199	5.44544	70.82	96.00
	Task 3	30	83.3828	6.72603	66.67	92.98

Players displayed lower average HBR values in Task 2 (M = 85.02; SD = 15.08) than in Task 1 (M = 99.92; SD = 20.23). Task 3 (M = 86.88; SD = 14.18) produced lower average HBR values when comparing to the baseline task. Average HBR values for both Task 2 and Task 3 appear close enough to support the evidence found with Wrong Lane Chase's trials.

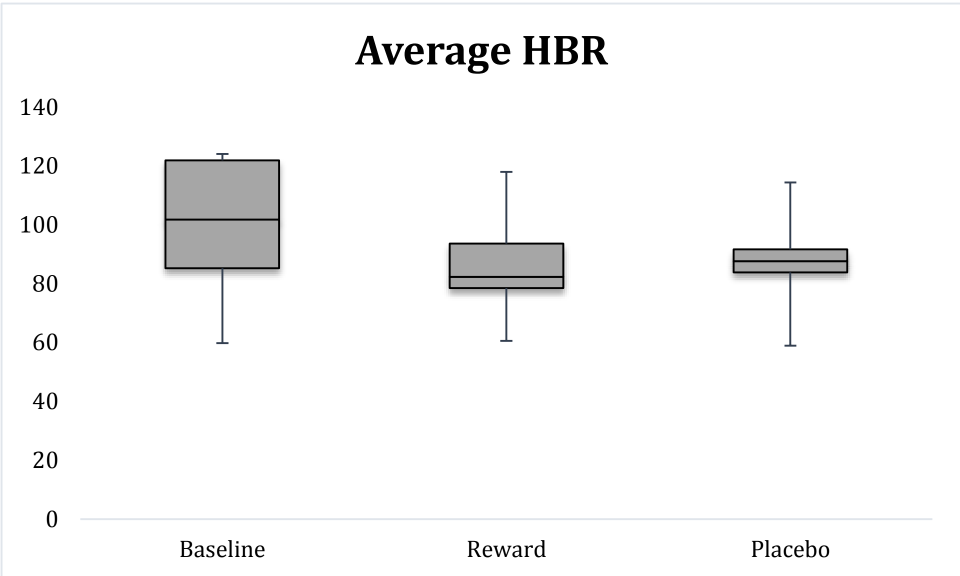


Figure 7.4 – Ctrl-Mole-Del average HBR boxplot.

Concerning the players' score, Task 1 (M = 299.00; SD = 57.25) presented noticeably lower values than either Task 2 (M = 350.12; SD = 32.41) or Task 3 (M = 339.53; SD = 46.88). Despite displaying a slightly lower score, the placebo version of the time extension mechanic still managed to stay relatively close to its real counterpart's values.

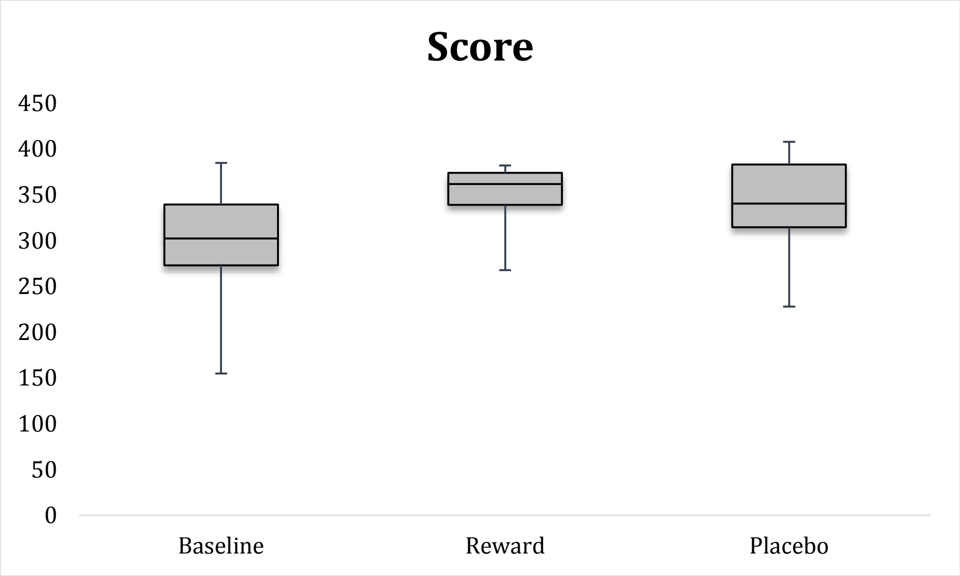


Figure 7.5 – Ctrl-Mole-Del player score boxplot.

Finally, results for the accuracy metric are not conclusive. Players in Task 1 (M = 83.63; SD = 8.65), Task 2 (M = 85.21; SD = 5.44), and Task 3 (M = 83.38; SD = 6.72) managed to achieve quite similar accuracy levels, inhibiting us from drawing immediate conclusions addressing this metric.

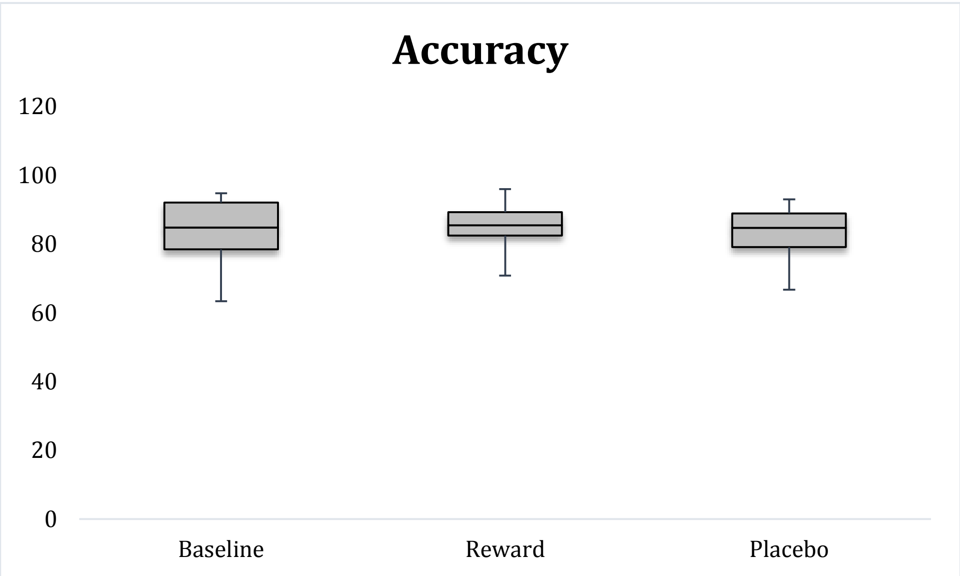


Figure 7.6 – Ctrl-Mole-Del accuracy boxplot.

7.3.7.4 Ctrl-Mole-Del – Statistical Analysis

As we proceeded to the statistical analysis of our results, we began by testing if our sample data followed a normal distribution using a Shapiro-Wilk test. Table 7.6 shows the results for this assessment. The highlighted regions show the tests which indicate our data is not normally distributed ($p < 0.05$).

Table 7.6 – Shapiro-Wilk normality test results for Ctrl-Mole-Del trials.

		Shapiro-Wilk		
		Statistic	**df**	**Sig.**
	Task 1	.909	30	.014
Average HBR	Task 2	.960	30	.301
	Task 3	.886	30	.004
	Task 1	.928	30	.044
Score	Task 2	.815	30	.000
	Task 3	.956	30	.237
	Task 1	.914	30	.019
Accuracy	Task 2	.923	30	.031
	Task 3	.919	30	.025

In light of these results, we resumed our analysis by conducting he non-parametric Friedman test. Table 7.7 presents the Friedman test results for Ctrl-Mole-Del trials. As observed, the results for the average HBR and score metrics (highlighted in the table) indicate that the intra-subject differences between tasks for those metrics are statistically significant. Unfortunately, we were not able to encounter any statistical relevance as far as the accuracy metric is concerned.

Table 7.7 – Friedman test results for Ctrl-Mole-Del trials.

	Average HBR	**Score**	**Accuracy**
N	30	30	30

Chi-Square	20.267	17.867	1.267
df	2	2	2
Asymp. Sig.	.000	.000	.531

Following this test, we proceeded to assess which tasks in particular possessed statistically significant differences between themselves. Again we opted for a set of Wilcoxon Signed Rank tests. Results can be observed in Table 7.8.

Table 7.8 – Wilcoxon Signed Rank test results for Ctrl-Mole-Del trials.

		Task 1 – Task 2	**Task 1 – Task 3**	**Task 2 – Task 3**
Average HBR	Z	-4.145[a]	-4.238[a]	-1.738[b]
	Asymp. Sig. (2-tailed)	.000	.000	.082
Score	Z	-4.557[a]	-3.045[a]	-1.368[b]
	Asymp. Sig. (2-tailed)	.000	.002	.171
Accuracy	Z	-.915[a]	-.381[b]	-1.656[b]
	Asymp. Sig. (2-tailed)	.360	.703	.098

For the average HBR metric, we found statistically significant differences ($p < 0.05$) when comparing Task 1 to either Task 2 ($Z = -4.14$; $p < 0.01$) or Task 3 ($Z = -4.23$; $p < 0.01$). Task 2 and Task 3 did not show any significant differences between each other ($Z = -1.73$; $p = 0.082$). All these results are in harmony with Wrong Lane Chase's findings concerning the players' average HBR.

The same outcome was witnessed for the score metric. Players were able to significantly increase their performance when comparing Task 1 to either Task 2 ($Z = -4.55$; $p < 0.01$) or Task 3 ($Z = -3.04$; $p = 0.02$). Again, no significant differences were encountered regarding Task 2 and Task 3 ($Z = -1.36$; $p = 0.171$), strengthening our findings until now.

Contrary to the score metric, the players' accuracy did not show any statistically significant differences between tasks. We believe that the absence of any statistical relevance is tied to the same rationale behind the discrepancy between the players' score and accuracy depicted in Chapter 6: the score policy. Players who are unsure they will be able to successfully hit a target can idle momentarily and wait for a new one. By adopting this behavior, players do not incur in any score penalty, since the deduction requires 3 seconds without partaking in any action.

7.4 Discussion

The outcome of these trials supports favorable answers for the research questions we established at the beginning of this chapter. We showed how persuasive strategies based on the existence of placebo reinforcements are able to impact on a player's physiological state and performance. Furthermore, our findings indicate there are no significant differences between a real and a deceitful persuasive mechanic in the assessed videogames. We will now delve into how this impacts on existing expertise in this area and how these results frame in the context of this research.

7.4.1 Placebos VS Real Persuasive Instruments

The main goal of this chapter consisted in showing that placebo reward mechanics have an equivalent impact on player experience to their real counterpart. The statistical evidence we presented determines that the usage of both real and placebo reward based persuasive instruments can steer a player towards a state of relaxation be effectively lowering their average heart rate values during gameplay period. Concurrently, we also gathered empirical evidence suggesting that both approaches are able to aid players in improving their performance. While the provision of rewards is part of the operant conditioning theory, a long established psychological approach to incentivize an individual into adopting certain behaviors and / or creeds (Verplanck, 1956), research considering the usage of rewards to achieve the same effect is often contained within the healthcare domain. Its usage in videogames is even more daring since, according to our literature review, no work mentions such approach as a way to motivate players.

In light of the empirical evidence gathered within the context of all experimental periods, what are the implications of these findings? We opted to divide the answer to this question in three parts: the first two related with the impact on the two facets of player experience assessed in this research and the final part concerning the psychological effect that rewards and their placebo counterpart have on players.

7.4.1.1 The Relaxation Effect

The way the player relaxes over gameplay period was the origin of our venture into the usage of deceitful persuasive approaches. We had witnessed that despite similar reward mechanisms having opposite effects on player performance, they still managed to relax over that playing period. We immediately theorized whether the knowledge of the presence of a reward mechanism was the catalyst for relaxation instead of witnessing its behavior during gameplay. We aimed at validating our hypothesis on this matter. The results showed that, indeed, players can relax when faced with real rewards and their placebo counterparts.

In both games, we believe that the discrepancy between the absence of any rewards and their inclusion can be explained via the feeling of comfort these mechanisms produce on players. While no subjective assessment was performed to extract this information, we argue that the knowledge of the existence of a feature which exists to potentially aid the player is enticing for players to enter a comfort zone. Ultimately, this comfort can result in a relaxation which explains the lower heart rate values.

7.4.1.2 Performance – Psychological Warfare VS In-Game Materialization

The most interesting (and surprising) result retrieved during these experimental periods concerns the effect that real and placebo rewards exert on the players' performance. While the outcome about the usage of real rewards had already been assessed in the previous experiments, the ways their placebo counterparts influence user performance emerge as an unexpected outcome. We gathered empirical evidence that not only shows that real and placebo rewards can be used to improve the players' performance but also that there are no significant differences between each other as far as this effect is concerned.

Among the variety of questions one can ask when faced with these results, we opted to select a single one which is dissimulated in the title of this section:

- Is the reward's activation effect / behavior paramount for player performance?

Our findings suggest that the reward's behavior is not determinant for improving player performance. In fact, regardless of its presence, subjects were able to reach equally good achievements. The struggle between the psychological influence of the knowledge of the existence of rewards and the way they are materialized within the game becomes the pivotal discussion point to better understand the witnessed impact. We argue that the psychological influence can far surpass the reward's behavior upon activation. The reason for this somewhat bold statement stems from Ctrl-Mole-Del's Time Extension reward mechanism's design. When we introduced the Time Extension's prototype design we briefly mentioned a small detail which has not been previously discussed, but which takes a central role in this discussion: we purposely left a feedback panel showcasing the remaining time for the game to finish. Given that this panel was already present in Chapter 6's experiment, it means that the performance gain (and associated relaxation effect) overlaps the negative effects witnessed in the same experiment's task involving the chronometer feedback panel (Task 3).

Let us now frame that design detail in this chapter's experiment. On the one hand we had the same fully functioning prototype addressing the time extension reward with a time remaining feedback panel. We also had a placebo version of this reward with the same feedback. The only difference between this task and the time remaining feedback panel one was the knowledge that players had that a reward mechanism was present in that trial. The conclusion we draw from this line of thought is that:

- The beneficial impact that the knowledge of the existence of a positive reinforcement exerts on a player is potentially stronger than the negative impact manifested by existing pejorative persuasive instruments.

