

## 20. Experimental Game Design

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**O**ne way to understand games better is to experiment with their design. While experimental game design is part of most game design, this chapter focuses on ways in which it can become a method to perform academic enquiry, eliciting deeper principles for game design.

Experimental game design relies on two parts: varying design, and doing some kind of studies with it. In this chapter we limit the discussion to experiments that involve *people* that play the game.

### Design science

The approaches we discuss in this chapter are best framed within the context of design science (Cross, 2001; Collins, et al., 2004). This research paradigm has two faces: it is the scientific study of design concepts and methods (Cross, 2001) but also encompasses the use of design as a research method (research by design) (Collins, et al., 2004; Kelly, 2003).

It is well known that design experiments are part of the design process for most games. Game designers tend to experiment throughout the design process; by adding and deleting components, changing rules, balancing, modifying themes and changing the way the game interacts with players. They also play-test their designs. Zimmerman (2003) writes exquisitely on how playing a game is part of the iterative design process, and how new questions about the design grows out of each play session, and Fullerton (2008) develops a full-fledged methodology for integrated playtesting and design.

What then, makes design experimentation a scientific research method? The short answer is that firstly, scientific experimentation must be done with some level of rigour, and secondly, it must be done to answer questions that are somewhat more generic than just making a singular game better. Experimental design is a research method when the aim is to understand something generic, some more fundamental aspect of game design. Thus, the way we discuss experimental game design in this chapter straddles both perspectives on design research: it is a way to, through designing, understand more about design principles for games.

While this chapter focuses on design experiments involving players, playtesting is not completely necessary in experimental design. Many dynamic aspects of game design can be tested without players. Seasoned game designers often use Excel or similar tools to calculate game balance (Clare, 2013). Joris Dormans has developed machinations (Adams and Dormans, 2012) as a useful tool for simulating the dynamics of resource management in games, and game theory presents theoretical tools to understand

some of the dynamics of multi-player gaming (Osborne, 1994). It is also possible to experiment with games using simulated players (Bjornsson and Finnsson, 2009).

All of these methods are valuable tools for game design, and have potential to also be valuable in experimental game design research. The problem is that they all rely on abstracting the player. They require that we already know something about how players are expected to behave. But this is seldom true in game design research—rather, we are looking to explore the link between game design and player's behaviour and experience. Hence, while calculations and simulations may help us trim and debug the game we want to experiment with, the research results will emerge from testing the game in practice, with players.

## **When is a game design experimental?**

We have already established that the experimental game designs we are looking at, are such that serve to elicit something interesting about design principles for games. Hence, it is not the status of the game design that marks it out as experimental or not. Experimental game designs can be sketchy, consisting of bare-bone game mechanics and interface sketches, or they can be full-fledged games or prototypes that are made publicly available for weeks or months. It is not the format of the game or the trial that determines whether it is experimental but the kind of experiment we plan to perform with the game. We can distinguish between classical, *controlled* experiments that aim to provide answers to descriptive or evaluative questions, and more open forms of experimentation where the aim is to explore and develop innovative solutions. The latter form of experimentation can concern game fragments as well as full games. Below, we distinguish between *evocative* and *explorative* design experiments, which both support more open design investigations.

### **CONTROLLED DESIGN EXPERIMENTS**

The classical approach to empirical experimentation is to use controlled experiments. In a controlled experiment, you contrast multiple setups against each other, to measure the effects of varying a small set of parameters. One performs a controlled experiment where one either subjects different participants to different conditions (inter-subject comparison) or each subject experiences all conditions (and within-subject comparison) (cf. chapter 10, experimental research designs). Applied to experimental game design research, this corresponds to varying one or more design factors in a game, and subject players to different versions of the same game.

Controlled experiments have their role in game research in general; and have for example been used in studies that explore how people learn to play games and in studies that investigate the gameplay experience. They have also recently got an interesting use in the context of online games. In A/B online testing, two versions of a game are launched in parallel to different parts of the player population and evaluated based on desirable responses. If one version makes players, say, pay more, then that version may later on be launched as the new standard.

Still, there are many pitfalls in using controlled experiments in the context of design research (cf. chapter 12). The obvious one is that in order to enable experimentation at all, the game must exist and run fairly smoothly. If your aim is to study variants of a computer game and must develop the game to be

able to study it, you end up with a very expensive experiment. It is sometimes possible to use game mods for this purpose (cf. chapter 19).

