Persuasive Pervasive Games

The Case of Impacting Energy Consumption

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Persuasive Pervasive Games: the Case of Impacting Energy Consumption

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To
Miranda and Theodor: you are the future

Foreword

This volume is the result of a research project carried out at the Department of Marketing and Strategy at the Stockholm School of Economics (SSE).

This volume is submitted as a doctor's thesis at SSE. In keeping with the policies of SSE, the author has been entirely free to conduct and present his research in the manner of his choosing as an expression of his own ideas.

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Stockholm, August 31 2014

Mattias Svahn

Contents

Chapter 1
Introduction

Research has shown that the number of media channels for persuasion and persuasive messaging has increased tremendously in recent years, and increasingly changed in character. Rosengren (2008) used the term "media clutter" for the vast and increasing amount of competing commercial messages that consumers are exposed to daily. Fischer et al. (2011) wrote a review on the issue of the changing character of persuasive messaging from a wide perspective, not just outright advertising but through all forms of value-strong media statements. The entity persuasion in the persuasive messaging discussed here is a process through which one party aims to affect the attitudes, values, and/or behaviour of one or several other parties (Perloff, 2010).

A further example of the changing character of persuasive messaging in the last few years is the review from Petrescu and Korgaonkar (2011) on persuasion strategies for social media. Other examples include Svahn et al. (2014) who explored a new model for persuasion strategies in converged media, Wahlund et al. (2013) who reviewed persuasion strategies for games as persuasion vehicles, and Perloff (2010) who found that persuasive messaging has over recent years developed by growing tremendously, becoming more rapid, more subtle, get greater financial stakes and becoming more complex.

A common denominator is that all the aforementioned research found that media-borne persuasive messaging was much more than what may be perceived as advertising. This thesis was written against that background. It is a study of the use of pervasive games to influence beliefs, knowledge, attitudes, and consumer behavior focusing on the process through which

persuasion occurs and leads to the intended changes. Despite all the new developments, some problems remain difficult for persuasive communications; for example, some consumer behaviours including drinking and driving, safe sex practises, and saving electricity. This will be discussed later in this work and is the main reason for choosing electricity consumption for the empirical studies by focusing on the influencing process of reducing such consumption. This is an example of a possible influencing goal of a public policy campaign.

Why pervasive games? First, pervasive games have such characteristics that they solve some of the problems with persuasive communications for certain consumer behaviours. This is exemplified through the involvement of other people playing and being influenced by pervasive games. Second, pervasive games have been almost completely ignored as persuasive media in marketing research in general, and more particularly in research on public policy campaigns. For example, neither Weiss and Tschirhart (1994), who reviewed 100 public policy information campaigns, nor Flor and Singleton (2011) who studied ecological issues of persuasion, or Fletcher et al. (2010) who studied civic responsibility, included pervasive games in their studies.

1.1 Games

Games are cultural structures likely to have been around human beings for as long as there has been a form of social culture. The oldest known example is "The Royal Game of Ur" from the Sumerian culture ca. 3000 BC (Parlett, 1999). The global market for digital games, including revenues from Personal Computer (PC) games, consoles, and mobile systems, as well as spending on dedicated game hardware devices, but excluding board games and toys, is forecasted to reach 96 billion (US dollars) by 2018 (DFC Intelligence, 2014).

Games can reach artistic heights and be the subject of creative and academic studies (Tavinor, 2009). "Game Studies" is an academic discipline that focuses on game design, players, and the role of games in society, culture, and technology. Game Studies existed before the advent of digital technology, though the field then consisted mostly of history and anthro-

pology (see for example the comprehensive catalogue of gaming implements and games from Native American tribes published in 1901/1992 by Stuart Culin).

The one common denominator from the Sumerian culture of 3000 BC to the near field communications technology included in the Nintendo Wii U of the 2010's AD is the element of human play, and human play is the focus of this thesis.

1.1.1 Persuasive games

Games produced with the intent of bringing about some persuasion (Bogost, 2007, Gardner, 2001) have been around for quite some time, longer than the media clutter and digital technology of recent years. Persuasive games are in various forms often projected to be of great business values (DFC Intelligence, 2011a; 2011b), in particular in the present media cluttered world. "The Mansion of Happiness" is a game from the early 1800's designed to imbue the player with Christian morality (Hofer, 2003). "The Landlords´ Game" is a political persuasive game created in 1904 (Parlett, 1999). These two early persuasive games demonstrate that "games with a day job" (Gardner, 2001) have been around for quite some time. One of the first cases of persuasive games in the modern digital media is the MC Donald's games for the Atari game console from the early 1980ies (Vedrashko, 2006).

In the area of research on persuasive games, we find that Svahn (2005), Svahn et al. (2014) and Wahlund et al. (2013) all have developed taxonomies of persuasive games. Acar (2008), Nicovich (2007), Winkler and Buckner (2007), and Glass (2007) all researched product placement in modern digital games. Chang et al. (2010) made a series of quantitative effectiveness studies on the practice of designing persuasive games for one single brand ("advergaming").

In the book "Persuasive Games", Bogost (2007) wrote a comprehensive summation of the development to that time. Comprehensive literature reviews can also be found in articles by Okazaki and Yagüe (2012), focusing on advergames based in social media, and by Okazaki and Taylor (2013) who went into theoretical implications of advertising in games. Choi et al.

(2013) researched how implicit brand memory related to persuasive games. Terlutter and Capella (2013) described theoretical frameworks for advertising in games and gamification of advertising. Peters and Leshner (2013) researched player processing of persuasive messaging in single message persuasive games. Research on persuasive games is rapidly maturing, though it still often lacks either established persuasion theory (e.g. Bogost, 2007) or theoretical game study depth (e.g. Choi, Lee, & Li, 2013; Peters & Leshner, 2013). This thesis remediates these two weaknesses.

1.1.2 Pervasive Games

A subfield of games is pervasive games (see also 2.2 in this thesis) and this is the focus of this thesis. The defining quality is that while games on digital media allow for the interaction with virtual objects in a digital virtual world, and board games allow for interaction with imaginary objects in an imaginary world, pervasive games allow for real world interaction while in a playful mind frame. In this way, pervasive games are more like sport or children's play. See Montola et al. (2009) for a presentation, Montola (2011) for a review, and Kasapakis et al. (2013) for a state of the art report on pervasive games.

There are many ways to taxonomize pervasive games. This work explored the use of pervasive games to influence consumer behaviour, particularly focusing on a persuasion process.

Therefore, this work focused on describing pervasive games through the three expansion characteristics (Montola et al., 2009). The three expansions include *Spatial expansion* which occurs when a game breaks the boundaries of its platform (e.g. Xbox or smartphone), and is played in an interplay between information systems around the player[1]. *Temporal expansion* occurs when the boundaries of the game sessions are dissolved and there is no clear beginning and end to the play. Finally, *social expansion* happens when the game is designed to engender play that considers unwitting bystanders.

[1] "Information systems around the player" include wi-fi nets, the pattern of wi-fi nets, "wi-fi fingerprinting", GPS, NFC, RFID, map systems, Bluetooth, digital billboards, bus stop time tables, EAN-codes, electricity networks, traffic data, anything visible, or invisible, digital, or non-digital that carries a structure of information.

These bystanders may or may not be aware of having become part of someone else's play (more on this in Chapter 2).

While the research field of persuasive games is rapidly maturing, there has still been little work on pervasive games in the persuasion field and even less with a theoretical depth of focus on persuasion theory. For example, when Schmitz et al. (2013) reviewed pervasive games from a learning perspective and Weber (2014) examined augmented reality games for tourism, they did not go into persuasion theory. Additionally, there has been no work on examining the three expansions put to use for persuasion. This work focused on the use of one modern persuasion platform, pervasive games, as means of persuasion on one of Weiss and Tschirhart's (1994) issues, the issue of saving household electricity.

1.2 Purpose of the thesis

The purpose of this thesis is to arrive at a better understanding of a persuasion process arising out of playing persuasive pervasive games and to explore possible persuasive effects of playing such games.

By this, I intend to contribute theoretically to the literature on persuasive pervasive games, and practically by providing game researchers and persuasion practitioners new insights that can be used for designing more effective persuasive pervasive games, thereby increasing the likelihood of reaching their persuasive goals. Four field experiments with three persuasive pervasive games have been used for the study, all four involving actual playing of persuasive pervasive games by consumers.

1.3 Delimitations

The research presented in this thesis is limited by using field experiments involving a series of three specific prototype persuasive pervasive games, with varied but specific design executions of one central technology design concept. The work is also limited by the choice of respondents being teenagers living with their parents at some specific locations in Sweden.

A further delimitation is that this work is about just one of Weiss and Tschirhart's consumption issues, the issue of saving household electricity. The reasons for choosing to apply that particular issue to pervasive games is detailed more in chapter three.

1.4. Outline of the thesis

The thesis consists of seven chapters.

Chapter 1 sets the background and presents games, persuasive games, and pervasive games.

Chapter 2 goes into the theoretical framework of the thesis, introduces theoretical concepts that are central to the work, and presents the research questions.

Chapter 3 presents and discusses the methods used for the empirical part of the research and a more detailed explanation into the reasons for choosing electricity as the test case. The altogether four field experiments, based on three persuasive pervasive games custom made as stimuli for the field studies, are also presented: "Power Agent"(two field experiments), "Power Explorer" (one field experiment), and "Agents Against Power Waste", AAPW, (one field experiment)."

Chapter 4 presents the results from Study 1, a quantitative study making use of questionnaire and server data from the *Power Explorer* field experiment to develop and test a causal structural equation model (SEM) using partial least square (PLS).

Chapter 5 presents the results from Study 2, a qualitative study making use of in-depth interviews from the three field experiments with Power Agent (two) and Power Explorer (one) presented in Chapter 3.

Chapter 6 presents the results from Study 3, a quantitative study making use of questionnaire and server data from the *Agents against Power Waste* field

experiment and the results from Studies 1 (Chapter 4) and 2 (Chapter 5) to inform the building of a structural equation model and testing it using partial least squares.

Chapter 7 contains the conclusions och discussion of the thesis. It revisits the thesis' stated purpose from Chapter 1 and the research questions from Chapter 2.

Chapter 2
Theory and Research Questions

This chapter presents and discusses the central theories, concepts, and constructs that generated the main research questions. Some of these were presented in the introductory chapter but more deeply described in this chapter. Accordingly, this chapter functions as the main platform for the subsequent empirical studies and as the lens through which the conclusions are drawn.

2.1 On Games

Chapter 1 stated that this work explored pervasive games put to the use of influencing consumers with a focus of the research investigating the influencing process that occurs. That was chosen due to the changing nature of persuasive messaging in recent years. However, what are these "games" that are the focus of this thesis?

"Games" is a concept that many people and researchers may hold an implicit unquestioned idea regarding. For example Choi et al. (2013), Terlutter and Capella (2013), Peters and Leshner (2013) and Choi, Lee, and Li (2013) all researched persuasive messaging through games and all published in the Journal of Advertising, yet they paid very little attention to the character of "games," the central object of research. These articles appear written from the perspective of an implicit understanding of what "games" are.

However, such an implicit understanding may not hold up to scrutiny. Television, radio, or web banners and most of all the other things that together make up media clutter (Rosengren 2008) are all technologies. They are technologies that have a clear point of invention and a clear technologi-

cal and semiotic infrastructure. The first known game in human society is from the ancient Sumerian culture (Parlett, 1999) and proves that games, unlike television, radio, web banners, or print media have no "Gutenberg moment" that can be pointed to as the time they came into existence. The definition of the construct "games" has been given much thought in the academic field game studies.

2.1.1 Review of Magic Circles, Frames, and Immersion

One of the first milestones in academic game studies is the construct "magic circle of gameplay." Johan Huizinga, who observed children playing with each other and animals playing with each other, coined the notion. He initially presented his thoughts in lectures in 1938, which were later published as the book "Homo Ludens" (Huizinga 1938/1998). Huizinga's concept became more widely known to the larger game studies community when Salen and Zimmerman (2003) developed it further. The notion of the magic circle can be seen as the separation of ordinary and special reality agreed upon by the game players. This is relevant for persuasive games because the "game reality" is in this way seen as separate from the real reality in which the persuasive message is the topic.

Montola et al. (2009) and Stenros (2010; 2012) view the Huzingian magic circle as a metaphorical mental contract that players of a game form between themselves and the non-playing world. The core idea of the magic circle is that it represents a degree of suspension of ordinary reality that arises when players agree that play commences. Bateson (1972/2006) declared that such suspension isolated the player from real life consequences of in-game actions. Bateson introduced psychological frames and discussed the meta-communication and the signal "this is play." Bateson's notion of frames delimited the meaningful actions and meta-communications about play. In that perspective it is important to remember that the individuals' own psychological mind-set of "playing a game," the social border set up in between the players, and the artefact or the site of play, are three different things. If that is not kept in mind, the conceptualization of play, games, and playing will be muddled (Stenros, 2012).

This construct has been the object of considerable discourse over the years. Pargman and Jacobsson (2006) and Malaby (2007) argued that most kinds of games, whether pervasive or non-pervasive, interweave with daily life. The intensity of the debate can perhaps result because the notion of the magic circle clearly evokes a duality of an "inside" and an "outside" – an "us" of players and a "them" of non-players. Such a duality makes it easier for humans and researchers to conceptualize the research objects "games," "play," and "playfulness." Copier (2005) argued that the magic circle could be favourably viewed in a perspective of role-play and ritual. Emmanoel and Thiago (2009) argued that the magic circle worked better as a cognitive mediation structure with graded "boundaries."

Poremba (2007) explored the problem of forbidden socially less acceptable games. In Poremba's view, the point of the magic circle is to be transgressed. Lieber (2008) made a comparative study of the magic circle over different kinds of games. Even one of the founders of the modern magic circle theory, Eric Zimmerman in 2012, rejected the strong boundary hypotheses that he found had been attributed erroneously to him through a popular misreading of the magic circle theory (Zimmerman, 2012).

The notion has been so intensely debated that it may have become a "straw man." However, there is something to be said for the notion of a tripoint of mutually exclusive interaction between player, non-player, and play site. Markus Montola and colleagues wrote that "*The function of the isolating contractual barrier is to forbid the players from bringing external motivations and personal histories into the world of game and to forbid taking game events into the realm of ordinary life*" (Montola et al., 2009, p. 11).

The scholar that may have been the strictest proponent of the separateness of games and play was Roger Caillois who insisted (1958, pp. 43–55) that games must be free, separate, uncertain, unproductive, unregulated, and wholly fictive. However, not even Caillois wholly believed that this was the reality and thus his argument was normative. The importance of the magic circle for this thesis was partly a result for its role as bedrock in games studies, and partly because it was the presumed normality, against which the three expansions deviated.

2.1.2 Frames

Another way of conceptualizing the social border between the players and the artefact or the site of play is Bateson's idea of a meta-communicative signal that defines "this is play" and the notion of psychological frames (Bateson 1972/2006). Bateson was a little unclear on whether the frames were social or psychological. This notion like the magic circle has the same function in this thesis of being the normality against which in particular social expansion and temporal expansion deviate.

Erving Goffman (1961; 1974), an influential theorist who built on Bateson, developed the concept of frame theory. The Goffmanian notion of frames organizes not only meaning, but also an individual's involvement in an experience. For example, if a player is so engrossed in the game that to some extent he/she forgets that it is supposed to be "just" play and lets a fight in a game influence a friendship in real life, this is referred to as "downkeying." The mirror image of that is "upkeying," when the player loses sight of the primary framework and forgets the meaning of the play equipment. Goffman's frame theory recently has found many proponents in game studies, for example Linderoth (2012) on the issue of player experience, and Bullingham and Vasconcelos (2013) on the issue of identity and self in on-line games.

2.1.3 Immersion, Commitment & Competitiveness

Further concepts, not about the borders of play but instead about the depths of play, relates to immersion. Immersion commonly is taken to mean that the player both feels a strong connection with the game at the cost of the same connection with the non-game real word, a feeling of "loosing oneself to the game." Brown and Cairns (2004) and Jennett et al. (2008) researched immersion and focused on sensory and cognitive immersions in virtual environments. Park and Chung (2011) studied how self-presentation in the online game community built game commitment. The three-fold immersion model proposed by Ermi and Mäyrä (2005) added a third alternative: imaginative immersion. This notion is the same as when game studies are described as "immersive."

Vorderer et al. (2003) studied the role of competition and competitiveness in games. These concepts make it salient that there is room in theory for allowing an individual to in-game do things that would otherwise be disallowed by that same individual and perhaps also by society. When that person does things, whether in game or not, that the person would otherwise not do, then there is a potential for an attitude change (Section 2.3). This review of theories of magic circles, frames, and immersion serves to illustrate that games are theoretical complex constructs not to be underestimated.

2.1.4 Review on the Structure of Play and Games

A further milestone in academic games studies is the book "Man Play and Games" written by the French Sociologist Roger Caillois (1958). Caillois placed forms of play on a continuum from ludus structured activities with explicit rules (i.e. games) to paidia unstructured and spontaneous activities (i.e. not only play but at the most extreme end of the continuum playfulness). Caillois' contribution was to make it clear that "play" (paidia) did not necessitate the presence of a "game" (ludus). The issue of the structure of play and games and the relationship between the two has been debated intensely in recent history by Caillois as well as Murray (1998; 2005) and Atkins (2003) who argued a view of games and play inspired by literature and text analysis. Aarseth (1997), Frasca (2003), and Malliet (2007) all argued for a more behaviour-oriented perspective to understand the structure of games and play. Ducheneaut, et al. (2006) made a study about how players cluster in groups.

A bedrock in game studies discourse is the construct of "rules." For example, in the spring of 2014 fifty papers with the keyword "rules" were found in the DIGRA digital library[2], a repository wholly devoted to game studies. The concept of rules is of relevance for the thesis, as the rules are the blueprint for the structure of a game. If a game is intended to initiate a persuasion process, then the rules are one of the main areas of persuasion design. Hughes (2006) found that game rules develop as a function of social

[2] http://www.digra.org/digital-library/ [Accessed 2014-04-11].

relations. Already in 1978, DeKoven (1978/2006) wrote on changing children's social behaviour through changing the rules of a game. The social focus of Hughes and DeKoven has relevance for the design of the social expansion.

Table 2-1. A list of further viewpoints on the structure of play and games

Researcher	**Standpoint**
Jesper Juul (2005)	A game is a rule-based system with variable and quantifiable outcome where different outcomes are assigned different values. The player exerts effort in order to influence the outcome and feels attached to the outcome. The consequences of the activity are optional and negotiable.
Salen and Zimmerman (2003)	[A game is] a system in which players engage in an artificial conflict defined by rules that results in a quantifiable outcome.
Chris Crawford (1997)	[A game is] made up of four common factors: representation, interaction, conflict, and safety.
Greg Costikyan (2002)	[A game is] an interactive structure of endogenous meaning that requires players to struggle toward a goal.
Bernard Suits (1967)	To play a game is to engage in activity directed toward bringing about a specific state of affairs, using only means permitted by specific rules.
Grant Tavinor (2009)	[Games are] formal systems set in a framework of behavioural norms.

This literature review underlines that it is insufficient to have implicit unquestioned ideas about games (Okazaki & Yagüe, 2012; Okazaki & Taylor, 2013; Choi et al., 2013; Peters & Leshner, 2013). Some theoretical depth from games studies is needed.

2.1.5 Trust in Persuasive Games

Persuasive games were introduced in Section 1.1.1. Here follows a deeper theoretical discussion of such games. Persuasive games are likely to be touched by the established notion that people perceive messages differently

depending on if the messages are presented with persuasion or not (Preston, 1967; Preston & Scharbach, 1971; Craig et al., 2012). Surveys of consumers repeatedly find that the overwhelming majority believe that persuasive messaging is by nature untruthful (Rotfeld, 2008).

If consumers perceive the source of a persuasive message as biased (e.g. by clearly being a persuasive message), this will weaken the significance of the message (Eagly et al., 1978; Petty et al., 2008), or the information may seem less credible (Dahl et al., 2003). Persuasive games are likely to be touched by this, as the elements of play and suspension of disbelief demand an element of trust in the separateness of the game (Caillois, 1958).

2.1.6 Persuasive Games as Learning Platforms

Persuasive games have also been used as learning platforms for quite some time. The advantages of games in digital media as learning platforms can be succinctly elucidated by a quote from James Paul Gee: "The argument in this book is not that what people are learning when they are playing video games is always good. Rather, what they are doing when they are playing good video games is often good learning" (Gee, 2003, p. 199).

Role-playing has been applied for learning. That has been labelled "EDU-larping" and described by Andresen (2012). Games for change and learning have also been described in Andersen (2008). The "Games for Change" festival is an annual festival dedicated to learning and change through games.[3] Connolly et al. (2012) made a review of the empirical evidence of learning games' impact on players. Wouters et al. (2013) made a meta-analysis of the cognitive and motivational effects of learning games. Methodologically this is a sound piece of work and very thorough on learning theory though it does not qualify its perspective on the "games" construct, nor does it go into pervasive games. These cited works all take a somewhat positive perspective on the issue of games and learning. They also have the sin of omission of holding an implicit unquestioned concept of "games."

[3] http://gamesforchange.org/festival/ [Accessed 2014-04-11].

Gee's perspective and the general enthusiasm for games as learning platforms have been criticised by Waern (2012) and Linderoth (2009). The latter found that spending time in a game could give an illusion of learning.

Lazzaro (2005) studied the driving forces of the players experience and found that non-pleasure could be a force in the allure of playing a game. While Lazzaro did not research persuasive games or games for learning, her finding of "hard fun" contrasted with Gee's notion of game play being good learning more or less by itself. Lazzaro (2005) is discussed here as social expansion does seen at a glance to have a potential for becoming ethically challenging. What is relevant for this thesis is to highlight that non-pleasant elements may be important for a game play experience and, in contrast to the mentioned writers, point out that games are not intrinsically good learning tools. There is nothing intrinsic about a game that makes it good learning. It is all about the design of both games and persuasion.

2.1.7 Games as enacted entities

All kinds of persuasive games have in common that they are games. This notion reflected the difference from other forms of persuasive media and must be pointed out. This was further explained in with the concept that the design of a game is only realized when the game is played (Stenros & Waern, 011). A web-banner, a TV-ad, or an outdoor poster does not need active and conscious interaction to come into being. Games are enacted experiences that come into existence only when played.

What a player experiences is not the game but a play session of the game. Every play session is an entity that is co-created among the players at each occurrence; hence, every play session is different from another. The entity of a play session has been further described by Björk and Holopainen (2004). When a listener hears a radio ad or sees a piece of guerrilla knitting, there is no corresponding layer between the ad/knitting and the listener/observer that needs to be enacted. Enacted entities, like games, are common in human life as exemplified by attending a masquerade or taking part in a sauna evening (Stenros & Waern, 2011), although most are not normally considered as vehicles for persuasion.

To view a persuasive game as an enacted experience has some consequences; one being that an enacted experience requires that a participant must engage and do so voluntarily, properly, and as intended by the designers. Game-induced persuasion cannot be passive. This makes a game a different from a web-banner, a TV-spot, or a poster, as these do not require active participation in the same way. The scepticism suggested by Preston (1967), Preston and Scharbach (1971), Rotfeld (2008), Eagly et al. (1978), Petty et al. (2008), and Dahl et al. (2003) makes the necessary voluntary enactment more difficult as it requires a mental drawing of the magic circle.

2.2 Pervasive Games

In Section 1.1.2, it was mentioned that pervasive games were a subfield of games defined by a strong relationship to and taking place in the non-game real world. Furthermore, it was explained that this work focused on the three expansions initially formulated in Montola et al. (2009) and reviewed by Montola (2011). Here follows a deeper discussion of that definition.

Non-pervasive games are staged in a closed self-sufficient universe, whether physical or virtual. The platform can be found in a living room console such as a Play Station or an Xbox. Take the example of the popular alien hunter game "Halo," which is played on a console and has no place in reality. The player may play in teams with others in various places in the world, but there are still no aliens out there on the streets of the players' cities. Angry Birds is played on a mobile phone, but not in the physical world. The size of the room the player is in does not interfere with the throwing of the birds. Scrabble is played on a piece of cardboard and so is Monopoly. Monopoly is not played with real mortgages and property deeds. The closed self-sufficient universe of non-pervasive games also include the time at which the game is played because there is a clear start and end, and it is clear who are and are not players.

The salient feature of a pervasive game is that it is not played in such a closed self-sufficient universe as e.g. Halo, Angry Birds, or Scrabble. The real world is taken into account in various ways. A simple example of a pervasive game is the recently closed game "Shadow Cities." Shadow Cities was a magic-and-wizardry themed game for iOS that took into account the

city the player was in at the point of play. If the player travelled from one city to another, the game changed and gave the player a different experience. Halo, Angry Birds, and Scrabble do not change when the player travels. If those were pervasive games then "pervasive Halo" would show aliens on the streets in close proximity to the player, "pervasive Angry Birds" would take into account the size of the room the player happens to be in and allow him/her to shoot birds at family and friends at a time chosen not necessarily by the player. "Pervasive Monopoly" would perhaps be played with real mortgages and property and bankrupt, for real, not only the player but also his/her family. The need for active co-creation of the game experience, i.e. the need for the game to be enacted (Stenros & Waern, 2011; Section 2.1.7), is even more true in the case of pervasive games.

Science has defined the concept of pervasive games in many ways. For reviews, see Nieuwdorp (2007), Montola (2011), and Kasapakis et al. (2013). Many of these have a technological perspective as exemplified by Kiefer et al. (2006). McGonigal (2006) took a performance perspective and defined pervasive games as disruptive, highly visible, and often artistic events.

The kinds of games that in discourse can be called pervasive can also be called transmedia products (Evans, 2008), alternate reality games (Szulborski, 2005), adaptronic games (Reis & Correia, 2012), or converged media products (Svahn et al., 2014). Each perspective brings out certain qualities of the design that may have a bearing on the analysis of the game as a vehicle for persuasion. This work focused the analysis on the three expansions. The chosen perspective highlights an aspect of pervasive game design that, in the following chapters, will be crucial for understanding their effects.

In this thesis, the focus is neither on technology nor on the performance of pervasive games. The focus is instead on the idea that pervasive games challenge the Huizingian magic circle, making Bateson's meta-communicative signals more salient (Bateson, 1972/2006; Neitzel, 2008). It is in the context of meta-communicative signals and frames that we should view the concept of the three expansions.

The word "expansion" in the term "social expansion" is a word that implicitly assumes that something is made more extensive. Neither the word nor the tem stands by themselves. There is an invisible reference in

the term "social expansion." That invisible reference is the magic circle (Section 2.1.1). The expansions are not an unproblematic taxonomy. There are other taxonomies. One such is Paavilainen et al. (2009) who stated that the most defining design aspect of pervasive games was the way they make use of and refer to the players' context. Paavilainen et al. (2009) defined four ways of incorporating the players' context into a game including, the environmental context such as the weather. The second is the spatio-temporal context, which is to let the media product be impacted by the user geographical location. The third is the proximity context, which is to let the game be impacted by elements in close proximity, for example open or closed Wi-Fi hotspots, Bluetooth signatures etc. The fourth is the social context. Paavilainen et al. (2009) exemplify the social context with the friend lists on Facebook. The taxonomy of Paavilainen et al. (2009) has much strength, though its focus on media gives it inherent limitations.

Montola et al. (2009) instead offer a purely conceptual definition of pervasive games. They defined pervasive games in terms of three "expansions" including spatial, temporal, and social (Section 1.1.2).

2.2.1 Spatial expansion

Spatial expansion means that the game "breaks its spatial boundaries" and expands to the streets of the real world (as opposed to assumed "normal" non-expanded digital games that are bound to being played on standard computers' game consoles or table top game boards). Spatially expanded games are not limited to certain controlled physical areas or are to a set playground game board or online service. The designed affordances of the game becomes if not infinite then at least as richly variable and unpredictable as the real world into which they have moved (Davies, 2007). Persuasion in relation to place, for example advertising for tourism and educational issues about the history of a place, match easily onto this design element (Benford et al., 2005; Colvert, 2009; Raessens, 2007; Walz & Ballagas, 2007). Worth noting is that this element requires the player to move physically making his/her real body into an avatar on the real life game board and giving a degree of physicality and emotional depth to the experience (Montola et al., 2009).

2.2.2 Temporal expansion

Temporal expansion occurs when a game interweaves the time structure of the play with daily life so that there is no "on" or "off" time from the game. Just as spatial expansion appropriates the everyday environment as a resource for producing the experience, temporal expansion does the same with every day some time management of the player. This is accomplished by making the game available for play at all times, adding real time to the game time, and decreasing player ability to control when to play and when not to play. The division between playtime and not playtime is obfuscated (Montola et al., 2009).

2.2.3 Social expansion

Social expansion is when the game is intentionally designed to utilize people who are not actual players of the game and who may or may not be aware they have become a game resource. This aspect, whether denoted as social expansion (Montola et al., 2009), integration of social context (Paavilainen et al., 2009), or as something else is the focus of this dissertation. Marcell et al. (2004) found that social elements in marketing were a variable that increased the efficiency of the message. As social expansion is both greater than and different from the social elements of Marcell et al. (2004), it can perhaps be assumed that social expansion in a persuasive pervasive game can lead to even greater effects. The important aspect with social expansion is to involve non-game outsiders into the scenario. In this thesis, those who play the game consciously on the "first level" will be denoted as "primary players" and others who are themselves unbidden yet drawn into the game will be denoted as "secondary players." Designing for involvement of participants that have not opted to take part in the game opens considerable quandaries and not only ethical ones (Section 2.2.7). The previously mentioned structure of Caillois (Section 2.1) has salience for pervasive games in general and social expansion in particular. While social expansion is carried out in a free-form paidia perspective, it is designed with a strict ludus perspective in mind (Caillois 1958).

2.2.4 Levels of social expansion

Social expansion has several nuances and levels (Montola et al., 2009, Ch. 1 & 6). It can range from mere spectatorship to full participation in an aware or unaware state as presented in Table 2-2. A player can move between the forms.