This sums the findings for the performance related analysis of how real and placebo rewards fare against each other.

7.4.2 Design Considerations

Our research focuses on the human factors associated with the usage of different types of persuasive instruments. One of the most enticing challenges regarding deceitful persuasion is its design process. Particularly, one question emerges as critical:

- Does designing a deceitful persuasive mechanic take the same amount of effort as a real persuasive mechanism?

We believe the answer is no. As we demonstrated, the provision of a deceitful reward mimics the essence of its real counterpart. The difference resides in the absence of any modification to the game world, which deprives the player from benefiting from its effects. From a development perspective, this should potentially decrease the amount of effort required, since no resources are spent on changing the game world. The most important challenge is transferred towards the design of the deceitful mechanic itself. This encompasses the identification of persuasive mechanics and reward strategies capable of being mimicked by deceitful versions with little to no risk of being detected by the players. In the end, we believe that this process requires less effort than implementing a fully functional persuasive element, potentiating an attractive option to designers and developers alike.

We are required to add a note here pertaining to the design process of these placebo rewards. Part of the effort had already been carried out in the previous chapter in the design of the reward itself using our own MSI model. Of course an immediate question arises:

- Is the MSI persuasion model broad enough to cover deceitful persuasive strategies and instruments?

For now, we provide a negative answer to this question. Deceit introduces a set of concepts to the persuasion context which are not easily graspable via the current MSI model (or any of the theories it is derived from). As we already suggested during the placebo design process, trickery, false promises and the mental models created by players are important aspects which are yet to be addressed in the MSI persuasion model. We will return to this topic in the next chapter. For now we will expand on this discussion by introducing three new topics: how easy it is to detect deceit, the role of suspension of disbelief and the ethics behind the usage of deceitful persuasive instruments.

7.4.2.1 Minimizing the Potential for Deceit Detection

The ability to minimize the potential that a certain deceitful mechanic can be discovered is a challenge that any designer will face. When we created Wrong Lane Chase we ended with a small set of potential rewards prone to be employed during the experiments. One example encompassed an energy field which increased the coin pick-up radius, while another allowed the player to shoot three bullets side by side during the game's second stage. While one may think that the imagination is the limit, some designs may not be entirely adequate to encompass deceit. For instance, playing with the energy field's radius in the example given above would be risky, since tricking players based on that visual cue alone would, most likely, not suffice to the requirements. Likewise, the second example provided (triple shooting) would easily be dismissed by players through the identification of duds.

Our two successful ventures deviate from these examples in a particular aspect: they possess supporting features capable of mitigating the potential of discovery. In the obstacle slowdown we utilize the game's scenery to conceal the unchanged obstacle speed. On the time extension deceitful instrument present in Ctrl-Mole-Del we played with the role of an authority figure providing information on the game's rules and the limitations of the players themselves who were not able to precisely detect the unchanged time. We argue that designers must capitalize not only on features involving the instruments in which they desire to add a deceit component but also on other characteristics surrounding them and which may play an important part in concealing the trickery.

7.4.2.2 Ensuring Suspension of Disbelief

One last challenge we were capable of identifying concerns how we were going to provide the deceptive persuasive mechanic and still ensure players would keep the perception that they were in possession of a real reinforcement – mostly related with the creation of mental models which persist regardless of the prototype being employed. We managed to rely on an immediate visual feedback effect which aided us in this purpose: since the real reward slowed down the background road and the obstacles simultaneously, we opted to maintain this visual effect in order to provide a clear perception that a certain mechanic had been activated within the game and the players were benefitting from it. This was verified by our results, allowing us to validate our hypothesis. Still, we do not consider this a straightforward exercise: a poor design may result in the alienation and provoke feelings of distrust to players.

Wrong Lane Chase's deceitful mechanic was already explained in the previous section. We did not give any room for the player to believe that the obstacles were not slowing down. By creating the general illusion that the game's speed was decreased, the extended that belief into each particular component of the game, including the incoming obstacles. This allowed for the illusion to come to fruition and thus it did not end up in creating a disruption between the game and the player.

Ctrl-Mole-Del capitalized on the role of an important authority (the game's developer and experiment's supervisor) to trick the players into believing they would be receiving certain rewards during the gameplay period. We argue that if the same procedure was carried out by a randomly selected individual, players would get suspicious instead of accepting the information as being from a trustworthy source. It is also important that this masquerade does not reveal its true nature during the interaction period, ensuring the player maintains his / her mental image in check.

In sum, designers must strive to successfully accomplish the deceitful intervention by maintaining the illusion throughout all interaction periods instead of merely working towards it momentarily. By tying this section with the previous one we can observe that suspension of disbelief should be attained by capitalizing on aspects surrounding the instruments of deceit. This process creates a mental image which capitalizes on the sum of a set of game features to perpetuate it, even if one of them falls short off of success in deceiving the target players.

7.4.3 Ethics

The final discussion point of this chapter addresses an important part regarding the innovative introduction of placebos as elements of play: are they ethically acceptable? The first part of the answer must build on a concept which inspired our research: placebos in the medical domain. Employing placebos to improve a patient's mental health condition is a practice justified by the multiple successful interventions of this type (Leslie, 1954; Simmons, 1978). From this standpoint, we believe the inclusion of deceitful persuasive strategies in videogames does not pose any questionable liabilities are still on course for the adoption of this type of persuasive technology. For pure entertainment purposes, we can foresee some potential hindrances towards the application of deceitful persuasive strategies. A few issues may emerge if a player discovers that some rewards do not produce any alterations in the game's mechanics. Such scenario can be quite probable in commercially available videogames, since there are multiple examples of players and companies specialized in using complex data-mining and logging tools to analyze this type of data (e.g. World of Logs, Digital Foundry, etc.).

The impact of discovering placebo persuasive mechanics is a challenging aspect of deceitful persuasive technology though. Most likely, this would promote feelings of alienation or distrust towards a certain game, or the developer. Even the intermingling of a real and a deceitful persuasive element would be quite difficult to justify if the discovery of the latter ensues. Despite this design problem, we cannot but defend our stance on deceitful persuasive mechanisms: these are a new contribution for videogame design and persuasive technology and one in which researchers and designers alike may build upon towards the creation of tailored persuasive games without the need of disrupting balance in competitive play.

7.4.4 Establishing a Theoretical Foundation

When faced with the previous chapter's results we opted to carry out yet another experimental period to dissipate our doubts regarding the plausibility of deceitful persuasive instruments. The highly empirical nature of this course of events may raise suspicions as of whether or not there are established models and / or frameworks tackling deceit in videogames. In light of this imbalance between theory and practice, we will dedicate the following chapter towards tying how these findings fit into existing persuasion and deceit theories. In particular, we are keen on addressing how the MSI persuasion model for videogames can be extended and / or adapted to accommodate the contributions stemming from this chapter's experimental period, bridging existing theories and the novel aspect of deceit as an alternative for rooted persuasive approaches.

7.4.5 Framing Results in our Goals

This chapter can be concluded with a note of success in light of reaching the goals we had set to surpass in the last couple of chapters. We were able to introduce a novel way of persuading players in videogames which breaks the conventional definitions of a persuasive intervention. The primary outcome of this chapter consisted in:

- Demonstrating the possibility of adapting existing reward based persuasive instruments into adopting a deceptive nature. In particular, we were able to create placebo versions of distinct natured rewards stemming from different game genres.
- Validating that placebo rewards can be used to steer players towards an optimal experience state, showing a transition from potential arousal / anxiety states towards flow.
- Showing that there are no significant differences between the impact of placebo rewards and their real counterparts on player experience. This result is valid for both the players' emotional response and their performance figures.

With all results aligned and with all major discussion points already addressed, we can safely answer the research questions presented at the beginning of this chapter:

- In a videogame, can placebo rewards affect the players' physiological state in order to steer them towards the optimal experience?

    - **Answer** – Yes. For the particular set of placebo rewards used in these experimental periods, we showed that the players' average heart rate significantly decreased when faced with placebo reward based persuasive instruments.

- In a videogame, can placebo rewards produce performance shifts capable of steering players towards the optimal experience state?

    - **Answer** – Yes. The empirical evidence collected from these trials clearly indicated a significant increase in player performance. Coupled with the physiological impact these placebo rewards produced, we can state that these deceitful instruments are capable of steering a player from a state of anxiety / arousal towards the optimal experience.

- In a videogame, is a placebo reward's impact of player experience significantly different from that of a real reward?

- **Answer** – No. We encountered no statistically significant differences between both the emotional responses and performance figures manifested by players to the usage of real and placebo reward based persuasive instruments.

The last intervention of this chapter forces us to revisit Fogg's (Fogg, 2002) definition of persuasion. Back in Chapter 2 we had presented persuasive interventions as:

- "an attempt to change attitudes or behaviors or both without using coercion or deception".

In light of the results obtained in this chapter, we are confident to change this definition, at least in the context of the videogame domain, towards:

- "an attempt to change attitudes or behaviors or both without using coercion".

In the end, this allows us to validate the hypothesis (H5) presented in this chapter.

7.5 Summary

Chapter 7 presented the most relevant and novel contribution of this thesis. The direction we adopted for this research stems from the outcome of the previous chapter's findings. The premise of players being able to relax themselves while being aware of the existence of reward mechanics but regardless of how well they were performing prompted us to assess whether a placebo-like effect could take place in videogames.

We immediately envisioned a final experimental period in which we would venture into unexplored territory regarding the plausibility and potential of deceitful persuasive instruments in videogames. Given the diversity of design possibilities to include deception in videogames, we opted to narrow down our research focus and capitalize on our previous experiments' settings. Ultimately, we ended up selecting placebo reward based persuasive instruments as our object of study, aiming at:

- Exploring how players responded physiologically to placebo rewards while playing videogames.
- Assessing how placebo rewards impacted on the players' performance figures.
- Demonstrating that real and placebo based rewards had equivalent impact on the players' experience.

To do so we created a couple of new prototypes for the games we had developed in this work. These prototypes feature placebo reward mechanics, acting as a counterpart for some of the already existing rewards present in both games.

The obtained results successfully favored our research questions. Players were, indeed, able to perform better and reduce their stress levels when confronted with the deceitful rewards. Statistical tests showed no relevant differences between the improvements in performance and the impact real and deceitful rewards had on the players' physiological state. Overall, we successfully addressed all empirical goals we proposed by the start of this chapter. The evidence retrieved paved the way to question existing definitions of persuasive interventions and issue an amendment by considering deceit as a viable approach inn this domain.

8 Theorizing Videogames & Deceit

Merriam-Webster's dictionary defines the act of deceiving someone or something as:

- "to make (someone) believe something that is not true".
- "to cause to accept as true or valid what is false or invalid".

Deceit is a term often associated with a negative connotation (Conti & Sobiesk, 2010). It is a strategy employed by scammers and other ill-intended agents for self-profit at the expense of someone else's possessions (if considering financial scams) or well-being (cognitive or physical) (Bell & Whaley, 1991) . It is therefore only natural that B. J. Fogg's definition of persuasive technology (which we tackled in previous chapters) addresses deceit quite clearly. He defines persuasion as:

- "(…) an attempt to change attitudes or behaviors or both without using coercion or deception".

This definition has since been widely adopted, accepted and cited as a quintessential statement within this area. Our venture in this particular domain produced results which question this definition. Despite the installed negative connotation, it is still a viable persuasive approach. A quick glance at existing literature in this area shows how seldom deceit has been the subject of research. One of the most recent ventures into exploring it was carried out by Adar et al (Adar et al., 2013), who stated that deceit happens when:

- "an explicit or implicit claim, omission of information, or system action, mediated by user perception, attention, comprehension, prior knowledge, beliefs, or other cognitive activity, creates a belief about a system or one of its attributes, which is demonstrably false or unsubstantiated as true, here it is likely that the belief will affect behavior, of a substantial percentage of users".

Instead of promptly dismissing deceit as a valid persuasion strategy, Adar enumerates typical approaches used to convey it. This definition approaches the success of the deceitful intervention cautiously, avoiding claims of ensured efficacy and opting to emphasize that those strategies are capable of reaching out to a significant number of users, but not necessarily the entirety of the targeted population. In addition to this research, Mechner (Mechner, 2010) has dedicated a substantial portion of his research towards understanding human behavior, creeds and strategies used to lead them into changing any of those. Among the subjects tackled by his research, deceit assumes a pivotal role, with multiple ventures into providing a theoretical background of the various approaches towards deceiving a group of users.

In light of this promising start, we will delve into the work of these two authors in detail. We will follow a chronological order, starting by Mechner's theories and then transitioning into the more recent theories defended by Adar et al and what new contributions they introduced to existing literature in this domain.

8.1 Mechner's Persuasion & Deceit Theories

Behavioral psychologist Francis Mechner (Mechner, 2010) has dedicated his life towards understanding behavior, contingencies and how users can be manipulated into adopting other creeds, ideals or attitudes. Among the theories explored, deception has also been subject of analysis, especially concerning different types of deceit. We opted to focus on the aspects of his research which are more tightly tied-in with our own research, especially considering the proposed MSI model and the results obtained thus far. Three topics emerged as being of significance for this research: the different types of deception approaches capable of persuading groups of users; which channels are used to convey deceit and what is the expected impact produced on the targets; practical examples where deceit was employed, not necessarily including modern technology as the main contributor to the intervention.

8.1.1 Types of Deceit

Mechner lists the following approaches as being suited to convey deception:

- **Masquerade & Impersonation** – Mercher defines this as an agent A assuming a certain role which is used to deceive a determined target B into believing that A is in fact properly certified for that role. This is an unfortunately common approach used to scam unaware individuals who don't ask for the appropriate credentials before committing into a false cause.
- **False Promises** – this strategy involves the deliberate usage of erroneous statements to deceive a determined target. Mercher suggests a World War 2 example concerning the usage of false landing sites messages by the allies before Operation Overlord, tricking the axis forces to mispredict those landing zones.
- **Indirect Deception** – this approach consists on deceiving a target B not due to the consequence of a determined act by agent A, but because it paved the way for another act by B whose consequence was detrimental to him / her.
- **Disguising Situations & Misrepresentation** – this approach is different from the usage of impersonation as it relates to a certain target B normally perceiving a determined state S but due to an agent A's actions it perceives a state S2. Examples range from a predator camouflaging to stalk on a prey to employees pretending to be busy when their boss is nearby.
- **Deceptive Advertising** – these are situations in which an agent deliberately states something (often false) which leads a target to take some behavior (often adhere to services). For instance, delivery companies often inform customers about their expected times of arrival, which sometimes are not consonant with what was advertised.
- **Counterfeiting** – this is a problematic issue particularly concerning retail. Several brands' products are subject to being imitated (sometimes faithfully) by sketchy

companies. These products' quality is often inferior and do not match the expectations that loyal users have for a product of their preferred brand. These sketchy items are typically sold in non-authorized stores (open markets, fairs, outlets).