The most challenging factor is directly related to experimenting with design. A game is a complex web of design decisions, making it hard to isolate and vary a particular factor without fundamentally changing the game. The only option is often to construct an experiment setup where the game works optimally in one of the conditions, and the other one is a crippled version of the original where a particular design feature has been disabled. This problem is aggravated by the fact that it makes little sense to do a controlled experiment, unless the factor that you are varying teaches us something interesting about game design. But if it is interesting, chances are that the factor is tightly integrated with the core design choices for the game, and is impossible to vary without drastically changing the game.

Furthermore, controlled game experiments suffer from the fact that the immediate effect of varying a game design is typically that people start to play the game differently. Salen and Zimmerman (2004) describe this as games being *second order design*. The player experience does not arise from the game as such, but from the game session in which the player has participated. As most games can be played in several ways, a small change in design can have a huge impact on how people play the game. While this is in itself worthy of study, many studies do not take this aspect into account, but only aim to capture the player experience. A confounding factor is that whereas game design certainly has an effect on player engagement, so do a host of other things: including how players were recruited to the study and whom they are teamed up with.

Finally, controlled experiments with design must be repeated several times over in order to yield reliable results. Unless experiments are repeated over several games, we know very little about the generalizability of results. In the particular game that you used it may be true that varying factor A leads to results B. However, will the same be true for another game? Are the results specific to a game genre? Where are the limits—what are the design factors that delimit the validity of the results? No single study can answer these questions. Refer to chapters 12 and 19 for more detailed discussion.

The example we will use to illustrate this approach is from applied psychology. Choi, et al. (2007) report on a rather well executed design experiment, concerning modes of collaboration in a MMORPG. The goal of this study was to investigate how reward sharing interacts with how dependent you are on grouping up to achieve a task. The authors tested for experiences of flow, satisfaction, and sense of competence. Essentially, the result was that if players could achieve a goal independently of each other (despite the fact that they played in a group), they had more fun, experienced more flow and felt more competent if they also received rewards independently of each other. And conversely, if the players were dependent on each other they had more fun, experienced more flow, and felt more competent if they also shared the rewards.

This experiment avoids several of the potential pitfalls. First of all, the experiment was done with a pre-existing game, rather than a game prototype developed for the purpose of the study, short-cutting the issue of having to develop a full game. The game was modified (cf. chapter 19) to generate the experiment conditions, and multiple versions of the game were installed at local servers. Secondly, the goal of the study was *not* to study the game with or without a given design feature. Instead, the study explored how two varied factors interacted with each other (solo or group goal achievement, solo or group reward), avoiding the comparison of an optimal setup with a suboptimal one. Finally, the factors

that were varied were at the game mechanics level and as such represented core design factors, while still sufficiently isolated so that they could be varied without rewriting large parts of the code.

Despite this, the study still fails to convince. The main problem is that in the setup where players could achieve the goal on their own without help of each other, the game also became significantly *easier*. Hence, it is possible that players changed their play style under this condition. Maybe they dispersed to do different challenges in parallel; maybe they just sat back and took turns in defeating the enemies. The article does not present any information on the gameplay strategies that developed under the different experiment conditions.

From a game design perspective, the topic of the article can also be challenged. Choi, et al. (2007) claim that interdependency is an important concept in MMORPG design. While this may be true, the results of the study come across as trivial. Most likely, any MMORPG player or game designer would dismiss the results of the paper as self-evident. It is significant that the article has been published in applied psychology rather than as a game research article; it says something about social psychology applied to games, but little about game design.

Finally, the article uses a rhetorical trick to inflate the generalizability of the study—it never mentions which game that is studied! The game is discussed only as “a MMORPG”. This tacitly implies that the results would hold for any game in the genre, an over-generalization that any game design researcher should be wary about.

### EVOCATIVE DESIGN EXPERIMENTS

Most of the informative design experiments in game design research are much less rigid than the controlled experiments discussed above. Essentially, they fulfil a similar role as iterative play testing does in the practice of game design; they are done to iteratively refine an innovation. The difference is that in design research, the design experiments are not about refining a particular game—they are done to elicit more abstract qualities about games.

The distinction is important, because experimental design research can have completely different objectives than looking for optimal design solutions. The games need not be meant to be good games, and the experiments may focus on other factors than player satisfaction. The overarching goal for this type of design experimentation is to explore the design space of game design, by understanding more about the behaviour and experiences that a design choice will evoke in players. Hence, we can call this class of design experiments *evocative*.

