IT UNIVERSITY OF COPENHAGEN

Coupling Action and Function in Games:

Towards a Better Understanding of how to Convey Meaning Intuitively in Game Design

Jonas Østergaard Haugesen

June 2018

Supervisor: Hans-Joachim Backe, Associate Professor

A thesis submitted in fulfilment of the requirements for the degree of Master of Science.

GAMES
IT-University of Copenhagen
Denmark

Contents

Abstract

This thesis attempts to further the understanding of what makes controls in video games intuitive. Extensive research has been done in the field of Human-Computer Interaction (HCI) on what makes interaction intuitive but in the field of game research a shortage has been identified. The thesis provides a foundational background to the HCI research on the subject and provides a critical argument against the exclusion of video games from the philosophy of embodied interaction. The thesis, addresses how research from HCI, specifically the Frogger Framework, can be adapted to fit a video game setting. Through this adaptation a framework for video game analysis is produced and from this framework a method for video game design has been developed. The method has been tested in its designated situation and the findings are discussed. Finally, both the method's and the framework's possible development is discussed and directions for further research is proposed.

Keywords: HCI, game design, game analysis, embodied interaction, intuitive, framework, method

Introduction

In the field of HCI research has been conducted on the subject of what information is communicated before and after an interaction. A design framework for analysing person-product interaction, the Interaction Frogger Framework, has been proposed by Wensveen, Djajadiningrat, and Overbeeke (2004) which has gained traction in the community (Stienstra, Alonso, Wensveen, & Kuenen, 2012; Chaboki, van Oorschot, Torguet, Wu, & Yao, 2012; Vermeulen, Luyten, van den Hoven, & Coninx, 2013; Zimmerman, Stolterman, & Forlizzi, 2010; Hummels, Overbeeke, & Klooster, 2007; Djajadiningrat, Matthews, & Stienstra, 2007). The framework promises that a unification between action and function through the coupling of six identified aspects results in intuitive interaction. In the field of game research and game design player interaction is of some consideration (Salen & Zimmerman, 2003; Fullerton, 2014; Schell, 2008; Adams, 2014; Agustin et al., 2007), but on the subject of comprehensive game-specific methods with intuitive game design as its focus, I have identified a need for furthering research. In this thesis, I will provide an adaptation of the Frogger Framework to a game-specific focus. I will ground the discussion in a rooted theoretical foundation and to accomplish this adaptation, I will argue against established limitations (Dourish, 2004) of what can be considered embodied interaction. In order to do so, I will attempt to position game design in relation to embodied interaction and examine how embodiment and playing games correlate. With the adapted framework, I will, furthermore, lay the groundwork for a method with the intent of providing game designers with a tool to design intuitive controls in video games. Finally, I will provide a perspective of what has been achieved and what needs to be done to further the research on the subject in focus.

The thesis will be divided into five chapters. The first chapter will address the foundational theory that the Frogger Framework is developed from. The second chapter will explore the applicability of the Frogger Framework and the potential alterations that would need to be made. The third chapter will present the adapted framework and apply it in three different game contexts. The fourth chapter will use the adapted framework as a springboard to propose a method for intuitive game design. The method will be tested by a group of experienced game developers with a prototype constructed for this purpose. The fifth and final chapter will provide a closing conclusion as well as a perspective on what is next for the framework and the method.

1 Theoretical Background

"So: Who is ready to make some science?"

Cave Johnson

Portal 2 (Valve Corporation, 2011)

1.1 Discoverability and Understanding

Norman (2013) identifies two properties of design: *Discoverability* and *understanding*. Discoverability is the design's probability of an agent comprehending the possible and intended interaction. For the design to have good discoverability it must communicate the proper information and only this. Understanding is the design's ability to make an agent understand why and how it works. For the design to have good understanding, it must learn the agent why the intended interaction works and perhaps more important why the unintended does not. These two properties are achieved by applying six psychological concepts. For discoverability there are five distinct concepts: *affordances, signifiers, constraints, mappings* and *feedback*. For understanding there is the concept of *conceptual models* (Norman, 2013). To fully unearth the properties of discoverability and understanding, I will clarify the definition of all of these six concepts. Before that, however, it is important to note that Norman (2013) defines these concepts with the lens of how to utilise them to achieve good design, so that while the concepts are presented as universal to all design, the evaluation of how to utilise the concepts for achieving good design is subjective.