- **Trickery** – this strategy introduces the concept of expectation: that is the probability to which a certain target B will adopt a determined behavior in response to being confronted with a behavior from agent A. The tale of the fall of Troy is given as an example of trickery (usage of the wooden horse to house soldiers who could infiltrate a city unnoticed).

Mechner lists a few more strategies which involve the concepts of property and time. However, these are mostly variations of the ones depicted in this list. In short, we can assert that deception recurs to lies, concealments and impersonations as the main instruments used to manipulate a target into adopting certain behaviors which are detrimental to them.

8.1.2 Channels & Impact

In the same research, Mechner (Mechner, 2010) also elaborates on a couple of other aspects of deception, namely channel types used to carry out the act of deception and the impact of the consequences achieved by those acts. The author identifies a set of characteristics which can help explain the outcome of these persuasive interventions recurring to deceit. He starts by describing the vehicle of deceit (this is the entity responsible for conveying deceitful intervention to the target(s)). As far the vehicle of deceit is concerned, the following were the emerging characteristics from Mechner's research:

- **Agent Type** – this definition of the deceit's delivery vehicle addresses whether it is an animate or inanimate entity. Scams can be carried out by actual individuals who approach target users with the intention of deceiving them. Optionally, the deceiving agent can recur to inanimate vehicles such as pamphlets or other medium for adverts to influence his / her target. The classification given to a machine can be ambiguous: on the one hand there is a trend to consider them inanimate objects; on the other hand, recent advances in artificial intelligence and adaptability allow for the creation of complex systems capable of reacting to the users' behavior and proactively suggest them some content. Additionally, a system may use third-party endorsement in video recording form to convey a determined message to the target user(s).

- **Channel Type** – deceitful information requires a channel between the deceitful entity and the target(s) of deceit. According to Mechner, this can be done directly or indirectly. The first addresses scenarios in which the deceiving agent directly engages the target and attempts to persuade him / her. The second pertains to situations where an intermediary (animate or inanimate) is involved. This is completely connected with the indirect deception scenario detailed in the previous section.

Following the characterization of the vehicle of deceit, the author concludes with detailing features associated with the intervention's impact on the target(s), according to three facets: whether there is a positive or negative outcome for the target(s); the rate at which the intervention unfolds itself; the rate at which the impact reveals itself. In detail, these three facets are described as:

- **Outcome Type** – regarding the results of the deceptive intervention, there are two possible outcomes. Either the deceptive intervention is advantageous (i.e. in terms of health, wealth, among other) to the target of the process or it results in a pejorative situation.
- **Persuasion Timeliness** – the rate at which the deceptive intervention develops is also an important characteristic. Some interventions may be sudden and attempt to deceive a target in a very short time frame. Others gradually expose the target to knowledge regarding the domain of the intervention, slowly paving the way for the target to be deceived.
- **Impact Timeliness** – complementing the timeliness of the persuasive process is the rate at which the consequences in the target(s) manifest or develop themselves. The consequences to the target of deceit can be immediate (e.g. investing in a fake fund, leading to an immediate financial loss) or they can be delayed (e.g. utilizing streams of adverts and promotional videos to gradually influence a target).

The conjunction of these characteristics enables a semi-formal description of deceptive interventions. Designers can recur to and combine these features to establish simple or complex processes which are capable of persuading one or multiple targets. The combination of different factors can be a determinant factor for the success of the intervention as it introduces the element of surprise, aiding the deceitful agent and having pejorative consequences for the target(s) of the intervention.

8.1.3 Practical Examples

Deceit is an act present throughout human history (B. H. Liddell Hart, Sun Tzu, 1971). Tricking others into pursuing different beliefs, attitudes or behaviors has been utilized in varied scenarios, ranging from the financial world (Bratton, 2002) to war theatres (ComNavEu, 1946). Examples across multiple domains and scenarios are diverse and utilize different strategies. We will now build on some hints left by Mechner and associate some of the most popular deceitful schemes with the approaches described in this section.

8.1.3.1 Employment Scams

Employment scams are a popular approach towards tricking people and gaining some financial leverage at the targets' expense (Christensen, 2013; ITT, 2013). The process typically involves an advert or direct contact with the targets. They are offered a favorable employment position with good salary, work conditions and bonuses, typically in a foreign country (ensuring the target is not fully aware of legislation). The deceit assumes the form of a pre-agreement that the target is required to sign with the agent of deceit. The agent requires the target to pay for some travel expenses, work visas and other legal documentation in advance to get the recruitment process unfolding. The recruiting agent (individual or company) then disappears once a satisfying financial revenue is acquired.

Considering the characteristics of deceit according to Mechner's theory, this process recurs to an animate agent using either a direct (e.g. personal contact) or an indirect (e.g. adverts) approach. The outcome is obviously disadvantageous to the target. The way the deceitful process unfolds is typically sudden but the actual negative impact may be delayed, as the target may not be immediately aware of the scam. Individuals are able to avoid falling in such scams by:

- Maintaining awareness that an easy entry to a job with significantly above average conditions is typically dubious.
- Investigating the legislation of the country where the job will take place.
- Tracking the background and authenticity of the entity making the offer.

8.1.3.2 Lottery Trickery

The lottery trick takes is a variant of the employment scheme. Here, individuals are informed that they have become the winners of a very large sum of money from a lottery game by email or phone (Lottery.co.uk, 2014). The targets are then asked to pay in advance for taxes, bank transfer fees and other expenses typically related with this type of prizes. Obviously, no lottery prize exists and the deceitful agent disappears once in possession of a considerable amount of paid fees.

This process usually uses a direct approach towards the targets as they are contacted on their emails or phone numbers by an animate deceitful agent. This results in a negative outcome for the targets as they are surprised by a sudden and, apparently, advantageous offer but which ends up in having immediate consequences for their financial accounts. Lottery trickery is fairly easy to avoid:

- Only someone who has paid and / or entered a contest is entitled to win something. So individuals who have not done either of these should be suspicious of the deceitful agents' intentions.
- Track the deceitful agents' background. In many countries, lottery prizes are subject to the legislation in vigor and are requires to be sanctioned by appropriate and authorized entities. If the offering / prize is not authorized by a properly identified entity, people should be suspicious as well.

8.1.3.3 Phishing

The widespread usage of computers, smart-phones and tablets as well as web-services in the last 15 years has changed the way people communicate and work (Keshav, 2005).

Time-consuming tasks such as going to the bank to request a transfer to another account has been trivialized with the usage of home-banking websites (Wire, 1995). However, this also means that we are increasingly putting sensitive information online, an opportunity which ill-intended agents eagerly expect to take advantage off of (Newswise, 2008).

Phishing is a technique in which a deceitful agent assumes a role of a trusted entity in an attempt to retrieve sensitive information about a target user (Stavroulakis & Stamp, 2010). This information typically concerns passwords for important sites (e.g. webmail, home-banking, etc.) or, in more extreme cases, credit card numbers. The process typically involves receiving an email from an agent claiming to be an intermediary to solve an issue with a service the user utilizes (e.g. bank accountant for home-banking, administrator for webmail services). In order for the problem to be completely solved the target is asked to provide his / her password and other sensitive information to the deceitful agent. The result is the latter impersonating the target of the trickery or using bank details for unauthorized payments.

This is a direct process initiated by an animate (e.g. individual posing as another entity) or inanimate (e.g. automatic mail generators). Obviously the outcome of this process is highly disadvantageous for the targets, as unaware individuals are suddenly confronted with an unexpected problem and reveal sensitive details, an act which has immediate consequences for them. Again, users may avoid falling for these tricks by investigating the authenticity of the entity sending the request and directly contacting the services which were flagged as having issues.

8.1.3.4 Ponzi Schemes

This strategy was baptized after a notorious and elaborate scheme unfolded by Charles Ponzi during early 20th century (Frankel, 2012). This is a financial fraud in which targets are confronted with relatively fast and high revenues upon accepting to make an initial investment. Deceiving agents usually recur to highly technical financial terms in order to amaze the targets with their expertise and ensure they are not aware of their hidden agenda. Unlike previous strategies, this scheme possesses a maturation process as in order to take out the full potential of the trickery, the deceitful agents are required to abide to proper and real investment approaches for a period, before capitalizing on all funds they are in possession of and disappear from their targets' reach.

An example of the process starts with a single person asking two targets to make an investment of 1000€ during 6 months, after which they receive their money back plus an interest rate of 10% to 15% (high values are used to easily seduce people). The money the deceiving agent gets is then used to fuel more of these deals and to actually pay some dividends to some investors. As the success of the scheme increases, people spread the word about its value – this is the time where bigger investors may take the chance to capitalize on their savings. When the deceitful agents have captured enough funds for their needs, they typically disappear, leaving all investors without their dividends and worse, their initial investments.

This scheme is the foundation of other and more sophisticated approaches such as the Pyramid Scheme. As of 2013, these are highly popular and known schemas especially considering the financial fraud carried out by Bernard Madoff (Shedlock, 2008), who was sentenced to jail for deceiving investors in high amounts of capital.

As far as the characteristics of this scheme are concerned, this is a mixture of masquerading and false promises. The agent is animate and the channel is direct (in relation to the actual person carrying out the deceit), but indirect to the origin of the scheme (top of the pyramid). The outcome of the intervention is mixed: initial investors may collect revenues as part of the deceitful agent's agenda to trick more clients; late adopters will be confronted with a negative outcome and, thus, be deprived of any revenue. The deceitful intervention is unfolded gradually, with the deceiving agent carefully treading and progressively garnering more clients into the scheme. The impact for the targets) is sudden, who will be deprived of their investments.

8.1.3.5 Spanish Prisoner

The Spanish prisoner schema has its roots in the 19th century. The original process develops as the deceitful agent contacts a target exposing a kidnapping / prisoner situation in which a ransom is required to save a person (Times, 1898). Obviously no one is endangered and the success of the schema relies on the naivety of the target to believe such situation and actually aid in paying that ransom. Throughout the years the schema has been refined, with more believable stories and scenarios being used to create empathy with the targets.

As far as the impact is concerned, the result is disadvantageous for the targets as they become deprived of the capital they invested for the ransom. This is actually an immediate consequence for falling into an offer which is presented to them promptly as if it was a sudden crisis requiring an immediate solution.

8.1.4 The Role of Technology

The channels used to convey deceptive cues evolved throughout history, justified by the diversity of periods which spanned from the earliest cited examples. From visual feedback in ancient times (e.g. lighting more torches than the size of one's army would imply), to the usage of false report messages or communications (e.g. during World War II messages often contained false information), the available technology has played a pivotal role in warranting the success of these interventions.

In the present day, modern technology is still paramount for deceptive interventions to come to fruition. While mail, pamphlets, telephone calls and television adverts were some of the most popular communication channels during most of the 20th century, the advent if the World Wide Web changed the way people communicate with each other. E-mail, fake advertisements in websites or fake websites are now some of the most common ways to deceive the masses.

The role of technology as an intermediary between the agents of persuasion / deceit and the target(s) of the intervention is typically one of dissemination. Elaborate schemes may capitalize on cutting-edge systems and / or applications, but, in general, technology is mostly used as the vehicle connecting the entities involved in the process. The success of the intervention is therefore tied with the creativity and quality of the process and instruments designed to achieved the desired end.

8.1.5 Summary

Deceit is a vast object of study within the social sciences and psychology domains. Several examples of its usage testify the popularity of these schemas as a mean to persuade users. The above mentioned strategies are just a subset from a rich and diverse spectrum of valid and successful approaches used to deceive unaware individuals.

In spite of the presented diversity, there is a common trait among all strategies: the impact is always disadvantageous for the target of deceit. Note that, while Ponzi schemes may adhere to proper channels and abide to a well-intentioned process, ultimately the goal is to deceive one or more targets. This is the main reason for the existing negative connotation with deceitful persuasive approaches. So, a question emerges: is it possible to use deceitful persuasion strategies for the benefit of the target of the deceitful intervention? According to existing research in the area, it is possible.

8.2 Adar's Benevolent Deception

Last chapter we were able to contradict the existing stigma revolving deceit: that its outcome is almost always pejorative towards the target(s) of the process. We collected empirical evidence suggesting the opposite phenomena. Players were capable of improving their performance figures (and thus approach the optimal experience state) despite being subject to a deceitful intervention consisting in the provision of placebo rewards.

As such, deceitful persuasive strategies can be employed for more than a target's prejudice (Adar et al., 2013). If correctly designed, the interventions can be used for the benefit of the target, improving life quality aspects (e.g. physical (Brewer, Fagan, Klatzky, & Matsuoka, 2005) and / or cognitive (Quetteville, 2008)) and other potential variables. Unlike pejorative deception in which the target of the persuasion process is typically taken advantage of, in benevolent deception scenarios the roles and who gets positive / negative consequences can be mixed (Adar et al., 2013).

Benevolent deception does not benefit from well-established and resilient theories, models and frameworks as witnessed for the persuasion and deceitful persuasion cases. Eytan Adar et al (Adar et al., 2013) provide a broad overview of how benevolent deception and technology can be intermingled. Their theories base themselves on the concepts of the rationale behind the usage of benevolent deception and the instruments used to convey deceptive cues. While the previous section focused on giving a broad view of the utilization of deception in everyday life, here we will narrow our scope and delve into the coupling of benevolent deception with technology.