Table 2-2. A table of the forms of social expansion

Levels of awareness	**Levels of participation**		
	a) No participation	b) Spectatorship	c) Full participation
1) Aware			
2) Ambiguously Aware			
3) Unaware			

The first issue to make clear is whether an individual spectator is merely coming into contact with the game (column b in table 2-2) or is a player, i.e. playing actively whether aware or unaware of this issue (column c in Table 2-2). Second, how much does the individual understand about what is going on (rows 1 to 3 in Table 2-2)? A participant can be a real life, playing customer who happens to be in a coffee shop when an active players enter in character. If the barista in the coffee shop is a part of the game she may be an aware player in relation to other players (cell 1c in Table 2-2), but not a participant when she turns to serve other real life unwitting participants (cell 1a Table 2-2). The other people in the coffee shop may not notice anything at all going on when the player enters in character, giving these people the position 3a in Table 2-2. When a person starts getting a gut feeling that something strange is going he/she gets the position 2a in Table 2-2.

The pervasive game "Killer" (Montola et al., 2009, Case A) uses a very simple form of social expansion. The game makes the players into secret agents with the mission to kill all other "secret agents" (i.e. Killer-players). The players are supposed to use fruit to symbolize weapons in order to blend in inconspicuously. Other people nearby become in-game obstacles

to be avoided. The obstacles are participants but not players. An outsider avoided as an in-game obstacle is likely never to know of having been avoided (cell 3c in Table 2-2). In the mobile phone based pervasive game "Insectopia" (Montola et al., 2009, Case I), a player collects Bluetooth signatures from the immediate environment and puts them in a virtual insect collection. In Insectopia, the outsider is a sought-after resource, but still most likely unknowing of his/her participation (also cell 3c in Table 2-2).

Third, a participant in a socially expanded game is one that may be fully unaware of being a participant. That person in no way has any part of any magic circle and believes that what happens is "real." That person lacks the protective framework of play shielding that person from disturbing experiences delivered by the game system (Section 2.1.1).

Fourth, a participant in a socially expanded game can have an ambiguous awareness. That person does notice that something strange is going on but do not understand what is happening. That person still does not have any part of the magic circle. The pervasive game "Cruel 2 B Kind"[4] has such a design. To complete the game, players must interact with ordinary non-game people in the streets in a seemingly benign manner. The outsider will know of having been contacted and talked to by a strange person but not likely to understand what the contact was about (cell 2c in Table 2-2).

Finally, participants in a socially expanded game can be aware and understand that a game is going on and can determine who is who and what is what. The game awareness level of a person may change during the game. Changes in game awareness take place through invitations. As the games are played in social environments, they constantly propagate explicit and implicit invitations to bystanders offering them a change to their mode of participation. Whatever the form, the most salient quality of social expansion is that non-game people near the player become resources necessary to construct or advance in the game world. When a pervasive game that has this design quality is used to carry persuasion, both the game and players interact with the larger non-game world. The embedded persuasive message also comes into play by bringing the design universe of a socially expanded

[4] http://www.cruelgame.com/ [Accessed 2014-04-11].

persuasive game into an intersection with the design universe of ambient advertising and viral media.

From a strictly analytical perspective, social expansion can be seen isolated as a quality in itself. However, in applied design practice, the social expansion of Montola et al. (2009) is an outcome of the spatial and temporal expansion. The three aspects depend on one another. When a pervasive game becomes expanded spatially and appropriates public spaces it is hard to find any "ordinary" non-playing people who do not become impacted by the happening. In such cases, the inside of the magic circle spills over onto the real world. If ordinary non-playing people are tokens in a game, the player is likely to at any time constantly interpret and reinterpret social semiotic cues from people in the environment making for a temporal expansion. This work emphasizes spatial and social expansion.

2.2.5 Frames and Immersion with pervasive games

Pervasive games almost by definition offer sensory immersion (Section 2.1.1) because it is hard not to be immersed in the real physical world. With pervasive games, the imaginative immersion (Ermi & Mäyrä, 2005) occurs in the form of reinterpretation of real world space as game space (Stenros et. al., 2012). Whereas non-pervasive computer games may offer a complete immersion, a pervasive game while seeming to offer complete immersion (albeit with some hold still in the real world), offers a more layered immersion as players constantly shift in and out of the play experience and the frame of the game (Fine, 1983; Goffman, 1961; Goffman, 1974). Collisions between frames of game experience are often reported as the most fun moments (Stenros et al., 2012).

2.2.6 Pervasive games as enacted entities

Pervasive games may be designed to employ the latest technological developments. Most often the role of sociability and the player as co-creator of the game is quite often greater in pervasive than in conventional games and in particular greater than in conventional console games. The digital fallacy theorised by Stenros and Waern (2011) may also become more pronounced

when researching pervasive games perhaps because pervasive-game design may lead to a larger need for enactment than common games (Section 2.1.7).

When studying pervasive games, the central challenge does not typically arise from understanding the game structure but from understanding how it is enacted in the real non-game physical world. Designing a persuasive pervasive game means designing a persuasive human activity. The game's rule system (and related paraphernalia) must provide a platform for a meaningfully persuasive activity to emerge (Stenros et al., 2012).

2.2.7 History of pervasive-game design

While the modern smartphone is an excellent platform for pervasive games, it must be emphasized that these games have historical and cultural roots that go deeper than the modern smartphone. For example, in a novel from 1905, a fictional company called the "Adventure and Romance Agency Limited" (Chesterton 1905/2013) was described as producing experiences that bear a striking resemblance to the pervasive games of the 21st century. A game called letterboxing bore a striking resemblance to geocaching but was non-technological and dated back to mid-19th century (Hall, 2011).

A canonical example is also the game "Killer" (Montola et al., 2009, Case A), invented sometime in the 1960's and still being played. Killer is a form of a live action role-playing game. Players take a guise of secret agents trying to eliminate each other from the game, in an effort to become the last surviving player, using mock weapons such as real bananas or apples. Killer is particularly popular on college campuses. Game play occurs at all hours and in all places. Since an elimination attempt could occur at any time, successful players are obliged to develop a healthy degree of watchful paranoia. Killer has social expansion where unaware co-players as bystanders get a role in the game as obstacles but never become aware of being part of the action. It has spatial expansion as any place is a game place, and it has temporal expansion as any time is a game time. Killer uses no technology at all, but is integrates fully into the mundane everyday world of both the player and unsuspecting bystanders.

In their book Pervasive Games Theory and Design, Montola and colleagues (2009) argue that pervasive games are a form of culture that inter-

sects city culture, reality fiction, and performing arts. Pervasive games do so by combining bits and pieces from various cultural contexts to produce new forms of play that show breadth and depth of a game concept.

2.2.8 Ethics of pervasive games

On a cursory glance, it seems that expanded games offer some ethical quandaries, in particular when social expansion is applied with intent. It is important for the designer of an expanded game to provide bystanders with exits. Inviting aware participants to refuse the game is quite easy (Section 2.2.3). It is not emotionally distressful to say no to strange people running around in a street dressed up as Pac Man5.

The tricky part is making refusal a valid and real option for unaware participants who are not cognizant that they are part of game or have an option to opt out (Section 2.2.3). The three games that are the experiment stimuli for this thesis (Chapter 3) did not offer any possibility of refusal for secondary players drawn into the game space.

That is a rather strong form of game design and it is made stronger by being located in the home, a place where one might expect to be safe from outside manipulation with persuasive purposes. On the other hand, outside manipulation with persuasive purposes enter a home by the hundreds every day in the form of normal advertising. When designing social expansion for persuasion it may be ethically wise to consider the choice of topic of the games and perhaps avoid strong horror or other upsetting themes (Montola et al., 2006).

2.2.9 Word-of-mouth theory and Pervasive Games

Word-of-mouth marketing (WOM) bears some similarity to persuasive pervasive games, as both are driven by social interaction and intentionally designed to persuade and both must be enacted in order to come into being (Sections 2.1.7 & 2.2.6). When the stimulus is a persuasive pervasive game,

[5] http://pacmanhattan.com/ [Accessed 2014-04-16].

it includes behaviours in the real world. Therefore, WOM need to be examined as it bears a passing resemblance to game engendered behaviours.

Word-of-mouth marketing has been an important research topic in marketing literature for several decades (Buttle, 1997 for an at that time comprehensive review, and Sweeney et al., 2012 for a later review). The concept of WOM is by nature a social phenomenon. Issues of trust, deception, and involvement are salient, just like in pervasive-game design, and have been researched extensively. Most existing WOM research investigates how it operates from either the perspective of the source ("speaker") or the recipient ("listener"). Martin and Leug (2011) presented a solid review on those topics. Kelly et al. (2010) researched the antecedents of WOM-advertising avoidance on social network sites ("E-WOM") and found that negative experiences of the media itself were a factor in advertising avoidance, in particular on social network sites and in E-WOM. This can be contrasted to how Lazzaro (2005) defined how unpleasant in-game experiences could be "hard fun."

2.3 A Persuasive Process

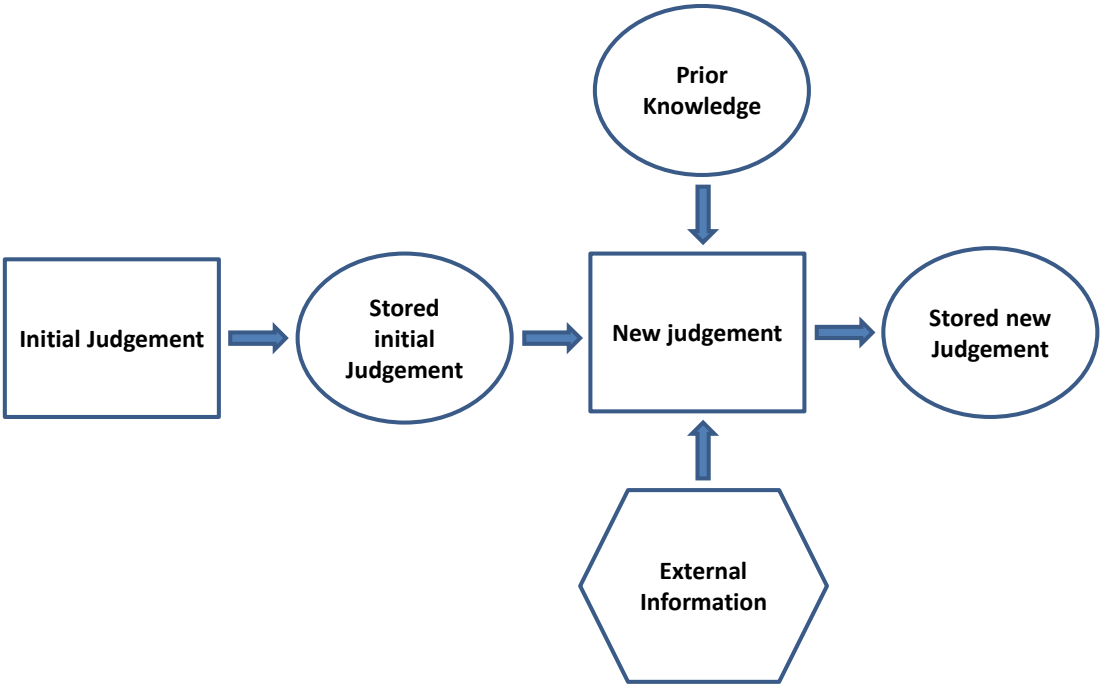
The game design theories presented in 2.1 and 2.2 are primarily descriptive. There is a missing piece in the puzzle and that is the process when the game-induced persuasion leads to a change in final attitudes. This thesis is a study of the use of pervasive games to influence player attitudes, beliefs, and to some extent behaviour with a focus on the influencing process, so this is the theory that lies at the base of how that is to be rectified. Egenfieldt-Nielsen (2006, 2007) and Linderoth (2009) in different ways both come to the similar end conclusion that supervised reflection is one integral element for the process of learning if a persuasive message is to be carried into a changed mind-set. Therefore, it may be worthwhile to dive into some theory of attitudes and thought.

2.3.1 The Structures of attitudes

The "persuasive" aspect of the term persuasive games evokes a discussion of attitudes. Therefore, it is worthwhile to leave game studies theory aside and delve into a discussion on the structure of attitudes. Although the term attitude structure is ubiquitous in literature (Albarracin et al., 2005), precise definitions are less common. An attitude may be viewed as a type of knowledge structure either stored in memory or created just at the time of judgement (Leandre et al., 2005). Alternatively, Fazio (1989; 1995) proposed that attitudes be thought of as an interface between the associations regarding an object and the valuation of that object. Building on Fazio, researchers posited that attitudes might be a small part of larger sets of knowledge structures about objects (Eagly & Chaiken, 1993; Eagly & Chaiken, 1998; Petty & Krosnick, 1995). For this thesis, it suffices to employ the "attitudes" construct as a measurement of emotions and knowledge.

Figure 2-1. Model of how attitudes are malleable.

The square boxes illustrates the judgement at the moment it is enacted, the ovals illustrate memories of judgements. For example at the moment the new judgement is enacted, it is influenced by external information, the memory of past judgments, and prior knowledge. After that moment [the square box] it becomes a memory of a judgement [the oval], and impacts further judgements (from Albarracin et al., 2005 fig.1.1).



2.3.2 Heuristic-Systematic Experiencing

The dual process modelling of attitude change is a paradigm that for some time has been influential in persuasion research and supplements the attitude change model in Figure 2-1 (see Perloff, 2010 for a review). This thesis puts the dual process modelling of attitude change as a central element in an explanatory model for pervasive game driven thought. The paradigm describes how individuals process and make judgments; for example, in the pervasive-game framed experience. Dual process modelling of attitude change is well researched (see for example Albarracin et al., 2005 for several articles), though it has rarely applied to pervasive games. Dual process modelling of attitude change is centered round cognitive processing of experiences. It has a focus on the relationship between variables in the indi-

vidual including previous experiences and judgements, and variables in the structures of the experience as exemplified by a subjectively new or common experience.

The dual processing paradigm houses several models. One is the Heuristic-Systematic Model (HSM; Chaiken & Eagly, 1987; Chaiken et al., 1989, 1996; Chen & Chaiken, 1999). The HSM assumes that persuasion is achieved when a person processes an experience according to two different modes that are distinctively different; the Systematic and the Heuristic mode. In this thesis, the HSM was applied to persuasive pervasive games.

A similar model, within the dual processing paradigm is Petty and Cacioppo's Elaboration Likelihood Model (ELM). The ELM has given significant contributions to attitude research (Petty & Wegener, 1999; Fullerton et al., 1986; Petty & Cacioppo, 1996), but this dissertation will primarily consider the HSM. The similarities between the two are limited in that both propose a dichotomy between "easy" and "effortful" modes of thought.

The HSM has the construct for the sufficiency continuum, presented below in Section 2.3.4, which allows for a gliding scale between the two modes of thought depending on, among other things, the amount of knowledge about the object of thought. Such knowledge is a central tenet when thinking about a new concept such as pervasive games (Section 2.3.6). As the HSM can integrate the amount of knowledge about the object of thought more easily than the ELM, that quality makes it more suitable.

While the HSM originated in the 1980's, researchers such as Wegener and Chien (2013) and Dhar and Gorlin (2013) further developed the dual processing paradigm into models of group choice and preference. Researchers found the HSM to be of considerable use when analysing and predicting the effects of persuasive messages. A large number of studies on advertising have validated the dual process model (Bolls & Muehling, 2007; Kruglanski & Stroebe, 2005; Perloff, 2010). Still, this thesis is not the only scientific work to apply the HSM to a game studies context. Cheung and Thadani (2012) applied it to the processing of E-wom, Watts and Shankaranarayanan (2009) applied it to the cognitive assessment of data quality, and Angst and Agarwal (2009) used it for the persuasion and adoption of technology.

When we have a high need for confidence in our understanding of a situation, we process our perceptions through logical and conscious thinking based on a desire to take in and understand the full spectrum of characteristics of that situation. Such processing is analytic and comprehensive. It is a judgment formed as a response to the actual content of the message, combined with the situation. Systematic processing requires that the perceiver have cognitive ability and capacity as well as the willingness to engage in systematic processing. This is what is called the Systematic Route. It runs from first perception of the situation, through systematic processing to a conscious decision on what to do and feel next (Chen & Chaiken, 1999; Greifeneder, 2011).

Heuristic processing is viewed as a mode offering a better cognitive economy than systematic processing. When processing heuristically, humans focus on a subset of available information enabling the use of simple inferential rules, schemata, or cognitive heuristics to formulate their judgments and decisions (Chaiken et al., 1989). Such processing entails the activation and application of rules or heuristics learned and stored in memory. These judgments reflect easily processed judgment-relevant cues. The heuristic mode is constrained by principles of knowledge activation, availability, accessibility, and applicability. That means that for heuristic processing to take place there must be heuristics, or "schemas" available (Wahlund, 1994; 2002). Heuristic processing has been characterized as more exclusively theory- or "schema"-driven than systematic processing. It has been described as "…more exclusively theory driven because recipients utilize minimal informational input in conjunction with simple (declarative or procedural) knowledge structures to determine message validity quickly and efficiently" (Chaiken et al., 1989, p. 216).

In short, the heuristic mode of processing presumes that the individual has a personal theory about the object that is processed. This may be an issue for persuasive pervasive games. The play experience can be expected to be novel, making heuristic processing difficult. The HSM assumes that a person's main motivation in a persuasion setting is the desire to formulate valid or accurate attitudes. Both modes of processing can drive attitudes (Chaiken et al., 1989). This paradigm has also been reviewed and integrated

with modern research on cognitive feelings and memory retrieval in Petty and Wegener (2003) and in Greifeneder (2011).

2.3.3 The Sufficiency Principle

Heuristic and Systematic judgements are not bipolar binary situations. It is a fluid continuum described by the "sufficiency principle." This principle states that in the human mind there is an ever-ongoing tension between cognitive economy, pushing the mind towards heuristic processing, and the wish to feel certain about one´s perceptions and judgements of situations, which pushes the mind towards systematic processing. Perceivers strike a balance between minimizing cognitive effort and satisfying motivational concerns (Chaiken et al., 1995).

Thus perceivers who are motivated to determine accurate judgments will exert as much cognitive effort as necessary to reach a sufficient degree of confidence that their judgments will satisfy their accuracy goals. When low effort heuristic processing fails to confer sufficient judgmental confidence, or cannot occur due to for example the absences of any judgment-relevant heuristic-cue information, perceivers are likely to engage in systematic processing in order to close this gap (Chen & Chaiken, 1999). Hence, it is possible that the novelty and rarity of pervasive-game experiences will drive players towards systematic processing.

2.3.4 Processing consequences

The HSM predicts that attitudes acquired via the systematic route are expected to manifest greater temporal persistence and exhibit greater resistance to counter persuasion than attitudes acquired via the heuristic route. The greater resistance and persistence follow from the expectation that under the systematic route, the issue-relevant attitude schema is accessed, rehearsed, and considered in the mind more often thereby strengthening the interconnections among the components and rendering the schema more internally consistent, accessible, enduring, and resistant than under the Heuristic route (Chen & Chaiken, 1999). The HSM allows for systematic and heuristic processing to co-occur.

The HSM also holds that motivational variables have similar effects on systematic and heuristic processing. For instance, personal relevance is assumed to influence not only the magnitude of systematic processing but also enhances the likelihood of heuristic processing because it increases the cognitive accessibility of relevant persuasion heuristics and/or increases the vigilance with which people search the setting or their memories for relevant heuristic cues (Chaiken et al., 1989, p. 226).

2.3.5 The Role of subjective Goals and Beliefs in the Heuristic-Systematic Model

An individual's prior beliefs and goals play a variety of roles in the processes of persuasion postulated by HSM. Prior beliefs may influence whether and to what degree a message argument is experienced as convincing or unconvincing. For instance, an argument that saving electricity is desirable because it contributes towards fighting global warming will probably find better traction with an individual that believes in global warming. Similarly, a game teaching evolution will not find any traction with creationist Christians. The persuasive effects of cues or heuristics rests on established beliefs. For instance, if formal expertise in the message source is something that convinces the recipient into being persuaded, then that message efficacy probably rests on a belief that expert statements generally are authoritative (Chen & Chaiken, 1999). This has been validated in another area of research, when Martin and Leug (2011) found that trustworthiness of the source was crucially important factor in WOM.

2.3.6 Categorization

In 2.3.5, it was stated that the presence of a personal idea about an experience is a prerequisite for heuristic processing. To have a personal idea about an experience is to have literacy for that incident. In the present day, most people in the affluent world are literate of most media experiences. Media literacy involves a repertoire of competences that enable people to analyse and evaluate persuasive messages from most media like TV, radio,

cinema, print, news media, life style magazines, and social media to name but a few.

A discussion of literacy of persuasive games should take place on two levels. One is the level of the player learning to play the game. The other is the level of the persuasion that the game is employed to convey. If the player has a hard time playing the game, then lacking media literacy may obstruct the creation of the personal theory about the play experience hence defining the way the player places the experience on the sufficiency continuum. That harks back to the presentation of pervasive-game design.

Creating categories of experiences is automatic and critical in everyday life. If every experience was treated as unique, a human would never be able to remember more than small fragments of the environment. Categorization is driven by the same principle of cognitive economy as the sufficiency principle. Cognitive heuristics increase the efficiency of human everyday lives, but it is also a very stereotypical process (Moreau et al., 2001). When we encounter something new as consumers, we have a strong inclination to fit it into existing categories. Consequently, existing categories always have an advantage over new categories (Lange, 2003; Svahn & Lange, 2009; Rosch, 1978). Categorization is a basis for media literacy and it may also define how much energy a person spends on learning to play a game (Smith & Medin, 1981).

Cognitive economy is one principle of categorization, another is category essence. A consumer, or in the case of this research a player, will assume there is a set of intrinsic underlying principles that makes a category (Smith & Samuelson, 1997). Thus, each category has an essential set of attributes that define what it is about (Heit, 1997; Murphy & Medin, 1985). When such essential attributes are present, non-essential ones may differ without loss of category cohesiveness (Lange, 2003; Rips et al., 2013; Smith & Samuelson, 1997; Murphy, 2004). Svahn and Lange (2009) hypothesized that the three expansions of a pervasive game will take it out of a "game"-category into another, perhaps more "leisure-time" oriented category. It may be that including the three expansions in a game will impact categorization as the player can be expected to have less literacy about the experience.

For the designer of a persuasive pervasive game, the issue then becomes whether a game can take into account the shape of *paidia* or *ludus*

(Caillois, 1958), the rule structure, or the learning form (Egenfeldt-Nielsen, 2006) and be designed to match the core essence of the persuasion it is employed to convey. The more it can fulfil all of these requirements, the easier it will be to categorize. For a category of games that is still rather unusual, such as pervasive games, the general publics´ unfamiliarity with the concept of pervasiveness may very well affect persuasion. Whether it is a positive or negative impact remains to be seen.

All three expansions – temporal, social and spatial – have consequences on the user's categorization of pervasive games. Let us take the temporal expansion as an example. In non-pervasive games, the players decide when the game commences, pauses, and finishes. In a temporally expanded game, player control over playtime is reduced in order to enhance the game experience. This also removes user choice of when to use the product thereby creating a product that chooses when it plays the user and not the other way around. This disturbs the consumers' work/play dichotomy and may influence the category reading of the experience (Svahn & Lange, 2009).

2.3.7 Ecological Psychology

The HSM is one model within the larger family of cognitive psychology. Ecological Psychology lately has become another popular theoretical background for game studies (Howell, 2011; Linderoth & Bennerstedt, 2007) and has accepted the HSM model perspective. Ecological psychology focuses primarily on the functional value of game features (i.e. its local meaning in the game structure).

The proponents of this line of theory takes as a point of departure the difficulties found when creating learning experiences through games and asks themselves if perhaps science misunderstood the gaming activity and how players perceive and learn from games. Linderoth (2013) describes ecological psychology as an approach that rests on strong anti-cognitivist assumptions, rejecting the existence of mental schemata. Instead, a basic assumption of ecological psychology is that learning and perception constitute a process of differentiating and making distinctions. The fundamental function of perception is to pick up and fine-tune information about possible ways of acting in the environment. This idea does have some poignancy

for pervasive games because such games do, largely, come about through a designed relationship with the player environment.

While Linderoth finds that the internal relations between different aspects of the game is an important variable in game analysis, this author finds that perspective is not fully sufficient as ecological psychology says little about how the fine-tuning of the process comes about. A consequence of ecological psychology is that categorization (Section 2.3.6) simply cannot be applied, nor can the HSM exist in the universe of ecological psychology because HSM postulates mental workings in internal resources. There is also little room for a construct of attitudes (fig. 2-1) in ecological psychology.

Cognitive psychology still has a strong foothold in social sciences in general and in marketing science in particular (Olson & Stone, 2005; Perloff, 2010). Therefore, in this thesis, HSM was the model of choice.

2.3.8 Research Question and Hypotheses

Based on the theoretical discussion in this chapter, the following three research questions and hypotheses are proposed:

RQ 1: Does playing a pervasive persuasive game have any effects on focal variables in the intended direction? If so, how and to what extent? Focal variables are those that are intended to be impacted by playing a persuasive pervasive game.
In chapter 4, three specific hypotheses related to this research questions are specified: H1 to H3. In chapter 6, two specific hypotheses related to this research questions are specified: H7 to H8.

RQ 2: What may a persuading process from playing a pervasive persuasive game look like, and what are the influencing effects in such a process?

Based on some more specific theoretical discussions in the chapter related to RQ 2, the following hypotheses are proposed:

- H4: The more enactment in playing a persuasive pervasive game, the more positive the effects on the focal variables will be.

- H5: The expansions of a pervasive game play a role in a persuasion process from playing a persuasive pervasive game, strengthening the process in the intended direction.

- H6: The more systematic processing and less heuristic processing when playing a persuasive pervasive game, the more positive are the effects on the focal variables.

- H9: Social expansion of a pervasive game play**s** a role in the persuasion process of playing a persuasive pervasive game, strengthening it in the intended direction.

RQ 3: Does categorization play a role in a persuasive process of playing a persuasive pervasive game, and if so, what role?

Chapter 3
Methodology

This chapter presents the reasons for choosing household electricity consumption as the case that represents the difficult problems for persuasive messaging and put it to the test with pervasive games (Section 2.2.). Thereafter, I discuss the context of the research, as that has contributed to shaping the study and then the choice of multi-method data collection from field-tests with full-scale playable games.

3.1 Energy and Electricity

The purpose of this thesis is to arrive at a better understanding of a persuasion process from playing persuasive pervasive games and to explore possible persuasive effects of playing such games (cf. Section 1.2). The topic of electricity consumption was chosen because it is an urgent global problem and has a price in political and economic issues. In the countries that are members of The Organisation for Economic Co-operation and Development (OECD) there has been a 160% rise in domestic electricity consumption during the 40 something years since the energy crisis in the seventies (IEA, 2008, p. II.43 in Gustafsson, 2010).

The rise in consumption of electricity leads to ecological, political, and economic problems. Electricity is in many countries to a large extent produced by burning fossil fuels. It contributes to global warming (Solomon et al., 2007), an ecological problem, and diminishing supplies of fossil fuels that in turn cause political instability (IEA, 2011). Furthermore, the price of electricity is also a strong driver of inflation due to it having weak price elasticity (ECB, 2011), which is an economic problem.

Research has shown a linkage between electricity consumption and economic development in the OPEC (Jay, 2007) and ASEAN countries (S.-H., 2006). It may appear that improvements in human living conditions are connected to a rise in the use of electricity (S.-H., 2006). However, research on Chinese economic growth (Zhang & Cheng, 2009) showed that electricity consumption did not necessarily have to rise in step with economic development. In the whole of the OECD, the household sector has more than doubled its electricity consumption from 1082 TWh in 1973 to 2814 TWh in 2006, an increase of 260%. This constitutes a significantly larger increase than the industry sector, which during the same time increased its consumption from 1836 TWh in 1973 to 3086 TWh in 2006, an increase of only 168% (IEA, 2008, Table 2.14 in Gustafsson, 2010).

The price of household electricity has risen in many countries in recent years. Electricity prices impact the wallets of individual households, so the importance of them are sharpened when taking into consideration that light, heat and cooked food are hard to abstain from. Electricity costs may become a "cuckoo in the nest" for households and crowd out other forms of consumption that would have done good in the general macro economy.

In 2005, Abrahamse et al. (2005) presented a review of 38 intervention studies aimed at household energy conservation and in 2012. Osbaldiston and Schott presented a meta-review of 253 studies into energy saving communication programs initiated by public authorities. Their reviews indicated that campaigns which included elements of cognitive dissonance, goal setting, social modelling, and public prompts provided the overall largest effect sizes. It appears as salient that these elements would be easy to implement in a game design, in particular in a pervasive game (Chapter 2).

However, Abrahamse et al., (2005) like others (Weiss & Tschirhart, 1994; Flor & Singleton, 2011; Fletcher et al., 2010) did not include gaming in their studies. Osbaldiston and Schott (2012) explicitly excluded studies that revolved around using games as the medium for a public energy saving program.

The topic of energy consumption with a focus on electricity consumption in households was also inspired by the Twin River project (Robert, 1978), and also by van Houwelingen and van Raaij (1989), and Abrahamse et al. (2005). These three all underline the value of human household be-

haviour in relation to consumption of electricity. Therefore, this thesis focused on pervasive games that shaped attitudes to human household behaviour in relation to electricity consumption. So why does electricity consumption not decrease? If prices consistently rise over a period of time that ought, according to any credo of the rational economic man lead to a decrease in consumption. However, electricity consumption has remained more or less constant. So why has electricity consumption not decreased? Van Houwelingen and van Raaij (1989) identified a cluster of difficulties related to the awareness of electricity and management of energy consumption that might resonate as to why so little decrease has been registered. Their findings were supported by Abrahamse et al. (2005) and Barr (2012) and are summarized in the following section.

3.1.1 Low Knowledge of electricity

Knowledge of how to conserve electricity is low in the general population. Van Houwelingen and van Raaij (1989) found that while there was a wish to conserve electricity, knowledge about household electricity is low. This finding was confirmed by a pre-study on Swedish households with teenage children made by the Energy Design Studio of the Interactive Institute Swedish ICT (Torstensson, 2005).