Affordances These are the relationships between the design object and the agent interacting with it. Human-centred design (HCD) would therefore have affordances that describe the relationship between humans and a design object. As an example, a push and pull door may have a handle on one side and not the other: The handle affords a grasping of the handle by a human, which in turn is necessary for the human to be able to pull the door open. The side with no handle does not afford grasping. This is described as an anti-affordance, i.e. the prevention of an interaction (Norman, 2013). Without the affordance of grasping the affordance of pushing should persuade the agent. If there had been handles on both sides of the door - thereby communicating wrong information on one side - this would likely lead to an amount of confused humans who would pull where one should push, and would be an example of misleading discoverability (Norman, 2013).

Signifiers Any affordance that cannot be could benefit from another type of communication to make the agent aware of it. Norman (2013) describes this a signifier. A signifier can be any perceivable indicator that instructs the agent of the possible and intended behaviour (Norman, 2013). Staying with the previous example of a push and pull door: A typical example of a signifier being used in this context is the 'push' or 'pull' signs placed somewhere obvious on the door. These signs signify the intended interaction with the door. Signifiers can also be something more abstract, like footprints in the snow, signalling the preferred route from point A to B (Norman, 2013).

Mappings In mathematics, mappings are "[...] the relationship between the elements of two sets of things" (Norman, 2013, p. 20). In design, mapping is relevant when designing the layout of controls and displays. Norman (2013) defines a good use of mapping in design as having spatial coherence between the layout of the controls and the elements that they control. In some modern 3D video games that use a dual analogue controller, a mapping is applied by the left analogue stick moving the player's avatar in its tilted direction and the right analogue stick rotating the view in its tilted direction. When designing for mapping one can use the techniques of *grouping* and *proximity* by grouping together related controls and by placing the control near the element that it controls (Norman, 2013).

A *natural mapping* (Norman, 2013) is a concept used for describing a design "[...] where the relationship between the controls and the object to be controlled [...] is obvious" (Norman, 2013, p. 115). In the original Pokémon Blue Version game (Game Freak Inc., 1996), the player controls a character in the centre of the screen in a top-down perspective. The device it was made for, the Game Boy, has a four-directional button and these four directions are mapped naturally to the character's movement on screen (see figure 1.1).

Constraints Norman (2013) defines constraints as being four-part: Physical, cultural, semantic and logical. The physical limits of a design, constrain the possible interactions with it (Norman, 2013). Consider a regular scissor: It has two holes for inserting fingers. One is large and the other smaller. The smaller hole constrains the number of fingers that may be inserted into it, thereby signifying the proper interaction method. The regular scissor is also an example of how physical constraints can be useful in preventing incorrect actions.

Figure 1.1. Pokémon Blue Version playing on a Game Boy

Cultural constraints are when culture provides a set of written and unwritten rules which affects the way a person may interpret a situation. A person from Greece may greet a friend differently than a person from Denmark. In design, these guidelines also act as constraints (Norman, 2013). As an example, the difference in right- and left-hand traffic. This cultural constraint has led to cars in Japan, a left-hand traffic country, being designed with the driver's seat in the left side, which is the opposite in Germany, a right-hand traffic country. A Japanese tourist renting a car in Germany, without knowing this cultural difference, would walk to the left side of the car to start the engine. In Japan, the constraint also affects the way people navigate on foot: Going up or down stairs, people keep to the left, which for a tourist from Germany may lead to some unexpected physical constraining.

Semantic constraints are when, as an example, using a regular claw hammer the situation constrains the interaction. If the user is about to hammer in a nail, the user is inclined to use the flat side of the hammer. If the user accidentally bends the nail and wants to extract it, the user is inclined to use the claw. This is a semantic constraint. (Norman, 2013).

Logical constraints are closely connected to the concept of natural mapping (Norman, 2013). In the case of the Game Boy and Pokémon as discussed earlier, the device provides five visible buttons, excluding volume and power, two of them are circular and grouped on the right side, another two have the appearance of slim lines and the fifth and final has a cross-shape pointing up, down, left, right. When faced with the problem of how to move the character, the logical constraint that *no other button points in directions*, should guide the player towards the cross-shaped button.