8.2.1 Rationale

The rationale is what drives the employment of deceptive persuasion cues as a mean to aid a target user, in the particular case of benevolent deception. Particularly, this discussion also addresses the best scenarios and settings in which benevolent deception can be used. The following are the four types of situations as defined by Adar et al:

- **Users' Expectations vs. System Image** – users have expectations about systems. Whether this is related with its performance, availability or security, individuals are able to preemptively create a mental model of what they perceive the system should be capable of. Occasionally, systems do not meet those expectations, a situation which designers and developers are often aware of. Multiple companies utilize deceptive strategies to conceal failures from users in an attempt to keep offering them a pleasant experience. 1ESS phone call routing system tricked users into believing they misdialed the number when the system itself failed to connect two users (Plauger, 1994). Netflix also switches from a personalized recommender system to a simpler one based on popular movies when no internet connection is available (Ciancutti, 2010). Benevolent deception is used in these cases to dissimulate system caveats, while striving to keep the user engaged in a pleasant experience.
- **User vs. Group** – this is a concern for system with several active users. Designers may feel the requirement to keep the needs of individuals and those of a group balanced. For instance, statistical databases add noise to search results (e.g. hiding real data or providing fake information) in order to preserve sensitive individual information from others as part of a security policy.
- **User vs. User** – the rationale behind this type of approach lies in the protection of the user from him / herself. For instance, rehabilitation patients can often lack the motivation to further exercise beyond the minimum requested. Designers can capitalize on this by underestimating the effort committed by the patients. A real word example took place in a German town where a fake bus stop was placed near an Alzheimer treatment center. Patients would frequently sit at the bus stop instead of wandering off and getting lost (Quetteville, 2008).
- **Design Goals vs. Design Goals** – the conflict between design goals can be a proper setting for the usage of deceit. This motivation is somewhat related with the rationale behind "Users' Expectations vs. System Image". Here, designers attempt to find a compromise between conflicting design directives. The example provided by Adar depicts a conflict between allowing a system to fail "gracefully" against failing "abruptly". The author argues that, occasionally, failing "gracefully" contains

the process of failing "abruptly", allowing the user to continue working unaware of the system's demise (albeit it may be restored without user knowledge).

8.2.2 Instruments

As observed throughout this document, successful persuasive interventions capitalize on a diversity of instruments utilized to convey small cues capable of affecting one's ideals and / or attitudes. Adar describes three types of deceptive instruments. These revolve around the ideas of dissimulating systems' shortcomings, deceiving as a response to user behavior and deceiving a user's mental model of a system:

- **System Image Deception** – shortcomings and limitations in a system can be dissimulated using deception. In this case, the goal is for the user to be unaware of these, keeping him / her enjoying a pleasant experience. Adar divides this type of instrument according to three different approaches:
    - **Functional Deception** – this is normally related with the conveyance of incorrect information to the user. A common example addresses the usage of progress bars (C. Harrison, Yeo, & Hudson, 2010). These controls give users a rough estimate about the time remaining to complete a determined task. However, several factors may impact on this prediction: latency and CPU usage are such examples. When latency scales, the progress bar is slowly updated, keeping an illusion of progress, albeit the task may require more time than initially scheduled to complete.
    - **Capability Based Deception** – this type of instrument is often used to disguise severe faults. The typical scenario involves having a backup system (sometimes with less potent functionalities than the original) which is used to replace the main system when it is temporarily disabled. The previously mentioned Netflix example falls into this category.
    - **Sandboxing** – on this approach, designers also recur to a secondary system to convey deception. However, its purpose is slightly different from the previous case: instead of replacing a faulty system, it is used to give the illusion of a working system, while some behavior or functionalities may

not actually be implemented. The quintessential example of sandboxing is the "Wizard of Oz" technique (Cross, 1977).

- **Behavioral Deception** – behavioral deception builds on human limitations to deceive users. Human beings possess restrictions in various areas which sometimes are fruit of their perceptions: vision, hearing or motor limitations are possible examples. Some designers capitalize on these limitations to introduce forms of deception which provide users with a perception and sense of success. Gesture recognizers typically are not able to detect with 100% accuracy the gestures users perform. To cope with this limitation, developers open the spectrum of accepted inputs to accommodate for similar but not entirely accurate gesture motions (Labs, 2013).
- **Mental Model Deception** – complementing the behavioral deception approach, designers can also rely on deceiving the users' mental model to improve their experiences. Users are capable of building a set of expectations regarding how a system should work. For instance, individuals expect a car to progressively stop when they press the brake pedal. Similarly, they expect for a window to close when they press the small cross shaped button in the upper right corner (on the most popular operating systems). When some of these expectations are not met, designers need to come up with techniques to dissimulate them. One recent example stems from the automobile industry. Electric vehicles produce almost no engine noise (Colwell, 2012). This may become a potential issue especially taking into account that drivers use it as a form of feedback during driving. Vehicle designers have come up with the idea of using artificial engine noises to give the same audio sensation of a combustion engine, attempting to mitigate the differences between the two types of vehicles.

8.2.3 Opportunities

Adar introduces one last argument concerning the existing opportunities for a successful benevolent deception intervention. There are two possible ways such interventions can be succeeded:

- The user willingly wants to be deceived

- The deceitful instrument is so well designed that users are not able to distinguish truth from deceit

The first occurs whenever an individual is in a state of acceptance for a persuasive and / or deceitful intervention. Suspension of disbelief plays a role here. Individuals are voluntarily committing themselves into altering their creeds and / or behaviors temporarily or permanently when they are addressed to do so. Typical examples of this situation occur in illusion shows. Even though the audience knows in advance that the tricks they will witness are nothing more than optical illusions, they willingly accept that in order to appreciate the spectacle (Cater, Chalmers, & Dalton, 2003).

The second is the most challenging scenario. The elaboration of a deceitful persuasive instrument which is not prone to immediate identification by the targets of the intervention is a design exercise which requires careful consideration. The exercise involves the identification of situations during which the deceitful instrument can be delivered without disrupting the interaction process or displaying an obvious change in the system state and / or diminished capabilities. This type of opportunities does not arise so frequently due to a couple of reasons. First, the discovery of the deceitful instrument, on behalf of the target of deceit, may incur on severe consequences for the entities exploring the opportunity of deceit (Barry & Rehel, 2013; Jamison, Karlan, & Schechter, 2008). From a consumer perspective, a feeling of distrust would likely be installed, potentially leading to negative consumer feedback and, ultimately, loss of costumers (Hasan & Subhani, 2011). Second, the ethical consideration behind this approach may have some implications and / or inconsistencies with determined practices of even the ensuing legislation (Legislation, 2003). This is a particularly relevant concern in scenarios with a critical nature such as healthcare (Benn, 2001) or online sales sites (Laws, 2013). These points were already approached from an empirical perspective in the previous chapter's discussion section.

8.2.4 Practical Examples

Examples of benevolent deception are not entirely common in existing literature and in commercial ventures. While persuasive interventions are relatively common with examples stemming from a variety of domains and recurring to a diversity of instruments, deceptive interventions suffer from a negative connotation stigma which relates them with having a pejorative impact. Existing literature and examples are scarce. In their review of this area, Adar et al (Adar et al., 2013) cover some ventures into this domain which utilize technology as a mediator between agent and target(s) of deceit.

8.2.4.1 Netflix

Netflix is an online provider of on-demand streaming media content which is available in various countries around the globe. The streaming of movies and television series are two examples of the type of content available through the service. Typically, in systems of this nature, it is fairly common for a user to be confronted with a recommendation system. This is a feature which suggests content to users based on what they have previously consumed (e.g. suggesting a horror movie to a user who has recently watched ten movies of that genre). Such feature evolves over time, as the suggestions become increasingly more personalized and tailored to the users' expectations and preferences. Given the online nature of the on-demand service, it is natural that a requirement for availability is pivotal for its success. However, despite all efforts, sometimes it is not possible to ensure the availability of the system at all times. Network failures or unforeseen bugs may impede the system from being up constantly.

Netflix engineers circumvented this kind of issue by maintaining two recommendation systems. The first, used by omission, recommends content to the user based on his / her preferences, backlog of watched content and other metrics which can contribute for a more accurate recommendation. The second, used whenever some failure emerges, is a less potent recommendation system merely based on what is most popular among the consumers, thus not reflecting personal choices. The success of this benevolent deception intervention stems from the design options taken for the transition period between the primary and secondary recommendation system. Netflix maintains the same visual appearance when the secondary recommendation system is online. This contributes to interface consistency and consequentially to maintaining the illusion that the system is running with no background faults.

8.2.4.2 Windows Vista Speech Tutorial

Microsoft's Windows Vista operation system contemplates a speech recognition system allowing users to vocalize their commands to the computer instead of interacting with the classic keyboard and mouse pointing device setup. An interaction paradigm change of this nature enforces users to go through a learning process (Loraas & Diaz, 2009; Russell, 1995; Somekh, 2000). In this particular case, the process was partially mediated using a tutorial section during which users could experiment with some voice commands.

Speech synthesizers can be sensitive for small variations of volume, background noise and other variables which may impact on the quality and accuracy of the recognition algorithms (Wang & Zhao, 2011). If a command is misinterpreted, the user may trigger an action which he / she did not originally intended to do so. At the same time, users incurring in a tutorial segment are typically those which are unaware of the functionality and perceive that they require some training before attempting to utilize a system to its full potential, avoiding to perform actions which would otherwise harm it.

To mitigate problems of this nature, Microsoft utilized a controlled environment during the Windows Vista Speech Tutorial. While the software appears to accept any voice command issued by the user, it actually only expects a determined command to be issued (i.e. the one which it prompted to the user), disabling the activation of other commands which could have been misinterpreted or involuntarily prompted. This approach maintains the illusion that the tutorial system is working as intended, since it asks directly for a specific command to be vocalized, while disabling the activation of other commands. Ultimately, this is a valid example of benevolent deception in which users are protected from activating unintended system actions while having no knowledge that such instrument is in place.

8.2.5 Summary

Adar's theories on benevolent deception fit-in properly with the empirical findings retrieved in the previous chapter. Deceit can, indeed, be used for more than taking advantage of some target user(s). It can be used to conceal system limitations and, according to our results, potentiate a user to excel in a determined task. The theory established by Adar et al introduces a number of concepts to ease the process of understanding benevolent deceitful interventions: the rationale, the instruments used and the opportunities which emerge for the intervention to take place.

Still, there are some unaddressed aspects which require our attention, particularly, given the context of this research. The most immediate one concerns the lack of examples addressing deceit in the videogames domain. We will fully dedicate the next section towards the analysis of such examples, taking into account the theories we explored in the previous couple of sections.

8.3 Deceit in Videogames

The usage of deceitful strategies in videogames resumes itself to a handful of examples. Most of these build on categories and concepts as described by Adar et al (Adar et al., 2013) . Videogames as an entertainment medium possess various characteristics which can be capitalized upon in order to convey deceitful persuasive instruments. While most systems rely on visual user interface tricks to deceive the user, videogames can utilize sound, gameplay mechanics or even storytelling to reach the user.

To assess the presence of benevolent deception strategies in videogames, we started by analyzing the game list which we had selected for our analysis of persuasive instruments in Chapter 3. Additionally, we sought other games which we knew, from experience, that they possessed certain characteristics which could be considered appropriate for this thematic. In the end, we were able to identify a set of categories of benevolent deception strategies which are applied in videogames: via storytelling, usage of behavioral deception instruments and the usage of benevolent deception as part of the gameplay experience and mechanics themselves.

8.3.1 Storytelling

Videogames evolved from having simple motivational stories (e.g. “Rescue the Princess” in “Super Mario” (Nintendo, 1985)) to complex and almost cinematic storylines such as the ones depicted in “Heavy Rain” (Dream, 2010), “The Last of Us” (Dog, 2013) or in “The Elder Scrolls” (B. G. Studios, 1994) franchise. The more complex these stories become, the higher the probability of finding literature or cinema techniques such as narration, dialogues, plot-twists and other storytelling approaches which are capable of engaging the player. In recent years, some games have presented elaborate storylines comprising chains of events which we consider to be deceitful in their own nature to the player.

The first example is "Diablo 3" (B. Entertainment, 2012). Throughout the game we journey across various lands in the presence of a girl named Leah which is said to be the key to imprisoning the forces of evil that we battle throughout the game. A chain of events, including the rescuing of her long lost mother and her own training to be able to accomplish the imprisonment technique are also told via narrated cut scenes and dialogues. In the end, Leah's mother betrays everyone by using her powers to unleash Leah's true form – Diablo, the enemy the player had been after the whole game.

In the critically acclaimed "Portal" (Corporation, 2007) game, the player is approached by a sentient AI called GlaDOS to carry out a set of tasks for it. In exchange, the player's character is promised a cake. Throughout the game's levels, GlaDOS' assignments pile up, with the player constantly being promised to receive a cake at the end. After the last level, GlaDOS betrays the player by declaring that "the cake is a lie", a statement and a scene of the game which went viral in the internet due to its impact on the game's ending (Figure 8.1).

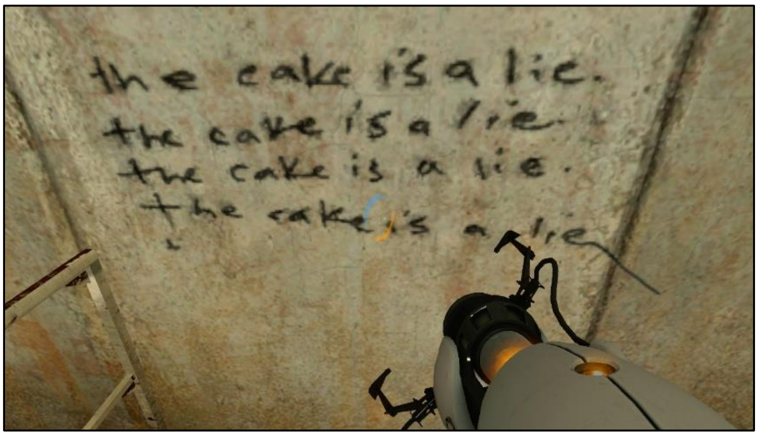


Figure 8.1 – Portal's infamous "The cake is a lie" quote.

"Bioshock" (2K Games, 2007) is a game in which the usage of deception is tied to the story's development. In the game, the player's assume the role of Jack, an individual who wakes up in a mysterious underwater colony called Rapture. The player is introduced to a set of characters, namely Frank Fontaine who befriends Jack. Andrew Ryan is also introduced as the leader of the colony and someone whom Frank Fontaine is interested in usurping his position of leadership. Fontaine politely asks players to perform seemingly harmless tasks by using the expression "Would you kindly…" (Figure 8.2). When the player finally meets Fontaine, it is revealed that the expression he used to convince Jack to do his bidding was actually a hypnotic trigger which forced his actions to Fontaine's desires.

Figure 8.2 – A wall writing hinting at the "Would you kindly" expression in Bioshock.