3.1.2 Issues of "backgrounding" of electricity

Another factor that influences electricity consumption is the character of electricity as a product. Production and consumption of electricity, while central to our society and ubiquitous in daily lives, is invisible in itself. The means for controlling electricity tend to be concealed inside the walls of houses or under the designed exteriors of household products. In a home, cables are deliberately tucked away behind furniture out of sight (Gustafsson, 2010). De Jong, Balksjö, and Katzeff (2013) and Katzeff (2010) discussed the need for energy visualisation in general as a way to put energy and electricity consumption in the foreground. Hargreaves et al. (2013) attempted to remedy the backgrounding of electricity consumption by giving the consumer information via smart meter monitors. Through qualitative

studies, Hargreaves et al. (2013) found that the smart meters monitors themselves after a while became 'backgrounded' within normal household routines and practices.

3.1.3 Insufficient consumer info

A third factor pointed out by van Houwelingen and van Raaij (1989) was that the cost of the electricity was not visible at the point of consumption. Extemporaneously expressed when a consumer purchased a piece of furniture in a store payment was made to the cashier on exiting the shop. When a buyer in a professional capacity buys the services of a consultancy, the buyer gets a specified bill. When a person consumes electricity, i.e. flicks a switch and turn on a light when entering the dark hallway of home in the afternoon, that consumer is not given any confirmation of having made a transaction. The switch does not pop up a message saying for example:

> "– Hello, I am your friendly light switch. Are you sure to want to buy this electricity? It will cost you X cents/minute. Press again to confirm."

Nor does the light switch pop up a message when it is turned off saying:

> "– Hello I am your friendly light switch. The light was on for 90 minutes and cost you X cents. Electricity Inc. welcomes you back as our customer."

That this does not happen illustrates the obscurity of purchasing electricity. Instead, the consumer gets an aggregated bill monthly or even bi-monthly, providing only the total electricity purchased with no info about the cost of each individual purchase. However, within the frame of a fictional universe of game play it would perhaps seem less strange if light switches were friendly and informative. A pervasive game could make it possible to have real life light switches be informative.

3.1.4 Issues of commoditization

A fourth factor that affects the ability to control energy consumption is that electricity is not purchased and consumed on its own. A consumer does not really consider that it is electricity that is purchased and consumed when the home is warm, the lamps are lit, the smartphone is online, or the coffee is hot (Torstensson, 2005). The consumer is not interested in a jar full of electrons, but rather what electricity can do. Electricity is such a ubiquitous resource and so fully integrated into all aspects of daily life that the consumption of it has sunk below an awareness threshold.

Household electricity consumptions is a real life technological system, so theory illustrates that it seems to be well-suited to be taken use of in a pervasive game with, for example, a spatial expansion in a game. A game that illustrates household electricity consumption could influence perceptions of electricity use (hereafter "beliefs") with putting electricity in the foreground of player awareness to give consumer info and build mindfulness regarding electricity.

3.1.5 Issues of Social Consumption

Most homes are used by several individuals of differing ages and incomes, yet it has only one contract with an electrical company as a shared resource for all household members. If the children of a family unit are teenagers they can be heavy users of electricity (for example, taking long showers, blow drying hair, washing and tumble drying one single favourite shirt) while not contributing towards the bill. Alcott (2011) examined a program that employed social norms to achieve electricity consumption behavioural change. Alcott found that teasing social norms achieved a change of 0.3 to 6.3%. Still, teasing social norms was not enough in itself, as the respondents had too little information regarding personal electricity consumption to achieve lasting behavioural change. That parallels the conclusions of Abrahamse et al. (2005) and Hargreaves et al. (2013) who found that information was not enough in itself. Neither teasing social norms, nor, giving more information is in itself enough to achieve changes in the view of household electricity consumption. Something more is needed. A pervasive

game that applies social expansion could perhaps consider social consumption, not as a problem but instead as an element of the game play and of a persuasion process.

The ecological and economical urgency of electricity consumption together with the seeming suitability of electricity consumption for pervasive games motivates the choice of electricity consumption as the platform for trying out pervasive game design for persuasion. Pervasive games can take many forms and shapes (Chapter 2). It is very difficult in practice to produce a game that employs all three expansions in full. Therefore, three games were produced for this thesis with slightly different focus loci.

3.2 The context of the research

The research chronicled in this thesis was carried out within the context of the design research project "Young Energy", one of the research projects within the Energy Design Studio of the Interactive Institute – Swedish ICT[6]. The point of departure for Young Energy was to impact energy awareness of youth through life interests and to achieve this impact through means that young people use to live and move through life; for example, by the use of technology such as digital games and mobile phones. Torstensson (2005) documents these considerations in a pre-study. This was in line with my own interest in household energy consumption and the difficulties in influencing such consumption behaviour.

Against that background, a series of workshops were held in 2007 under the auspices of the Energy Design Studio of the Interactive Institute Swedish ICT, with game designers and youth organisations as participants. The first workshop focused on avoiding presenting energy use as something negative in itself and to strive for a message that was both challenging and simple and an execution that involved physical activity and evoked curiosity. It was in this context that the decision to attempt using pervasive games was made. The second workshop focused on initial development of a game idea that could incorporate household electricity as a parameter. The result was the first game: Power Agent, presented and developed by

[6] https://www.tii.se/groups/energydesign [Accessed 2014-04-11].

Bang et al. (2007), Interactive Institute (2010), and Torstensson (2005). This author did not take part in this first phase, although did get insight into Power Agent and came to the vision that Young Energy could be a test bed where research exploring a persuasive impact of the three expansions could take place. Based on the existing game Power Agent two additional games were developed to address the cluster of difficulties 3.1.1 – 3.1.5.

After Power Agent, a renewed series of workshops was held in 2008 within the context of the Young Energy project. This second series included only researchers, of which this author was one. The aims were to explore the possibility to produce a game that could overcome what was seen as limitations in the previous Power Agent game. Another game was then developed – Power Explorer (Bång et al., 2009; Gustafsson, 2010; Interactive Institute, 2010). Power Explorer was intended to explore temporal expansion in ways that Power Agent had been unable to do, but both Power Agent and Power Explorer covered all thee expansions and directly tried to address the cluster of difficulties in 3.1.1 -3.1.5.

Power Agent and Power Explorer were both seen as successful and inspirational designs, so the Energy Design Studio joined with the Mälardalen Energy Board[7] and found funding from the Swedish Energy Agency[8] to explore what would happen when these designs were scaled up in a quantitatively larger scale field experiment and played for a longer period of time. That project became the game Agents Against Power Waste with the goal to explore the three expansions when played for a longer time and with a larger player base than the two previous games. The Interactive Institute provided an updated game design aesthetic based on Power Agent and new missions designed for four weeks of playtime.

This author provided research design for the evaluation of AAPW and, became the project owner, project manager, and executed the game project together with Mälardalen Energy Board and the company Mobile interaction. The AAPW-project is described by Larsson (2011), and AAPW as a game is described and partially analysed by Svahn and Waern (2014).

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[7] http://www.energikontor.se/ [Accessed 2014-04-10].

[8] http://www.energimyndigheten.se/ [Accessed 2014-04-10].

Table 3-1. A table of how the expansions are represented in the games.

	Spatial Expansion	**Temporal Expansion**	**Social Expansion**	**Play Time**
Power Agent (2007)	Strongly represented, but limited to the household	Mid-to-strongly represented	Strongly represented	One week
Power Explorer (2008)	Strongly represented, but limited to the household	Strongly represented	Mid-to-strongly represented	Ten days
Agents Against Power Waste (2010)	Strongly represented, but limited to the household	Mid-to-strongly represented	Strongly represented	Four weeks.

3.3 Field Experiments

Power Agent, Power Explorer, and Agents Against Power Waste were trialled in altogether four field experiments: Power Agent twice in 2007 with six players per test: Power Explorer once in 2008 with 15 players and Agents Against Power Waste once in 2010 with 126 players.

Pupils in middle and high schools aged 10 – 15 years old and living in families were asked to play one of the three games. The families were recruited through contact with local schools. Contracts of consent had to be exchanged between the parents of the families and the researchers. That exchange of contracts happened mostly via the teachers and went smoothly. It demanded some coaxing and repeated asking from the researchers so that all respondents became fully aware they were part of a research project. The purpose of this thesis is to arrive at a better understanding of a persuasion processes from playing persuasive pervasive games and to explore possible persuasive effects of playing such games (cf. Section 1.2).

The core essence of the three expansions is to let the game take place in the everyday real-life world of the players. Therefore, field experiments became the chosen method since they take place in the real world of the respondents. A further specific reason for the choice of field experiments was the open nature of pervasive games. When the game takes place in real life,

anything that can happen in real life can happen in the game. Field experiments can capture emergent behaviours not foreseen at the outset.. For example, a laboratory experiment with a pervasive game would not afford any insight into the game interface with the everyday world because that everyday world is not present in the laboratory. In particular, the real social aspects of play cannot be simulated in a laboratory. The three games of this thesis apply social expansion (Section 2.2.3) intentionally to create a certain amount of discomfort and engagement in the interface between the players and the mundane world. The discomfort is hypothesised to drive thought and hence be a central part of the persuasive effect of the three games. The discomfort would not arise in a laboratory, as the play experience would then not be framed as "real life" (Sections 2.1.1, 2.1.7, 2.2.4 & 2.2.5).

For some pervasive games, the consequence of the necessity to interface with the everyday erases the difference between the game and the play session (Björk and Holopainen, 2004). The game is either only staged once, or every staging meets different everyday worlds that in turn lead to interfaces with them differently. Therefore, they cannot be quite exactly the same game each time (Björk & Holopainen, 2004; Stenros et al., 2012). As such, only a field experiment allows both players and researchers to see the design fully enacted.

In the case of the games studied in this dissertation this concept is particularly important because the social expansion design resides in the everyday life of the participants. For example, if the whole household was relocated to a laboratory and asked to play the game, the friction in the everyday life relations between household members that is postulated to drive thought/action would likely not arise or arise differently. The more naturalistic setting of a field experiment allows for the households real social behaviours to arise within the experiment situation. Field experiments were suitable as the sought after truth was what happens to the player and the players surrounding context when a design meets real life. The focus loci of interest was the impacted real life, it was not actually the games.

3.3.1 First stimulus: Power Agent

Power Agent was the first custom-made game. The concept was generated through a series of workshops in 2006 involving game researchers, designers, behavioural researchers, energy consultants, professional game designers, and the presumed target group of teenagers (Gustafsson, 2010). This author did not take part in those workshops.

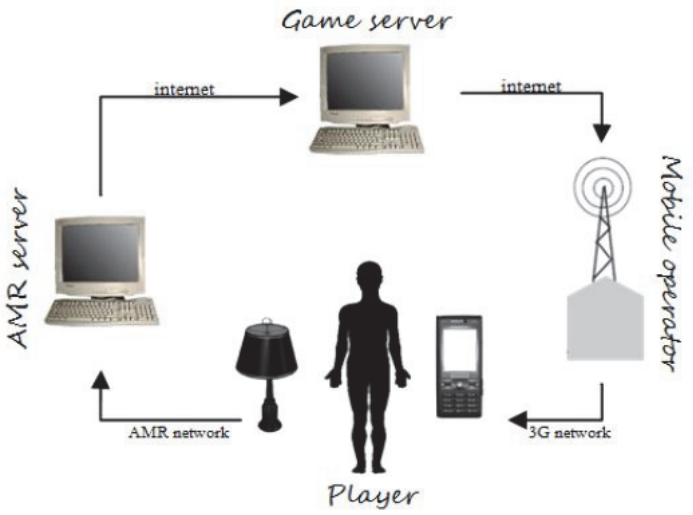
3.3.1.1 Power Agent System

Power Agent was a pervasive-persuasive game for standard java-enabled mobile phones at the time. The game client was software only, requiring no custom hardware. Power Agent was designed to reside on top of and connect with the automatic meter-reading system (AMR). The AMR system is utilized by power companies to automatically and remotely measure consumption of electricity for use in billing. The currently used AMR system typically makes a data log entry of consumption on an hourly basis. However, due to data transmission costs, the data are only transmitted to the company´s central server once every 24 hours (during the early morning hours). That is sufficient for billing purposes, but it is a challenge for game play design. Therefore, Power Agent was a slow turn based adventure style role-playing game.

The electricity consumption data were relayed from the electricity company to the game server during the early morning hours. The data were processed on the game server and results calculated. The results were then sent to the Java client on the mobile phones where the information was transformed into visual and aural feedback to the players in the form of game graphics and announcements from "MR Q" a non-playing in-game character that provided exposition.

Figure 3-1. The Power Agent System from Gustafsson (2010, fig. 16)

This picture shows the loop of extra-game input and extra-game output.



3.3.1.2 Power Agent Gameplay

Power Agent was an adventure and role-playing styled pervasive-persuasive game centred on social team play (Björk & Holopainen, 2004). In Power Agent, the player was a secret agent receiving quests in the form of secret agent "missions" with a goal to conserve household electricity. The missions were tasks focused around household chores in daily life including cooking and doing the laundry. The player played within a team of three households. The unit of team membership was not the player but rather it was the household. Hence, a player had to build cooperation within the team of three and in his/her own household.

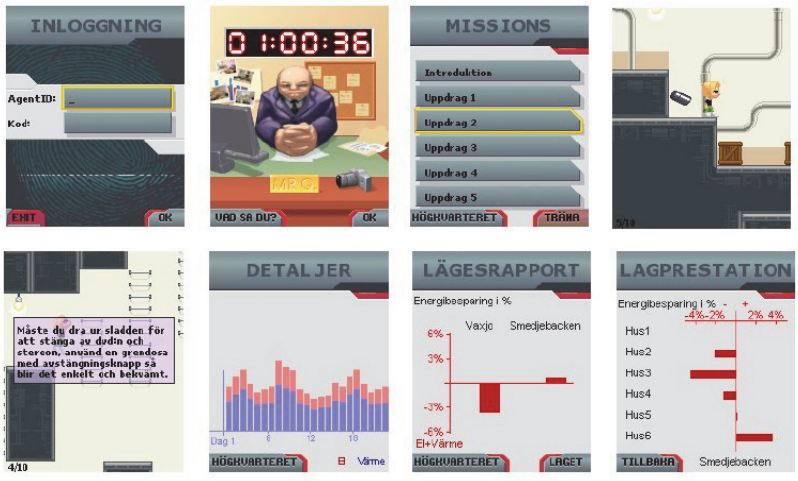
The team of three competed with another team of three agents located in another town. A successful player persuaded everyone in their own household to conserve as much electricity as they could during the daily "Mission" (i.e. a quest) that most often took place 17:00 and 22:00. A successful team was one where all three players managed to persuade their own households to conserve energy. To strengthen the narrative plot of being a Secret Agent, Power Agent employed the mobile phone camera and encouraged players to take pictures of actions performed to reduce electricity consumption in their homes. These pictures, when present, were dis-

played on top of the time axis with personal consumption data. This was called the "Agent Camera."

A message board was included in the game to allow participants to send messages to each other. All functions in the game were accessed by selecting the items behind MR Q on the main screen. This was done by using the phone's navigation key. Selectable items included the camera (the agent camera function), the message board (message function to the other players), the computer (the warm-up tracks), the card index (brief information about the other players), the papers in front of MR Q (the missions), and the pictures and graphs (feedback and results).

The underlying game play was to let players compete in teams and learn hands-on how to conserve energy in their homes. When MR Q gave the player the mission a warm-up track for the mission, in the form of a small platform game, was unlocked in the phone. At the warm-up track, players could collect batteries. Each battery was associated with a clue on how to succeed better with the assignment during the evening's mission. A clue could include "Unplug wall sockets to prevent the DVD or the stereo from using electricity when not in use."

Figure 3-2. Screen shots from Power Agent (Gustafsson 2010, fig. 17).



The first six missions in the game all had an energy saving theme. The themes were (1) lamps, (2) activities in the kitchen, (3) entertainment equipment, (4) heating of the house, (5) washing and cleaning, and finally (6) showering and bathing. In the final mission, players took on the task of lowering the total electricity consumption of the household for a longer period as this mission played out over the entire weekend. The feedback after a mission was given on the morning after it was performed by the animation of MR Q. MR Q would encourage the unsuccessful players to try harder and praised the successful ones.

In addition to the voice responses from MR Q, a set of screens and bars visualized the result in more detail. These bars consisted of scrollable vertical charts with player personal home consumption, horizontal bars indicating the individual effort within the team and bars indicating the team results. There was also a high-score list showing the winning team for each of the different missions. After the final mission, a summarizing message was sent from MR Q. This message concluded the game and provided additional feedback on how much the reduction in consumption during the final would become translated into money and carbon emissions if it were maintained over an entire year. Power Agent is described by Bang et al. (2007), Gustafsson and Bang (2008), Gustafsson (2010), and in the final report to the funding board.

3.3.1.3 Fieldwork and data collection of Power Agent

Fieldwork: Power Agent was field tested twice. The first time was seven days in January of 2007 in order to test the viability of the game concept and the data collection method. The second test was eleven days in March 2007. Each test had two teams, one in the city of Smedjebacken and the other in the city of Växjö. These are two cities in Sweden several hundred kilometres apart. Each time the two teams consisted of three players each. The primary players and their auxiliary players (their families) played the game for ten consecutive days during the spring of 2007.

Data collection: Electricity consumption data for the participating households were collected before, during, and after the field test. The total period monitored after the gaming sessions extended to 7 days for the three play-

ers on Team Smedjebacken. There was a non-playing control group against which to measure the effects of Power Agent on electricity consumption. The field test was followed by semi-structured interviews with the players and their families. There were no questionnaires. Pictures taken by the agent camera provided a further source of information on the actions players took to reduce electricity consumption.

The author of this thesis did not take part in the field test of Power Agent. The author has through the gracious courtesy of the Energy Design Studio of the Interactive Institute gotten access to transcripts of the interview data and been able to use that as secondary data for the qualitative analysis of Study One, for resolving the research questions of Chapter 3 of this dissertation.

The agent camera pictures and the AMR data from Power Agent were not considered in this thesis. The fieldwork of Power Agent has been described by Bang et al. (2007), Gustafsson and Bang (2008), and Gustafsson (2010).

3.3.1.4 Power Agent and the Three Expansions

Power Agent design has a strong but limited spatial expansion. The strength of the spatial expansion is that all household appliances are mirrored in the game. The limitation is that the expansion only takes place within the house. The aspect of temporal expansion is not so strong in the design because the game sessions have a clear temporal demarcation. . The social expansion elements of the design are strong and the game is played through "quests" that are best settled by mobilizing the rest of the household so that they are not aware that their everyday lives have become part of a game. The rest of the household are secondary players that are initially unaware, as the consent form only concerned the primary player, but fully participating. It is up to the primary player to make the rest of the household aware and fully participate as secondary players (area 3c in Table 2-2 Chapter 2.2.3 this thesis).

3.3.2 Second Stimulus: Power Explorer

Power Explorer was the second prototype. Its concept was generated through a series of workshops in 2008 in which this author did take part. The workshops took the shape of brainstorming sessions with game researchers from the Energy Design Studio, most prominently Anton Gustafsson, Magnus Bång, and Carin Torstensson and with Mattias Svahn the author of this thesis from the Stockholm School of Economics. The groundwork was laid with the Power Agent work and the results and experiences from Power Agent were available to be built upon. The role of Mobile Interaction AB was to perform the actual building of the custom software that Power Explorer required.

3.3.2.1 Power Explorer System

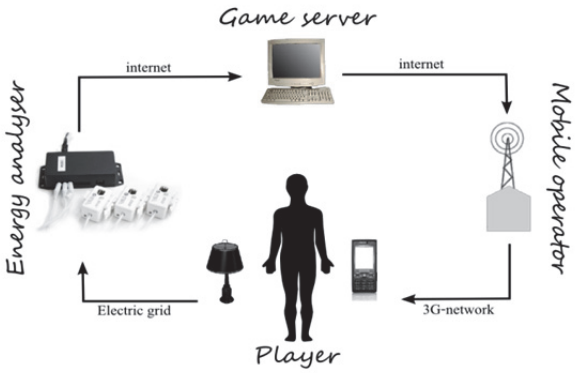
The main design idea of integrating household electricity into a central parameter for individual game play was kept for Power Explorer, but in all other aspects Power Explorer was designed as an antithesis of Power Agent. While the design of Power Agent was not so strong on temporal expansion, Power Explorer was designed to be strong on that element. The quest structure of Power Agent was designed to lead to a strong element of social expansion in the home and the action-oriented players versus player structure of Power Explorer would lead to weaker elements of social expansion.

The main difference was that Power Agent was designed to function as a software client making use of existing societal infrastructure and adapted to the 24-hour cycles of the AMR system. Power Explorer was instead designed with both custom built hardware and software making it possible to quicken the game play cycle from the 24 hours cycle of the AMR system to a cycle of 25 milliseconds.

This was achieved by designing a system where the flow of electrons (i.e. the electricity) into the house was measured as variations in the magnetic field surrounding the main electric cable entering the house. That information was sent from a custom-built measurement unit via a Wi-Fi network in the house to an internet connection in the respondent's house, making use of the households existing broadband. The information then

went to the game server and from there to the game client in a cycle of 25 milliseconds. This gave the player the experience of virtually instant feedback. For example shutting of the tumble dryer in the house gave instantly visible effects in the game software on the mobile phone.

Figure 3-3. The Power Explorer game system (Gustafsson 2010, fig. 1 p. 206)



While Power Agent was dependent on cooperation with a local power company that gave access to the AMR system, through the custom hardware, Power Explorer could work in any household independently of the power companies. Power Explorer was played on an HSDPA and Java-enabled handset (for example a SonyEricsson K660i). The game client remained dormant in the background when not in use and could push messages to the player about exceedingly high consumption and deliver challenges. It could also act as an ambient interface by making electric sounds as consumption rose, to pull the player back into the game when something interesting happened (i.e. temporal expansion see Section 2.2.2).

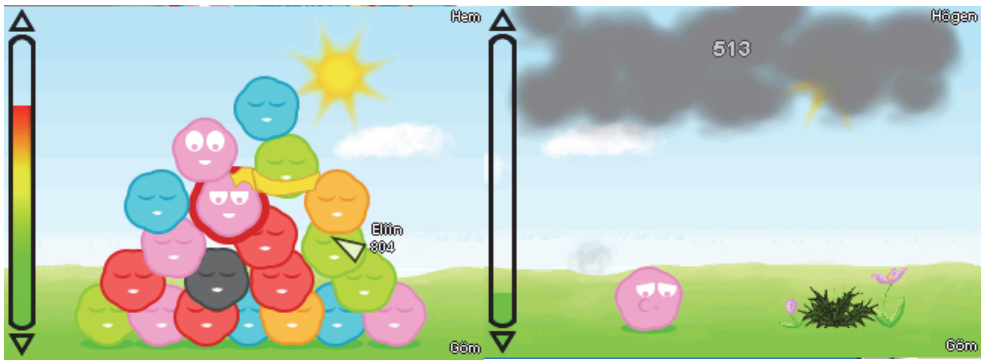
3.3.2.2 Power Explorer Game Play

The players were represented by a game avatar described as a "monster blob" that was individual to all players. The blob could visit four different environments that each had a different mode of interaction: the pile, the habitat, and two duels. The game was designed to balance the two opposing

goals of saving electricity (habitat and pile) versus engaging players in using and learning about appliances (the duels). The two existing duels in the current version of the game included the rainforest and polar dual. Playing the duels offered an engaging real-time player-to-player competition while playing in the habitat was a quite low-key explorative task. Power Explorer was played as a fast-paced action oriented game. It was designed to be a Multiplayer Online Role Playing Game.

Figures 3-4 and 3-5

"The Pile" "The Habitat".



Power Explorer had four play areas. The Pile (fig. 3-4), The Habitat (fig. 3-5) and two player-versus-player duels (fig. 3-6 and 3-7). The duels offered action oriented real-time player-to-player combat. When the player logged in to the game the first screen showed was "The Pile." In that view, the monster-blobs representing all participating players were stacked in a pile. The ranking of the player was represented by the place in the pile, and the one with an image of a feather was recognized by this publicly as the latest winner. This was meant to stimulate and visualize feelings of competitiveness (Section 3.4). The bar on the left of the screen visualized the current power level. The place of the player's own avatar in the pile corresponded to the player's current ranking in the game in a King of the hill fashion.

The Habitat was a virtual environment for the avatar. Playing in single player mode in "The Habitat" was quite low key. The data controlling the

climate was virtually real-time feedback of the electricity usage in the player's home. The bar on the left of the screen visualized the current power level. Electricity events such as turning something on was visualized by thistles growing up around the monster blob while turning something off resulted in thistles disappearing and flowers growing. The size of the power event occurring, translated proportionally into the size of the plant appearing, whether it was a thistle or flower. These flowers served as nourishment for the monster blob; the thistles were also eaten by the avatar but to a detrimental digestive effect. When the player used electricity, thistles would appear, the "monster blob" would eat them, get indigestion, and start emitting small clouds of CO2 (the grey cloud and number 513 in fig. 3-5), leading to more thistles in a negative spiral that could only be broken if the player reduced real life electricity consumption by turning off appliances in the home.

Each gas cloud emitted from the avatar represented a fixed amount of electricity used in the household. The gas emitted would rise and join the big cloud. This means that decreasing electricity consumption would make the cloud shrink, while increasing consumption would cause it to grow until it eventually filled the entire screen. When this happened, the avatar would become sick. In order to keep the avatar happy and healthy, the player must keep electricity consumption down. The equation is set so that the level where the cloud goes from increasing to decreasing is 85% of the participant's normal household consumption in reference to the weeks prior to the game.

Figure 3-6. The duel in the rainforest level

The duel in the rainforest level illustrated the amount of electricity different devices consumed when in continuous use. The duel set the player's two avatars running side-by-side on a racetrack in the middle of a rain forest. Obstacles moved or appeared periodically throughout the duel. Most obstacles could not be avoided by controls on the console but instead only by timing the avatars speed to the periodic movements of the obstacles and only accomplished by manipulating household electricity consumption. Increasing the electricity consumption increased running speed but had a price of increasing the precipitation in the rainforest leading to the drowning of both players. Consequently, the task is to maintain a balance between gaining enough speed to make it through the obstacles without flooding the forest.

Figure 3-7. The duel on the North Pole level

The duel on the North Pole level aimed to knock the opponent off the ice-cap into the water by throwing various objects. Small objects such as snowballs, fish, and seals had little impact on the opponent but reached further and polar bears and whales had a major impact on the rival but used only if the opponent was close.

The player got access to the objects by changing the electricity consumption in the home. For example, to get a powerful whale the player had to understand that the task was to turn on a major electricity-consuming device such as a tumble dryer, just for a second or two. For a smaller game object such as a snowball, a lamp was sufficient. This forced the player to explore the power (rather than the electricity) aspect of electric appliances in the home. The players combined consumption rate would affect the sun

over the polar landscape. A high consumption corresponded to a hot sun that would melt the ice cap more quickly, once again making both players drown.

Power Agent was by necessity an exercise in slow-paced game play and became an event for the whole family. Power Explorer was designed to learn what would happen if the feedback was virtually instant and the game play fast paced and action oriented. There was no guiding theory previously in place to suggest what this design change would result in for the player. The approach was fully inductive. Power Explorer is described by Bång et al. (2009), Gustafsson et al. (2009), Gustafsson (2010), and in the final report to the funding board Interactive Institute (2010).

3.3.2.3 Fieldwork and data collection of Power Explorer

Fieldwork: Power Explorer was run by the Energy Design Studio of the Interactive Institute and the company Mobile Interaction AB together with the author of this dissertation in one controlled field-experiment performed in the Swedish municipality of Smedjebacken for seven days in May 2008. The team recruited one school class with pupils aged 10-11 years. Their parents were not asked to take part. The Power Explorer game had a playing test group of 20 players (15 local teenagers + 5 researchers, anonymous to the respondents) and a non-playing reference group that comprised 21 people in the same municipality and of a similar demographic profile.

Data Collection: The Power Explorer test supplied primary data to this dissertation. as the author of this thesis took full part. In-depth interviews for qualitative data were made, and pre-and post-game questionnaires towards test and control groups regarding respondents' beliefs of and attitudes towards energy and electricity issues, were distributed, filled in, and collected.

The questionnaires were designed using a seven point Likert scale for statements anchored at each scale end. The teams also collected log files from the game servers. The log files reflected and all activity the player took in the game. AMR data of both players and control groups were also collected. The AMR data of Power Explorer cover four weeks before and after the playing for each respondent. The author and Magnus Bång also

performed six post-factum in-depth interviews with the players. The fieldwork of Power Explorer is described in Bång et al. (2009), Gustafsson et al. (2009), and Gustafsson (2010).

3.3.2.4 Power Explorer and the Three Expansions

Power Explorer, like Power Agent, had a strong but limited spatial expansion design based on integrating the household appliances into the game play system. The spatial expansion of Power Explorer is strong as the household appliances are integrated into the game system. The direct feedback makes it possible to say that the Power Explorer spatial expansion is perhaps slightly stronger than that of Power Agent. The spatial expansion of Power Explorer is like that of Power Agent limited to the house. The aspect of temporal expansion was strong because a challenge could reach the player at any time. The element of letting sudden household electricity events lead to a game event also emphasized that the delimitation of the game session was intentionally fussy (Section 2.2.2). The social expansion elements were designed to become less emphasised. The element of the primary player having to marshal the rest of the household into secondary players was still there, but by having a challenge-based rather than a quest-based structure made for a play style more focused on player-vs-player action than on household marshalling.

3.3.3 Third Stimulus: Agents Against Power Waste (AAPW)

AAPW was the third custom-made game. The team included The Energy Board of Mälardalen, Mobile Interaction AB, and the Energy Design Studio of the Interactive Institute. This author was invited to research the campaign and designed the research and data collection process. This author together with the Energy Board of Mälardalen collected the data, and I performed the analysis.

3.3.3.1 AAPW System

The game engine of AAPW is the same as in Power Agent. Like Power Agent, AAPW was a pervasive-persuasive game for simple standard java-enabled mobile phones and with the same basic game design patterns. Like

with Power Agent, the game client of AAPW was software only requiring no custom hardware and was designed to lie on top of and connect with the automatic meter-reading system (AMR) in the 24-hour cycle (see fig. 3-3).

The Mr Q character, the agent camera, and the message board of Power Agent were not present in AAPW in order to streamline AAPW and make it more immersive (Sections 2.1.1 and 2.2.4) than Power Agent had been.