Evocative design experiments tend to be rather open. Even if designers typically already have an idea of how a particular design choice will affect player behaviour and experience, the unexpected effects tend to be even more important. Schön (1983) describes how most design practices include design sketching, such as the drawings used in architecture. When the design manifest in material form it ‘talks back’ to the designer, highlighting qualities of the idea that were previously unarticulated or even unintended. Since game design is second order design, games do not manifest in sketches, but by being played.

It may or may not matter who plays the game. Zimmerman (2003) describes a game design process where the early game play sessions were carried out within the designer group. The argument for designers

playing the game is that it provides them with the full subjective experience of being a player. The argument against this approach is that internal playtesting very easily turns into designers designing for themselves, rather than for an intended audience. Both designer play and early user group playtesting have a function in game design research, and the choice depends on the design qualities you are exploring. Design experimentation is typically first done within the designer group, but if the core research questions are intrinsically related to the target group, it might be better to involve players from the target group from start.

It is often possible to do evocative game design experiments with very early game prototypes. The game mechanics for computer games can be tested early by implementing them in a board game (Fullerton, 2008) or by simulating them in *Wizard of Oz setups* (Márquez Segura, et al., 2013). An interesting option is *body-storming* (Márquez Segura, et al., 2013), which can be used when you wish to study the social or physical interaction between players in a computer or otherwise technology-dependent game. In body-storming, players are given mock-up technology that they *pretend* is working. This means that the rules of the game are not enforced by the technology, but through the social agreement between players. An interesting aspect of body-storming a game is that its rules need not even be complete, as players may very well develop their own rules while pretending to play the game.

While evocative design experiments are considerably simpler to perform than controlled design experiments, they still present some pitfalls. First of all, the games need to be rather simple. To enable experiments that elicit something about the design factor tested, the game needs to be stripped of as much as possible apart from this factor. This requirement may be difficult to reconcile with the fact that the game also must be playable, and that the game must have a way to manifest. Game structures cannot be tested without some kind of surface structure—there must be something that players can interact with.

In an on-going project (Back and Waern, 2013; 2014) a range of evocative game design experiments were performed, and two in particular serve well to illustrate the opportunities and pitfalls of evocative game design experiments. The game under development, *Codename Heroes*, is a pervasive game (cf. Montola, et al., 2009). It is played on mobile phones in public place as well as with hidden physical artefacts. The core game mechanics center on virtual messages that players move between the artefacts by walking from place to place. The game is developed as a research prototype. The research goals for this project are two-fold: one is to develop game mechanics and thematic aesthetics that can be engaging for young women and encourage them to move more freely in public space (Back and Waern, 2013). The second goal is to develop pervasive game mechanics that can scale to large number of players over large areas (Back and Waern, 2014), while the game can still manifest physically rather than being confined to the mobile phone display. In order to understand better how the different aspects of the game worked to fulfil our design goals, the game was deconstructed and tested it in parts, in the form of meaningful mini-games.

### Game test 1: pen-and-paper prototyping

An early game test with *Codename Heroes* focussed on developing an understanding of the types of gameplay that would emerge from the core game mechanic, the message passing system. This playtest focussed on the experience of moving physically to transport virtual messages: and delivering them to other players and to specific locations.

This design experiment was done very early during the design process, and while the end result would be a game on mobile phones, no implementation was running at the time of the test. Hence, we had to somehow simulate the core game mechanics, that of physically carrying—and potentially also *losing* – messages. In order to make message passing an interesting challenge, messages can be lost in *Codename Heroes*. If a message is carried too far or for too long time, a team may lose it and other teams may pick it up. We needed to simulate this function in the playtest. It was simulated using coloured envelopes: every team had a colour, and could only carry messages in envelopes of their own colour. A location tracking system from a previous development project was repurposed to enable tracking the participants. If a team would travel too far in one direction the game masters would send them a text message, telling them to change the envelope of a message and leave it at their current location.



It is important to emphasise that while this function was simulated, other parts of the game design were not. In particular, the play experiment was done with actual movement (as seen in figure 1)—we did not test the game mechanics in the form of a board game, which easily could have been done. Since a core design goal of *Codename Heroes* is to encourage and empower young women to move in public space, we specifically did not want to take away this aspect. Players walked—and ran—considerable distances in this play test, and part of the game was located in an area that we thought could make players feel uncomfortable. It was also important to recruit players from the target audience to this test—most of the players were young women.

Several things were learned from this game test. Firstly, the experiment supported the assumption that the spy-style message passing game mechanics indeed was attractive to the participating young women

representing our core target group. We also found that the game indeed had the potential to encourage the participating women to move about in public space. We could observe that by teaming up and making the movement part of a game, the participants selected to move about in areas they otherwise would have avoided, and also that this was a positive and empowering experience (Back and Waern, 2013).