These are three examples of deception in videogames which use storytelling as the vehicle to convey the persuasive instruments. Even so, an important question emerges: does the presence of deception in storytelling have any impact on the players' performance or willingness to play the game? We believe it doesn't. While players may feel more connected to the story and / or characters or prefer the overall storytelling experience, the precise way these stories unfold is typically not a strong enough motive to forfeit the game (note that we are not addressing the quality of the story, but the way it is conveyed). In addition, this approach falls into one of the opportunity cases as described by Adar: players need to willingly accept that they will be deceived during the game. While Portal and Bioshock only reveal the deception at the very end of the story, Diablo 3 shows minor cues throughout the game, leading the player to suspect the true intentions behind the character's actions. This requires the players to voluntarily accept that they will be deceived in time in order to enjoy the experience. Using storytelling as an instrument of deceit is a plausible approach, but one which typically only works for the first time the player goes through the story as the impact is severely diminished in posterior experiences.

8.3.2 Behavioral Deception

Behavioral deception addresses the usage of instruments capable of dissimulating both a system's shortcomings (e.g. difficulty in accurately identifying determined gestures) and a user's own limitations (e.g. difficulty to accurately select an item from a list box). One of the prime examples of this phenomenon in videogames is tied with the surge of motion-based videogames. Lead by the introduction of the Nintendo Wii (Nintendo, 2006) console, other manufacturers entered the fray with their own devices: Microsoft with Kinect (Microsoft, 2010) and Sony with Move (Sony, 2010). Videogames typically require fast movements and quick reflexes to the events in the virtual world. The processing power required to accurately identify the gestures performed in quick succession during frenetic segments of gameplay may be too demanding for consoles. At the same time, players may not perform the exact gestures required to trigger determined commands as instructed to them but instead display movements which are close enough to resemble the action they intended to carry out. For these cases, developers typically allow for movements with a determined degree of similarity to a baseline gesture be accepted as valid.

A similar approach is taken in "Guitar Hero" (Harmonix, 2005). In the game, players visualize a simplification of guitar tabs for a given song. They are required to hit the appropriate buttons in the gamepad or plastic guitar when the notes appear over a determined trigger line (Figure 8.3 – bottom). The game, however, does not require the note to be precisely over the line, allowing for a very small degree of error for playing the note too soon or too late.

Figure 8.3 – Guitar Hero's note triggering line at the bottom.

Both examples fall, exactly into the behavioral deception category as exemplified by Adar et al. The benevolent deception aspect stems from the fact that the players' performance is improved by an intended design choice, while at the same time ignoring those design limitations. An important note here is that we believe that in their inception, although fitting for Adar's categorization, these examples do not have the intent to deceive users, but rather to conceal a system's and algorithms' shortcomings when it comes to the accurate identification of user input.

8.3.3 Core Gameplay Mechanics

Deceit can also manifest itself as part of a game's core gameplay mechanics. "Metal Gear Solid" (Konami, 1998), a game by Konami which brought the stealth-action genre into mainstream success, capitalizes on the usage of deception as the primary mechanic to advance through the game. Action games typically require the player to defeat waves of enemies in order to advance the plot or proceed to the next level. "Tomb Raider" (Design, 1996) and "Gears of War" (E. Games, 2006) are all examples which fit this category. In the late 80s, some designers saw the opportunity of utilizing stealth and deceit as the main instruments to successfully advance through the game. In "Metal Gear Solid" (Konami, 1998), players controlled a super-agent who infiltrated heavily guarded military precincts with the goal of impeding a nuclear crisis. To do so, players would need to carefully advance each scenario by: a) not being spotted by enemy soldiers and / or cameras; b) killing as few enemies as possible; c) not raising any alarms. This can be achieved by attentively observing patrol maneuvers, using tranquilizing shots or using objects to deceive the enemies (e.g. a cardboard box – Figure 8.4 – left). In more recent entries of the franchise, the main character is equipped with a technologically advanced suit which automatically adapts to the surroundings (Figure 8.4 – right).

Figure 8.4 – Deception in Metal Gear Solid: go unnoticed in a cardboard box (left); automatic camouflage (right).

The “Assassin’s Creed” (Ubisoft, 2007) series has also capitalized on the usage of deceit as one of the game’s core mechanics. Here, the player controls an assassin which is required to travel through multiple settlements in order to silence a group of designated targets. Since these are often heavily guarded, players are required to utilize a diversity of skills and tricks to get to their targets, execute them and escape unscathed. Among these, players can blend in in crowds (e.g. sit between people talking in benches, mix in-between religious groups – Figure 8.5 left). When the player is discovered, enemy guards enter a state of alert, trying to catch the player. During these segments, players can not only used the previously explained tricks, but also hide in haystack piles until the guards lower their alert level (Figure 8.5 – right). Concurrently, players can use haystack to hide deceased bodies.

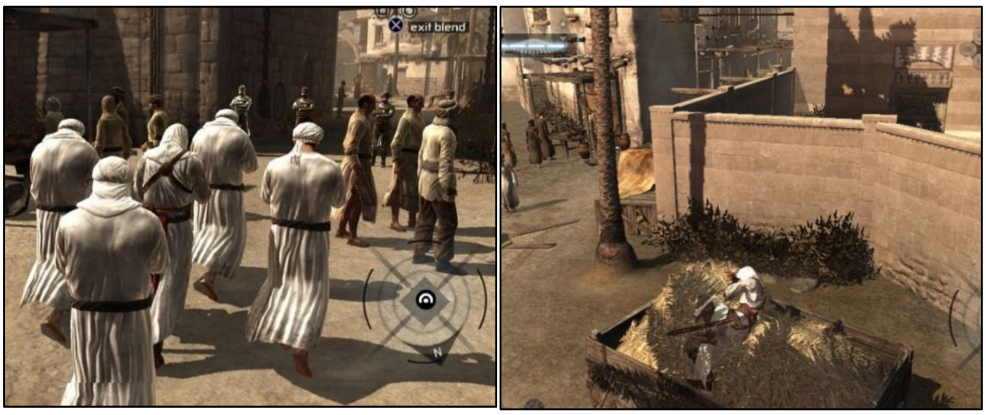


Figure 8.5 – Deception in Assassin’s Creed: blending in crowds (left; usage of haystack piles to hide (right).

Other games in this genre (or partially capitalizing on its features) utilize similar strategies to aid players in deceiving his / her opponents. Games like "Hitman – Absolution" (I. Interactive, 2012), "Splinter Cell" (Ubisoft, 2002) or "Far Cry 3" (Ubisoft, 2012) utilize stealth, cunning and other deceiving tricks as some of the main weapons players have at their disposal. In "Hitman" (I. Interactive, 2012), players can pick disguises to pose as someone authorized to be in determined places (e.g. janitor in a hotel, store clerk in an arms shop, etc.) and thus deceive enemy characters to accomplish the executions the player is hired for. In "Splinter Cell" (Ubisoft, 2002) players can use the environment's conditions (namely lighting) to pass unnoticed through heavily patrolled / guarded areas. In "Far Cry 3" (Ubisoft, 2012) players can utilize a variety of instruments such as rocks to distract enemies while slipping through for their targets by suppressing their footsteps and treading lightly.

The type of deceit presented in these examples heavily differs from our previously analyzed ones. The reason is straightforward: there is an inversion in the agent and target(s) of the deceitful intervention. While players have been the target in the storytelling and behavioral deception examples, in the reported cases for gameplay mechanics as instruments of deceit we looked at examples where players become the agents of persuasion and use deceitful strategies to trick artificially controlled entities. While this is not the type of deceit we want to explore in the context of our research, we needed to show that players can assume both roles (as the agent and as the target).

Examples in which deceitful gameplay mechanics are employed and the user is the target of the intervention are not this common. We showed in the previous chapter that it is possible to achieve it through clever usage of in-game mechanics and supporting deceiving channels and instruments such as a figure of authority providing players with deceitful information regarding a game's rules.

8.3.4 Caveats & Opportunities

This quick overview of deceit in videogames unveiled some trends as far as this persuasive approach is concerned. The first addresses the concealment of technical shortcomings. While we can stretch this course of action and admit it may be a case of persuading the players in order to keep them playing the game properly instead of delivering them a faulty product, it is not a classic type of persuasive intervention as depicted throughout this document. Our research line attempts at exploring the way persuasive strategies and instruments impact on the players' experience in order to potentiate it and bring them to a state of flow. This particular case falls into a category in which developers and designers attempt to hide technical shortcomings through the usage of masquerading and deceit (not necessarily as a full-fledged persuasive intervention as defined and characterized in Chapter 3).

The second trend we witnessed is related with the usage of deceit in complex storytelling. Literature regarding how storyline development affects a player's experience and, in particular, performance are scarce. We admit that story and character development may prompt players to feel emotionally connected to it, and thus affect their experience (Craveirinha & Roque, 2010). However, we didn't find any evidence tying player performance (an important part of the optimal experience as testified by our trials) with storytelling. Roth et al proposed a dimensional model that intermingles user experience with the motivational facet of storytelling (Roth, Vorderer, & Klimmt, 2009). Player flow is part of the model but, ultimately, there is no reference towards the specificities of the concept, leaving the way players are really influenced open for discussion and research. Additionally, storytelling based deceit's success is contingent to some premises: the first requires the players' commitment and willingness to be deceived; the second addresses the importance of experiencing the deceitful passages for the first time, since the impact is typically diminished in subsequent exposures.

The last group of examples we provided concerned the usage of deceit as part of a game's core mechanics, a design choice which is closer that what we had experimented with (especially considering the usage of reward and placebo based persuasive instruments). All analyzed examples possessed a common feature which deviate them from our research focus: they invert the role of the player from being the target of deceit towards the deceitful agent. Our goal with the introduction of deceit as a valid persuasive strategy consists in exploring how to deceive players amidst the gameplay period in order to alter their emotional state and performance. In this case, players are empowered with in-game abilities which allow them to trick computer-controlled agents. Since these agents' behavior is deterministic and abide to a finite set of states pre-programmed by their developers, we do not consider this to be a valid case of a deceitful persuasive intervention as far as our research is concerned.

We have summed up the main limitations present in the examples provided in our analysis. While the outcome may be apparently grim, with just a few examples actually abiding to existing theories, we look positively at the symbiotic relation we can establish between the state of deceit in videogames and our novel contribution in this area. Deceit as an in-game mechanic capable of stimulating a player both regarding his / her emotional state and performance is an inexistent type of assessment which we introduced in this document and which paves the way to explore other types of persuasive approaches and other clever ways to introduce deceit as an integral part of videogames.

There is, however, a missing link to conclude our research. We have assessed a respectable number of videogames which include deceit in their core. We have also been able to successfully design a couple of deceitful persuasive instruments which were shown to have significant influence on a player's experience. Still, this exercise was carried out without the assistance of a theoretical model or framework in which we based our decisions. That behavior is partially justified: none of the theories analyzed in Chapter 3 (Fogg's computer as social actors, Oinas-Kukkonen's PSD model or King and Tester's theories) consider deceit to be a valid persuasive strategy. However, so does our own MSI model. None of the devised strategies, support approaches or instruments are able to grasp the idiosyncrasies of deceit. From a theoretical point-of-view, the MSI model mapping for the real and placebo reward present in Wrong Lane Chase is the same. However, their strategies are completely different from each other. The same can be stated about storytelling based deceit: how would Portal's story development be expressed in a MSI model mapping? Furthermore, how could we build on Adar's benevolent deception theories and distinguish an intervention which is pejorative from one which is benevolent? These questions obviously suggest that there is a grand opportunity as far as creating a new theoretical model is concerned. We will dedicated the next section to this matter, analyzing the main points connecting deceit, benevolent deceit, videogames and our MSI model in order to produce a new and improved version of it.

8.4 Reviewing the MSI Persuasion Model

As suggested, the MSI model is insufficient to contemplate deceit as a valid persuasive approach. New concepts and / or extensions are, therefore, required to broaden the model's coverage and embrace deceit in videogames as we empirically showed in previous chapters. The broadening process will build on an insightful analysis covering two fronts:

- A retrospective "lessons learned" discussion regarding the design of deceitful persuasive instruments based on the experience with both Wrong Lane Chase and Ctrl-Mole-Del.
- A quick analysis of the concepts present in the theories about deceit and benevolent deception discussed in the current chapter and how they fit in with both the videogames domain and the existing MSI model.

8.4.1 Lessons Learned from our Experiments

Tying this conceptual framing and the existing results stemming from the trials reported in the previous chapters should produce new research opportunities as far as the usage of benevolent deception mechanisms is concerned. First, we will assess the persuasive instruments which were in the origin of all subsequent studies: the Accuracy Booster mechanic present in the Ctrl-Mole-Del trials in Chapter 6.

8.4.1.1 The Flawed Accuracy Booster

The flawed Accuracy Booster comprised the reward's expected behavior (i.e. temporarily increase the targets' hit-window time frame) and also an unforeseen side-effect which decreased the target's spawn rate. The latter, ultimately, ended up leading players to worse performance figures. Players not only started ignoring the reward but also provided us with (now) invaluable feedback at the end of the experiment:

- It interrupted the flow of gameplay.
- There was no apparent benefit.
- They were not expecting the spawn rate to be affected.

If we take into account all knowledge introduce in this chapter, we can tie-in this discontent, the characteristics of deceit and this particular instrument. The mechanic was originally designed to directly influence players by providing them with an advantageous outcome which was delivered immediately. Unfortunately, users viewed the outcome of this instrument as being pejorative. What had been proposed to them, according to their feedback, was an instrument based on trickery or false promises whose only purpose was to be detrimental to their experience. We believed that upon explaining to them the type of reward they would be confronted with, players built a mental model contemplating a set of expectations they assumed would come to fruition. The actual behavior of the persuasive instrument conflicted with the built mental model leading players to adopt the behavior they manifested. In sum, user expectations and the mental model they build around a determined concept is key for persuasion and deceit.

8.4.1.2 Designing Placebo Rewards

The design process associated with the placebo rewards employed in our experiments was carried out before venturing deeply into the theoretical models for deceitful interventions described in this chapter. Still, it is fairly straightforward to describe the way that those particular instruments can be mapped in the two models described. We will begin by addressing Mechner's theories. Since the instruments were designed to have a benevolent effect on the targets of the intervention, we will also carry out this mapping in regards to Adar et al's theories on benevolent deception.

Table 8.1 presents Wrong Lane Chase's and Ctrl-Mole-Del's deceitful instruments mapping according to Mechner's theory. Wrong Lane Chase's obstacle slowdown placebo reward is a case of disguising a situation and of misrepresentation. This is justified by the fact that the game utilizes auxiliary visual cues to lead the player into believing the obstacles are really being slowed down. The intervention is carried out by an inanimate agent (the game itself, since players discovered voluntarily the instrument's effects) and was done directly upon the target player. The outcome was, ultimately, advantageous to the player with the process being of a sudden nature and its impact being immediately recognized. Ctrl-Mole-Del's placebo time extension instrument possesses a similar mapping. The difference resides in the usage of false promises instead if misrepresentation, since it was an explicit experimental procedure to announce the time extension value verbally to the players. Such approach leads to the only other change in the mapping, which concerns the usage of an animate agent to deceive the targets, in this case the experiment's conductor. There are no other differences in this mapping exercise in regards to Wrong Lane Chase's.