3.3.3.2 AAPW Game Play

Like Power Agent, AAPW was an adventure and role-playing styled pervasive-persuasive game centred on social team play, with the player receiving quests in the form of secret agent "missions." However, AAPW was more clearly an agent styled game with more immersive aesthetics. Compared to Power Agent, the focus loci of AAPW was less on the mobile phone interface and more on the play area of the household (Björk & Holopainen, 2004). MR Q, the agent camera, and the in-game message board were removed and the game became more focused on role-playing the agent character. Like Power Agent, AAPW was a slow play turn based game with a mission to conserve household electricity. Like in Power Agent, the player received quests in the form of secret agent "missions" as previously described. The household was the unit of team membership, not the player. The player had to like in Power Agent build cooperation as well within the team of three as within his/her own real life household. Like Power Agent, AAPW let players compete in teams and learn hands-on how to conserve electricity in their homes.

The missions were given in text (fig. 3-9) instead of from MR Q. The text gave the mission then the warm-up track was unlocked. After that track, the player could choose to take a quiz to exercise the newfound skills and then the mission started. Like Power Agent, AAPW was played in a mobile first person perspective. That perspective was more pronounced in AAPW due to MR Q, the non-player character, not being present. This lead to a more immersive play as there was no element of narrative in between the player and the real world.

Figure 3-9

AAPW Pictures 1 – 10 screen dumps from a mobile phone playing Agents Against Power Waste. From upper left login screen, login-splash screen, presentation screen, agent profile/player profile, practice run in the form of a simple labyrinth game, a quiz, a mission presentation, a status screen, a navigation menu, and an end prognosis screen giving the player info on how much the player would save if the player continues living in the same way as during play.

3.3.3.3 Fieldwork and data collection of AAPW

Fieldwork: Agents Against Power Waste was run by the author in cooperation with Mobile Interaction AB and the Mälardalen Energy Board in one controlled field experiment in 2010 in the Swedish city of Eskilstuna. The team recruited four school classes with pupils aged 13-15 years. Their parents were asked to take part. The parents became the secondary players that participated through social expansion (Chapter 2). The children and their families took part in the game for 28 consecutive days and data were gathered from 126 households (Larsson, 2011).

Data Collection: The AAPW field experiment supplied primary data to this dissertation. There were pre-and post-game questionnaires towards test and control groups regarding attitudes towards energy and electricity issues. As measurements in the questionnaires, statements were used with seven point Likert scales anchored at each end of the scale. The team also collect-

ed log files from the game servers. The AMR data of both player and control groups were collected and fed into the game system to function as a central parameter in the game system. However, collecting the AMR data for the purpose of post-stimuli analysis did not work, so the AMR data could not be used for analyses in this second study. The fieldwork of AAPW has previously been published only in the final report to the funding board (Larsson, 2011).

3.3.2.4 AAPW and the Three Expansions

On the issue of the three expansions AAPW is similar to Power Agent. It has the same strengths and weaknesses (Section 3.3.1.4). AAPW came out of a development of Power Agent. Power Agent got a developed game play and a developed degree of immersion. This development did not influence the execution of the three expansions.

3.4 Common design elements of the games

The three games are all dependent on digital media for their realization. The games were played in the physical world. Mobile phones were used and also several other media forms that communicated the rules of the game and the results. It is possible to classify the three games as transmedia games (Evans, 2008), alternate reality games (Szulborski, 2005), adaptronic games (Reis & Correia, 2012), or as pervasive games (Montola, 2011). Each denomination points out certain qualities of the game design that may have a bearing on the analysis of the three games as vehicles for persuasion. This chapter makes use of the design patterns of Björk and Holopainen (2004), Björk (2012), and Lankoski and Björk (2012).

As discussed previously, the three prototypes were pervasive games (Section 2.2). All three games were in varying ways spatially, temporally, and socially expanded (Section 2.2.). As the activities of everyone in the household affect the game, the notion of who was a "player" became expanded. The "player" was no longer just the person who held the phone. This made social expansion the most prominent instance of the three expansions. The other household members at no point in time asked to be

part of the game, yet they unwittingly became drafted into the game (Sections 2.2.3 & 2.2.8). Another prominent feature of all three games was the spatial expansion (Section 2.2.1). That was realized with the game being played both on the controls of the game console (mobile phone) and also on elements outside the game console (electrical appliances). The third expansion was temporal (Section 2.2.2). That one was the most realized in Power Explorer when the game contacted the player at any hour and alerted him/her to electricity events in the house.

The way the game server in all three cases was connected to the electricity meter of the home expanded the playspace from the mobile phone screen to the entire household. It should be noted that this afforded an almost infinite number of ways that actions could influence the game. For example, buying a new dishwasher could be an in-game action. In the terms of game design patterns (Björk & Holopainen, 2004; Björk, 2012), all three featured the design pattern "extra game input", as they related to the input of the real life electricity system. Because of that design pattern, the three games were bound to have the design pattern of "connection to the real world".

They were also persuasive games, meaning they have the extra task of persuasion on top of functioning as games – to make the household reduce their electricity consumption. Because of that, they also have the design pattern "extra game output", the persuasion being that extra-game output. The overall game design patterns for social interaction from Björk and Holopainen (2004) are the element of competition both between and within the team(s). A salient pattern for all three is the need to build cooperation within the household. However, the salient pattern is not the cooperation as described in game design patterns; rather it is a form of extra-game collaboration. That need for extra-game collaboration can also be expressed as a form of goal hierarchy (Björk & Holopainen, 2004). If progressing in the game is the main goal, then building cooperation within the household is a sub-goal necessary to achieve the primary goal.

The game makes use of a thin layer of fiction. In the case of AAPW and Power Agent, the idea is that players are secret agents. In the case of Power Explorer, the idea is that the players combat "blobs." Most of the game world is authentic in the form of the players' homes. Furthermore,

though the game is played over a set time (some specific weeks), the actions in the game are normal everyday household chores. These everyday actions get a secondary meaning from being part of the game, but they are still the ordinary real life actions.

Svahn (2005) developed a taxonomy of persuasive games based on the extent to which a game was dominated by its´ message(s), or dominated its´ message(s). The main point of that taxonomy was to identify whether the game itself was unrelated to the message it carried, or if the game itself was the message; the answer highlights different aspects of game design. In those terms, all three games 'were' the message (cf. McLuhan & Fiore, 1967). In that situation, any thought about the game, or the game experience was inseparable from thought about the message. The design was meant to give the player little room to think about the games or the game play experience without thinking about saving electricity. Since their electricity consumption affected the game result, these people willingly or unwillingly become co-players in the player's team (Section 2.2.3). The central intention with the design was to present a challenge to the player who cannot win unless he/she was able to get siblings and parents to change their electricity consumption behaviour in a way that fit the game objective.

The potential for educational and persuasive use of pervasive games has been discussed by Palazzi (2010). Some previous examples of educational pervasive games include Rexplorer, an educational tourist game developed for Regensburg (Walz & Ballagas, 2007), and Frequency 1550, an educational game for Amsterdam (Raessens, 2007). Coenen et al (2013) proposed a high-level architecture for pervasive serious games applied to cultural heritage. Most examples focussed on the use of spatial expansion for physically grounding the learning experience in an authentic environment. This author knows of no previous examples of pervasive games that made deliberate use of social expansion to extend the persuasive effect outside the scope of the original players.

3.5 The persuasive goals of the games

The three games had several persuasive goals in common that worked together towards the ultimate objective of creating behavioural change in the

whole household. Section 3.1.1 mentioned that the beliefs of appliances' electricity consumption can be low, so the games aimed to give knowledge about electricity consumption. Power Agent and AAPW did that by having focused daylong missions around certain topics such as washing clothes or using the kitchen. The games could only give delayed feedback, so in order for the feedback to be informative on the day it arrived the actions taken in the household the day before must focus on a certain topic. Power Explorer did not have focused topics in the same way; instead, the feedback was close to instantaneous between action and informative feedback. In 3.1.2 it is mentioned that electricity consumption is "backgrounded" meaning that everyday environments are designed to hide electricity.

This means consumption of electricity as product is so commoditized that consumption has sunk below an awareness threshold. The three games used social expansion to bring the persuasive goal of electricity consumption to the foreground for the primary (a child of the household) and secondary players (the rest of the household). Section 3.1.5 mentioned that social consumption of electricity can hinder ones willingness to act to reduce consumption. To address this issue, the games had to create social friction, which served to foreground electricity consumption.

3.6 The data collection and analysis methods

The data collection methods used in the field experiments were post-play depth interviews, questionnaires before and after each game play, log data and some AMR data before, during and after a play, thus supplying both qualitative and quantitative data, and capturing the persuasion processes over time. This makes it possible to employ both qualitative and quantitative analysis techniques for answering the research questions.

3.6.1 The qualitative data analysis

A common qualitative method of accessing the experience of playing a game is by doing in-depth interviews with the players after a game has ended. For pervasive games with short duration, this may work very well. For

example, the pervasive game studies by University of Nottingham on the pervasive game Uncle Roy all Around You, (Benford et al., 2004; Rider Spoke Rowland et al., 2009) relied primarily on post-game interviews.

The post-play depth interview data were collected in the three first field experiments – Power Agent (two) and Power Explorer (one) – and used for a qualitative analysis which constitutes Study Two (Chapter five). The goal was to answer the qualitative part of research question 1, i.e. to arrive at a better understanding of persuasive processes of pervasive games *per se*, but also to get qualitative input for the development of causal structural equation models in the following two field experiments. The qualitative analysis was thus not meant to give definitive conclusions, but to drive insights by inspiring new thoughts. Qualitative research is an appropriate approach when the aim is to explore perceptions and experiences of people as they interact with the world. One of the strengths of qualitative research is that it can in an intimate way involve the people most involved in the interaction (Denzin & Lincoln, 2000; Sharan, 2002).

The qualitative data were treated as one pool because the similarities in spatial and social expansion between the games were large. In Study Two, the qualitative study, was the structure of the understanding subordinate to glimpses of insight .It was therefore appropriate to turn to the in-depth interviews with players of Power Agent and Power Explorer. At this point in the research process, there was little information available and little pre-understanding. Exploratory research is useful in such a situation (Cooper & Schindler, 2010).

One problem with doing in-depth interviews after a game is that it does not capture the experience in progress. The experience is narrativized when retold by the respondents to the interviewer and turned into a story, in the context of what happened last in the game. That narrativization reframes (Sections 2.1.1 – 2.1.2) and changes the meaning of the experience and, by that, the respondents´ memory of the experience. This is a reason for using frame theory in the interpretation (Section 2.1.1). The narrativization is a reason not to use focus groups for post-game evaluation because hearing other player stories may influence the participants into forming a socially constructed implicitly agreed upon common narrative (Stenros et al., 2012).

3.6.1.1 Interview Procedure of Power Agent

The data from Power Agent came from in-depth interviews with the children and their parents. The interviews were conducted immediately after the game play days ended. The interviews were conducted so that the child was interviewed first in a one-on-one session with the researcher. After a time the parents were included, and both child and parents were interviewed together. This created three respondents per full interview session (child + either parent + other parent). The transcripts do not show any interaction effects or obvious forming of a socially constructed implicitly agreed upon common narrative (Stenros et al., 2012). The Power Agent interviews took place in the home. This author was not personally present during the Power Agent interviews, but was given access to literal transcripts of the interviews, courtesy of the Energy Design Studio of the Interactive Institute. Overall, six interviews sessions were conducted with the child (primary player) and the parents (secondary players) of the Power Agent playing households.

3.6.1.2 Interview Procedure of Power Explorer

In the case of Power Explorer, only the playing children were interviewed. The interviews were conducted immediately after the game play days ended. Six interviews were performed, of which five took place in school and one at home. The author of this study was a co-interviewer in collaboration with Magnus Bång from the Interactive Institute.

3.6.1.3 The Interview method in Power Agent and Power Explorer

While the interview methods for the Power Agent and Power Explorer had some differences, there were also some commonalties. All interviews were completed in an open-ended manner letting the respondent drive a free-form discussion. The interviews were structured by a Critical Incident Theory inspired approach (Gremler, 2004) with the critical incident being game play. After base constructs regarding the most salient incidents of the game play experience were covered, the interviews then flowed freely turning into a general description of the experience. The purpose with the structure was to elicit what meaning and meaning-themes the respondents found in the

experience, with the interviewers taking a passive approach and letting the respondent take the driver's seat. The interviewers took care to follow up on most topics with "why?" and "why so?" questions. The close timing to the game-play experience allowed recovery of lingering vividness of the experiences from the respondent's memory.

3.6.1.4 The analysis method of Power Agent and Power Explorer qualitative data

This author read the transcriptions of raw interviews from Power Agent and Explorer, listened to the sound files of the raw interviews from Power Explorer, and initially reflected on them. Then in a rather free-form process some lines, sentences, and paragraphs from all the interviews were highlighted and labelled. The titles of the labels ranged from the quite descriptive to the abstract and conceptual. In the labelling process, this author took care not to restrict the free flow of associations the respondents´ expressions evoked. After that, several key words and concepts were identified. This process was inspired by Silverman (2006) and Spiggle (1994). Later, labels were grouped and the interview material coded.

This author did iterations of coding to renew the focus on free associations. This was done in order to avoid developing a conceptual grid that would limit the coding to the thoughts that were generated when making the codebook (Atkins, 1992 in Silverman, 2006, p. 146). When coding and analysing the data, this author focused on trying to read the respondents' expressions from the own lived experiences of the topic of discussion (Blomberg, 2006).

3.6.2 The Quantitative data analysis

In order to address research question one on whether the extent to which– the three expansions are employed during play – played a role in a persuading process intended by the game, the author had to find an instrument to test game play effects.

To ascertain the presence or absence of such effects, the thesis used a Student's t-test for Studies One and Three. That is a proper statistical test for statements with opposing anchoring at each end, i.e. Likert scales

(Trochim, 2013), and where the answers are assumed to be non multivariatelly distributed.

The next steps was to try and asses research question two, if the degree of enactment was an element that drove effect, research question three whether a persuasion process from playing a persuasive pervasive game was sorted as either Heuristic or Systematic thought, as delineated by the Heuristic Systematic Model. These questions were addressed quantitatively with Structural Equation Modelling (SEM). Research question four about whether categorization had an impact on a persuasion process was only addressed in the qualitative analysis.

3.6.3 Clarifying Structural Equation Modelling

In confirmatory Structural Equation Modelling, a structure of causal relations is modelled and then tested. Structure Equation Modelling may also be exploratory, especially in the case there are no strong theories about the causal structure. In such a case, a structural model is developed through theoretical reasoning, then tested/estimated, then evaluated, and readjusted in several iterations in the light of the evidence the model gives at hand, trying to optimize the model as much as possible to reflect the reality of the data, while still answering research questions. That is how SEM was applied in this thesis .

3.6.3.1 Manifest and latent variables

One of the core strengths of SEM is the ability to take the actual data points, define them as manifest variables, and then via a theoretical idea combine these manifest variables together into the larger entity called a latent variable. Latent variables reflect abstract concepts that cannot be measured directly, like factors in a factor analysis. Instead, a latent variable is made of groupings of measured variables, called manifest variables, as each one of these measured manifest variables is considered to reflect a facet of the abstract concept. The group of measured (manifest) variables together cover the abstract concept in a way a single measurement cannot.

A latent variable can be exogenous, which means that it is an independent variable, not influenced by any other latent variables. A latent variable

can also be endogenous, meaning it is intermediate or dependent because it is influenced by other latent variables.

Structural Equation Modelling was chosen because it is a method for studying a process, where some variables are influencing other variables via still other variables, i.e. a structure of causal relations . There are a number of different techniques for testing structural equation models. In this thesis partial least square (PLS-SEM) has been used. The primary objective of PLS-SEM is to maximize explained variance in dependent constructs. One of the strengths of a PLS-SEM is that it can work efficiently even when complex models are built on small sample sizes and it does not assume the data to be multi-variatelly normally distributed, which the data in this thesis cannot be assumed to be. Another technique for testing SEM is covariance based SEM (CB-SEM). That method offers greater theoretical freedom when imagining the modelling structure, but it could not be applied on the data available for this thesis.

The PLS-SEM method was chosen because of its ability to explore how impact travels from one construct, via a second, into a third, and because it could be applied to the data available. That former was necessary in order to address the research questions about a persuasion process and its effects. It is generally preferable to have established theoretical constructs as the underlying base when constructing the latent variables and applying and evaluating a PLS-SEM; preferably with constructs and scales validated from other research. That became a bit of an issue in this thesis (Section 3.6.3.12).

3.6.3.2 Reflective and Formative Latent Variables

The latent variables can be either formative or reflective, each of which represent a slightly different theoretical perspective. Both are represented in this thesis.

Reflective latent variables are underlying constructs to and thus measured by manifest variables, the construct is interpreted based on the factor loadings, which are the correlations between the manifest and the latent variable. Thus, if the construct theoretically is meant to reflect the presence of an existing idea, then it is a reflective latent variable. Therefore, internal consistency is an important issue for a reflective latent variable and

its´ key numbers should always be closely observed when applying a reflective latent variable. A sign of reflective nature of a latent variable is if it is possible to remove one or several manifest variables from the latent variable without the researcher finding a change in its meaning (Hair et al., 2011; Hair et al., 2013).

Formative latent variables are causal indicators of the construct, which is sometimes termed a combination variable (Maccallum et al. 1993) or composite variable (MacKenzie et al. 2005). This means that the measures cause the construct and that the construct is fully derived by its measurement. It is therefore graphically represented by ingoing arrows from the manifest variables. Interpretation is made from the regression weights of the manifest variables onto the latent variable. The theory of a formative latent variable is that the ingoing manifest variables together form a construct. That makes internal consistency into a non-issue for a formative latent variable. A rule of thumb on formative latent variables is to consider if the removal of one manifest variable changes the meaning of the construct the latent variable represents, then that latent variable has a formative nature (Hair et al., 2011; Hair et al., 2013).

3.6.3.3 Evaluating the measurement model; Cronbach's Alpha Composite Reliability and AVE.

The first criterion of the measurement model that was evaluated was the internal consistency criterion. One of the measures of internal consistency is the Cronbach's Alpha of the manifest variables that make up the latent variable. The Cronbach's Alpha was applied as a measure of the extent of which the manifest variables were consistent with each other. The calculation of the Cronbach's Alpha presumes all manifest variables are equally reliable, i.e. that all manifest variables have equal outer loadings and the same strength in their relations to the latent variable they comprise. That is unlikely ever to be the real case, so another measure is the Composite Reliability. That measure takes into account different outer loadings of manifest variables. Both measures are interpreted in the same way and sensitive for semantic redundancies in the manifest variables, i.e. questionnaire items that respondents found too similar. The presence of semantic redundancy

can only be ascertained by the researcher taking an active role in the interpretation.

Average Variance Extracted (AVE) is a measure of convergent validity. It is the mean value of the squared loadings of the manifest variables. It is equivalent to the communality of a construct (Hair et al., 2011; Hair et al., 2013). These three measures only apply to reflective latent variables.

3.6.3.4 Evaluating the measurement model: Cross-Loadings

The cross loadings table is an important tool to evaluate the measurement model. It gives the distribution of factor loadings of all the manifest variables across all the latent variables of a PLS-SEM. It is desirable to see all the manifest variables of a latent variable load strongly only onto the latent variable they belong to, and only onto that latent variable. If all the manifest variables load strongly onto their latent variable and only onto that one, then the measurement model is mathematically sound. If not it needs to be rethought. The cross loadings are considered to be a liberal evaluation criterion (Hair et al., 2011; Hair et al., 2013), though they have the strength of illustrating the measurement model in full detail.

3.6.3.5 Evaluating the measurement model: Fornell-Larcker

The Fornell-Larcker Criterion is considered to be a more conservative estimate than the cross loadings. It compares the square root of the AVE-values with the latent variable correlations. The square root of each construct AVE should be greater than its highest correlation with any other construct. The logic of this method is based on the idea that a construct shall share more variance with its associated indicators that with any other construct (Hair et al., 2011; Hair et al., 2013).

3.6.3.6 The structural model

Once the measurement models for this thesis were defined, the next step was to view the theory and the findings of Study One and hypothesise what the relationships in between the latent variables were. Which latent variable was dependent or independent to another? The result of that thought process was the structural model.

The structural model was developed to reflect a persuasion process, based on theory and other insights. The structural model bound together the latent variables by hypotheses of whether the theoretical construct of one latent variable represented had a causal effect on another theoretical construct represented by another latent variable. These hypotheses were represented graphically by a structure of unidirectional arrows between latent variables (Hair et al., 2011; Hair et al., 2013).

The software Smart PLS (Ringle et al., 2005) was used for the analyses. The PLS-SEM in Smart PLS is specified in a graphic interface where the structural model is drawn and the indicators are assigned to the latent variables

3.6.3.7 Assessing the Structural Model: Path coefficients

One element in the evaluation of the structural model was to observe the path coefficients (similar to Beta coefficients) of the relations between the latent variables. The path coefficient came from calculating the degree to which one independent or intermediate latent variable was connected to one other dependent latent variable. A path coefficient is usually from -1 via 0 to +1. When it is +1 the connection between one and another is 100% and when one moves, the other moves equally in the same direction. When the connection is -1, the connection is also 100% but when one moves, the other moves equally in the other direction. Hair et al., 2013).

3.6.3.8 Assessing the Structural Model: R Squared value

The R-squared value is a measure of the extent to which all independent or intermediate latent variables that are hypothesised to impact one dependent latent variable actually do succeed in this action. If a latent variable has three incoming paths from other latent variables coming towards it and the R-squared value of the receiving latent variables is for example 0.6, which means that it is a model where the variance in one latent variable is hypothesised to be caused by three other latent variables. Further in this case, this means that the three latent variables together cause 0.6 of the variance in the dependent, receiving latent variable. The remaining 0.4 is the share of the variance in the dependent latent variable that this model of altogether four latent variables does not capture and so remains unexplained by this

particular model. Exogenous latent variables have an R-squared value of zero as an exogenous latent variable has no latent variables to which it has a dependent relation.

3.6.3.9 Assessing the Structural Model: Total Effect

A further way to evaluate a PLS-SEM is to calculate and read the "total effect" measure. That is a measure where the combined direct and indirect explanatory value of one latent independent or intermediate variable through several other intermediate latent variables onto one final dependent variable is calculated. In a complex model with many latent variables and paths there may be more than one possible route by which an independent variable influences the end dependent latent variable. The total effect measure is a calculation of all possible paths from start to end.

3.6.3.10 Assessing the t-values and p-values

When formulating a statistical hypothesis there must be appropriate ways available for testing. If the test can measure an effect, then the null hypothesis can be rejected. The p-value is used to assess the "level of unusualness" that the researcher sets as the satisfactory level. Each statistical test has an associated value of the likelihood that a pattern observed in the test would occur due to mere chance.

The worst commonly used p-value is 0.05. The reason for this is that 0.05 historically has been accepted as the standard (Pallant, 2010). That consensus has been criticized for being gratuitous and having a potential for misinterpretation (Schervish, 1996; Dienes, 2011; Yates, 1984). It is true that the p-value should be set in relation to the research context. It should perhaps be set to be even more stringent in the case of for example clinical drug trials. This thesis is a venture into explorative research into media effects. It is not in any way about absolute certainties of life and death issues, so liberal p-values can be allowed.

Study two regarding Power Explorer has a base of only 15 respondents while Study Three for AAPW has a base of 126. This means that the t-values in Study One has from the outset little potential to reach traditionally acceptable levels while Study Three has better potential to do so. That does

not reflect poorly on Study One or well on Study Three per se; rather, it is merely a mathematical effect from the differences in size of the database.

3.6.3.11 SEM Holistic Assessment of a PLS-SEM

A researcher applying a PLS-SEM takes all measures of the measurement and structural models into account and makes a holistic evaluation informed by theory when interpreting the PLS-SEM against the research questions. The PLS-SEM itself is only a mathematical artefact. That holistic interpretation is performed in Chapters six and seven, and is in the case of this thesis also informed by the qualitative Study One.

3.6.3.12 Work Process towards arriving at a PLS-SEM

A common general work process for a PLS-SEM, such as the ones in this thesis, is to first set up the theoretically simplest causal model and then add hypothesised influencing factors consecutively until the theory is fulfilled or the resulting output values start breaking down. Another work process is to first set up a theoretical model with all the paths and indicators supposedly imaginable and then remove one path or indicator per iteration until the key numbers have been maximized while not losing sight of the original theory. In this thesis, the work process was less straightforward when building the two PLS-SEM models.

In 3.6.3.1, it was mentioned that it was preferable to have established theoretical constructs when applying and evaluating a PLS-SEM in the ways described in 3.6.3.2 – 3.6.3.11. The field of pervasive game design (Section 2.2.) is very new and employing it for persuasion processes even newer. There are few if any scales for evaluating persuasive pervasive gaming that have been through iterations of mathematical and empirical validation. That fact had an impact on the building of the two PLS-SEM models that explored the impact of the Power Games. It had some impact on Study One for Power Explorer and a considerable impact on Study Three for AAPW. That situation was dealt with in the following way.

3.7 Constructs & Crossroads

There are few if any validated scales for assessing persuasive pervasive play. That which was applied came about in the following way.

3.7.1 PLS-Constructs in Power Explorer

The constructs applied in the Power Explorer field study were developed in the workshops that led up to making the game. They came about through iterations of discussions among the work groups, principally among the main researchers Magnus Bång, Anton Gustafasson, and Mattias Svahn. These workshops applied theory (Chapter 2) and the existing results at that time from Power Agent as the input to the workshops that forged the constructs and reached face and content validity.

3.7.2 PLS-Constructs AAPW

The constructs applied in the AAPW field study were developed through a series of workshops at the Stockholm School of Economics among senior researchers, principally Mattias Svahn, Richard Wahlund, and Per Hedberg. These workshops applied theory (Chapter 2) and the existing results from the Power Agent and Power Explorer studies available at that time in order to reach face and content validity. The constructs were tested in focus groups on four teenagers of similar age and demographic as the AAPW-respondents.

At the point in time when the field experiments were to be carried out, the research design stood at a crossroad. One strategy considered was to try to apply the constructs narrowly but stringently (i.e. collect few data points and have confidence in that these could represent the theory). That would, if it worked, give a clear and traditional work process when setting up the measurement model, the structure model, and iteratively purifying the PLSE-SEM (Sections 4.7 - 4.9; Hair et al., 2013; Chapters 3 – 6). The risk that choice would run is that the field-experiment data collection might not be able to capture the experience of the theoretical constructs and then the researcher would have nothing.

Another route was to design the field-experiment data collection to cast a theoretically inspired but very wide data capturing net, admittedly with a lesser degree of precision in its theoretical constructs. This process would capture a large amount of data and has large amounts of "noise" (i.e. spuriously caught data in relation to the "signal"). However, there would be a greater chance of capturing relevant data to a greater extent. The amount of noise in the data would make the process of building the PLS-SEM difficult, in particular the process of iteratively optimising the model in conjunction with the continuing holistic application of theory and research questions. Still the wider data collection approach could be carried through if the reduction and purification process was kept within theoretical bounds (i.e. manifest variables could be dropped one by one as long as all the original theoretical constructs remain represented in the final data set that underlies the PLS-SEM). The second route would, while considerably more laborious than the first route, mean there would be a better chance that data pertaining to the interrelationships of the constructs would be captured as compared to the first route (i.e. a lesser risk that the field work would be for nought). The first route was chosen for Study One on Power Explorer and the second route was chosen for Study Three on AAPW.

3.8 The latent variables in Study One Power Explorer

Study One using Power Explorer had the design to inform and empower players regarding electricity in two forms: effect and kilowatt hours (i.e., one form of electricity as a continuous measure and one form of electricity as a fixed measure) and to catch how the respondents perceived these two different forms of electricity consumption (Section 3.3.2). Power Explorer functioned as it intended (Gustafsson et al., 2009; Institute Interactive, 2010). The latent variables in the model for Study Two representing Power Explorer became in the end the following., all measured with seven point Likert scales.

3.8.1 Electricity consumption Beliefs Before Power Explorer (A)

This reflective latent variable is made up of six questionnaire items from the survey handed out to the respondents before any exposure to stimuli – the game (Section 3.7.4.1). The items are ”Estimate the amount of electricity it takes to take a bath for 30 minutes”, “Estimate the amount of electricity it takes run a dishwasher for 90 minutes,” “Estimate the amount of electricity it takes to run a micro wave oven for 10 minutes,” “Estimate the amount of electricity it takes to play music through loudspeakers for one hour,” “Estimate the amount of electricity it takes run a home computer for two hours,” and “Estimate the amount of electricity it takes to run a television set for two hours.” These items reflect what the respondents believed regarding electricity consumption of household appliances using a fixed measure (fig. 3-8). The same questionnaire items were repeated after the game, and make up the latent variable (J).

3.8.2 Attitudes Toward Electricity Saving Before Study Two (B)

This reflective latent variable is made up of five questionnaire items from the survey handed out to the respondents before any exposure to stimuli (Section 3.7.4.1). The items are “I usually urge my friends to save electricity,” “Do you see you yourselves as an electricity aware person?,” “Can you consider urging your friends to save electricity?,” “Can you consider saving electricity at home?,” and “Do you think it is easy or hard to save electricity at home?.” The items reflect how the respondents felt about electricity saving, primarily, and consumption. The same questionnaire items were repeated after the game, and those answers make up the intermediate latent variable of “attitudes after” (I).

3.8.3 Out-game activities (spatial expansion) (C)

This formative latent variable is made up of two questionnaire items from the survey on elements of game play related to spatial expansion. These questions were handed out to the respondents after game play. The two indicators are “how many appliances did you shut off in order to play the

game," and "It happened that I went home just to play the game on my home." They are indicators of actions taken outside of the primary game universe in relation to the real world. They are used for measuring instances of spatially expanded pervasive-game play and also a measure of the degree of enactment.

3.8.4 In-game experiences from the polar level (D)

This reflective latent variable is made up of server data of three game experiences captured while playing the polar level of Power Explorer. The three indicators that make up this latent variable are "number of polar challenges completed," "number of polar challenges lost," and "number of polar challenges won." They all have a common denominator that they are experiences gained inside a traditional primary non-pervasive game universe. These are also a measure of the degree of enactment.