The design experiment also talked back to us in a slightly unexpected way. Despite the quite clumsy way that players had to simulate some of the game functionality, the physicality of messages and envelopes added greatly to the game experience. For example, on one occasion a group of players came across a message that another group had been forced to leave. When spotting the envelope from afar they shouted out in joy, and reported this as one of the highlights in the playtest.

This playtest also exhibited an element of body-storming in that not all of the game rules were given. In particular, we did not tell the groups whether they would be competing or collaborating. The rule mechanic of leaving and picking up messages from each other could be interpreted either way. At the end of the game, the three groups came together to solve a riddle, but we had also used a scoring system to calculate scores for the individual teams. Players were not informed about this before starting to play. The reason was that we wanted to test how the participating young women would interpret the situation. Would they collaborate, or compete? In the end, we saw elements of both. The groups did a bit of collaboration on finding messages, in particular towards the end, but mostly played separately. When asked about it after the game had finished, they decided that they had been doing both. One of the participants articulated this as “we won together, but *they*” (the group that had got the highest score) “get to sit at the high end of the table”.

This is a good example of an evocative game experiment. It used a stripped-down game design with a partial implementation, letting players simulate some of the functions that later were to be implemented. Furthermore, while one of the reasons for doing the experiment was to test if the core game mechanics (carrying messages around) was sufficiently engaging, we left parts of the game underspecified and looked for how the participants would interpret the situation. We studied the activities and experiences that the game evoked, and, some of the core insights came from unexpected aspects of the experiment design, such as the high value of the physical aspects of message passing.

### Game test 2, testing the artefacts

In subsequent design experiments, we focussed specifically on the physical aspects of the game. While the message passing system is virtual and supported by a mobile phone app in *Codename Heroes*, the game includes physical artefacts that can affect its function.

In order for the game to scale to arbitrary space and arbitrary numbers of users, the number of artefacts must also scale. This is why the game primarily relies on players constructing the artefacts. The construction, activation and physical distribution of artefacts constitute the second core game mechanic in *Codename Heroes*, and more general is an interesting game mechanic. While the example of *Geocaching* (cf. by Neustaedter, et al., 2013) shows that it is fun to both hide and find artefacts in a treasure hunt style game, *Codename Heroes* is not a treasure hunt game. Hence, it was not certain that the experience would be the same. Furthermore, it was important to understand under which conditions the activity of constructing a game artefact would be an attractive game activity in itself.

Again, we constructed a mini-game, this time with focus on artefact construction and distribution. We



let players build artefacts in a workshop, and use them to search for and distribute messages (see figure 2). However, we left out the challenges related to messages: players could not lose messages and there was no challenge related to finding a particular set of messages.



Figure 2. Artefacts being built during the construction game test.

While the activity of building artefacts in a workshop was engaging and rewarding, the rest of the experiment suffered from a lack of game mechanics. In particular, it was unclear to players if there was any progression towards some kind of goal. The effect was that we ran into difficulties both with recruiting participants to the experiment, and with players not completing the game.

The setup illustrates a risk with the mini-game approach, in that not every game mechanic can run in isolation. In our strife to at the same time avoid testing the message passing over again and not creating a hide and seek game, we had unintentionally created an interactive experiment that was not a game at all.

### EXPLORING A GAME GENRE

An ambitious objective for experimental game design is to explore a novel game genre. Although such experiments still can be small and focussed, this ambitious goal will sometimes require the development of full-scale and sufficiently complex games, and study them extensively. An example of an ambitious project that aimed to explore design for an entire game genre was the European project *IPerG: the Integrated Project on Pervasive Games*. The project included several large-scale experiments with a fairly novel and under-researched genre, that of pervasive games (Montola, et al., 2009).



Needless to say, this form of design experimentation is time- and resource-consuming. There is very little difference in effort between developing a full-scale game in order to research it, and launching it as a commercial or artistic product. A large-scale game experiment will typically go through the same design process, with multiple design iterations and playtesting, an alpha and a beta phase, etcetera. While the process may end after beta testing rather than include a commercial launch (as that falls outside the scope of research), the final experiments can be large-scale and come across as open beta testing to the players (McMillan, et al., 2010).