Table 8.1 – Experimental placebo rewards' mapping on Mechner's theories.

	Type of Deceit	Channel		Impact		
		Agent Type	**Channel Type**	**Outcome Type**	**Persuasion Timeliness**	**Impact Timeliness**
Wrong Lane Chase	Disguising Situations; Misrepresentation	Inanimate	Direct	Advantageous	Sudden	Immediate
Ctrl-Mole-Del	Disguising Situations; False Promises	Animate	Direct	Advantageous	Sudden	Immediate

This mapping taught us that disguise should be a fairly common type of deceit in videogames. Since this is an entertainment medium heavily reliant on visual cues, it comes to no surprise that ocular tricks come into play when the goal is to deceive the player. Even though false promises were one of the types addressed in our experiment, we believe that it was a very special situation due to being an integral part of an experimental period. In the case of a commercially available videogame, this would happen if any kind third-party endorsement (according to the MSI model) was in play. Both channel and impact can vary according to the designers' approach, as we do not foresee heavy confluence towards a particular combination.

Following this mapping exercise, we proceeded towards carrying out a similar process with Adar's benevolent deception theory. Table 8.2 summarizes the result. Both Wrong Lane Chase and Ctrl-Mole-Del capitalize on a rationale based on the User Expectations vs System Image paradigm. This approach mirrors the "Disguising Situations" present in Mechner's mapping, since both rely on using clever mechanics to conceal the deceit. Ctrl-Mole-Del also recurs to the "User vs User" approach, as we view the (unfulfilled) promise of adding more gameplay time as a way for users to gain confidence in beating their own performances and steadily improve their figures. On the instruments side, we can observe that a "System Image Deception" approach was employed for Wrong Lane Chase. This was based on the "Sandboxing" paradigm which is justified by the usage, not of a secondary system, but of a set of mechanisms which occlude the inexistence of any behavior upon activating the obstacle slowdown reward. In both Wrong Lane Chase and Ctrl-Mole-Del we can witness the deployment of "Behavioral Deception" instruments. This is justified via the capitalization on the limitations of human vision which inhibits players from accurately identifying the trickery being cast upon them. Finally, as far as the opportunity to deceive is concerned, both games rely on the players' inability to distinguish truth from deceit, allowing the intervention to successfully come to fruition.

Table 8.2 – Experimental placebo rewards' mapping on Adar et al's benevolent deception theories.

	Rationale	**Instruments**	**Opportunity**
Wrong Lane Chase	User Expectations vs System Image	System Image Deception – Sandboxing; Behavioral Deception	Inability to distinguish truth from deceit
Ctrl-Mole-Del	User Expectations vs System Image; User vs User	Behavioral Deception	Inability to distinguish truth from deceit

Despite narrowing the focus of deceit towards benevolent deception (and, consequently, utilizing a specialized theory for it) it is fairly obvious that the image produced by a system in a user's mental model is still a strong approach towards a detailed description and conceptualization of a deceitful intervention. The instruments utilized can be varied and, unlike in the previous theory, we are not able to rule out any of the discussed strategies concerning their usage for the videogames domain. The type of opportunity is easily graspable: willingness to be deceived is expected to characterize story based deceitful interventions, while the inability to distinguish truth from deceit is reserved for everything else.

While this exercise was carried out for two very particular placebo reward based persuasive instruments, we believe that the spectrum of choices provided by both theories will not be excessively wide. We witnessed that system image plays an important role, especially when intermingled with the users' expectations. The characterization of the instruments and other specificities of the process are prone to change according to each intervention. Still, we believe that for benevolent deception approaches, behavioral deception will play a key role, since the exploitation of human sensory and cognitive limitations is the foundation of other domains where deceit is recurrently employed such as healthcare and illusionism.

8.4.2 Bridging Existing Literature

The second step carried out to review the MSI persuasion model encompassed looking at the analyzed theories about deceit and check which concepts are pivotal towards the characterization of a persuasive intervention which may or may not recur to deceitful techniques. This exercise encompassed two steps: the first addressed an initial filtering of strategies and / or instruments which are inadequate for the videogames domain; the second step comprised grouping concepts from the addressed theories and merged them into unified categories capable of abstracting those terms.

8.4.2.1 Domain Adequacy Filtering

Videogames provide a virtual environment for players to indulge in. While designers strive to faithfully recreate real-world characteristics and events in those virtual worlds, it comes to no surprise that some are either not adequate or simply cannot be replicated in such setting. By analyzing Mechner's theory we can identify two deceitful strategies which do not appear to be in consonance with the characteristics of the videogame domain. Deceiving players via either deceptive advertising or via counterfeiting are two approaches which we have not encountered in our review of deceit in videogames. Even if we build on examples of their execution in real-world settings, one immediately fails to encounter any scenario where their presence is plausible. Still, we have to state that we believe that deceptive advertising is partially embedded in approaches recurring to false promises schemes, with the latter providing a broader coverage to this type of strategy by refraining from being tied to a particular way of conveying information.

Adar's theories on benevolent deception only show a single instrument which we argue that does not fit the videogames domain. "Capability Based Deception" is not present in videogames. There are multiple examples of games where offline and online worlds collide to provide a seamless experience between those two paradigms. Recently released examples include Need for Speed Rivals. However, both modes are overlaid. This means that players typically have a game world where AI entities and online partners co-exist. When an error occurs, players are immediately informed about it. Even if the message was omitted, players could easily grasp the servers' status relying on other players' activity around them.

8.4.2.2 Merging Concepts

We proceeded with our exercise towards cataloguing both theories' concepts. This was done in two steps, already having the existing MSI model's structure in mind. First we identified which concepts could be classified as strategies, support or instruments. Table 8.3 showcases the resulting catalogue. Our first remark addresses the absence of any concepts related to the support partition of the MSI model. None of the analyzed theories gave importance to features used to explicitly support the strategy or instruments being deployed to carry out a deceitful intervention. Yet, we can also observe that there are three uncategorized concepts in Table 8.3: Mechner's channel and impact characterization along with Adar et al's opportunity. While we do not consider them to fit the support partition, we can label them as improving persuasive intervention's characteristics. We will return to this topic in the next section.

Table 8.3 – Cataloguing deceitful theories concepts into the MSI model's partitions.

Methods	Instruments	Uncategorized
▪ Disguising Situations & Misrepresentation ▪ Indirect Deception ▪ Trickery ▪ User Expectations vs System Image ▪ User vs Group ▪ User vs User ▪ Design Goals vs Design Goals ▪ Functional Deception ▪ Behavioral Deception ▪ Mental Model Deception	▪ False Promises ▪ Masquerade & Impersonation	▪ Channels ▪ Impact ▪ Opportunity

The remaining concepts were assigned to the appropriate partition. The immediate conclusion asserts that there is a noticeable imbalance between the number of identified methods and instruments. Despite Adar et al categorize a set of ideas as instruments (e.g. "Functional Deception", "Behavioral Deception", and "Mental Model Deception"), we still consider them to be closer to the description of a strategy rather than the actual mechanisms used to convey persuasive and deceitful cues to the target(s) of the intervention. Concepts like trickery, misrepresentation, playing with user expectations or the image that the system produces on the targets' mind are some examples of the methods identified from existing literature. The instruments partition only accommodated the usage of "False Promises" and "Masquerading & Impersonation". These mechanisms are typically deployed in order to convey deceitful information while using one of the methods we retrieved from existing literature. For instance, false promises can be seen as a way for users to improve themselves ("User vs User" method) or as a mechanism used to unfold a scenario where trickery is used.

After finishing accommodating these concepts into the MSI model's partitions, we delved deeply into the methods we analyzed. In particular, and since we extracted them from two different theories, we assessed whether they could be merged together into broader definitions capable of providing the necessary coverage for designers to grasp the underlying concepts. This exercise was carried out in two stages: identifying recurring themes among the methods; devising a new label to cover those methods according to the nomenclature used in the MSI model. Table 8.4 depicts the outcome of this exercise.

Table 8.4 – Merging deceitful methods into unified categories for the MSI model.

	Theme		
	User Expectations	User Context & Performance Awareness	Disguise & Misrepresentation
	▪ User Expectations vs System Image ▪ Functional Deception ▪ Mental Model Deception	▪ User vs Group ▪ User vs User	▪ Disguising Situations & Misrepresentation ▪ Design Goals vs Design Goals ▪ Behavioral Deception
New Category	Expectations vs Mental Model	Fuzzy Awareness	Disguise

Three themes were initially identified. The first pertains to strategies where the deceiver plays with the users' expectations and the perceived image they create about the system they are interacting with. Mechner's "User Expectations vs System Image" along with Adar et al's "System Image Deception" approaches (i.e. "Functional Deception" and "Mental Model Deception") are covered in this theme. In the context of the MSI model we labelled this type of method as "Expectations vs Mental Model". The second theme is related with methods where designers capitalize on the users' own influence on themselves or social dynamics (e.g. peer pressure) to deceive them. Examples include underestimating performances to entice users, hoping for better performance figures in future outings. This theme is supported by two of Adar et al's methods: "User vs Group" and "User vs User". We decided to label this family of approaches as deceit based on "Fuzzy Awareness". The last theme aggregates the remaining methods which are based on the usage of disguise and misrepresentation. Mechner's "Disguising Situations & Misrepresentation" along with Adar et al's "Design Goals vs Design Goals" and "Behavioral Deception" appear as the supporting pillars of this theme. In the context of the MSI model we decided to refer to this type of method merely as "Disguise". We will describe these families in more detail in the next section

8.4.3 The MSII Persuasion Model

After successfully concluding the extraction of concepts and other relevant cues from existing literature and our own experience with the design of deceitful persuasive mechanisms we were finally ready to channel that expertise towards the improvement of the MSI model the result can be observed Figure 8.6.

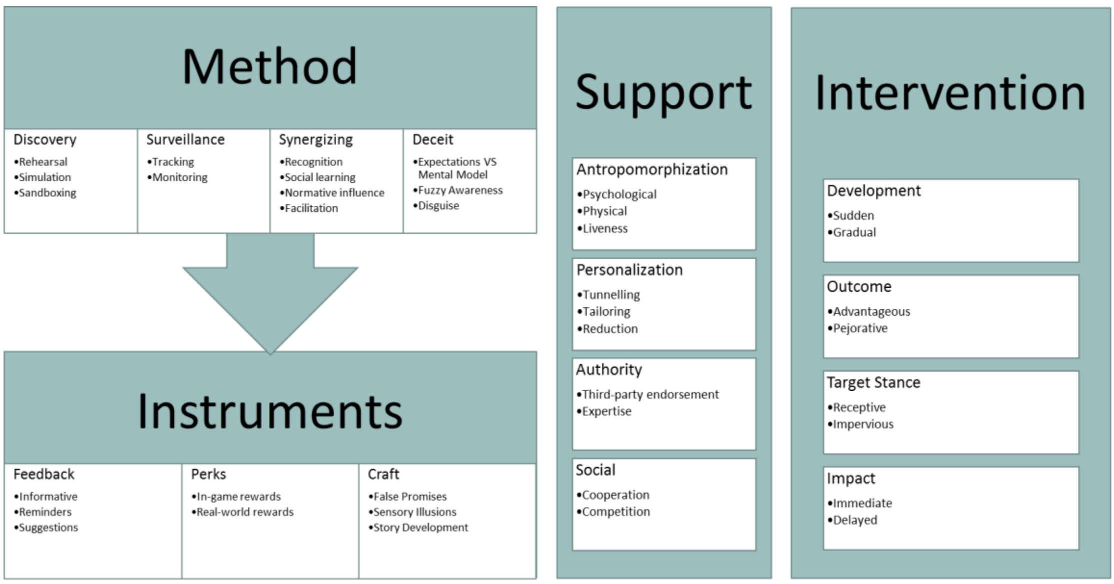


Figure 8.6 – The MSII persuasion model's components.

The intervention done to this model forced us to slightly alter its title, now being denominated the Method, Support, Instruments & Intervention (MSII) persuasion model.

8.4.3.1 The Deceit Method

There are noticeable changes in multiple partitions with the exception of the "Support" one. A new type of method, entitled "Deceit" was introduced, in order to provide coverage to this class of persuasive interventions. In the context of videogames, deceitful methods encompass:

- **Expectations vs Mental Model** – these approaches rely on a set of preconceived expectations built by users which may not be met by the system they are interacting with. Examples include the provision of placebo rewards such as the ones reported in the previous chapter.
- **Fuzzy Awareness** – these strategies rely on the users' imprecise awareness about the game's status and / or their own performance figures. While they are capable of maintaining an idea of how they fare, they are incapable of pinpointing with precision the actual values. Designers can capitalize on this to underestimate or overestimate these figures and engage users in the activities at hand.
- **Disguise** – as its name implies, this method is related with the usage of masquerading, misrepresentation and other types of disguising techniques as a way to conceal the absence of behavior that determined features in the videogame.

Note that the model is flexible enough to be able to accommodate other types of methods and approaches within those and, as such is not limited to the examples depicted in this diagram.

8.4.3.2 Crafty Instruments

The instruments partition was also upgraded with the addition of "Craft" as a section with noteworthy dedication towards deceitful instruments, although not exclusively. One of the examples provided stems from the review of existing literature in the area, while the remaining two were inherited from either our experience or the review of commercially available videogames which recur to deceitful techniques:

- **False Promises** – originate from Mechner's theory. We also deployed this instrument in Ctrl-Mole-Del's experimental period reported in Chapter 7. It consists in providing players with erroneous information which is not confirmed by the game's mechanics. For instance, informing that a determined behavior will be triggered when the game is not programmed to do it.
- **Sensory Illusions** – this type of instrument was inspired by Wrong Lane Chase's placebo reward and also by some related literature reports. This type of instrument is expected to be tied with methods based on user expectations. We define it as a mechanic capable of capitalizing on the game's feature set to provide an illusion that a determined event is being triggered when, in fact, nothing is happening. Note that we delved beyond optical illusions, allowing for the occurrence of illusions which capitalize on other human senses (e.g. audio based cues, vibrotacticle feedback, etc.).
- **Story Development** – the last instrument addresses the development of complex storylines. It feeds on existing examples such as Bioshock or Portal to justify its inclusion as a type of instrument. We define it as the unravelling of a storyline over the game's timeline. Whether it is a story with deceitful elements or not, it depends on the method being utilized in the persuasive intervention.