3.8.5 In-game experiences from the jungle level (E)

This latent variable is comprised of server data of six game experiences captured while playing the jungle level within Power Explorer. The six indicators that make up this latent variable are "number of jungle challenges completed," "number of jungle challenges won," "number of jungle challenges started," "number of jungle challenges sent," "number of jungle challenges lost," and "number of jungle challenges received." They all have the common denominator of experiences gained inside a traditional primary non-pervasive game universe. These are also a measure of the degree of enactment.

3.8.6 Commitment (F)

This latent variable is made of six manifest variables that cover feelings of engagement, feelings of immersion, the feeling of wanting to play again, wanting to know how to perform better in the game, and the conscious awareness of how the play felt in different spatial places (Section 2.1.3). They all have the common denominator that they are actions taken inside a

traditional primary non-pervasive game universe (Sections 2.1 & 3.7.4.1). These are: "It felt exciting to turn appliances off and on in order to play the game," "I would like to have seen more narration in the game," "I felt a large difference playing outdoors and playing indoors," "The blob felt like part of me," "I would happily play the game again," and "I would have liked to know more about appliances, so I could play the game better." All these measures may seem heterogeneous at first glance. However, the cross loadings (table A3 show that these items indeed are one latent variable. The common theoretical construct becomes salient when realizing that an imagined player that simultaneously scores high on all of these six items would be a player both highly engaged and highly immersed, thereby defining this latent variable as "Commitment" (Section 2.1.3.)

3.8.7 Competitiveness (G)

This latent variable is made up of five questionnaire items relating to how the respondent felt about winning the game (Section 2.1.3). The manifest variables are: "It felt motivating to see my position in the pile," "It felt interesting to see the appliances reflected in the game," "It felt important to get to the top of the pile," "It felt important to win the feather," and "I could imagine going home just to play the game". This latent variable covers two central elements of competitiveness. One is to assign importance to extrinsic price motivations, (i.e. seeing oneself at the top of the ranking and winning "the feather", the symbol of having won a duel; fig. 3-4). The other is to ascertain to what extent he/she would undertake an effort (leaving school and going home) to score in the game. The common denominator of these manifest items is an element that we can call "competitiveness" (Section 2.1.3)

3.8.8 Pervasive thought (H)

This latent variable is made of five questionnaire items relating to how the respondent felt and thought about elements of the social and temporal expansion in Power Explorer (Sections 2.2. & 2.3). "I thought about getting better," "It felt exciting that other players could contact me at any time," "I

urged the others in my family to save electricity so I could play," "I thought a lot about the game," and "I felt a connection between what I did in reality and what I did in the game." The theory in Chapter 2 defined thought about the game and positioned the experience of the pervasive design as two clear separate elements. However, initial exploratory factor analysis indicated that the players did not see these constructs as two separate elements in the way the researcher initially posited.

The latent variable "Pervasive Thought" came from manifest variables that covered the experience of temporal expansion, the experience of social expansion, and the degree to which the game mechanics was understood by the player as well as thoughts about getting better in the game. This latent variable also covered the thought element for Power Explorer (Section 2.3).

The theoretical cohesiveness for this latent variable is that the five measures reflect the way that temporal and social expansion of the game went together as one common experience for the players, thereby blurring the boundaries of the game. As temporal and social expansion is a fundamental part of the game design, it is not strange that responses regarding pervasiveness, would share variance with the understanding of the game, and thoughts about getting better in the game.

3.8.9 Attitudes toward Electricity Saving After (I)

This latent variable is made of six questionnaire items from a survey handed out to the respondents after exposure to the stimuli. The items reflect how the respondents felt about electricity saving, primarily, and consumption. The latent variable is a post-intervention repetition of the same questionnaire items that make up the latent variable (B).

3.8.10 Electricity Consumption Beliefs After (J)

This latent variable is made of six questionnaire items from a survey handed out to the respondents after exposure to playing Power Explorer. The latent variable is a post-intervention repetition of the same questionnaire items that make up the latent variable (A).

3.8.11 Change in electricity consumption (K)

This is a latent variable which captures the change in electricity consumption before and after playing Power Explorer. The latent variable has four manifest items. These were made by taking three days of hourly electricity measures (72 hourly measures), and adding them together in one variable. These variables were then divided after/before, hence getting a percentage-value of changed electricity consumption. One of the four reflects long-term changes four weeks after and four weeks before, one reflects the changes immediately after and immediately before, one reflects the changes long before and immediately after and the final one reflects the changes immediately before and long after.

3.9 The latent variables for Study Three, AAPW

Based on the theoretical discussion (Chapter 3) and insights from Study 1 and Study 2, a new structural equation model is developed and tested in Study 3. The model intends to picture a persuasion process behind and leading to post-playing attitudes toward electricity saving (and consumption), including social expansion to a greater extent than in Study 2. Thus data from two groups of respondents are used – the players and their parents – between which there are interdependencies (causal relations 3.8.8.1 The attitude constructs in AAPW

The most central of the theoretically identified constructs are "attitudes to electricity." It is a central independent construct both before and after the game play. This is the construct postulated to be able to measure the effects of AAPW. In the theoretical analysis it became clear that an attitude construct for AAPW would have to concern attitudes towards electricity; not attitudes towards "electricity-something-else." To elaborate, there has been research done on attitudes toward electricity disclosure, toward electricity transmission, toward electricity network reliability, and toward electricity generating options. A more neutral construct was difficult to find in previous research. The theoretical analysis came out with the insight that the attitudes construct could be expressed in the terms of three latent variables. These three constructs were realized with twelve latent variables

(three latent variables times two– before and after – times two, for parents and children, respectively).

Proposed LV 1: Attitudes toward electricity consumption behaviour
This has a place in the theory, as AAPW may drive attitudes toward behaviours. AAPW:s spatial expansion makes game events take place in the form of real life electricity consumption behaviours. These are thus performed in reality not just as in-game behaviour, but also simultaneously as real-life behaviours. Therefore, it is theoretically motivated to try capture attitudes towards these behaviours.

Proposed LV 2: Beliefs about restrictions and empowerments as to electricity consumption
This latent variable has a place in the theory because AAPW is designed to impact attitudes and empowerment.. This latent variable is meant to illuminate the player (whether primary or secondary) that change is possible. AAPW can be described as an illustration of behaviour changed through emotional and intellectual empowerment.

Proposed LV 3: General attitudes towards electricity and the environment
The first two variables are based on a theoretical idea that they are reflected in the data. This third variable is more of a "backup" should the first two prove to be mirages and not reflected in the data from the field experiment. If this were the case, then this third one would be the catch-all construct.

3.9.1 The experience of social expansion construct in AAPW

Another central theoretically identified construct is the "experience of social expansion" (Section 2.2.3). It is a central construct postulated to cause variation in the attitude constructs (Section 2.3) and also to interact with other constructs. It exists in two versions, one for primary players (the children) and one for secondary players (the parents).

This was one of the places were uncertainty as regards scales was at its most acute. The theoretical analysis had found a relationship to word-of-mouth, so the construct was operationalized with two dimensions. One

reflected socially expanded impressions of the game play and the other echoed word-of-mouth experiences as regards to the game. This construct is, in the case of the children, meant to capture the experience of involuntarily involving the rest of the household in the game. In the case of the parents, it is meant to capture the experience of becoming involuntarily involved in AAPW. This construct became the thirteenth and fourteenth hypothesised latent variables in the model, one each for the parents and children.

3.9.2 The game related thoughts constructs for AAPW

The third central construct for AAPW is the game related thoughts construct. It is postulated to cause variation in the attitude constructs and to interact with the experience of social expansion construct. This construct was designed to capture the respondents' amount of thought. A large amount of self-reported awareness of thoughts about playing the game was taken to mean systematic thought in the terminology of the HSM (Section 2.3).

Also, this construct finds a place in the model in two different versions, one for the parents and one for the children. The parental game related thoughts construct has only one dimension, which contains items about intensity of thought (Section 2.3). The children's game related thoughts constructs had two dimensions. The other dimension being an "effect" coming out of a line of questions where the respondents was shown screen dumps of the game and queried to what extent these made the respondent want to take electricity-saving actions. This became the fifteenth and sixteenth hypothesised latent variables of the model.

3.9.3 The game play actions constructs in AAPW

A fourth construct identified in the theoretical analysis is "game experiences in AAPW." This was theoretically defined as all of the actions and outcomes of game play that could be extricated from the AAPW game servers. The construct is postulated to be able impact the experience of the social expansion, as expressed by the social expansion latent variable; and also to

be able to impact the game related thoughts latent variable, and the attitudes variables, via the thoughts mapped in the HSM (Section 2.3).

The construct of game experiences is more straightforward than the other constructs. It is the number of game actions that could be extracted from the log files on the game server. It consists of the number of player log-ins, player personal points, team points, and teams ranking. This latent variable has no counterpart for the parents, as they were only socially expanded co-players (Section 2.2.3) and did not make in-game actions in the primary game universe, so they were never in direct contact with the server. These manifest variables were made into a formative latent variable. It was postulated that these measurements together form rather than reflect something. This is the seventeenth hypothesized latent variable.

3.9.4 The psychological profile construct in AAPW

Another construct identified in the theoretical analysis and not covered in the first two studies is the psychological profile of the primary players. From the theoretical analysis arises a construct of psychological profiling of the players that should mirror a need for self-expression and the way the respondent viewed relations with other people as the expanded game design affected relations and self-expression. Such questionnaire items were developed and pretested on three fifteen years old individuals. After that test these questionnaire items were re-worked and became somewhat more softly expressed.

The construct of the children's psychological background was developed based on the field experiments as a reflection of the ethical quandaries coming out of social expansion. This latent variable was an attempt to capture what kind of personality would be more prone to being an active player of a socially expanded game (Section 2.2.7). This became the eighteenth hypothesized latent variable and applied only to the primary players.

3.9.5 PLS-SEM Purification Process AAPW

All the above constructs and their manifest variables were entered into an initial theoretically based PLS-SEM. This model had a great deal of com-

plexity and an exceedingly large number of manifest variables per latent variable. This was – perhaps not so surprising – a model with insufficient mathematical key numbers (according to the principle of the wide net). There was both room for and a necessity to optimize the model mathematically while staying within the realms of the theory and the research questions. So the model was purified iteratively (Hair 2013, Chapters 4-6) with the aim of greater parsimony and better key numbers. This was done as a way to improve the signal-to-noise ratio (Section 3.5.4).

Manifest variables with low factor loadings, or low regression weights, were iteratively eliminated and the model re-estimated and re-modelled. Each new model was evaluated continuously against theory in an inductive process. In the process, the model to some extent grew further in complexity when a new construct was identified during the purification process. This construct was unforeseen in the initial theoretical analysis and came from the purification process. The construct is "children's negative game experience." It was made into a latent variable of its own. The construct depicts the extent to which the primary player thought the AAPW was difficult to understand, difficult to play, and generally boring. The process also increased the initial models parsimony primarily by excluding quite many of the attitude variables and forming the attitude measures into one latent variable with a composition common for parents and children, before and after.

It is considered a rule of thumb in PLS-SEM that even if latent variables with one single manifest variable are technically possible, it is recommended to keep the number of manifest variables to 3 to 6 per latent variable (Hair et al., 2011; Hair et al., 2013). The purification process aimed at arriving at a point where the number of both manifest and latent variables were reduced while in the end at least one manifest variable per original theoretically proposed latent variable should still be represented.

3.9.6 Attitudes purified

In the end, the attitude constructs became one latent variable with seven manifest variables. All the original three attitude constructs are represented in this final attitude construct. "Attitudes toward electricity consumption

behaviour (in short "ATB") is represented with four manifest variables, "Perceptions of restrictions and empowerments as to electricity use" (R) is represented with two manifest variables and the "General attitudes towards electricity and the environment (in short "GA") construct is represented with one manifest variable. These items make up the final attitude measures for both parents and children, and both before and after game play:

- "I know very well that I can impact my household's electricity consumption" (R).
- "My household cannot save electricity, we must use all the electricity we do right now" (R).
- "I usually urge my friends to conserve electricity" (ATB).
- "I can consider urging my friends to conserve electricity" (ATB).
- "I check how much electricity appliances consume" (ATB).
- "I turn out the lights when I leave a room" (ATB).
- "Saving electricity is cool" (GA).

3.9.7 The new purified social expansion construct – primary players

The processes of purifying the construct "experience of social expansion (SocEx)" led to that latent variable in the model having both original dimensions represented by both social expansion (Section 2.2.3) with two manifest variables and the WOM related dimension (Section 2.2.8) represented with one manifest variable:

- "Do you think the whole household became a team?" (SocEx).
- "We talked with each other about how to play AAPW" (VOM).
- "Did you try to persuade the other members of the household to conserve electricity so you could play?" (SocEx).

3.9.8 The new purified social expansion construct – secondary players

- "Do you think the whole household became a team"? (SocEx).
- "We talked with each other about how to play AAPW" (VOM).
- "Did the teenager's game play impact the electricity consumption of the rest of the household?" (SocEx).

3.9.9 The secondly players´ game thoughts construct purified

- "Now afterwards I sometimes think about playing AAPW" (IT[9]).
- "In the beginning of the play period I thought a lot about playing AAPW" (IT).
- "I would like to have played AAPW myself" (IT).
- "I thought about AAPW the whole play period" (IT).

3.9.10. The primary players´ game thoughts construct purified

- "Now afterwards I sometimes think about playing AAPW (IT).
- "In the beginning of the period I thought a lot about playing AAPW" (IT).
- "I wanted to save electricity at home" (E[10]).
- "At the end of the play period I thought a lot about AAPW" (IT).
- "I wanted to see my team at the top of the ranking" (E).

3.9.11 The children's game experiences construct purified

- Players own ranking within the team.
- Teams ranking, versus other teams.
- The players number of logins.
- The players own points.

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[9] IT = Intensity of thought c.f 2.3.2 – 2.3.4.

[10] E =Effect.

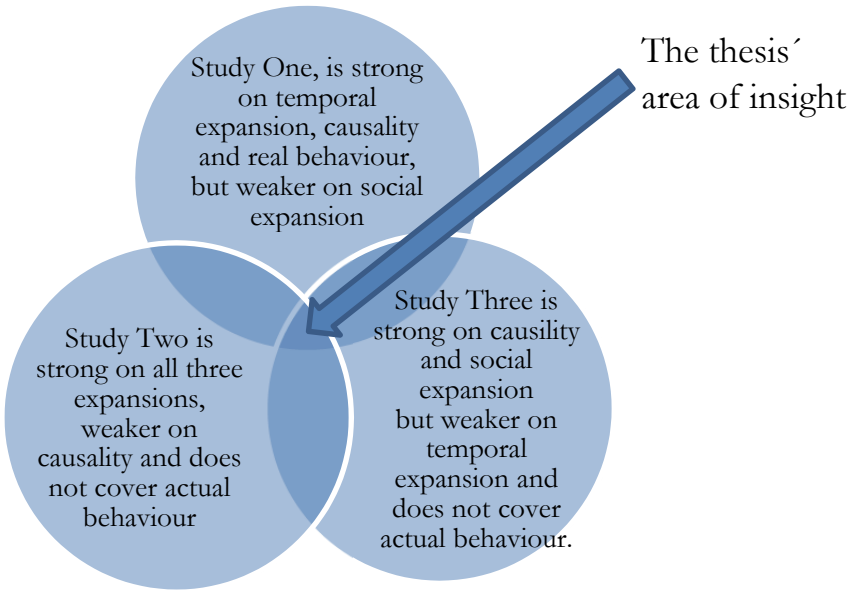
3.9.12 The children's psychological profile

- "It is important to feel that I achieve something."
- "It is important not to hurt people."
- "It is important that other people respect me."
- "It is important to feel self-respect."

3.10 Concluding summary Chapter Three

The purpose of this thesis is to arrive at a better understanding of a persuasion process arising out of playing persuasive pervasive games and to explore possible persuasive effects of playing such games (cf. Section 1.2). Four field experiments with three games were employed and analysed in the three studies. The three studies have different strengths and weaknesses in their operationalization of the three expansions and cover the topic in slightly different ways. Together they give a composite insight that will contribute to new theory and give games researches and persuasion strategist's deeper insight into the process of persuasion that comes about when the three expansions are applied to the play experience of a persuasive game (cf. fig 3.10).

Figure 3-10. This is a graphic illustration of how three studies cover each other, both overlapping and diverging



Chapter 4
Study One: Results from Power Explorer

4.1 Research Question One about Effects

The thesis´ first research question was: Does playing a pervasive persuasive game have any effects on focal variables in the intended direction? Focal variables are those that are intended to be impacted by playing a persuasive pervasive game. In Power Explorer, these variables are beliefs about electricity use by appliances, attitudes toward saving electricity, and actual electricity consumption in the household. The following hypotheses are thus stated:

H 1: Playing Power Explorer will lead to higher believed electricity use by electrical appliances among the players.

H 2: Playing Power Explorer will lead to more positive attitudes among the players toward electricity saving.

H 3: Playing Power Explorer will lead to less electricity consumption in the players' households.

The Power Explorer study was limited in its execution of social expansion and there were no data from secondary players (other household members). Therefore, Power Explorer could approach research question one only from the primary players' perspectives. However, while Study One was the

most limited of the three in data collection relating to the issue of social expansion, it did have the best data – AMR data – on electricity consumption, allowing for exploring actual effects on household electricity consumption from playing the game.

4.1.1 H1: Effects on the players' electricity use beliefs

The effect of playing Power Explorer on beliefs about electricity use by appliances was tested by comparing the means of the beliefs of players before and after the playing, of the reference group before and after the playing by the experimental group, not by the reference group, and of the reference versus the players group after. The beliefs were interesting as a construct, less so as individual measurements as the object of interest was not how the players considered individual appliances, but instead how the larger construct of the players' beliefs of electricity use was impacted.

According to the analysis, the players' beliefs about electricity use by appliances increased by 9% from playing Power Explorer ($p < 0.01$). The beliefs of the reference group were 5% lower after than before the experimental group played Power Explorer ($p = 0.075$), and the beliefs of the playgroup after were 16% higher than the beliefs of the reference group after ($p < 0.01$. According to the analyses, there was an effect on the players' beliefs of electricity appliances use from playing Power Explorer in the intended direction, thus supporting hypothesis 1.

4.1.2 H2: Effects on attitudes toward electricity saving

The effect of playing Power Explorer on attitudes toward electricity saving was tested by comparing the means of the attitudes of players before and after playing Power Explorer, of the reference group before and after the experimental group played Power Explorer, and of the reference group versus the players after the playing by the experimental group.

The attitudes toward electricity saving of the players after game play were 5.5% more positive than the attitudes of the players before ($p = 0.06$). The corresponding attitudes of the reference group were 7% more negative after the experimental group had played Power Explorer than before ($p =$

0.04). The attitudes of the playgroup after game play were thus 14.2% higher than the corresponding attitudes of the reference group ($p = 0.01$). According to the analyses, there was an effect on the players' attitudes toward saving electricity from playing Power Explorer, thus supporting hypothesis 2.

It should be noted that there was a dip in the scores of the reference group on both beliefs and attitudes from the start of the measurement period to the end. This may be attributed to the small database. However, since the dip was present in both the beliefs and the attitudes it may be attributable to a general change in the target population during the game play period, which was countervailed by playing Power Explorer.

4.1.3 H3: Effects on household consumption of electricity

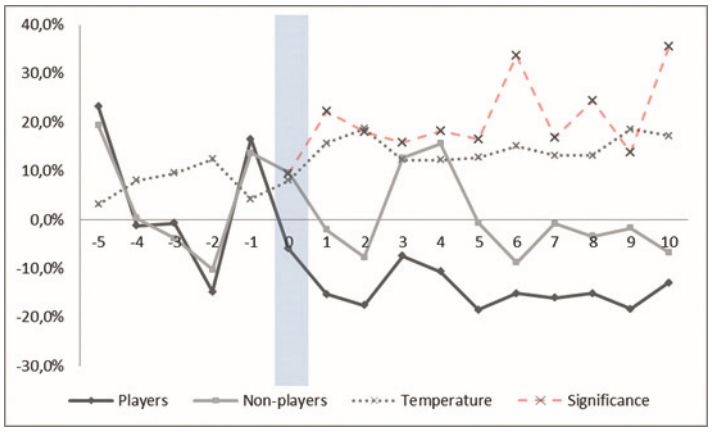
To study the effect on the households' electricity consumption from playing Power Explorer, the AMR data from the households were used. That was not an unproblematic measure (cf. 3.1.5). A case where the game effect on the primary player was large, but the effect on the secondary players was next to zero, would most likely register as a negligible effect on household consumption and give the impression of the games failing to impact the behaviour of their players. It would though be right to register that as a failure because the aim of the three games was to influence the attitudes, beliefs and behaviour of the whole household, i.e. both primary and secondary players.

The results of Power Explorer on the players' household consumption of electricity has been previously published (Gustafsson et al., 2009, Gustafsson, 2010). The measures of attitudes and beliefs differ between those publications and this thesis. The construct of electricity consumption was the same in those publications as in this thesis (see fig. 4-1 below for the results).

Figure 4-1 shows that the electricity consumption of the players' households and the electricity consumption of the reference group synchronized with the outside temperature during the weeks prior to the game. The black line is the average of the relative electricity consumption for the players and the grey line corresponds to the data from the reference group.

The outside temperature is plotted as the dotted line. The dashed line shows the p-values for the differences between the two groups. The light grey area indicates the week of the game trial. As expected at the point of the game trial (week 0), the two groups start to diverge. This diversion then persists during the entire post-game period measured. Consumption during the 10 weeks following the game trial was on average 14% lower in the player group compared to the reference group (mean p = 0.16). Overall, the p-values are poor, most likely due to the small database.

Figure 4-1. Electricity Consumption from players of Power Explorer and reference group (from Gustafsson et al., 2009).



The poor p-values may make it seem as though the electricity consumption data cannot contribute towards resolving hypothesis three. However, the 15 respondents can also be viewed individually, and of the fifteen respondents, twelve showed some level of decrease in the use of electricity (some with large decreases of 14% - 23% in the post-game period). Only three of the participants' households increased or showed no changes in their consumption during the game trial. The combined results of the analyses of effects on attitudes, beliefs, and consumption from playing Power Explorer indicate that there was some effects in the intended direction Research ques-

tion 1 can therefore be answered by yes, there are persuasive effects in the intended direction in a persuasive process of a pervasive persuasive game.

4.2 Research Questions Two about the Persuasion Process

The thesis' second research question asked what a persuading process from playing a pervasive persuasive game may look like and what the influencing effects are through such a process. The question is answered by developing and testing a structural equation model, aimed at picturing the persuasion process from playing Power Explorer and estimating the influencing effects through the process. The final model arrived at is shown in Figure 4-2.

In Chapter 2, some more specific hypotheses were also proposed as to a persuading process of playing a persuasive pervasive game, which will be analysed in Section 4.2.2. These were:

H4: The more enactment in playing a persuasive pervasive game, the more positive the effects on the focal variables will be.

H5: The expansions of a pervasive game play a role in a persuasion process from playing a persuasive pervasive game, strengthening the process in the intended direction.

H6: The more systematic processing and less heuristic processing when playing a persuasive pervasive game, the more positive are the effects on the focal variables.

4.2.1 Key Numbers of the Measurement Power Explorer PLS–SEM

The first step taken when applying PLS-SEM to the Power Explorer data was to assess the measurement model. Sections 3.6.2. – 3.8.11 explain the following terms. The analysis was done with the software Smart PLS (Ringle et al., 2005), with bootstrap estimates as bases for the significance tests.

The names of the latent variables will in the following occasionally be abbreviated for the sake of the readability of the prose.

4.2.1.1 AVE, Composite Reliability and Cronbach's Alpha

AVE was greater than 0.5 for ten of the eleven Power Explorer latent variables where the AVE-measure was applicable (see Table A1). Average Variance Extracted was not an applicable measure for the formative latent variable "Outgame activities (Spatial Expansion) (C)". The Composite Reliability values were 0.87 thru 0.98. The Cronbach Alpha values were 0.81 thru 0.97 and all indicated good discriminant validity for the latent variables. AVE was not an applicable measure in the case of the latent variable "Outgame activities (Spatial Expansion) (C)" as it was formative.

The overall degree of internal consistency in the measurement model, as measured by Cronbach's Alpha and Composite Reliability, was acceptable. That nine out of the nine latent variables where AVE was applicable had an AVE greater than 0.5, indicates that the variances captured by the latent variables were larger than variances due to measurement error, thus demonstrating uni-dimensionality and convergent validity of the constructs, at least as far as could be expected given the circumstances of only fifteen cases in the model.

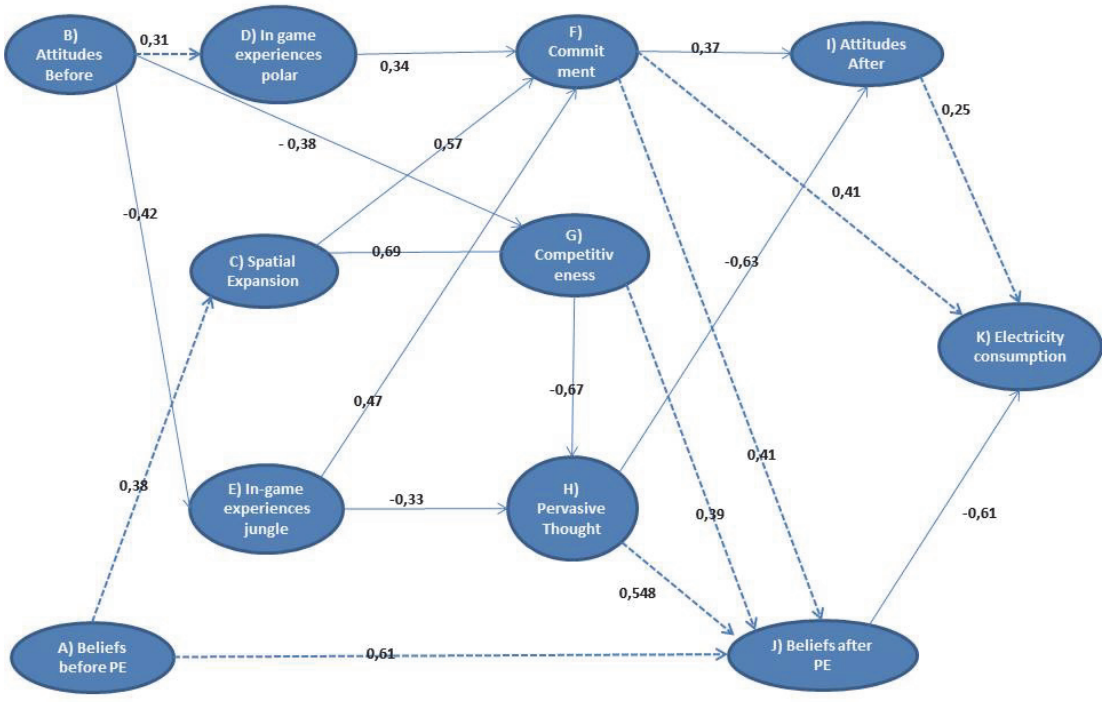
4.2.1.2 The Fornell-Larcker test and cross loadings

The Fornell-Larcker test (Table A2) indicates that all square roots of the AVE measures exceed the construct inter-correlations, which further support discriminant validity of the measurement model. The cross loadings (Table A3) show that the loadings within the constructs exceed the loadings outside the constructs, thereby indicating some level of discriminant validity. The key numbers and the Fornell-Larcker test are strong and the cross loadings seem good as all loadings within exceeded those outside the constructs. However, there are many cross loadings that do not exceed the loadings, yet still are quite high (Table A3) – 101 of 513 cells in the cross loadings table (17.3%) show the presence of cross loadings above 0.4. This is negative and to some extent undermines the discriminant validity of the latent variables. It is not a fatal problem, just a reason for some concern.

4.2.2 The final total Power Explorer PLS–SEM

After having established the measurement model, the next step is to establish the structural model. The final estimated Power Explorer structural model is shown in Figure 4.2. The model consists of eleven latent variables, of which two were exogenous (A & B) and nine endogenous, constructed from 53 manifest variables and connected with 19 paths. The model converged in 12 iterations. The final dependent variable in the model is percentage of change in electricity consumption by playing Power Explorer (see 3.8.11 for how the construct was measured). This means that the explanatory focus is on actual changes in consumption, not on the consumption level as such.

Figure 4-2. The PLS-based structural equation model, showing the found causal relations and their path coefficients. The dotted lines represent paths with rather high path coefficients, but somewhat low t-values for those coefficients.



The path coefficients (β), i.e. the estimated direct effects from independent or intermediate variables on dependent variables, are shown in Figure 4-2 and in Table A4. They are all quite high, although the t-values in many cases are unsatisfactory low due to the few cases. It is still argued that the final model does contribute exploratory to the greater understanding aimed at. The t-values of the path coefficients are shown in Table A5. The R-squares, i.e. the degree to which the model manages to explain the variance in the latent variables, are shown in Table A1. They are also in general high, with the same reservation as concerning the path coefficients.

Some path coefficients are very high, for example the path, in other words the direct effect, from the latent variable "Pervasive Thought" to the latent variable "Attitudes After"(β = 0.69). On the other hand, there were some ambiguous results like the t-value of 1.33 for the path from the latent variable "in-game experiences polar" (D) to the latent variable "Commitment" (F), despite the estimated effect being quite high (β = 0.34). The lowest t-value has the path from the latent variables "Commitment" to "Electricity Beliefs After", although the estimated effect is high (β = 0.41; t = 0.58). The t-values were calculated in Smart PLS using a bootstrap method with the "individual level sign changes" setting applied. This setting maximized the outcome of the t-values by correcting for extreme samples in the resampling run (Hair et al., 2013). The bootstrap procedure involved an element of random sampling so every bootstrap estimate came out with slightly different estimates. That the Power Explorer model was built on so few cases exacerbated that fluctuation.

During the procedure of building and testing the model, it was found that the t-values of the bootstraped estimates could vary up to ±0.2 between iterations of estimates. Still, this was the best that could be done, although the weak significances of some of the paths have to be taken into account when drawing conclusions from the model. At the same time, it should be pointed out that the aim is explorative. The assessment of a PLS-SEM is not absolute. However, the combined measures of the measurement model, together with the strengths of the paths and the weak to acceptable t-values gives the overall impression that the Power Explorer PLS-SEM model landed on the side of overall acceptability, picturing a possible persuasion process.