The differences again lie in how the game is designed, and in how the testing is done. An experimental game needs to emphasise the factors that are interesting from a design research perspective. For example, the pervasive game *Momentum* was extreme in its attempt to merge role-play with everyday life (Stenros, et al., 2007; Waern, et al., 2009). This research was ethically challenging, as it meant that role-players would meet and interact with people who were not themselves playing and that might not even be aware of the game. A major result from this research was a deepened understanding of the ethical challenges of pervasive games in general (Montola and Waern, 2006a; 2006b).

The emphasis on trialling specific design factors can come in conflict with the designers' desire to also make an interesting and attractive game. This is less of a problem in evocative design experiments as these are smaller and also often done early, as part of the design process for a larger game. In full-scale design experiments, the balance between experimenting and creating an attractive game can lead to conflicts within the research group as well as cumbersome compromises in design. Montola (2011) discusses this in particular in relationship to technology-focussed research questions. If one of the purposes of the project is to develop and test new technology, this can very easily come in conflict with the designers' wish to make a good game, if the technology is not ready on time, or is buggy or slow.

Studying large game experiments presents its own challenges (Stenros, et al., 2011), in particular with understanding something about the relationship between specific design choices and the play behaviour and experiences that players exhibit. This is the reason why a typical game experiment will look rather different from an ordinary beta test. The game experiment requires extensive documentation, both in terms of filming, recording and logging play behaviour, and player's active reporting of their game play activities and experiences. It may be necessary to emphasise quality over quantity in data collection (Stenros, et al., 2011). Rich data is necessary in order to be able to deconstruct the play behaviour to identify instances of play that reflect particular game design elements. These can then be scrutinized in detail, to understand something about their effects on player behaviour and experience.

The study of experimental games is thus a complex and expensive interpretative process, which can be very rewarding if the game is innovative or focussed on interesting design qualities. In total, the process of experimentally developing a design understanding of a game genre is very expensive, in design and development as well as in testing, and can only be recommended when genre in question is novel, important, and under-researched.

## **Best practices and considerations**

There are many similarities between game design research, and the practice of game design. In particular, game design research will often use explorative and interpretative experiments rather than classical controlled scientific experiments. However, there are also some important differences. In particular,

there is a difference in the goals—experimental game design should aim to explore design factors that are novel or may be problematic, rather than strive to generate good games. This difference underlies the best practice recommendations summarized below.

In order for a *controlled experiment* to be relevant in game design research, it must be possible to vary the game in a way that does not cripple it. Furthermore, the design factor that is varied must be sufficiently interesting. As argued by Zimmerman, Forlizzi, and Evenson, (2007), design research is judged by its relevance to design rather than its repeatability.

Trialling a specific game design factor can also be done in *open and evocative design experiments*. These can even be done with incompletely designed or implemented games. But evocative design experiments must still be properly documented, and open for the fact that they can yield unexpected results. Also, it does not work to trial just any random idea – the game must be understandable and be playable by the participants.

Even *large-scale and fully developed games* can be developed for the purpose of explorative design research, if the goal is to trial innovative game design solutions in underexplored game genres. These experiments face particular challenges in data gathering and hypothesis testing, as it becomes difficult to attribute player behaviour to particular design factors. This is discussed in more depth in Stenros, Waern and Montola (2011).

## Concluding remarks

While this chapter has focussed on experimental game design as a scientific paradigm, many of the practices are similar to those of user-centred game design as a practice. Tracy Fullerton's book *The game design workshop* (2008) is hence an excellent resource for developing a good overall process also in experimental game design.

The concept of *design science* was originally proposed by Herbert Simon (1981) in his book *science of the artificial*. It has been under intense debate ever since. Nigel Cross (2001) presents a nice summary of the different perspectives, advocating a paradigm that lies close to the one of this article.

There exist very little meta-level discussion of the kinds of knowledge that is the result of design research on games. However, there has been an intense discussion in the field of interaction design research that also is relevant for design research on games. Zimmerman, Forlizzi and Evenson (2007) argue that the designs produced within design science is a contribution in themselves, but stress a requirement that the results must be relevant for future design projects. Adopting a more theory-focussed perspective, Höök and Löwgren (2012) instead argue that design research should aim to produce 'strong concepts', as loose description of design theories that are at the same time scientifically defensible and relevant in the design process. Lim, et al. (2007) present one such concept that may be particularly well suited to trial in experimental game design; a framework for aesthetically pleasing interactivity.

Finally, proper data gathering is central to maintaining scientific rigor also in design science, but data gathering can be tricky in particular in large design experiments. Stenros, Waern and Montola (2011) present an overview of data gathering methods for pervasive games. While the article focuses on games

that are played over large physical areas, most of the issues presented in the article apply to a wide range of games.

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