8.4.3.3 Characterizing the Intervention

Our final statements address the introduction of a fourth partition, entitled Intervention. The most important aspect attached to it concerns the fact that, although it was introduced as part of an exercise revolving around the concept of deceit, the Intervention partition is not exclusively related to it. In fact, a quick glance at the previous version of this model suggests that this partition could already be present there as a way to add more detail into the persuasive intervention's characterization. While each dimension is not mandatory to describe a persuasive intervention (deceitful or not), the inclusion of a full characterization according to the proposed concepts adds to its understandability. The ideas present in the partition were extracted from the related literature discussed throughout this chapter and are described as follows:

- **Development** – this dimension was inspired by Mechner's persuasion timeliness. It classifies the intervention's development according to rate at which it is unfolded. Players can be confronted with interventions in which the intervention is sudden or with one whose progress rate is gradual and will carry out the persuasion at a slower rate.
- **Outcome** – the intervention's outcome was inspired by the homonymous property in Mechner's theories. It refers to whether the outcome of the intervention is advantageous to the target(s) or not. Ultimately, this is a decisive characteristic to differentiate between benevolent and pejorative interventions, whether or not they recur to deceitful approaches and techniques.
- **Target Stance** – this dimension is tied with Adar et al's opportunity concept. We slightly altered the values that the concept can assume with the intent of providing a broader coverage which spans beyond deceitful interventions only. As such, we allow the target(s) to be defined as receptive (i.e. willing to be persuaded) or impervious (i.e. the target is potentially resilient to the effects of the intervention).
- **Impact** – inspired by Mechner's persuasion impact, it absorbs the same description as in its inception. The persuasive intervention's impact on the target user(s) may be immediate, after they finish being confronted with it. Alternatively, that same impact can be delayed and start manifesting itself sometime after the intervention was concluded.

8.4.3.4 Validating the MSII Model

The final step of this thesis and research encompasses the validation of the MSII model. The newly added type of method and instrument along with possibility of fully describing the intervention are components which are yet to be addressed in a mapping exercise. Since the MSII model is intended to be an improved version of the original MSI model, the latter's replacement was expected. This decision mandates that the new model is still capable of characterizing a persuasive intervention (deceitful or not) as the ceasing model was. In short, we want to ensure some kind of backwards compatibility with the MSI model.

Despite the validation of the MSII model not requiring an extensive mapping exercise (after all, the differences to its ancestor reside in newly added features, not removed ones), we opted to perform this exercise by tackling thee different fronts:

- **Validate the Placebo Rewards used in the Experiments** – the first step tackles the placebo instruments used in the previous chapter's experiments. We recall that the mapping carried out at that time, still using the MSI model, resulted in no differences regarding the non-deceitful version of the same instruments, suggesting that the model was insufficient for this type of approach. In light of this occurrence, we decided to tackle those same deceitful instruments and submit them to the MSII model in order to retrieve a more robust characterization.
- **Validate a Subset of the Analyzed Deceitful Videogames** – the second step involves performing the mapping exercise with a minor selection of games which employ any form of deceit, as analyzed in the previous sections of this chapter. With this step, we venture beyond assuring the model is suited for our own instruments, showing that it is a valid approach towards characterizing commercially available games.
- **Validate a Subset of the Videogames Assessed in Chapter 3** – the last step is present to not only ensure that the MSII model is backwards compatible with the MSI model, but also to show that it can enrich existing characterizations by, among other, detailing the persuasive intervention process with information which was unavailable in the previous outing.

The resulting characterizations can be observed in Table 8.5.

Table 8.5 – Deceitful and persuasive interventions' mapping on the MSII model.

Mechanic	Method	Support	Instruments	Intervention
Mapping Experimental Placebo Rewards				
Wrong Lane Chase – Placebo Obstacle	Discovery ▪ Sandboxing Deceit	Personalization ▪ Tunneling ▪ Reduction	Feedback ▪ Informative Perks	Development ▪ Sudden Outcome

Slowdown	▪ Expectations vs Mental Model		▪ In-Game Rewards Craft ▪ Sensory Illusions	▪ Advantageous Target Stance ▪ Impervious Impact ▪ Immediate
Ctrl-Mole-Del – Placebo Time Extension	Discovery ▪ Sandboxing Deceit ▪ Fuzzy Awareness	Personalization ▪ Tunneling ▪ Reduction	Feedback ▪ Informative Perks ▪ In-Game Rewards Craft ▪ False Promises	Development ▪ Sudden Outcome ▪ Advantageous Target Stance ▪ Impervious Impact ▪ Immediate
Mapping Deceit in Commercially Available Games				
Bioshock – Deceitful Storyline	Discovery ▪ Sandboxing Deceit ▪ Disguise	Antropomorphizatio n ▪ Psychological	Craft ▪ Story	Development ▪ Gradual Target Stance ▪ Receptive Impact ▪ Delayed
Fuzzy Gesture Detection (Kinect, Move, Wii)	Discovery ▪ Sandboxing Deceit ▪ Expectations vs Mental Model	Personalization ▪ Tunneling	Feedback ▪ Informative Craft ▪ Sensory Illusions	Development ▪ Sudden Outcome ▪ Advantageous Impact ▪ Immediate
Mapping Persuasion in Commercially Available Games				

Starcraft 2	Discovery ▪ Rehearsal ▪ Sandboxing	Social ▪ Competition ▪ Cooperation Antropomorphizatio n ▪ Psychological	Perks ▪ In-game rewards	Development ▪ Sudden Target Stance ▪ Impervious Impact ▪ Delayed
Uncharted	Discovery ▪ Sandboxing	Personalization ▪ Tunneling	Feedback ▪ Suggestions	Development ▪ Gradual Outcome ▪ Advantageous Impact ▪ Immediate

Both of the placebo versions of the instruments deployed during the previous chapter's experimental period maintain their characterization. The MSII model adds new value to this by allowing us to fully detail the characteristics of deceit. In Wrong Lane Chase, the chosen method relies on what the users expect to happen when they observe that the game's world slows down for a limited time frame. While the illusion is created, the actual obstacle speed remains unchanged, suggesting a situation of "Expectations vs Mental Model". As this instrument relied in an optical illusion to maintain a certain degree of suspension of disbelief, the instrument itself falls into the "Sensory Illusion" category. As far as the intervention's characteristics are concerned, the development is immediate (rewards spawn and player picks them up) and the expected outcome for the target of the process is advantageous. The same target is assumed to be impervious to the intervention, requiring it to be highly dissimulated in the game (especially taking into account its deceitful nature). Finally, the impact of the reward unveils itself immediately to the player. Ctrl-Mole-Del's placebo time extension relies on a "Fuzzy Awareness" approach, expecting players to keep an approximate but still inaccurate perception of their play time. The instrument of deception in this case consist s in transmitting false promises via the game's developer. The characterization according to the Intervention's partition is exactly the same as Wrong Lane Chase's.

Moving on towards the mapping games which feature some sort of deceit, we opted to select Bioshock for its infamous storyline and also decided to bulk games with some sort of gesture detection into a single entry. Bioshock's plot development utilizes a "Sandboxing" approach as players are given the possibility of discovering story parts freely in order to enrich their understanding of the game world. Simultaneously, the deceitful component of the same storyline is presented in form of disguise via persuasive human-like characters (support provided using the "Antropomorphization – Psychology" strategy). Unsurprisingly, the instrument used to carry out the intervention relies on crafting a believable storyline capable of engaging the player. The story's development slowly develops itself, a characteristic which is also found on the impact's timeliness. Obviously players are required to be receptive in order for the intervention to be successful. Motion-based games employ deceit in gesture recognition algorithms. Since there is a vast spectrum of possible valid movements, developers create broad acceptance thresholds to accommodate the players' expectations. As such, the deceit method is based on the discovery of the gesture possibilities, while at the same time the system deceives the player based on the expectations built by the latter. Since these games have very specific tasks, users usually are guided towards them ("Support – Tunneling"), leading them to become unaware of the system's caveats. Deceit is carried out via two types of instruments: informative feedback, acknowledging the correct gesture input and sensory illusions to create a corresponding link between user input and his / her avatar's movements. The intervention itself is sudden, advantageous and its outcome is instantaneous to the player (who may not be receptive towards being deceived).

The final step consisted in validating the MSII model with a reissue of the mapping carried out in Chapter 3. We selected Starcraft 2 and Uncharted as our choices given the differences in how persuasion is used in each case. As a reminder, Starcraft 2 provided players with numerous rewards (e.g. portraits, cosmetic unit texture changes) as they progressed through multiplayer matches. While the method, support mechanisms and instruments remain the same, the intervention partition can now better describe the persuasive process. First, this is a case where both player stance and the outcome of the intervention are not relevant (despite players being actually rewarded for their effort). The important facets are related with the development of the process and of its impact. While the development is sudden (since users are immediately confronted with an achievement's list which shows them the unlockable rewards), the impact is delayed as it requires a lot of time and commitment before players benefit from the rewards. Uncharted's persuasive cues consist in reminders whenever players get stuck and do not make any progress for a specific time frame. The important characteristics here relate to the instruments used which are based on clever suggestions. The intervention itself is characterized by a gradual development, since players are, at first, subtly guided towards their target, until a written message appears on screen suggesting where they need to go. The impact reveals itself immediately to the players and has an obviously advantageous nature for them.

As we can observe, the MSII model not only is capable of characterizing deceitful interventions, but also enrich existing knowledge regarding traditional persuasive strategies. The improvement over isolated persuasion theories is noteworthy: we managed to unify a set of concepts into a single theory capable of fully characterizing persuasive approaches in the context of videogames. We believe that, with little effort, the MSII model can be extended for any type of persuasion context, given the broad partitions and categories which comprise it. Still, such validation exercise falls outside the scope of this thesis and can be viewed as future work.

8.5 Summary

This chapter provided the necessary theoretical background to understand how deceit relates to persuasion theories, allowing us to provide the last contribution of this research. Following the encouraging results stemming from the previous chapter's experiments, we were able to contextualize important and unexplored facets of persuasion theories. Common definitions of persuasion characterize it as the art of changing others' beliefs, creeds, attitudes and / or behaviors without using coercion or deceit. However, there are examples of successful persuasion interventions which broke the bounds of this definition throughout history. While its ends may be often questionable, deceit is a viable instrument to persuade a determined target and steer him / her into adopting new ideals and / or behaviors.

Deceitful persuasion is the act of using obscure strategies (e.g. trickery, disguise, misrepresentations) to convince a user to adopt new beliefs and / or behaviors. Existing knowledge in this domain attempts to characterize this type of intervention according to:

- General approach.
- Agents involved.
- Impact extent on persuasion target(s).

Examples of successful deceitful persuasion processes encompass various types of scams, phishing, Ponzi schemes, among other. Nevertheless, these interventions are typically tied with sketchy schemes in which the target of the process is left in an unfavorable position. In order to demystify this negative connotation, some researchers began exploring alternative scenarios for deceitful persuasion.

This rationale led us to the second facet of persuasion explored in this chapter and another key element for this research's contributions. The usage of deceit for more than self-gain started gaining momentum in the last decade, especially when considering the inclusion of technology mediation. Benevolent deception can be defined as the process of applying deceitful persuasion techniques for the benefit of the target of the intervention. The characterizing traits of this process encompass the identification of:

- An opportunity for deception.
- The type of approach most suitable for the scenario being considered.
- The instruments employed to carry out the intervention.

Examples of successful deployments include the usage of replacement systems to cover temporary.

After analyzing a set of videogames which comprise deceitful techniques and the caveats exposed in the MSI model, we decided to extend the latter by merging relevant concepts extracted from the literature addressed in this chapter. The resulting MSII persuasion model is a robust characterization framework capable of addressing not only traditional persuasive interventions, but also deceitful ones. The extensions added to the original model encompassed:

- A new method to address deceitful strategies.
- New instruments capable of conveying deceit.
- A new partition capable of fully describing a persuasive intervention according to its development, impact and user receptivity.

The MSII model was validated according to a three-step exercise, encompassing the experimental games used in our experiments, videogames which comprise any kind of deceit and videogames which include any other type of persuasion. This mapping allowed us to witness the robustness of this new model, showing its capability to not only cover the persuasive approaches already addressed in our previous model, but also the innovative usage of deceit in videogames.

This theoretical chapter closes this research by providing the last contribution in this thesis. After providing empirical evidence concerning the possibility of using persuasive strategies to bring players closer to a flow state and that deceitful persuasive strategies are also a viable approach to the same end, we were required to look at the theoretical background in this subject. We managed to create a unified and resilient model which sustains our claims regarding the relation between flow, videogames, persuasion and deceit. In the end, we can safely state that our entire hypothesis was validated throughout this document.

9 CONCLUSIONS & FUTURE WORK

This research tackled how persuasive instruments can impact on a user's experience while playing videogames. We built on knowledge from multiple disciplines (namely the videogames, persuasive technology and user experience domains) to elaborate on a central issue which is present in this domain: steering players towards their state of optimal experience. We hypothesized that persuasive technology can be adopted in the videogames domain and utilized to that purpose. Our objectives were achieved by conducting experimental periods addressing how different persuasive strategies impact on player experience and by elaborating on how these same strategies can be characterized from a theoretical point-of-view. The resulting contributions cover these two perspectives.

The contributions were enriched with a set of experimental and theoretical findings which were not present in our initial research plan. Throughout our trials we were confronted with an interesting and unexpected outcome. Originating from a small inconsistent result in one of our experiments, we theorized whether deceit could play a major role in videogames. In particular, we sought at demonstrating whether placebo reward based persuasive instruments could have the same impact on player experience as their real counterparts. Results highly supported our theory, introducing deceit as an integral part of persuasion in videogames and, thus, reshaping how these theories can potentially be capitalized upon.

Our conclusions addressed the two most important themes and contributions of this document – reaching optimal experience through persuasive technology mediation and the usage of deceitful persuasive approaches to motivate players. We will now revisit each of these themes and provide closure to their impact on the domains addressed within this document.