The model is an answer to the second research question about what a persuading process from playing a persuasive pervasive game may look like and what the influencing effects are through such a process.

4.2.3 Direct, indirect and total effects in the Power Explorer PLS-SEM

All total effect estimates for the dependent and intermediate variables in the Power Explorer PLS-SEM are shown in Table A6.

As to the final latent variable "Change in electricity consumption (K)", it is the latent variable "Electricity Consumption Beliefs After (J)" that has the largest direct and total effect on real changed consumption (β = - 0.62), which means that the higher the perceived electricity use by electrical appliances, after playing the game is, the more the electricity consumption of the household has been reduced (the more negative is the change).

The next most influential latent variable on change in consumption is "Electricity Consumption Beliefs Before" (A), which has an indirect total effect of -0.40 on consumption change. That indirect effect goes to a large extent via the latent variable "Electricity Beliefs After" (J), on which the latent variable "Electricity Consumption Beliefs Before" (A) has a high direct effect (β = 0.61). However, the model shows that the total effect of A on J is even higher (0.71), enlarged by indirect effects via the latent variables "Outgame Activities (Spatial expansion) (C)", "Commitment (F)", "Competitiveness(G)" and "Pervasive Thought(H)", indicating reasons for the change in the latent variable "Change in electricity consumption (K)" from playing, in the intended direction.

Other latent variables with noticeable and intended total effects on change in consumption are "Attitudes toward Electricity Saving (I)" (β = - 0.26, which is also the total effect), "Pervasive Thought (H)" (the indirect total effect being -0.18), and "Competitiveness (G)" (the indirect total effect being -0.12). The variable "Outgame Activites (spatial expansion) (C)" has the intended total effect, but a very low one, close to zero (-0.05). This result is discussed below.

The remaining independent or intermediary latent variables all have close to zero total effects, but positive signs contrary to the intended per-

suasion. The reason is countervailing indirect effects, indicating where and why in the persuasion process the game fails with respect to its intended persuasion aim. This is also elaborated on below, when discussing the more specific hypotheses.

Other latent variables with noticeable direct, indirect or total intended effects on "Electricity Consumption Beliefs After (J)", in addition to the effect from "Electricity Consumption Beliefs Before (A)" discussed above, are "Pervasive Thought (H)" (β = 0.55, which is also the total effect), "Commitment (F)" (β = 0.41, which is also the total effect), "Outgame Activities (spatial expansion) (C)", with an indirect total effect of 0.25 via "Commitment (F)", "Competitiveness (G)" and " Pervasive Thought (H)", and "In-game experiences jungle (E)", i.e. degree of enactment (an indirect total effect of 0.14). "Competitiveness (G)" has a noticeable direct effect in the intended direction (β = 0.39), but this is completely countervailed by the negative indirect effect via "Pervasive Thought (H)". None of the remaining variables has any direct or total effect on "Electricity Consumption Beliefs After(J)".

"Pervasive thought (H)" has the greatest direct and total effect on "attitudes towards electricity consumption after (I)" (β = -0.63, which is also the total effect), meaning that the more systematic (less heuristic) the thinking when playing, the more negative post-attitudes toward saving electricity. This is an unexpected and therefore interesting finding, which will be elaborated on when discussing H6 below. As pointed out earlier, the total effect on change in consumption from "pervasive thought" is still in the intended direction, but the indirect effect via post-attitudes means a countervailing effect to the found intended effect via "Electricity Consumption Beliefs After (J)".

Other latent variables with direct or indirect total effects on "Attitudes towards electricity saving after (I)" in the intended direction are "Outgame Acivities (spatial expansion) (C)" (an indirect total effect of 0.50), "Competitiveness(G") (an indirect total effect of 0.42), "In-game experiences jungle (E)", one of the measures of degree of enactment (an indirect total effect of 0.38), "Commitment" (F) (β = 0.37, which is also the total effect), "Electricity Consumption Beliefs Before (A)" (an indirect total effect of 0.19)

and "in-game experiences Polar (D)", another of the measures of enactment (an indirect total effect of 0.13).

"Attitudes before" (B) had a negative indirect total effect on "attitudes after (I)", meaning that those with negative or less positive pre-attitudes toward electricity saving became more positive or less negative, while those already having positive such attitudes became more negative or less positive. One explanation is "regression towards the mean", in this case meaning that those with very strong positive or negative attitudes could only change them in the opposite direction, as measured in the questionnaires.

Another explanation is given by the impacting paths from "attitudes before (B") to "Attitudes After (I)" via the mediating variables "in-game experiences jungle level (E)", "Competitiveness (G)" and "Pervasive thought (H)", paths that are countervailing the path "attitudes before" → "in-game experiences polar" → "commitment" → "attitudes after", with some paths resulting in a positive effect while others result in a negative effect.

As to the remaining intermediate variables, three are explained to a large degree by other variables in the models: "pervasive thought (H)" (R^2 = 0.71), "Competitiveness (G)" (R^2 = 0.67) and "Commitment (F)" (R^2 = 0.69). Three other variables further back in the model are explained to some degree by still other variables: "in-game experiences jungle (E)" (R^2 = 0.17), "in-game experiences polar (D)" (R^2 = 0.10) and "spatial expansion" (R^2 = 0.15). To sum up: all the found effects are indications of a persuasion process in place while playing a persuasive pervasive game Power Explorer.

4.2.4 Results concerning H4, H5 and H6

In Chapter 2, three more specific hypotheses were proposed: H4, H5 and H6. All three have been tested within the Power Explorer PLS-SEM, with some results already reported above. The results from testing the three specific hypotheses will here be discussed in more detail.

H4: The more enactment in playing a persuasive pervasive game, the more positive the effects on the focal variables will be.

Enactment was represented in the model by several variables. The ones that realize enactment in the most direct way are the two somewhat differing variables: "In-game experiences from the polar level (D)" and "In-game experiences from the jungle level (E)". As stated earlier, the focal variables in Power Explorer are beliefs of appliances' electricity use, attitudes toward saving electricity, and actual electricity consumption in the household. As to the latter, it was the *change* in electricity consumption during the play that was measured in the Power Explorer PLS-SEM.

Only the second enactment variable – "in-game experiences from the jungle level (E)" – had a total indirect effect on changed consumption, and a rather small such effect (0.09). The first enactment variable – "in-game experiences polar (D)" – had no such effect. As to "Electricity Beliefs After (J)", only the first enactment variable (polar D) had an indirect total effect (0.14), also rather small, while the second enactment variable (jungle) had no such effect.

Finally, both enactment variables had an indirect total effect on "Attitudes Towards Electricity Saving After (I)": "In-game experiences from the polar level" (D) of 0.13 and "In-game experiences from the jungle level" (E) of 0.38, the latter being sizeable. All the effects found were in the intended direction. These findings support the hypothesis that the more enactment in playing a persuasive pervasive game, the more positive the effects on the focal variables. However, in some respects the impact was small. Obviously, the polar level was not very successful. The difference in outcomes from these two enactment variables can perhaps be attributed to that the jungle level was designed for a game-play related to continuous electricity consumption, and the less successful polar level for a game play related to short spikes in consumption (cf. Section 3.3.2). Moreover, it does not have to be the difference in persuasive aims that caused the difference; it could be elements of play design or the execution.

As to research question 2, what a persuading process from playing a pervasive persuasive game may look like and what the influencing effects are through such a process, the first enactment variable – "In-game experiences from the polar level (D)" – had its indirect effect on both the "attitudes after (I)" and the "Electricity Beliefs After (J)" via "Commitment (F)" ($\beta = 0.34$), and it went in the intended direction. The more enactment, the

more commitment, the more positive attitudes and the "higher" beliefs as regards to electricity use by appliances.

The further indirect effects on change in consumption from "Commitment (F)" via "attitudes after (I)" and "Electricity Beliefs After (J)" were, however, countervailed by a direct positive effect from "commitment" on change in consumption.

In other words, at the same time as the attitudes and electricity beliefs were changed in the intended direction, along with higher commitment to the game, there may have been something in the game design urging for some compensations for having to reduce electricity consumption when becoming more committed to the game as such. That may be an expression of clashing frames of the experience in the mind of the player (cf. 2.1.1). This is further discussed in Chapter Five (Study Two).

It is related to the issue of one group of players playing with the main aim to win, and one group of players taking in the game to a fuller extent. Such a clustering of players is not unknown in game studies (cf. Ducheneaut, et al. 2006).

"In-game experiences from the jungle level" (E) also influenced the "attitudes after" (I), the beliefs after (J) and the latent variable "Change in electricity consumption (K)" via "commitment (F)" ($\beta = 0.47$) and from there in the same way as "in-game experiences polar" (D), but it also influenced the focal variables via "Pervasive Thought" (H) ($\beta = -0.33$), which has been discussed above. That "Pervasive Thought" (H) is inverse relative to attitudes and beliefs can perhaps be explained by the more thought about the games 'qualities', the more thought about it as a game, removing it from the frame of reality (cf. 2.1.1 and Study Two, Chapter Five).

H5: The expansions of a pervasive game play a role in a persuasion process of playing a persuasive pervasive game, strengthening the intended persuasion.

As to the expansions, only spatial expansion was measured and included as a particular latent variable in the Power Explorer PLS-SEM. As stated above, "Outgame activities (Spatial Expansion) (C)" had an indirect total effect on both "attitudes after (I)" (0.50) and "Electricity Beliefs After" (J)

(0.25) in the intended direction, but no such effect on change in consumption due to countervailing paths. The indirect effects on the attitudes after was both via the "Commitment (F)" latent variable (β = 0.57) and from there further on as described above, and via the "Competitiveness (G)" latent variable (β = 69) and further through "Pervasive Thought (H)" (an indirect total effect of -0.47). The indirect effects on "Electricity Beliefs After" (J) was via the same path. There was, however, no indirect total effect on change in consumption due to the countervailing effects discussed above. The hypothesis is thus only partly supported when it comes to Power Explorer.

H6: The more systematic processing and less heuristic processing when playing a persuasive pervasive game, the more positive the effects on the focal variables.

In the Power Explorer model, the thought construct that can resolve H6 is to be found in the latent variable "Pervasive Thought" (H). It had a direct and total effect on both "attitudes after" (I) (β =-0.63) and "Electricity Beliefs After" (J) of (β =0.55) and an indirect total effect on "Change in electricity consumption (K)" of -0.18. Like mentioned above the negative relation in between "Pervasive Thought" (H) and "attitudes after" (I) can perhaps be attributed to clashing frames (cf. Study Two, Chapter Five). Power Explorer was fun to play and also slightly frivolous, with cute nonsensical avatars that farted carbon dioxide that made flowers wilt. A player that enjoyed the game, i.e. thought about it a lot, may not have connected a game of such character to a serious message about everyday life. That is supported by Study Two in Chapter Five. On the other hand, there was a strong effect on "Electricity Beliefs After" (J) (β =0,55) in a positive direction. That indicates that even if the enjoyment of a frivolous game did not necessarily transfer to more positive attitudes towards the game's message, then thoughts about the game did transfer into increases into beliefs about the electricity use of home appliances. That is supported by the actual consumption somewhat decreasing (β = -0,18) when "pervasive thoughts" (H) increases. The hypothesis is thus not supported on attitudes, but is supported on beliefs and behaviour.

In the case of Power Explorer, one reason may be that the game design actually made possible some gains contrary to the intended persuasion of the game by being "smart". The more systematic (less heuristic) thinking, the greater chance of being "smart". One reaction from this counteracting tendency may then be to adjust one's attitudes in the non-intended direction. This effect is thus important to consider when designing a persuasive pervasive game.

4.2.5 Summing up the Power Explorer study

Relating to research question one, the results presented in this chapter show that Power Explorer had an effect on vocal variables in the intended direction, both as to the players' beliefs on electricity use by household appliances, attitudes towards saving electricity, and on real life consumption of household electricity. As to the second research question, what a persuading process from playing a pervasive persuasive game may look like, and what the influencing effects are through such a process, such a persuasion process of a pervasive persuasive game – Power Explorer – was modelled and tested, and the results give indications both as to how such a process may look like, and the persuading effects through the process.

As to some specific findings, degree of enactment was a factor in determining the impact. It was also found the differing levels of Power Explorer that used different designs of game play to convey different messages gave highly different results. This indicates that the impact is play dependant, not game dependent. Power Explorer also showed that spatial expansion does play a role when determining persuasive impact. It may have been so that the somewhat frivolous nature of Power Explorer may have caused colliding frames when thinking about the game and thinking about the message. That is to be explored further in Chapter Five.

Chapter 5
Study Two: results from the qualitative analysis

In this chapter, the three research questions below are addressed based on qualitative data from depth interviews with players (see Section 3.6.1). The aim is to deepen the understanding of the persuasion processes from playing a persuasive pervasive game.

RQ 1: Does playing a pervasive persuasive game have any effects on focal variables in the intended direction? If so, how and to what extent?

Especially the how – or why – is elaborated on in this chapter. To what extent is not addressed in this chapter.

RQ 2: What does the persuading process from playing a pervasive persuasive game look like, and what are the influencing effects from such a process?

The focus in this chapter is on qualitative aspects of the process that may explain influencing effects.

RQ 3: Does categorization play a role in the persuasive process of playing a persuasive pervasive game, and if so, what role?

The qualitative analyses in this chapter are based on twelve in-depth interviews with players of Power Agent and Power Explorer. The respondents

were interviewed in their capacity as children in the household (primary players) and parents in the household (secondary players).

The qualitative analyses in this chapter are performed as a further realization of the choice of field experiments. Pervasive games are by nature an open experience where anything that can happen in real life can become a game happening. Field experiments are an open method that allows anything to happen. However, quantitative analyses can only analyse those issues that were pre-planned to be analysed. A qualitative data collection can capture emergent behaviours and put them through analysis into emergent insights. An overarching objective of the thesis is to contribute theoretically to the literature on persuasive pervasive games (Section 1.2), and emergent insights contribute to theory.

Study Two takes inspiration from Goffman's frame theory (Section 2.1.1) in its attempt to explore the persuasion process from playing a persuasive pervasive game, as mirrored by the quotes from the players. It put the work in the terms of Goffman's frame analysis and attempts to show how players in the game actively "upkey," "downkey," or "not-at-all-key" elements from their primary frameworks in order to create and uphold the social framework of playing Power Agent and Power Explorer. The choice of frame theory is motivated by the two games being designed to change the meaning of mundane behaviours towards household appliances, by the games being pervasive games, and by the data having been collected through field experiments. Goffman's frame theory is also good background against which to illuminate the three expansions.

In the terms of frame theory, the mundane act of turning off a light at home was *upkeyed* when done as an execution of spatial expansion in order to achieve an effect in the game since that mundane act became removed from reality and put into the realm of the game. The activity of looking at the in-game info to observe the household electricity consumption (fig. 3-9) was a *downkeying*. When applying frame theory it may be noted that the two games, while strong in their game play and strong in leading the player to take actions in real life that has consequences for duels, scores, and points in-game, were both rather weak on the narrative element. This may or may not have consequences for the applying of frames. Other studies that applied frame theory to games (Linderoth, 2012; Stenros, 2008) did so with

games that had a stronger narrative element than Power Agent and Power Explorer.

The two games also have the central quality of being related to real life economic actions in a real life household. While the two were indeed games, and therefore should have the metaphorical interaction membrane delimiting their game universe from the outside world (Sections 2.1.1 - 2.1.2), there was nothing shielding the player from the real life economic consequences of electricity consumption. This made them simultaneously both removed-from-life in the terms of Huizinga and Goffman, as they both were games, and not-at-all-removed from life in direct contrast to the terms of Huizinga and Goffman, and in particular violation of Caillois theory of games apart. This quality they share with all persuasive pervasive games.

5.1 Research question 3 about categorization

This section addresses research question 3: Does categorization play a role in the persuasive process of playing a persuasive pervasive game, and if so, what role?

The first finding is that the words, comparisons, and metaphors chosen in-between respondents were highly heterogeneous. That heterogeneity may be a reflection of a weak cognitive product-level typicalisation process in the minds of the respondents (Section 2.3.6). This assumption was to some extent substantiated by the result that all interviewees that got questions regarding the product-level typicalisation process of the game experience (Power Explorer only), came up completely blank on that issue. There was thus quite clear that there was a lack of product-level typicalisation processes in place for the experience. From this would follow that the respondents' lack of pre-made notions of category essence or prototype for the experience necessitated a greater degree of effortful thought about the experience, and hence about the message (Section 2.3.2).

The stories, even though individually phrased, told of similar topics in recurring ways. There was a degree of commonality across the respondents when telling how the play experience constructs were perceived. Such commonality was an indication of an impact and that this impact was

shaped by the design of the game play experience that related to the three expansions. This occurred since the pervasive-game design could drive a common impression in the player, even when the player had little with which to compare. The keying process and the formation of new frames were both impacted by the player's common experience of playing games with persuasive pervasive game design. The absence of answers relating to product level typicality (Section 2.3.6) was not proof that no idea of category essence existed in the respondents. It was an indication that the experience was not clear and typical. The lack of categorization of the experience would lead to quite different ways of expressing the experience and this was why a terminology-based content analysis could not be used.

5.2 Research Question One and Two about the persuading process and its effects

We first turn to the issue of what, if any, impact playing the games had on the player (research question one). Since the social, temporal, and spatial expansion of the games were designed to make little room for the player to experience it without experiencing an enhanced relation to saving electricity (Svahn, 2005), it was expected that some kind of impact would be found.

In the interviews, a large number of stories and utterances were told that reflected the players did think on both game play and electricity consumption. Overall, the interview data from the three tests of the two games yielded 105 citations that could be read as reflections of effect. However, it was also seen that these stories were divided in two strands, where only one of the strands reflected an influence from the game onto awareness of the larger topic of conserving electricity. Excerpts in Table 5-1 represent that first strand.

Table 5-1. Quotes about playing the message; first strand

	First strand of thought (R= respondent, I = Interviewer)
1.	**(R)** Well now, [after having played the games] when I see the stove on with all four hot plates, I really feel…like..hew, that´s not good."
2.	**(R)** Yeah, we read about it, [the message about conserving electricity] and the city council sent us some book about it. But like who cares..but not after game, now when I saw an article about saving electricity in the paper, I cut it out and put in on the fridge and we discussed the article over dinner, that would never have happened before…
3.	**(R)** …sometimes, I think, ...One ought to save some [electricity], so, when One goes out to do things, if One has been watching TV, then I both turn it off, and turn off the standby… **(I)**-, did you not do so before? [playing the game]. **(R)**-, no then I just left the room, and the house not even bothering to turn it off.
4.	**(I)** About saving electricity, and affecting your consumption at home, how does that feel now, how do you think about the topic now… **(R)** Don't know... **(I)** It is a topic, that´s on your mind? **(R)** No, not really…..but I think more about it than I did before…. **(I)** You do....- so if you see a machine running at home, like the washing machine or the stove, how do you feel? **(R)** I totally just, turn em ´off (respondent waiving his hand in a clicking motion)…
5.	**(I)**: How did it feel to play the game and shut of appliances? **(R)**: Yeah….it felt good… And then You felt that it feels good not consume electricity in the house. ….sort of… **(I)**: What is your view on consuming electricity now? **(R)**: It is important to not consume too much electricity. **(I)** Have you always felt that way? **(R)**: Ahh….well……yes-no, no It was when I started playing this game that I started realizing it. **(I)**: Realize what? **(R)**: That it is good to save electricity. Cause, it costs so much, and so…and that is not good...

The quotes in Table 5-1 should not be read as if a fictional layer came from the game regarding consuming electricity, as that would be an upkeying in the Goffmanian sense of the term. However, they do represent that new liminal but strong game type elements added to the electricity consumption situation. Perhaps new heuristics in the term of the HSM (Section 2.3) were

added as an outcome of the game situations where electricity consumption was keyed up.

The other strand reflected how players thought on energy consumption as a means to win the game. These reflections were strictly game related, reflected game thinking and were not necessarily related to the larger global topic of conserving household electricity. The quotes in Table 5-2 represent this strand.

Table 5-2. Quotes about winning the game

	Second strand of thought (R= respondent, I = Interviewer)
1.	**(I)** "- Just for fun, If you pretend that we have never heard of the game, - how would you describe it to me?" **(R) "**- As…well, a fun way of saving electricity, it works by you drawing down on your electricity, and you do that because you want to win, and..winning is the greatest joy, that's´ why you think it is fun!..
2.	**(R: child)** I was going to try using the kettle and the micro instead of the stove, but I want to win…[beat]…So I wound up going out and buying pizza. **(I – to parent):** You too? **(R: child)** Yeeaaah, the whole family, no It was only me and mum that went for pizza. Dad and [illegible] was going to eat someplace else.

A possible interpretation of the second strand (Table 5-2) was that these quotes represent situations where the player more clearly than in Table 5-1 keyed up the play experience. This could be situations where the player found a category prototype for the experience situation, the category of "this is a game = I must win it" as detailed in Section 2.3.6.

5.2.1 The impact of pervasive game design on thought and keying

Another finding was the extent to which the design elements of social and spatial expansion of the game (Section 2.2) caused intra-household discourse on the topic of electricity. The design of the games aimed to create

such intra-familial social incidents as the realization of the persuasive goals of the game.

The interviews offered some support for a connection between the element of social expansion in the game, the keying process, and intra-familial discourse. The interviews showed that the non-playing family members got involved to varying degrees. The level of involvement varied from a passing interest to intra-familial social incidents and considerable discourse. In most cases, the families wholeheartedly supported their players. Conflicts of interest did occur at times (see Table 5-3).

The interview sessions indicate that the playing child was more engaged in the game when the parents were actively involved. This drove a dialectic of game involvement between family members that in some cases spiralled into rather extreme heights (see Table 5-3). Talking about the games meant forming new categories (Section 2.3.6), and it is unlikely that such talk could come about without active systematic thought.

Table 5-3. Quotes pertaining to design and thought

Quotes pertaining to design and thought	
1.	**(I)** Do you cook at home? **(R)** Occasionally yeah…I help out **(I)** Did you tell the rest of the family what to do? **(R**) I said which missions I had and made them help me out as well as they could. And they turned out the lights after me, I forgot that, but all of a sudden mum and dad helped me out on that..actually the house has been rather dark lately..
2.	**(I):** Did you turn of the home theatre just for the game? **(Parent),** yeah we did. (**Other parent)** But you could really tell, when NN showed the game, that garden and the bar, you could really tell, when we did all that.
3.	**(I)**, You said, your mom was into the game too…. **(R)** Yeah, she thought it was cool… **(I)** Did she give you any tips? **(R)** Yeah, she said I should pull out plugs, and stuff that just sit there sucking electricity, and like turn off stand-by states on the TV and computers and stuff…
4.	**(I):**"How did you do to get the family to cooperate? Did you use any special kind of tricks?" **(R):** "No it was more like… Now I'm going to do this, we can win this and they stood with me…" **(I)**: "They wanted to be in on it?" **(R):** "Yes, yes. They thought it was interesting as well. How it worked and so on, that is was a game where you save electricity. They also thought it was interesting."
5.	**(I)** Did you talk with your family about what to do? **(R)** Yeah, there was a bit of a fight, with my sister, she wanted to use the computers, but I said NO. **(I)** Did she get annoyed by that? **(R)** Yeah!...but we talked about it…a lot.. and then no one used the computer for the whole day.. **(I)** Was this because you said that that was necessary for the game? **(R)** Mmm.... (**I)** You said that it was to save energy for the games, - did she understand that? **(R)**Yeah, we talked a lot, but in the end she gave in….
6.	**(R)** I thought..and then I thought…and then I realized that the best way to save electricity for the games is not to cook at all, (laughter). **(I)** So you did not cook any food? **(R)** No!...and, like we had had a party the day before so we had leftovers…didn't need to cook..
7.	**(R)**- I asked my dad to switch the whole house to low-energy light bulbs, at first he did not want to,- but after I kept asking for a while, in the end he did.

8.	**(I)** So you talked about this then and then? **(R)** Yeah we did, and [illegible, but not the player] turned off lights and so when we were not…. If we were downstairs they [the lights] were turned off upstairs..and then we started watching the same TV-show. Before we could sit some of us downstairs and some of us upstairs and watch the same TV-show, now we talk with each other and sit together, when we watch the same TV-show.
9.	**(R)…**then I tell mum and dad not to have too many lights on. And, like don´t do too much that draws electricity. And like then I go off to some friends, and when I come back and like forgotten about it all, I turn on the lights in the hall, and there is my dad who almost chews me out, he goes like; what are you doing we're playing and rationing. And I go like "Yeah but I got to see what I´m .." And he goes like No turn off, So I stand there in the dark taking my shoes off….like..hehehehe…

In all, the interviews indicated that the games succeeded in creating topical intra-familial engagement through the three expansions, in particular social expansion, and that the engagement spilled over into extra-familial topical social discourse on conserving electricity.

5.2.2 Upkeying and downkeying – keys in the elevator

In the terms of Goffman's frame theory, the findings indicate that the games to some extent did key up the mundane act of electricity consumption showing that a persuasive pervasive game could have an impact and that the three expansions was a contributing variable in causing that impact.

Seen in the light of the HSM (Section 2.3), however, it is not obvious that upkeying is desirable, when persuasion is a goal. If an act is keyed up, and, in the terms of Goffman, becomes "laminated" with several frames of play and fiction, the result could be that the respondent becomes focused on "gamish" heuristic thoughts of playing and winning. That may not lead to the effortful systematic thought that is more desirable if learning and persuasion is to be achieved. In short, upkeying could be a process that makes the respondent find categories to place the experience, even though shallow ones based on the simple heuristic game of play to win, obscuring other aspects of the experience. This was illustrated by the finding of the two strands.

However, the results so far also lend themselves to be read as if considerable amounts of downkeying went on as well when elements of game play

through spatial and social expansion were brought into the mundane through necessary discussion with the other household members regarding household electricity consumption. That would have necessitated the player to break frame and take a step out into "reality." That is a more desirable outcome, when persuasion is the goal and as such a process would necessitate more systematic thought.

When setting up a game, the social contract of setting up the liminal space needs to be communicated to the participants (Stenros, 2008). That is necessary because that process established the frames and the setting of the keys. In the case of the two games Power Agent and Power Explorer, the social-expansion design made that process intentionally vague and weak. The reason was that the protective psychological bubble (Section 2.1.1) was meant to be as thin as a pervasive game could possible make it. The games were designed to make the frames of the players become unclear; perhaps directly conflicting to let that lack of clarity of frames generate systematic thought.

The quotes show what happens when the different players react to this vagueness and this highlights the conflicting frames of the primary players (the children of the household) in particular, but also the secondary players (the parents and siblings). Another possible reading of the quotes was that the mundane family interaction was keyed up into game elements. The game-stimulated discussions on electricity were necessary as game elements, and hence were keyed up. To take the real life surroundings and key them up into game elements is a typical expression of pervasive-game design. That would also lead to a rethink about the same real life elements. That would mean new thought that is systematic. We have so far seen Study One that was strong on insights on causality, but weaker on insights on social expansion, and Study Two that was stronger on showing the presence and effect of all three expansions, but weaker on showing causality (fig. 3-10).

5.3 Summing up the qualitative study

This chapter addressed research question one about if playing a pervasive persuasive game has any effects on focal variables in the intended direction, and if so how, based on analyses of qualitative data. The qualitative data

indicated clear effect, and the causes were elaborated on. The chapter also addressed research question two about what a persuading process from playing a pervasive persuasive game may look like, and what are the influencing effects in such a process. This qualitative study showed, among other things, that there was a tendency that some players played to win while other players played to explore the game. It was argued that this is a result of differing frames.

Finally, the study also addressed research question three on categorization, and it was found that most players lacked a category prototype for their experience.

Chapter 6
Study Three: Agents Against Power Waste (AAPW)

Study Three is a follow-up study to Studies One and Two, again addressing the following research questions with a quantitative analysis, building on what was uncovered in Studies One and Two:

RQ 1: Does playing a pervasive persuasive game have any effects on focal variables in the intended direction?

RQ 2: How may a persuading process from playing a pervasive persuasive game look like and what are the influencing effects through such a process?

Both questions are answered by analyzing data from field experiment four, the playing of the Agents Against Power Waste (AAPW) persuasive pervasive game described in Section 3.3.3

Study Three is best suited to give a modicum of stability on the issue of causality in between constructs that lie as the base for the research questions. The issue of playing for winning or for the message (Section 5.1.1) cannot be addressed in Study Three, as that insight arose out of the post facto analysis of Study Two and was not prepared for in Study Three. Study Three differ from Study One in that the data, like in Study Two, were collected from both parents and children, allowing for the issue of interaction between the primary (the child) and secondary player (the parent), i.e. the social expansion, to be better covered in Study Three.

6.1 Research Question One about effects

In this section, the first research question if playing a pervasive persuasive game have any effects on focal variables in the intended direction is addressed. The focal variables in AAPW are attitudes toward saving electricity of both primary and secondary (parents) players (the latter within the social expansion of AAPW). The following two hypotheses are thus stated:

H7: Playing AAPW will lead to more positive attitudes toward saving electricity among the primary players.

H8: Playing AAPW will lead to more positive attitudes toward saving electricity among the secondary players – the parents.

The hypotheses have been tested by comparing the means of the indexed variable "Attitudes toward saving electricity" before and after AAPW, for the primary and secondary (parents) players, respectively, using t-test. The hypotheses were further tested by comparisons with the control group. As to H7, the result is that the primary players were 6% more positive toward electricity saving after than before playing AAPW ($p < 0.01$), which supports the hypothesis. As to H8, the result is that the secondary players (the parents) were 8% more positive toward electricity saving after than before playing AAPW ($p < 0.01$). H8 was thus also supported..

The hypotheses were also tested by comparing the mean attitudes of the primary and secondary players after AAPW against the control group, also after AAPW. The result concerning H7 shows that the primary players were 7% more positive toward saving electricity after playing AAPW ($p < 0.01$) than the control group at the same point in time. The result concerning H8 shows that the secondary players were 6% more positive toward saving electricity after participating in AAPW than the control group at the same point in time ($p < 0.01$). These results give further support to H7 and H8. Overall, the first research question can be answered in the affirmative that there was an effect on both primary and secondary players from playing AAPW.