9.1 The Road to Optimal Experience

The premise of this research states that users typically desire to achieve a state of optimal experience – denominated flow – while playing videogames. However, achieving that state can sometimes be more difficult than it appears. Several factors may impact on the players' experience which steer them away from it (e.g. imposing difficulty, linear content, disengaging storyline, lack of self-motivation, etc.). We hypothesized that persuasive technology can be used to mediate the transitions towards a state of optimal experience. Based on existing literature, we found out that the flow state is highly linked with the players' performance level (although not necessarily the best possible) and their emotional response (a balance between arousal and relaxation).

Our goal consisted in empirically showing that different types of persuasive strategies can be employed in videogames to steer players from states of relaxation and / or arousal towards the optimal experience. To do so, we carried out several experimental periods in which our subjects were confronted with game prototypes sporting a variety of persuasive instruments. The main conclusions we drew from those experiments were:

- Steering players via the influence of persuasive technology is possible.
- Multiple types of persuasive instruments have different effects: some showed to be more impactful on player performance while others produce more prominent effects on their emotional response.

We will now delve into each one of the main conclusions and present the detailed conclusions of this research.

9.1.1 Relaxing the Players

We identified player relaxation effects over the two experimental periods which aimed at analyzing the influence of persuasive instruments on player experience. We utilized two games belonging to two different genres to pursue our goals. The main conclusions consisted in:

- The provision of rewards being pivotal towards lowering the players' average heart rate. When confronted with reward based persuasive instruments, players showcased noticeably lower heart rate values than with the absence of those mechanisms. This trend was witnessed in both assessed games.
- The usage of praise based persuasive approaches was also pivotal in lowering the players' stress levels. We encountered no noteworthy distinctions between the effects of praise and rewards as far as the emotional response are concerned.

9.1.2 Enticing the Players

Results involving the promotion of more stressful gameplay segments were not as conclusive as those for the relaxation process. We hypothesized that the inclusion of feedback panels showcasing specific information (e.g. player performance data, time to complete a task, among other) in a videogame could have a stressing effect, leading players to increase their heart rate during the course of gameplay. While no statistical significance was found in the experimental period in which we sought to answer this, we found some trends which may be used to elaborate some suggestions:

- Displaying the available time to finish the gameplay period was an impacting factor on player experience, leading subjects to marginally lower their heart rate when confronted with this persuasive strategy.
- The usage of performance related metrics in a feedback display did not produce any major changes in the players' emotional response. There is a research opportunity, though, addressing the way that information is conveyed. Some games tend to have real-time displays showing the evolution of some metrics,

others display that information at the end of a match or level and finally some alternatives require the player to voluntarily access that information.

9.1.3 Active Player Performance Regulation

The assessed persuasive instruments' impact on player performance generated interesting results. We were able to identify a set of mechanisms which are capable of significantly improving the players' performance figures. The analysis allowed us to conclude that:

- Rewards based persuasive strategies are highly effective in increasing a player's performance. This outcome stems from testing with multiple types of rewards across different games.
- Praise based persuasive approaches are also effective in aiding players to achieve better performance figures. Anecdotal evidence suggests that players become thrilled by popping messages which encourage them and acknowledge their efforts and good performance.

At the same time, we pinpointed another set of persuasive mechanisms which had the opposite effect – they effectively deteriorated player performance:

- Feedback based persuasive instruments can effectively decrease a player's performance. The presentation of distinct content can have the same effect on users, as we were not able to find any significant differences between showcasing performance figures and the available time to complete the game (albeit the latter had slightly more impact).

These findings allow us to conclude that:

- Different types of persuasive strategies can be employed in videogames to effectively regulate a player's performance. Although the scope of our research has its limits, we can foresee that other strategies can yield interesting results, broadening the spectrum of instruments which designers have at their disposal to provide the best playing experience possible.

9.1.4 Encouraging Behavior Shifts

Another witnessed effect pertains to the ability that persuasive instruments possess to change a user's behavior. Existing literature on the field of persuasion clearly indicates that behavior, attitude and creeds may change when an individual is submitted to a persuasive intervention. This holds true for a variety of domains. In videogames, however, there is not a large spectrum of behaviors which players can assume. Still, our results have provided some interesting indicators as of how persuasive instruments can be capitalized upon to change behavior during gameplay. The main conclusions related with this topic were:

- Praise feedback based persuasive instruments can potentiate behavior changes in players. Individuals eagerly replaced their main goal within one of the assessed games (collecting coins) with an unpredicted play-style which involved avoiding obstacles in order to pop praise messages. This outcome suggests that praise persuasive approaches can be a catalyst to pursue secondary goals, creating disruption points with the primary objectives of a game and, thus, creating a rich environment for exploration suited for different individuals' play-styles.

9.1.5 Overlapping Persuasive Instruments

Our experimental setup was designed with the intent of analyzing the impact of each persuasive instrument in isolation. Still, in one particular trial we assessed the effect of a reward based persuasive mechanic with the simultaneous presence of a feedback panel containing the time available to play the game. The latter had been shown to have a significantly pejorative effect on player performance and a tendency to increase their heart rate. The results for this trial, however, showed that players were able to significantly increase their performance figure and substantially reduce their heart rate values. This led us to conclude that:

- Persuasive instruments may possess different impact levels on player experience depending on the scenario or game being considered. The effects vary from mechanic to mechanic and can be utilized to favor or undermine player experience. Some effects may be strong enough to completely overlap the influence of other persuasive instruments, introducing an interesting range of possibilities as far as game design is concerned.

9.2 Introducing Deceit as a Research Subject in Videogames

The most important contribution of this research addresses the introduction of deceitful persuasion approaches in videogames. Deceit is an often marginalized subject due to its negative connotation. Existing literature, however, provides sufficient reports addressing examples of deceitful persuasive interventions where targets benefitted from an intended positive outcome. Among these examples, we emphasize the usage of placebos in the healthcare domain as a way to improve a patient's psychological condition with the aid of a pill deprived from any chemical compounds. Supported by a curious result in one of our experimental periods, we aimed at assessing whether deceitful and, in particular, placebo rewards could also steer players towards the state of optimal experience.

9.2.1 Replacing Real Persuasive Instruments

One of our research goals encompassed comparing how placebo rewards fared against their real counterparts. On its original definition, the premise of a placebo is that, despite the absence of any chemical components, it exerts a positive psychological influence on a patient, removing the necessity of administering them with real medicine. We sought at finding a similar effect for placebos in videogames, reaching the following conclusion:

- The influence that placebo and real reward based persuasive instruments exert on users while playing videogames showed no significant differences between each other. These results held true for the effect on both the players' emotional response and the performance figures. We state that placebos can effectively be used to replace real rewards if they are properly designed and meet the requirements imposed in the proposed conceptual framework for benevolent deceitful persuasive mechanisms.

9.2.2 Psychological Leverage

Perhaps the most unexpected phenomenon occurred in a particular reward utilized in one of the experiments. The results show that the placebo version of that reward significantly reduced their heart rate and increased their performance. However, in its placebo version, this particular game prototype was equivalent to another which had been shown to have a pejorative effect on player performance as well as a stressing effect on players, due to the presence of a feedback panel displaying the available play time. Facing these arguments were conclude that:

- Similarly to their real counterparts, the effect exerted by placebo reward based persuasive instruments on a user during play period can overlap the influence produced by other persuasive mechanics present in the game.
- Designers are, thus, able to capitalize on placebo reward based persuasive mechanics to temporarily cancel the effect produced by determined persuasive instruments present within a game. The advantage provided here, is that the placebo reward does not give an explicit tactical advantage, with any produced changes stemming from the inherent motivational influence of the instruments.

9.3 Proposing a new Persuasion Model

The experimental nature of this research was counterbalanced by one important contribution which was envisioned in a two stage exercise. All expertise extracted from related literature and our trials was channeled towards the creation of a model capable of characterizing persuasive interventions in videogames. The goal was to provide designers with a broad and robust way of detailing which strategies are prone to lead players towards the optimal experience state.

The first proposed model was envisioned when we concluded the review of related literature addressing persuasive technology. While we encountered research which covered a variety of topics within this domain we also witnessed that sometimes they often overlapped each other and in other occasions the extent of their detail level undermined the ability to characterize persuasive interventions in a more unified way. To mitigate these shortcomings, we proposed the MSI persuasion model, with three important supporting pillars (comprising the model's name). The Method defines the general strategy for the intervention; Support consists in auxiliary components capable of improving the odds of success; Instruments encompass the actual mechanisms used to convey persuasive cues to end-users. This model was validated via an extensive mapping of videogames comprising any type of persuasive features. Additionally, we deployed it as an auxiliary design tool during the development stage of the experimental games present in our trials. The model, however, possessed a few shortcomings. The most striking one emerged when we began designing deceitful versions of the persuasive instruments present in the experimental games: the model was incapable of providing an adequate characterization of those deceitful interventions, leading us to the same mapping as in the original characterization.

With these caveats and existing theories regarding deceit, we reviewed the MSI model in order to introduce the necessary changes to accommodate both traditional persuasive interventions and deceitful ones. The resulting MSII model features a set of extensions to the existing partitions, mostly to support deceitful interventions. The most important introduction was a new partition entitled "Intervention" which is capable of describing how the persuasive process unfolds, how the impact is expected to occur and whether or not the outcome is beneficial to the intervention's targets. Validation was carried out in three stages: the first addressed characterizing the deceitful persuasive instrument present in the experimental prototypes; the second concerned videogames which encompass some kind of deceit in their core gameplay elements; the last one encompassed assuring backwards compatibility via the characterization of videogames whose mapping had been performed with the original MSI model. The model design and validation process allowed us to conclude that:

- An intervention is characterized by the main strategies employed, how the process unfolds and which instruments are used to convey persuasive cues to target users. While some related models address the importance of these facets, they either fail to allow a full characterization as present in the MSII model or do not consider deceit to be a viable persuasive strategy.
- Deceit really is an avoided subject. Recent developments revolving around this subject have attempted to demystify the concept and emphasize the potentially benevolent nature which can be capitalized upon. To our knowledge, the MSII model is the first persuasion model embracing deceit as a viable and powerful persuasive approach for the videogames domain. An important remark is that

deceit can be carried out using traditional persuasive instruments, forcing designers to characterize the intervention according to the general strategy employed, process development and expected outcome.

9.4 Future Work

Our criticizing nature and the need to constantly advance existing knowledge led us to assess which research opportunities were left unaddressed or could benefit from a deeper analysis approach. The first is a caveat which partially limits the impact of one of our findings and is related with the transition from relaxation or boredom towards the optimal experience state. The remaining two future work directions were selected based on what we envision to be enticing, challenging and complementary researches to our own work.

9.4.1 From Relaxation States towards the Optimal Experience

Despite our efforts to equally explore transition towards a state of optimal experience transitioning from both boredom / relaxation and arousal / anxiety states, the tips of the scale clearly indicate that we gave more emphasis towards mechanisms capable of steering a player from states of arousal. One of the consequences of this imbalance concerns our inability to obtain statistical significance when empirically demonstrating that determined persuasive instruments can significantly increase a player's heart rate.

We envision that other types of persuasive instruments may be deployed to assess how they impact on player experience. Besides rewards, feedback and praise, designers and researchers alike can experiment with strategies such as the antropomorphization of characters (or the opposite process) to check if player affinity impacts on the emotional response and / or performance. Similarly, one can also experiment with different types of feedback. For instance, checking whether a commanding voice exerts a more stressful experience than a softer tone would. The spectrum of possible persuasive instruments is immense, allowing for potentially interesting outcomes on this matter.

9.4.2 Quantifying the Impact of Persuasion

Arguably one of the most exciting results of this research, the possibility of persuasive instruments overlapping each other's' effect in videogames opens a panoply of opportunities and challenges. Despite the somewhat limited nature of our finding (merely being validated with one game), we believe that this outcome can be generalized for not only other games, but genres and persuasive instruments as well. Parallel to this finding, we also discussed, within the same game, how each persuasive instrument fared against each other. For instance, we found that extending the available play time had a more prominent effect on player performance than boosting their accuracy rate. In light of this research direction, a question emerges:

- How much more powerful can a persuasive instrument be over another?

Measuring the impact that each approach has on players could be beneficial, providing developers and designers with semi-accurate predictions regarding the effects of the persuasive instruments. Ideally, this research exercise should not limit itself to comparing persuasive instruments. Reaching a resilient and rich way to immediately describe and identify which persuasive mechanisms are more favorable for specific scenarios, games and / or genres is, in our perspective, an enticing research direction. Ultimately this would result in a conceptual framework which integrates a quantifiable metric regarding the influence of each persuasive approach on player experience. Akin to our own persuasion model, we envision that the characteristics of the instrument, player, game and genre are pivotal to reach an agreeable metric. Pursuing this goal would, most likely, lead us into the social psychology domain. Raven et al (Raven, Schwarzwald, & Koslowsky, 1998; Raven, 1992) have dedicated extensise research towards understanding the power exerted by individuals to influence one another in a social setting. Some of the heuristics used in their Power Interaction Model and even how each concept ties in with each other can be valuable assets in the context of our ongoing research.

9.4.3 Do we always need the Optimal Experience?

The last research direction we propose addresses a problematic which, to our knowledge, has yet to spark the interest of researchers worldwide. McMahon et al (McMahon, Wyeth, & Johnson, 2012) has explored how players can described according to the characteristics of their play-style. One of the results is that players have quite different approaches in games: while some opt to discover everything a game has to offer, others content themselves with experiencing the main storyline. One of the questions which are not addressed in this study is whether players can change roles from game to game and, more particularly, within the same game according to their mood.

This rationale is behind this discussion point: do we really need to strive for the optimal experience at all times? We believe that this is not the case. We hypothesize that sometimes players merely want to relax and enjoy a game to pass time, entering an almost catatonic state of enjoyment. In other cases, players strive for challenges which are typically way beyond their skill or in-game level of expertise. This is the case of the "Demon's Souls" (Software, 2009) and "Dark Souls" (Software, 2011) games which are known for their extreme difficulty and punishing the player for reckless behavior. Are players who enjoy these games considered "gluttons for punishment"? Or is it that the experience they go through is what drives them forward even if it not within their comfort zone?

Carrying out an analysis addressing whether players enjoy being outside their optimal experience state, how they cope with it and what drives them to be in those states could provide interesting new expertise regarding flow. This research should be coupled with the assessment of whether the usage of persuasive instruments which are known to steer a player towards the optimal experience can still be of use in order to drive players away from that state. In particular, and building from the previously proposed research direction, does an instrument's persuasion power fluctuate when the player is in different mental states as according to (M. Csikszentmihalyi, 1990).

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