6.2 Research Question Two about the persuasion process

The thesis' second research question asked what a persuading process from playing a pervasive persuasive game may look like and what the influencing effects through such a process are. The question is answered by developing and testing another structural equation model, aimed at picturing the persuasion process from playing AAPW and estimating the influencing effects through the process. The final model arrived at is shown in Figure 6.1. A special focus in AAPW is on social expansion.

In Chapter 2, some more specific hypotheses were proposed as to the persuading process of playing a persuasive pervasive game, which will be analysed in Section 6.2.2. These were:

H4: The more enactment in playing a persuasive pervasive game, the more positive the effects on the focal variables will be.

H6: The more systematic processing and less heuristic processing when playing a persuasive pervasive game, the more positive are the effects on the focal variables.

H9: Social expansion of a pervasive game play a role in the persuasion process of playing a persuasive pervasive game, strengthening it in the intended direction.

6.2.1 Key Numbers of the Measurement Models AAPW PLS-SEM

The first step taken when applying PLS-SEM to the AAPW data was to assess the measurement model. The sections 3.6.3 - 3.6.3.12 explained the following terms generically. This chapter applies those terms to the test of the AAPW model. The analysis was, like in Study Two, performed with the software Smart PLS (Ringle et al., 2005), which also uses bootstrapping when calculating t-values.

6.2.1.1 AVE, Composite Reliability and Cronbach's Alpha

Did the proposed latent variables (3.9-3.9.12) work out? The results were that the AVE was greater than 0.5 for five of the nine latent variables where the AVE-measure was applicable (Table A8). The names of the latent variables will in the following occasionally be abbreviated for the sake of the readability of the prose.

Average Variance Extracted was not an applicable measure for the two formative latent variables children´s "Enactment: Game Experiences" (BE) and children´s "Enactment: Negative Game Experience" (BG). The Composite Reliability values were 0.77 - 0.92 and the Cronbach's Alpha values were 0.71 - 0.89 (Table A8), all indicating an acceptable discriminant validity for the latent variables.

That four out of the nine latent variables for which AVE was applicable had an AVE lesser than 0.5 was troublesome. It indicated an uncertainty as to whether the variance captured by the latent variables really was larger than the variance due to the measurement error. It appeared that the unidimensionality and convergent validity of the constructs to some degree was "in flux."

The problem was to some degree alleviated because two of the four weak constructs were the attitudes toward saving electricity of both parents and children of the family *before* playing AAPW. These variables were constructed based on the "best" corresponding constructs for attitudes *after* playing AAPW, in order to make them comparable. What was found was that the attitude constructs and thus the attitudes themselves were more indefinite *before* AAPW than *after* AAPW. This means that playing AAPW had an effect on the quality of the attitudes toward saving electricity, making them more distinct after than before playing AAPW. This was an unforeseen but interesting finding.

Altogether, the overall degree of internal consistency in the measurement model as measured by Cronbach's Alpha and Composite Reliability was acceptable.

6.2.1.2 The Fornell-Larcker test and cross loadings

The Fornell-Larcker test (Table A9) indicated that all the square roots of the AVE measures exceeded the construct inter-correlations, thereby sup-

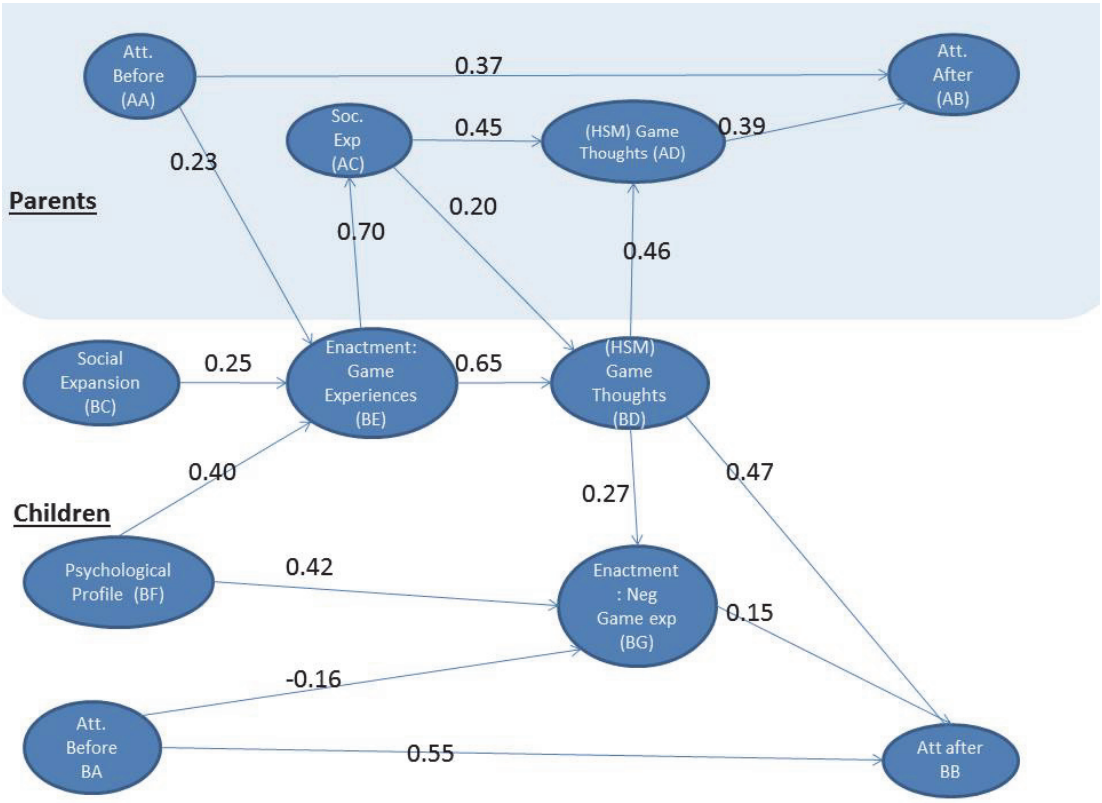
porting the otherwise weak discriminant validity of the measurement model expressed by the AVE values.

The cross loadings table (Table A10) showed that loadings within constructs exceeded loadings outside the constructs, indicating some level of discriminant validity. The key numbers and the Fornell-Larcker test were acceptable and the cross loadings seemed strong as all loadings within constructs exceeded loadings outside the constructs. However, there were many cross loadings that while not exceeding the loadings of the constructs still were quite strong (Table A10). 40 out of 616 cells in the cross loadings table (6.4%) showed the presence of cross loadings above 0.4 (Table A10). However, that was not enough to undermine the overall discriminant validity of the latent variables.

6.2.2 The final total AAPW PLS-SEM

After having established the measurement model, the next step was to establish the final structural model. The final estimated structural model is presented in Figure 6-1. The model has 56 manifest variables loading on eleven latent variables (Table A11), of which four are exogenous (BA, BF, AA and BC), and seven endogenous, connected with 16 paths. The model converged in 16 iterations.

Figure 6-1. The PLS-based structural equation model for AAPW, showing the found causal relations and their path coefficients.



6.2.2.1 Overall Assessment of the AAPW PLS-SEM

The path coefficients presented in Table A11 are generally quite high. The R-squared values in Table A8 are also rather high.

The t-values were calculated using the "Bootstrap Method" with the "no sign changes" setting applied in Smart PLS. It was the most conservative setting. If the significances err, they err on the side of false negatives rather than on the side of false positives (Hair et al., 2013, p. 164). The t-values of the path coefficients in the model are shown in Table A12. Some are very high, the highest (t = 11,4) being for the path from the latent variable Children's "Enactment: Game Experiences" (BE) to the latent variable Parents´ "Social Expansion" (AC). That was in itself an interesting result

that resonated towards hypothesis H9 as it gives support to expansion being an important element in the persuading process. The t-values are in general higher in AAPW than in Power Explorer, mostly due to the larger database.

The combined measures of the measurement model, the sizes of the path coefficients and the acceptable t-values gives the overall impression that both the measurement model and structural model of AAPW is acceptable.

6.2.3 Analysis of the AAPW PLS-SEM

The AAPW PLS-SEM includes both primary and secondary players. That makes the AAPW model more sophisticated than the Power Explorer model on the issue of social expansion. All total effect estimates for the dependent and intermediate variables in the AAPW PLS-SEM are shown in Table A13.

As to the focal variable children's attitudes towards electricity saving after AAPW, i.e. their "post-play attitudes" , the corresponding attitudes before AAPW. i.e. their "pre-play attitudes", has the largest total effect (0.53), with a high direct effect ($\beta = 0.55$). This means that pre-attitudes do matter, and become more positive by playing AAPW. At the same time, there is a slight countervailing negative effect via children's "Enactment: negative game experiences". The latter had a direct and total effect on the children's post-play attitudes of $\beta = 0.15$. The next most influential variable on children's post-play attitudes is their "(HSM) game thoughts", with a total effect of 0.51 and a direct effect of $\beta = 0.47$. The effect is increased by an indirect effect via children's "Enactment: negative game experiences" (as were the children's pre-attitudes). Thus, the more systematic thinking and the more negative the children are towards the game itself, the more positive toward electricity saving are the children after playing AAPW.

The third most influential variable on the children's post-attitudes was their "Enactment: game experiences" (the indirect total effect being 0.41). The influence goes via the children's "(HSM) game thoughts" and "negative game experiences" as described above, but also via the parents' involvement (their level of "social expansion") and its effect on the children's

"(HSM) game thought. Thus, the more one played and the better it went, the more positive post-attitudes among the children toward electricity saving.

Other variables that were found to have an indirect positive total effect on children's post-attitudes are parents' pre-attitudes (0.09) and their level of social expansion (0.10), as well as the children's level of social expansion (0.10) and their "psychological profile" (0.10). The latter is a rather complex but still coherent variable made up of four manifest variables relating to need for achievement and being respected (see Table A10). All these effects on children's post-attitudes are thus positive and the intended.

As to the focal social expansion variable "parents' post-attitudes toward electricity saving", the variable with the highest total effect (0.43) is "parents' pre-attitudes toward electricity saving", with a direct effect ($\beta = 0.37$) that is enhanced by indirect effects via children's "Enactment: game experiences", "parents' level of social expansion" and both the children's and the parents' "(HSM) game thoughts". The children's "Enactment: game experiences" and "(HSM) game thoughts" are thus stimulated by the parents' pre-attitudes and level of social expansion.

The second most influential variable on "parents' post-attitude toward electricity saving" is parents' "(HSM) game thoughts" ($\beta = 0.39$, which is also the total effect), in turn effected by the "parents' level of social expansion" ($\beta = 0.45$, with a total effect of 0.54) and children's "(HSM) game thoughts" ($\beta = 0.46$). The third most influential variable is children's "Enactment: game experiences", the total effect being 0.26 via "parents' level of social expansion", children's "(HSM) game thoughts" and parents' "(HSM) game thoughts", with the parents' "level of social expansion" being the fourth most influential variable (the total effect being 0.21) and followed by children's "(HSM) game thoughts" (the total effect being 0.18). The level of interactions between the primary and secondary players when playing AAPW, i.e. the social expansion of AAPW, clearly has an effect on both players' focal attitudes in the intended direction.

The AAPW PLS-SEM presented above is an answer to the thesis' second research question about how a persuading process from playing a pervasive persuasive game may look like and what the influencing effects through such a process is. It can also be concluded that all variables

thought of to play a role in the AAPW persuasion process did so, and in the intended direction. All three specific hypotheses proposed were thus also supported by the AAPW PLS-SEM. These will be addressed in the next section.

6.2.4 Results concerning H4, H6 and H9

Above and in Chapter 2, three more specific hypotheses related to research question two were proposed. Three corresponding hypotheses were tested in Chapter 4 within the Power Explorer PLS-SEM. In this Chapter they have been tested within the AAPW PLS-SEM, with some results already reported above. The results from testing the three specific hypotheses will here be discussed in more detail.

H4: The more enactment in playing a persuasive pervasive game, the more positive the effects on the focal variables will be.

Enactment was included in the AAPW model by several variables. The ones that realize enactment in the most direct way are the two somewhat differing variables: children's "Enactment: Game Experiences" (BE) that was measured by server data from the game actions taken by the primary player, the child. The other one is the children's "Enactment: Negative Game experience" (BG), that is measured by survey data on the extent to which the primary player found AAPW hard to play, hard to understand and/or simply boring.

As stated earlier, the focal variables for AAPW are both primary and secondary players´ attitudes toward conserving household electricity.

The first enactment variable – children's "Enactment: Game Experiences" – had an indirect total effect on post-game attitudes of the primary players of 0.41, and on the post-attitudes of the secondary players of 0.26. As to children's "Enactment: Negative Game experience", it had no indirect total effect on the post-game attitudes of the secondary players, and a rather small indirect total effect of 0.15 on the primary players. All the effects found were in the expected direction. These findings support hypothesis H4, that the more enactment in playing a persuasive pervasive game,

the more positive the effects on the focal variables, although it depends on type of enactment.

H6: The more systematic processing and less heuristic processing when playing a persuasive pervasive game, the more positive are the effects on the focal variables.

The HSM was included in the AAPW model by two latent variables, the parents´ "game thoughts" and the children's "game thoughts". These are both intermediate latent variables meaning that while they have an incoming impact from other variables, they also impact other latent variables in turn "downstream" to which these HSM variables are independent or explanatory.

The parents´ "game thoughts" is independent in relation to, i.e. influences Parents' "attitudes after" with a direct effect of $\beta = 0.39$. Children's "game thoughts" is independent in relation to, i.e. impacts the latent variable children's "attitudes after" with an impact of no less than $\beta = 0.51$. These are high and are an indication that the more effortful and conscious the thoughts about the game, i.e. the more systematic, the stronger the attitudes downstream from the thought latent variables.

It is also notable that the children's "Enactment: game experiences" has an indirect effect of 0.41 on the children's post-attitudes via their "Game Thoughts". That means that the higher the enactment, the higher the degree of effortful, systematic thought and the stronger the attitudes after the enactment, all in the primary player.

The primary players´ "Enactment: game experiences" also has an indirect effect of 0.26 on the secondary players´ post-attitudes. This means that the higher the enactment in the primary player, the higher the effortful systematic thought in the primary player, the higher the secondary players´ experience of social expansion, the higher the secondary players´ effortful, systematic game related thought, the stronger the secondary players´ attitudes after the primary players´ game enactment (total effect = 0.26). Thus, H6 is supported.

H9: Social expansion of a pervasive game play a role in the persuasion process of playing a persuasive pervasive game, strengthening it in the intended direction.

As to the expansions, only social expansion was measured and included in the AAPW PLS-SEM, however in the AAPW-model social expansion was included for both primary and secondary players, respectively. As mentioned above, the children's "Social Expansion" had a rather small indirect total effect on children's "post-attitudes" (0.10), and an even smaller indirect total effect on parents' "post-attitudes" (0.07). The children's "Social Expansion" did, however, have notable influencing effects within the persuasion process on parents' "Social Expansion" (0.18), via the children's "Enactment: game experiences" ($\beta = 0.25$) and further on parents' "(HSM) Game Thoughts" (0.17). The indirect total effect of the children's "Social Expansion" on their own "(HSM) Game Thoughts" was 0.20.

The parents' experience of social expansion (AC) had a large total effect on their "(HSM) Game Thoughts" (0.54) and from there on their "post-attitudes" (0.21). It also had an effect on the children's "(HSM) Game Thoughts" (0.20) and then a somewhat lower total effect on the children's "post-attitudes" (0.10).

Social expansion obviously play a role in the persuasion process, somewhat strengthening the persuasion in the intended direction, thus supporting H9.

6.2.5 Summing up the AAPW study

Relating to research question one, the results presented in this chapter show that also AAPW had an effect on vocal variables in the intended direction, both as to the players' post-attitudes toward saving electricity, and the parents' post-attitudes toward saving electricity. As to the second research question, what a persuading process from playing a pervasive persuasive game may look like, and what the influencing effects are through such a process, such a persuasion process of still another pervasive persuasive game – AAPW – was modelled and tested, and the results give indica-

tions both as to how such a process may look like, and the persuading effects through the process.

As to some specific findings, degree of enactment was again found to be a factor influencing the focal variables in the intended way. AAPW also showed that social expansion, both on the primary player (the child) and the secondary players (the parents), does play a role in the persuasive process, influencing other variables in the process in the intended way. The same is true for type of thought in the process: the more systematic/less heuristic the thought process of both primary and secondary players, the more positive the post-attitudes of both primary and secondary players toward saving electricity.

Chapter 7
Conclusions and Implications

7.1 Conclusions

The purpose of this thesis was to arrive at a better understanding of a persuasion process arising out of playing persuasive pervasive games and to explore possible persuasive effects of playing such games. By this I intended to contribute theoretically to the literature on persuasive pervasive games and practically by providing game researchers and persuasion practitioners new insights that can be used for designing more effective persuasive pervasive games, thereby increasing their likelihood of reaching their persuasive goals.

By developing three such games – Power Agent, Power Explorer and AAPW – and testing them in field experiments it was found that all did result in persuasion processes, which in turn had effects on the focal variables of the persuasion pervasive games, in the intended direction. Focal variables are those that are intended to be impacted by playing a persuasive pervasive game. Both persuasion practitioners and academic game researchers stand to gain from the way the three studies illustrate persuasion processes from playing pervasive persuasive games.

7.1.1 Research Question One about effects

The first specific research question asked if playing a pervasive persuasive game have any effects on focal variables in the intended direction, and if so, how and to what extent. The question was approached in three studies, two of which were quantitative and one that was qualitative. Power Agent was

used only in the qualitative study, with the effects being discerned trough inductive reasoning from depth interviews (Chapter 5). Power Explorer was both qualitatively and quantitatively approached (Chapters 4-5). It had three focal variables: the respondents´ attitudes to saving electricity, their beliefs of appliances' use of electricity, and the actual electricity consumption of the players' households (ARM data). Only quantitative data were used from AAPW with one focal variable: attitudes toward saving electricity, not only the attitudes of the primary players, the children, but also those of secondary players, the parents (Chapter 6).

In all three studies were found the intended effects on the focal variables of the persuasive pervasive games played, and the effects were measured in the two quantitative studies. In the third study, based on AAPW, it was shown that a persuasive pervasive game can also influence secondary players (the parents), not only the primary players (the children).

The results open for pervasive persuasive games being a way forward in a world where number of media channels for persuasion and persuasive messaging has increased tremendously in recent years, and media-borne persuasive messaging can be much more than what may be perceived as advertising (cf. Rosengren 2008, Fischer et al. 2011, Petrescu & Korgaonkar 2011, and Svahn et al. (2014).

7.1.2 Research Question Two about Persuasion Processes

Research question two asked what a persuading process from playing a pervasive persuasive game may look like, and what are the influencing effects in such a process. The question was approached in the two quantitative studies by developing structural equation models (PLS-SEMs) intended to picture the persuasion processes arising from playing the games. These models were tested using a PLS technique on data from field experiments, with measures from both before, during and after the playing, and also from control groups (similar non-playing households).

The final PLS-SEMs showed how persuasive processes from playing an persuasive pervasive game may look like and also gave estimates for persuasive effects through these persuasive processes, from consumption of electricity before playing the games and pre-attitudes to saving electricity to

consumption of electricity after playing the games or post-attitudes towards saving electricity.

Some more specific hypotheses were also proposed and tested within the PLS-SEMs. The findings were:

- The more enactment in playing a persuasive pervasive game, the more positive the effects on the focal variables will be. That means that in particular the practitioner knows that activating the player is a necessary prerequisite for making an impression.

- Spatial and social expansions of a pervasive game play a role in persuasion processes from playing a persuasive pervasive game, strengthening the process in the intended direction.

- The more systematic processing and less heuristic processing when playing a persuasive pervasive game, the more positive are the effects on the focal variables.

7.1.3 Research Question Three about Categorization

Research question three asked whether categorization play a role in a persuasive process of playing a persuasive pervasive game, and if so, what role. This question was researched only in Study Two, the qualitative study. The result of that study showed that there was little – if any – previous categorization present in the individual. That is an important finding for practitioners as categorization has been a well-known marketing tool for practitioners for a long time, and since categorization lies as the basis of many a good marketing plan.

Study Two showed a lack of category prototype with which to interpret the experience. Therefore new experience interpretation categories must be formed, and it takes effortful conscious thought to do so, hence a process that requires systematic thought. When that systematic thought is about an experience designed to persuade, then that engenders a stronger persuasion. So if the media experience from which the persuasive message comes can-

not be categorized, then that will make the impact and hence also the persuasive impact stronger.

7.2 Contributions to theory and the literature

This thesis is written in the realms of marketing science. It has used prototyping and field experiments as the method. It has begun the work of applying established persuasion theory such as the Heuristic-Systematic-Model (HSM) to pervasive game design. This is a new direction for both persuasion research and game studies. It was found that the HSM is applicable to a pervasive game experience and in the case of a persuasive pervasive game can explain the persuasion. That is previously rarely done, if at all, and opens up a new area of research where the HSM can be the bridge between established persuasion research and pervasive game design science, an area where this thesis was a trailblazer but hopefully not the first and last and only.

Another contribution is to show that it is possible to apply PLS-SEMs to study persuasion processes of persuasion pervasive games, taking among other things both involvement in expansions, HSM and level of enactment into consideration. This may serve as a stepping stone for researchers wishing to continue studying persuasive processes from persuasive pervasive games played.

7.3 Implications for practitioners

The thesis has pointed out problems with media clutter and that certain persuasion situations are difficult, for example due to characteristics of a certain product or the consumption situation. Games in general and persuasive pervasive games in particular were suggested as possible media to find new ways forward in that situation. The findings in this thesis support this suggestion.

The three studies provide a source of input to marketing practitioners in the position of having to navigate the new landscape of recent years as described by for example Petrescu and Korgaonkar (2011), Svahn et al.

(2014), Wahlund et al. (2013) or Perloff (2010), all who find that persuasive messages are much more than what may be perceived as advertising.

Through the three studies it was found that by stimulating enactment, spatial and social expansion, and systematic processing in persuasive pervasive games, such could be used for communication campaigns in difficult communicative situations in order to influence attitudes or behaviours, and to create category awareness where there is none.

Difficult communicative situations may concern, for example, drinking and driving, safe sex practises, reducing waste, and saving electricity or energy in general (Weiss & Tschirhart 1994), issues of environmental ecology (Flor & Singleton 2011) or issues of civic responsibility (Fletcher et al 2010). The thesis showed that persuasive pervasive games with social expansion may be a way forward in these and other cases characterized by low knowledge, "backgrounding", little information, low category awareness, and social consumption.

One explanation to this is that enactment was found to be central, not only for the game experience in general or for a pervasive game experience, but also for games being persuasive games. That was shown by the intensity of the experience found in Study Two and by the close connection between game play constructs and thought and experience constructs in the two PLS-SEMs.

A further insight that is yet rather unbroken ground for game studies and of great practical implications for persuasion practitioners is that this thesis has found that categorization does play a role in the processing of a persuasive message from a pervasive game. That is highly relevant because of the central place of categorisation theory in the commercial practice of marketing and persuasion strategy.

7.4 Limitations and further research

The thesis is limited in its research approach by focusing on pervasive games, i.e. a focus on bringing game actions into the real world. Virtual worlds and gamification was excluded, by virtue of the three test stimuli being fully-fledged games. It is fully possible to produce gamification em-

ploying the three expansions of pervasive games. That would differ from this thesis as this one employed fully-fledged games.

This thesis is limited in practice by using field experiments with a series of specific prototype persuasive pervasive games with varied specific design executions of one central technology design concept. The work is also limited by the choice of the respondents being teenagers and their parents living in families in Sweden. Further research would do well to go into other research methods and commercially available stimuli, when such becomes available.

As the concluding words I send a wish that some researcher will pick up the baton on the issue of playing for winning or playing for learning, establish and validate constructs and scales for PLS-SEMs applied to pervasive persuasive games, and go into the implications of countermanding streams of impact in PLS-SEMs for pervasive persuasive games.

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Appendix A

Table A1: AVE CA CR in Study Two Power Explorer

	AVE	CR	R Square	Cronbach's Alpha
A Beliefs before polar	0.57	0.89	N/A	0.85
B Attitudes before	0.58	0.87	N/A	0.81
C Spatial expansion	N/A	N/A	0.15	N/A
D in-game experiences polar	0.90	0.96	0.10	0.94
E in-game experiences jungle	0.87	0.98	0.17	0.97
F Commitment	0.77	0.95	0.69	0.94
G Competitiveness	0.72	0.93	0.67	0.9
H Pervasive Thought	0.70	0.92	0.71	0.89
I Attitudes after	0.64	0.90	0.86	0.85
J Beliefs after polar	0.65	0.92	0.43	0.89
K Electricity After	0.65	0.88	0.40	0.86

Table A2: The Fornell-Larcker in Study Two Power Explorer

	A	B	D	E	F	G	H	I	J	K
A Beliefs before polar	**0.75**									
B Attitudes before	0.22	**0.76**								
D in-game actions polar	0.05	0.31	**0.94**							
E in-game actions jungle	0.01	-0.42	-0.17	**0.93**						
F Commitment	0.05	-0.27	0.18	0.56	**0.87**					
G Competitiveness	0.07	-0.44	-0.12	0.33	0.66	**0.84**				
H Pervasive Thought	-0.28	0.4	0.31	-0.55	-0.71	-0.78	**0.83**			
I Attitudes after	0.37	-0.13	-0.02	0.43	0.82	0.81	-0.89	**0.80**		
J Beliefs after polar	0.51	-0.21	0.20	0.14	0.31	0.27	-0.22	0.35	**0.80**	
K Electricity Consumption	-0.46	0.05	0.30	0.05	0.01	-0.23	0.09	-0.14	-0.58	**0.80**

Table A3: Cross loadings Study in Two Power Explorer

	A	B	D	E	F	G	H	I	J	K	Z
Attitudes Before											
I usually urge my friends to save energy	**0.73**	-0.05	-0.13	0.37	0	-0.39	0.26	-0.07	-0.11	-0.20	0.12
Do you see you yourself as an energy aware person?	**0.93**	0.13	-0.42	0.1	-0.33	-0.32	0.31	0.01	-0.07	-0.27	0.07
Can you consider urging your friends to save energy to save energy?	**0.86**	0.29	0.49	0.28	-0.23	-0.37	0.35	-0.11	-0.08	-0.20	-0.01
Can you consider saving electricity at home?	**0.52**	0.34	-0.12	0.29	-0.41	-0.39	0.41	-0.12	-0.25	0.01	0.07
Do you think it is easy or hard to save energy at home?	**0.69**	0.09	-0.37	0.11	-0.04	-0.15	0.15	0.03	0.03	-0.08	-0.08
Beliefs Before Polar											
Estimate the amount of energy it takes to take a bath for 30 minutes	-0.01	**0.75**	0.06	-0.08	0.41	0.42	-0.57	0.61	0.67	0.48	-0.52
Estimate the amount of energy it takes run a dish-washer for 90 minutes	0.26	**0.87**	-0.22	-0.08	-0.38	-0.22	-0.01	0.04	-0.01	0.36	-0.42

Estimate the amount of energy it takes to run a micro wave oven for 10 minutes	0.45	**0.73**	-0.18	-0.13	-0.31	-0.15	-0.04	0.22	0.06	0.11	-0.38
Estimate the amount of energy it takes to play music through loud-speakers for one hour	0.23	**0.52**	0.15	0.45	0.45	-0.15	-0.13	0.24	0.3	0.27	0.14
Estimate the amount of energy it takes run a home computer for two hours	0.20	**0.90**	0.02	0.01	-0.21	0.02	-0.13	0.21	0.17	0.43	-0.44
Estimate the amount of energy it takes to run a televi-sion set for two hours	0.18	**0.7**	0.01	0.13	-0.3	-0.16	0.10	-0.04	-0.08	0.42	-0.28
In-game ac-tions jungle											
number of jungle chal-lenges com-pleted	-0.41	-0.01	**0.97**	-0.08	0.57	0.39	-0.53	0.27	0.45	0.15	0.06
number of jungle chal-lenges won	-0.33	0.07	**0.96**	0.06	0.59	0.28	-0.43	0.28	0.4	0.2	0.04
number of jungle chal-lenges started	-0.36	-0.07	**0.95**	-0.20	0.51	0.15	-0.49	0.19	0.34	0.13	0.13
number of jungle chal-lenges sent	-0.37	-0.05	**0.92**	-0.24	0.46	0.12	-0.48	0.18	0.31	0.13	0.14
Number of jungle chal-lenges lost	-0.47	-0.1	**0.91**	-0.22	0.49	0.48	-0.58	0.24	0.47	0.07	0.08
number of jungle chal-lenges re-ceived"	-0.38	0.14	**0.88**	-0.27	0.52	0.35	-0.57	0.34	0.42	0.14	0.15

In game actions polar											
E_5_1	0.31	0.05	-0.17	**0.97**	0.18	-0.12	0.31	-0.14	-0.02	0.20	0.30
E_5_2	0.32	0.14	-0.12	**0.92**	0.12	-0.23	0.43	-0.10	-0.12	0.28	0.03
E_5_3	0.26	-0.05	-0.19	**0.92**	0.22	0.01	0.14	-0.15	0.10	0.09	0.53
Commitment											
It felt exciting to turn appliances off and on in order to play the game	-0.31	0.02	0.54	0.08	**0.96**	0.69	-0.71	0.63	0.79	0.24	0.04
I would like to have seen more narration in the game	-0.34	-0.04	0.47	0.37	**0.91**	0.67	-0.62	0.52	0.75	0.42	0.05
I felt a large difference playing outdoors and playing indoors	-0.34	-0.13	0.64	-0.12	**0.84**	0.47	-0.63	0.49	0.57	0.10	-0.10
The blob felt like part of me	-0.39	0.04	0.58	-0.02	**0.94**	0.75	-0.8	0.63	0.82	0.2	-0.02
I would happily play the game again	-0.05	0.19	0.28	0.25	**0.88**	0.64	-0.64	0.65	0.78	0.24	-0.01
I would have liked to know more about appliances, so I could play the game better	-0.1	0.17	0.47	0.36	**0.73**	0.21	-0.32	0.47	0.55	0.43	0.08

Competitiveness											
It felt motivating to see my position in the pile	-0.05	-0.2	0.04	-0.01	0.1	**0.49**	-0.29	0.26	0.26	-0.35	0.08
It felt interesting to see the appliances reflected in the game	-0.42	0.10	0.14	-0.22	0.46	**0.93**	-0.70	0..60	0.71	0.32	-0.29
It felt important to get to the top of the pile	-0.42	0.10	0.14	-0.22	0.46	**0.93**	-0.70	0.60	0.71	0.32	-0.29
"It felt important to win the feather"	-0.44	0.12	0.41	-0.04	0.69	**0.89**	-0.73	0.75	0.75	0.24	-0.17
I could imagine going home just to play the game	-0.39	-0.01	0.5	-0.01	0.85	**0.91**	-0.75	0.72	0.83	.26	0.18
Pervasive Thought											
I thought about getting better	0.02	-0.53	-0.26	0.25	-0.31	-0.49	**0.74**	-0.41	-0.70	0.04	0.01
It felt exciting that other player could contact me at any time	0.42	-0.34	-0.62	0.16	-0.73	-0.75	**0.97**	-0.61	-0.89	-0.37	0.09
I urged the others in my family to save electricity so I could play	0.44	-0.17	-0.51	0.25	-0.68	0.74	**0.94**	-0.55	-0.82	-0.33	0.09
I thought a lot about the game	0.45	0.05	-0.41	0.32	-0.67	-0.84	**0.89**	-0.56	-0.78	-0.07	-0.03
I felt that a connection between what I did in reality and what I did in the game	0.27	-0.34	-0.5	0.43	-0.51	-0.31	**0.61**	-0.69	-0.49	-0.11	0.31

Spatial Expansion											
How many appliances did you shut off in order to play the game?	-0.01	0.39	0.19	-0.11	0.61	0.72	-0.63	**0.98**	0.8	0.34	-0.47
It happened that I went home just to play the game on my home	-0.21	-0.28	0.15	-0.04	-0.26	-0.43	0.32	**0.54**	-0.52	-0.10	0.30
Attitudes after											
I usually urge my friends to save energy	-0.06	0.30	0.28	0.12	0.69	0.56	-0.52	0.74	**0.70**	0.30	-0.23
Do you see you yourself as an energy aware person?	0.04	0.21	0.12	-0.42	0.34	0.61	-0.65	0.58	**0.66**	-0.17	-0.08
Can you consider urging your friends to save energy to save energy?	-0.07	0.39	0.44	-0.11	0.75	0.74	-0.89	0.69	**0.94**	0.28	-0.16
Can you consider saving electricity at home?	-0.08	0.5	0.3	0.28	0.64	0.68	-0.71	0.62	**0.86**	0.42	-0.01
Do you think it is easy or hard to save energy at home?	-0.31	0.09	0.49	0.02	0.78	0.65	-0.76	0.59	**0.8**	0.48	-0.08

Beliefs After Polar											
Estimate the amount of energy it takes to take a bath for 30 minutes	0.11	0.57	0.06	-0.23	0,.32	0.44	0.5	0.58	0.61	**0.73**	-0.52
Estimate the amount of energy it takes run a dish-washer for 90 minutes	-0.29	0.52	0.27	0.04	0.31	0.2	-0.23	0.26	0.28	**0.86**	-0.59
Estimate the amount of energy it takes to run a micro wave oven for 10 minutes	-0.17	0.47	0.18	0.4	0.32	0.28	-0.21	0.27	0.37	**0.95**	0.41
Estimate the amount of energy it takes to play music through loud-speakers for one hour	0.09	0.1	-0.16	0.07	0.2	0.12	0.01	0.43	0.16	**0.62**	-0.63
Estimate the amount of energy it takes run a home computer for two hours	-0.18	0.29	0.2	0.48	0.16	0.05	0.03	0.03	0.09	**0.82**	-0.19
Estimate the amount of energy it takes to run a televi-sion set for two hours	-0.31	0.4	0.12	0.42	0.12	0.13	0.01	0.10	0.06	**0.82**	-0.34
Change in electricity consumption											
Change 1	-0.27	-0.13	0.19	0.37	0.29	0.13	-0.18	-0.14	0.23	0.14	**0.62**
Change 2	-0.14	-0.23	0.06	0.38	0.18	0,3	-0.08	-0.32	0.1	-0.26	**0.85**
Change 3	0.09	-0.56	0.13	0.22	-0.09	-0.39	0.23	-0.45	-0.27	-0.26	**0.72**
Change 4	0.09	-0.42	0.02	0.25	-0.01	-0.23	0.08	-0.44	-0.14	-0.71	**0.97**

Table A4: Path Coefficients in Study Two Power Explorer

	C	D	E	F	G	H	I	J	K
A Beliefs before polar	0.38							0.62	
B Attitudes before		0.31	-0.42		-0.39				
C spatial expansion				0.57	0.69				
D in-game actions polar				0.34					
E in-game actions jungle				0.47		-0.33			
F Commitment							0.37	0.41	0.41
G Competitiveness						-0.67		0.39	
H Pervasive Thought							-0.63	0.55	
I Attitudes after									-0.26
J Beliefs after polar									-0.62

Table A5: T-values of Paths Coefficients in Study Two Power Explorer paths

	TStatistics(|O/STERR|)
A Beliefs before polar->C spatial expansion	0.89
A Beliefs before polar->J Beliefs after polar	1.39
B Attitudes before->D in-game actions polar	1.08
B Attitudes before->E in-game actions jungle	1.24
B Attitudes before->G Competitiveness	1.62
C spatial expansion->F Commitment	2.27
C spatial expansion->G Competitiveness	2.87
D in-game actions polar->F Commitment	1.33
E in-game actions jungle->F Commitment	2.45
E in-game actions jungle->H Pervasive Thought	1.77
F Commitment->I Attitudes after	1.80
F Commitment->J Beliefs after polar	0.58
F Commitment->K Change in electricity consumption	0.89
G Competitiveness->H Pervasive Thought	3.71
G Competitiveness->J Beliefs after polar	0.71
H Pervasive Thought->I Attitudes after	3.57
H Pervasive Thought->J Beliefs after polar	0.68
I Attitudes after->K Change in electricity consumption	0.46
J Beliefs after polar->K Change in Electricty Consumption	1.48

Table A6: Total effects in Study Two Power Explorer

	C	D	E	F	G	H	I	J	K
A Beliefs before polar	0.38			0.22	0.26	-0.18	0.19	0.71	-0.40
B Attitudes before		0.31	-0.42	-0.09	-0.39	0.4	-0.28	0.03	0.02
C spatial expansion				0.57	0.69	-0.47	0.5	0.25	-0.05
Din-game actions polar				0.34			0.13	0.14	0.02
Ein-game actions jungle				0.47		-0.33	0.38	0.01	0.09
F Commitment							0.37	0.41	0.07
G Competitiveness						-0.62	0.42	0.02	-0.12
H Pervasive Thought							-0.63	0.55	-0.18
I Attitudes after									-0.26
J Beliefs after polar									-0.62

Table A7: T-values of total effects in Power Explorer

	T Statistics
H Pervasive Thought->I Attitudes after	4,23
G Competitiveness->H Pervasive Thought	3,85
C spatial expansion->G Competitiveness	3,12
E in-game actions jungle->F Commitment	2,68
C spatial expansion->F Commitment	2,57
E in-game actions jungle->I Attitudes after	2,56
G Competitiveness->I Attitudes after	2,54
C spatial expansion->I Attitudes after	2,52
B Attitudes before->H Pervasive Thought	2,33
C spatial expansion->H Pervasive Thought	2,21
F Commitment->I Attitudes after	2,18
E in-game actions jungle->H Pervasive Thought	1,84
B Attitudes before->I Attitudes after	1,78
A Beliefs before polar->J Beliefs after polar	1,71
B Attitudes before->G Competitiveness	1,66
Din-game actions polar->F Commitment	1,58
J Beliefs after polar->K Electricity Consumption After	1,47
B Attitudes before->E in-game actions jungle	1,45
Din-game actions polar->I Attitudes after	1,24
B Attitudes before->D in-game actions polar	1,17
A Beliefs before polar->K Electricity Consumption After	0.99
A Beliefs before polar->C spatial expansion	0.92
A Beliefs before polar->G Competitiveness	0.90
C spatial expansion->J Beliefs after polar	0.84
A Beliefs before polar->H Pervasive Thought	0.78
A Beliefs before polar->I Attitudes after	0.78
A Beliefs before polar->F Commitment	0.77
H Pervasive Thought->J Beliefs after polar	0.73
F Commitment->J Beliefs after polar	0.56
B Attitudes before->F Commitment	0.49
I Attitudes after->K Electricity Consumption After	0.45
D in-game actions polar->J Beliefs after polar	0.42
E in-game actions jungle->K Electricity Consumption After	0.34
G Competitiveness->K Electricity Consumption After	0.26
HPervasiveThought->KElkonsumtionefterkort	0.26

Cspatialexpansion->KElkonsumtionefterkort	0.18
BAttitudesbefore->JBeliefsafterpolar	0.17
BAttitudesbefore->KElkonsumtionefterkort	0.1
FCommitment->KElkonsumtionefterkort	0.1
Din-gameactionspolar->KElkonsumtionefterkort	0.08
GCompetetiveness->JBeliefsafterpolar	0.04
Ein-gameactionsdjungel->JBeliefsafterpolar	0.03

Table A8: AVE CA CR PE in Study Three AAPW

	AVE	Composite Reliability	R Square	Cronbach's´ Alpha
AA Parents´ attitudes before	0.41	0.77	N/A	0.70
AB Parents´ attitudes after	0.63	0.92	0.37	0.89
AC Parents´ Social Expansion	0.71	0.88	0.49	0.79
AD Parents´ game thoughts	0.68	0.89	0.68	0.84
BA Children´ attitudes before	0.40	0.79	N/A	0.79
BB children´ attitudes after	0.44	0.82	0.61	0.83
BC Children´ social expansion	0.75	0.90	N/A	0.84
BD Children´ game thoughts	0.47	0.80	0.66	0.70
BE Children´ game actions	N/A	N/A	0.33	N/A
BF children´ psychology	0.71	0.91	N/A	0.86
BG Children 'negative game experience	N/A	N/A	0.34	N/A

N/A = Not Applicable

Table A9: The Fornell-Larcker in Study Three AAPW

	AA	AB	AC	AD	BA	BB	BC	BD	BF
AA Parents´ attitudes before	**0.64**								
AB Parents 'attitudes after	0.48	**0.79**							
AC Parents´ Social Expansion	0.29	0.38	**0.84**						
AD Parents´ game thoughts	0.28	0.49	0.75	**0.82**					
BA Children´ attitudes before	0.26	0.19	0.06	0.10	**0.63**				
BB children´ attitudes after	0.25	0.19	0.43	0.37	0.60	**0.66**			
BC Children´ social Expansion	0.20	0.20	0.11	0.14	-0.01	-0.01	**0.86**		
BD Children´ game thoughts	0.34	0.36	0.66	0.76	0.13	0.56	0.10	**0.68**	
BF Children´ psychology	0.17	0.05	0.25	0.21	-0.05	0.04	-0.01	0.25	**0.84**

Table A10: Cross loadings in Study Three AAPW

	AA	AB	AC	AD	BA	BB	BC	BD	BE	BF	BG
AA Parents attitudes before											
1 "I know very well that I can impact my households´ electricity consumption"	**0.48**	0.14	0.03	-0.08	0.1	0.08	0.01	0.02	0.02	0.03	0.07
2 "My household cannot save electricity, we must use all the electricity we do right now"	**0.55**	0.25	0.05	0.12	0.2	0.14	0.05	0.13	0.08	-0.03	0.02
4 "I usually urge my friends to conserve electricity"	**0.49**	0.14	0.13	-0.10	0.11	0.08	0.11	0.02	0.02	0.03	0.07
5 "I can consider urging my friends to conserve electricity"	**0.54**	0.25	0.05	0.12	0.2	0.14	0.05	0.13	0.08	-0.03	0.02
6 "I check how much electricity appliances consume"	**0.78**	0.44	0.43	0.41	0.18	0.25	0.25	0.42	0.45	0.24	-0.21
7 "I turn out the lights when I leave a room"	**0.72**	0.33	0.04	0.01	0.22	0.12	0.07	0.11	0.14	0.06	0.03

8 "Saving electricity is cool"	**0.61**	0.16	-0.03	0.1	0.1	0.09	0.07	0.07	0.02	0.04	0.02
AB Parents 'attitudes after	AA	AB	AC	AD	BA	BB	BC	BD	BE	BF	BG
9 "I know very well that I can impact my house-holds´ elec-tricity consumption"	0.61	**0.65**	0.51	0.48	0.23	0.39	0.17	0.54	0.54	0.08	-0.11
10 "My household cannot save electricity, we must use all the electricity we do right now"	0.45	**0.55**	0.04	0.21	0.22	0.12	0.07	0.11	0.14	0.06	0.03
11)"I usually urge my friends to conserve elec-tricity"	0.32	**0.91**	0.3	0.44	0.09	0.07	0.17	0.23	0.23	0.05	0.06
12)"I can consider urg-ing my friends to conserve electricity"	0.31	**0.88**	0.28	0.38	0.11	0.11	0.16	0.22	0.23	0.02	0.1
13)"I check how much electricity appliances consume"	0.28	**0.88**	0.24	0.42	0.09	0.04	0.17	0.21	0.22	0.03	0.03
14)"I turn out the lights when I leave a room"	0.29	**0.87**	0.25	0.41	0.08	0.06	0.16	0.19	0.2	-0.01	0.06

15) "Saving electricity is cool" ()	0.26	**0.88**	0.25	0.43	0.06	0.03	0.15	0.21	0.21	0.01	0.01
AC Parents ´social expansion	AA	AB	AC	AD	BA	BB	BC	BD	BE	BF	BG
16)"Do you think the whole household became a team?	0.14	0.27	**0.84**	0.82	0.02	0.27	0.06	0.54	0.48	0.24	-0.2
17)"We talked with each other about how to play AAPW".	0.34	0.35	**0.75**	0.43	0.09	0.41	0.12	0.53	0.6	0.14	-0.03
18)"Did the teenager's game play I pact the electricity consumption of the rest of the household?"	0.26	0.35	**0.92**	0.62	0.05	0.41	0.1	0.6	0.69	0.23	-0.2
AD Parents´ game thoughts	AA	AB	AC	AD	BA	BB	BC	BD	BE	BF	BG
19)"Now afterwards I sometimes think about playing AAPW"	0.21	0.39	0.57	**0.88**	0.11	0.17	0.06	0.5	0.38	0.21	-0.23
20)"In the beginning of the play period I thought a lot about playing AAPW"	0.14	0.38	0.68	**0.89**	0.05	0.19	0.11	0.53	0.43	0.21	-0.24

21)"I would like to have played AAPW myself"	0.2	0.48	0.49	**0.87**	0.11	0.13	0.11	0.48	0.33	0.11	-0.22
22)"I thought about AAPW the whole play period	0.34	0.35	0.66	**0.69**	0.05	0.61	0.16	0.66	0.61	0.15	-0.09
BA children´ attitudes before	AA	AB	AC	AD	BA	BB	BC	BD	BE	BF	BG
23)"I know very well that I can impact my house-holds´ elec-tricity consumption"	0.26	0.17	0.05	0.09	**0.98**	0.63	-0.02	0.14	0.07	-0.04	-0.19
24)"My household cannot save electricity, we must use all the electricity we do right now"	0.26	0.17	0.05	0.09	**0.98**	0.63	-0.02	0.14	0.07	-0.04	-0.19
25 "I usually urge my friends to conserve elec-tricity"	0.17	0.03	0.19	0.17	**0.41**	0.19	0.04	0.12	0.1	0.04	-0.05
26 "I can consider urg-ing my friends to conserve electricity"	0.09	-0.04	-0.02	-0.08	**0.27**	-0.06	-0.02	-0.14	-0.12	0.04	-0.08
27 "I check how much electricity appliances consume"	0.06	0.14	-0.02	0.04	**0.56**	0.19	0.01	0.01	-0.05	-0.08	-0.05

28 "I turn out the light when I leave a room	0.11	0.18	0.04	0.06	**0.34**	0.05	0.04	0.02	-0.01	0.05	-0.05
29 "Saving electricity is cool"	0.05	0.14	-0.15	-0.1	**0.46**	0.1	0.04	-0.09	-0.05	-0.08	-0.05
BB Children 'attitudes after	AA	AB	AC	AD	BA	BB	BC	BD	BE	BF	BG
30 "I know very well that I can impact my house-holds´ elec-tricity consumption"	0.34	0.35	0.66	0.63	0.25	**0.65**	0.16	0.64	0.61	0.15	-0.12
31 "My household cannot save electricity, we must use all the electricity we do right now"	0.3	0.19	0.31	0.27	0.80	**0.83**	0.02	0.42	0.37	0.06	-0.25
32 "I usually urge my friends to conserve elec-tricity"	-0.13	-0.08	0	-0.08	0.37	**0.62**	-0.2	0.23	0.03	-0.13	-0.15
33 "I can consider urg-ing my friends to conserve electricity"	-0.06	-0.08	0.02	-0.01	0.38	**0.62**	-0.14	0.12	0.02	-0.07	-0.14
34 "I check how much electricity appliances consume"	-0.06	-0.08	0.02	-0.01	0.38	**0.62**	-0.14	0.12	0.02	-0.07	-0.14

35 "I turn out the lights when I leave a room"	-0.13	-0.08	0	-0.08	0.37	**0.62**	.2	0.23	0.03	-0.13	-0.13
36 "Saving electricity is cool"	-0.06	-0.08	0.02	-0.01	0.28	**0.62**	-0.14	0.02	0.02	-0.07	-0.04
BC Children´ social ex-pansion	AA	AB	AC	AD	BA	BB	BC	BD	BE	BF	BG
37 "Do you think the whole house-hold became a team?"	0.15	0.16	0.06	0.11	-0.16	-0.15	**0.81**	0.03	0.25	-0.04	0.13
38 "We talked with each other about how to play AAPW"	0.22	0.20	0.10	0.13	0.06	0.01	**0.9**	0.08	0.28	0.01	0.03
39 "Did you try to per-suade the other mem-bers of the household to conserve elec-tricity so you could play?"	0.14	0.16	0.12	0.12	0.02	0.07	**0.89**	0.12	0.28	0.01	0.04
BD Teen´s game thoughts	AA	B	AC	AD	BA	BB	BC	BD	BE	BF	BG
40)"Now afterwards I sometimes think about playing AAPW	0.34	0.35	0.66	0.63	0.05	0.61	0.16	**0.86**	0.81	0.15	-0.09

42) "In the beginning of the period I thought a lot about playing AAPW"	0.02	.04	0.08	0.17	0.19	0.13	0.07	**0.33**	0.25	0.32	-0.88
43)"I wanted to save electricity at home"	0.17	0.21	0.32	0.52	0.14	0.15	0.03	**0.62**	0.32	0.18	-0.33
44)"At the end of the play period I thought a lot about AAPW"	0.14	0.17	0.3	0.55	0.12	0.14	0.11	**0.6**	0.26	0.15	-0.39
45)"I wanted to see my team at the top of the ranking"	0.34	0.35	0.66	0.63	0.05	0.61	0.16	**0.86**	0.81	0.15	-0.09
BE Children game actions (F)	AA	AB	AC	AD	BA	BB	BC	BD	BE	BF	BG
46) Players´ own ranking within the team.	0.32	0.34	0.66	0.57	0.09	0.56	0.13	0.79	**0.85**	0.09	-0.12
47) Teams´ ranking, versus other teams.	0.28	0.35	0.61	0.58	0.08	0.46	0.08	0.71	**0.81**	0.27	-0.32
48) The players number of logins.	0.22	0.2	0.1	0.13	0.06	0.01	0.45	0.08	**0.48**	0.01	0.03
49(The players 'own points	0.06	0.03	0.28	0.21	-0.08	0.08	-0.03	0.27	**0.62**	0.46	-0.46
BF Children´ Psychology											

50)"It is important to feel that I achieve something"	0.08	-0.02	0.11	0.09	-0.11	-0.06	0.02	0.08	0.25	**0.78**	-0.32
51)"It is important not to hurt people",	0.06	0.03	0.28	0.21	-0.08	0.08	-0.03	0.27	0.52	**0.86**	-0.46
52)"It is important that other people respect me".	0.22	0.09	0.23	0.21	0.05	0.1	-0.03	0.27	0.35	**0.86**	-0.44
53)"It is important to feel self-respect".	0.23	0.07	0.16	0.16	-0.03	-0.02	0.03	0.16	0.26	**0.86**	-0.36
BG Children´ negative game experience (F)	AA	AB	AC	AD	BA	BB	C	BD	BE	BF	BG
54 I found AAPW difficult to play".	-0.05	-0.02	-0.1	-0.17	-0.19	-0.14	.08	-0.35	-0.29	-0.44	**0.92**
55)"I found AAPW difficult to understand".	-0.08	0.03	-0.14	-0.18	-0.13	-0.11	0.13	-0.35	-0.3	-0.43	**0.86**
56)"I found AAPW boring".	-0.13	0.08	-0.23	-0.26	-0.14	-0.17	0.01	-0.34	-0.3	-0.41	**0.86**

Table A11: Path Coefficients in Study Three AAPW

	AA	AB	AC	AD	BA	BB	BC	BD	BE	BG
AA Parents´ attitudes before		0.37							0.23	
AB Parents´ attitudes after										
AC Parents´ Social Expansion				0.45				0.20		
AD Parents´ game thoughts		0.39								
BA Children´ attitudes before						0.55				-0.16
BB Children´ attitudes after										
BC Children´ social expansion									0.25	
BD Children´ game thoughts				0.46		0.47				-0.27
BE Children´ game actions			0.7					0.66		
BF Children´ psychology									0.40	-0.42
BG Children 'negative game experience						0.15				

Table A12: T-values of path coefficients in Study Three AAPW

	T-Statistics
1. AA Parents attitudes before->AB Parents attitudes after	1,99
2. AA Parents attitudes before->BE Children game actions(M)	1,79
3. AC Parents SocX->AD Parents game thoughts	5,21
4. AC Parents SocX->BD Children game thoughts	3
5. AD Parents game thoughts->AB Parents attitudes after	3,43
6. BA Children attitudes before->BB children attitudes after	4,62
7. BA Children attitudes before->BG Children negative game experience	1,96
8. BC Children socialexp->BE Children game actions (M)	1,47
9. BD Children game thoughts->AD Parents game thoughts	4,6
10. BD Children game thoughts->BB children attitudes after	2,13
11. BD Children game thoughts->BG Children negative game experience	1,93
12. BE Children game actions(M)->AC Parents SocX	11,39
13. BE Children game actions(M)->BD Children game thoughts	8,92
14. BF childrens´ psych->BE Children game actions (M)	2,71
15. BF children´s psych->BG Children negative game experience	5,77
16. BG Children negative game experience->BB children's attitudes after	1,63

Table A13: Total Effects in Study Three AAPW

	AB	AC	AD	BB	BD	BE	BG
AA Parents´ attitudes before	0.43	0.16	0.16	0.09	0.18	0.23	-0.05
AB Parents´ attitudes after							
AC Parents´ Social Expansion	0.21		0.54	0.10	0.20		-0.05
AD Parents´ game thoughts	0.39						
BA Children´ attitudes before				0.53			-0.16
BC Children´ social expansion	0.07	0.18	0.17	0.10	0.20	0.25	-0.05
BD Children´ game thoughts	0.18		0.46	0.51			-0.27
BE Enactment Game Experiences	0.26	0.70	0.68	0.41	0.80		-0.21
BF Children 'psychology	0.11	0.28	0.27	0.10	0.32	0.40	-0.51
BG Children´ negative game experience				0.15			

Appendix B

Two posters on the two games Power Explorer and Agents Against Power Waste

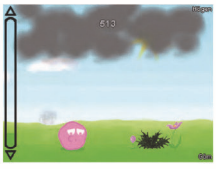
Power Explorer

Electricity consumption in a game

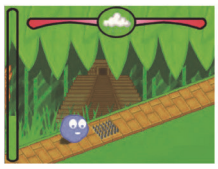
Power Explorer is a prototype mobile phone based Serious Game. It is designed to teach players how much electricity household appliances actually consume, and to change their attitudes about it. The target group is advertising weary and media-savvy teenagers, just the groups who are tuning out on advertising campaigns.

Power Explorer reaches the target group by giving the players a chance to "live the message", and to "learn by doing", by exploring new previously unknown aspects of their own home. Power Explorer turns advertising into lived reality.

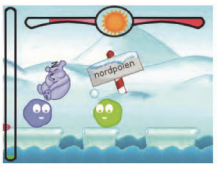
Power Explorer is a Massively Multiplayer Online game, (MMO) and it is also a Pervasive Game. It is played not only on its' game console – the whole of the players' home turns into the game interface. A winning game play strategy can be to turn off the tumble dryer in reality. Pervasiveness and persuasiveness are achieved by a unique system where the home electricity meters are fed into the game-system, giving near instantaneous feedback of household electricity consumption into the game system. The Power Games are the only games in the world to include home electricity consumption into a game.



Single Player mode. A player consuming large amounts of household electricity and doing badly. The avatar is unhappy, there are thistles in the garden and the cloud of noxious carbon dioxide is large.

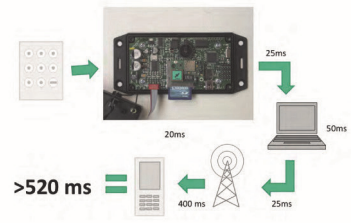


Duel mode. One player is challenging another to a racing duel in the rainforest. The speed in the race is determined by the players' household electricity consumption level.



Duel mode. One player is challenging another to a duel on the North Pole. The aim is to knock the other player of the iceberg. The effectiveness of the weapons is determined by fluctuations in the players' household electricity consumption level.

The Starter-Mode. "The Pile", the pink avatar with a red ring around is the player; the green sleeping avatar with the golden scarf is the one who has last won a duel. The avatars with closed eyes are off-line; the ones with open eyes are on-line.



Today, most electricity meters use internet protocols to send individual consumption data to the company distribution and billing system.

A joint venture between the Interactive Institute, go/ communication and The Stockholm School of Economics. The Interactive Institute has produced the prototype game, and The Stockholm School of economics and go/ communication contributes with evaluation of game design, persuasion design and psychological evaluation of the game play experience.

STOCKHOLM SCHOOL OF ECONOMICS

go/ (go/communication)

INTERACTIVE INSTITUTE
ENERGY DESIGN

Agents Against Power Waste

Play you are an agent, and save the real world,

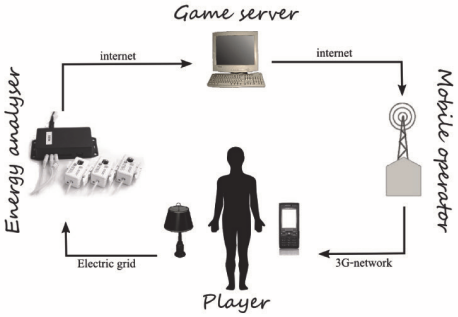
Agents Against Power Waste is a large scale field experiment using a pervasive game to teach about, change attitudes towards, and create interest for an unsexy topic. The project uses a mobile phone based persuasive pervasive game to teach players how much electricity their households really consumes and change their attitudes about it. It is played not only on the game console – the whole of the players' home turns into the game interface. A winning game play strategy can for example be to turn off the tumble dryer in reality.

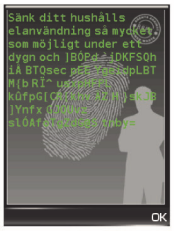
Agents Against Power Waste reaches the target group by using experiential learning to give the players a chance to "live the message" and "learn by doing" by exploring new previously unknown aspects of their own home. It turns the advertising message into lived reality. The game players are 200-300 teenagers advertising weary and media-savvy.

The project researches their attitude change, coupled with their real behaviour as both game moves and electricity consumption are logged in real time, and evaluated with parametric and non-parametric statistics using consumer psychology science and ludic theory.

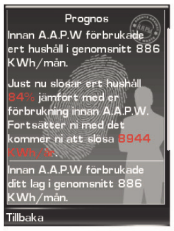
Pervasive game qualities and persuasiveness are achieved by designing the game for social expansion with a unique system where the home electricity meters are fed into the game-system feeding back real household electricity consumption into the game system.

The series of Power Games also include Power Agent and Power Explorer. This series of games are the only games in the world to include home electricity consumption into a game.



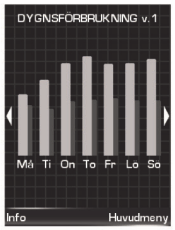


The player plays as secret agent hunting down wasteful electricity use. The winner is the one whose team has decreased their electricty use the most.

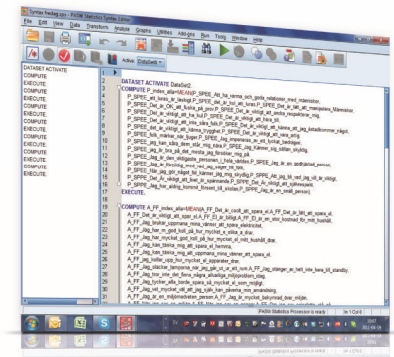


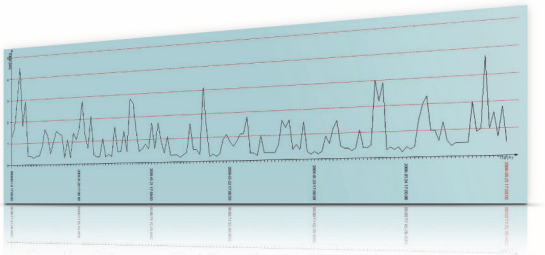
The players gets an evaluation of their personal decrease of electricity use, during the time of play and a prognosis of what that would mean for a whole year.

The players play a number of "missions" that can be from a day long up to a whole weekend. Each mission is a task to in different ways detect their family's' wasteful personal habits.



The players gets 24-hourly in-game feedback on developments in their personal electricity consumption in the real world.





A joint venture between The Stockholm School of Economics, go/ communication The Interactive Institute and The Mälardalen Energy Agency. Interactive Institute has produced the game. The Stockholm School of economics and go/ communication contributes with evaluation of game design, persuasion design and psychological evaluation of the game play experience.

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