Feedback Feedback describes the information that is relayed back when an action has occurred. In design, it can be utilised to let the user know that her input has been received and/or let the user know the consequence of the action. Norman (2013) argues that feedback should be immediate and informative. Imagine hitting a button to turn on the light and having no other immediate feedback than the tactile sensation of the button being pressed in and springing back out. There is a delay between the button press and the light turning on, but you do not know this. You wait for a while for the light to turn on, but get impatient. You press again, confused, and still, nothing happens since you have unbeknownst turned off the light before it was able to light up. This is an example where the feedback is not immediate and there is no way for the user to know if her input has been received. Take the same example, but swap the button with a switch and take away the delay. Now, you push the switch and get the immediate feedback of the switch being in an altered state and the light turning on. The switch is more informative than the button since it can be in two different states, mimicking the light that can be either on or off. Another aspect to keep in mind when designing feedback is that too much feedback can end up confusing the user (Norman, 2013). Complex systems can accumulate an abundance of information and relay a great deal of this back to the user, which can result in overburdening and confusing the user. This means that design that deals with much information need to prioritise and plan its feedback so that important trumps less important information and that all feedback is not presented in the same instance (Norman, 2013).

Conceptual Models A toaster is a device that many of us know how to operate. The common toaster is operated by pulling down a lever that lowers a slice of bread and exposing it to radiating heat. Suppose a toaster is delivered to a secluded tribe deep in the Amazon. It would be within reason to argue that the tribe would have no clue to what it was for and more importantly: how it works. A conceptual model is a simple explanation, that resides in our minds, of how something works. The reader of this would, in most cases, have a conceptual model of how a common toaster works and would be able to use that understanding to operate said toaster. The residents of the aforementioned tribe would, however, not have such a conceptual model, and would therefore not be able to operate the toaster, disregarding the probable lack of electricity anywhere near them. A conceptual model is, however, not just a model of how something is used properly, but also a model of what makes the thing work. Staying with the toaster example, the reader will presumably know that the lever that lowers the bread, is coupled with a spring that is locked down when the lever is lowered sufficiently. Let us conceive of a situation where you lower the lever of a toaster and assume that the lever is lowered sufficiently, however, it is not. The lever springs back up since the spring has not been locked down. With your conceptual model of the toaster, you surmise that the lever was not lowered enough for the spring to be locked down, and you attempt the lowering once more, making sure to check for the tactile feedback of the locking mechanism. This is an example of a conceptual model providing the knowledge to evaluate a failed interaction and calibrate the approach to successfully carry out the intended operation. “Conceptual models are valuable in providing understanding, in predicting how things will behave, and in figuring out what to do when things do not go as planned” (Norman, 2013, p. 28). The question of how one obtains a conceptual model is then relevant. Norman (2013) defines the *system image* as the image from which one gain a conceptual model. The system image is perceived through all the available material describing the object: documentation, signifiers, the object’s physicality, “what was told to us in the sales literature, by salespeople and advertisements, by articles we may have read, by the product website and instruction manuals” (Norman, 2013, p. 31), et cetera. It is then the role of the designer to as closely as possible match her own conceptual model with the user’s through the utilisation of the system image (Norman, 2013).

1.2 Purpose and Coupling

With these concepts defined by Norman (2013) there is a strong foundation for creating a game design framework, however, these concepts focus solely on communicating how something works: "You can figure out the scissors because their operating parts are visible and the implications clear. The conceptual model is obvious, and there is an effective use of signifiers, affordances, and constraints" (Norman, 2013, p. 27). But how does one realise that a scissor is for cutting paper? Norman (2013) does not describe how a design can communicate its purpose. Furthermore, when Norman (2013) writes that the fact that a scissor's operating parts are visible is what makes the scissor intuitive, an interesting point is made but is not further explored in Norman (2013). In Norman (1988), the reason for what makes the scissors intuitive could be described by the concept of *visibility*, but this concept seems to have been incorporated into the more general concept of signifiers. Djajadiningrat, Overbeeke, and Wensveen (2002) and Wensveen et al. (2004) offer a more detailed explanation with their definitions of *feedforward* and *feedback* with their subdivisions *inherent, augmented* and *functional*. I will describe their definitions and delve into their definitions of these two concepts in correlation to the concepts of Norman (2013) because they themselves consider the concepts as building on top of the notions of Norman (1988), and because Norman's concepts have been revised (Norman, 2013) after the fact. A major revision to regard is the addition of the concept of signifiers and the alteration of the definition for affordances. Norman (2013) notes about affordances that "[a]las, the term became used in ways that had nothing to do with the original" (Norman, 2013, p. 13). He argues that the design community understood the term as a property instead of a relationship when it needed a term to describe the addition of instructional elements. Therefore, signifiers were termed and affordances were made more concrete. The more broad understanding of affordances is, therefore, the one that is present in Djajadiningrat et al. (2002) and Wensveen et al. (2004). However, the arguments and definitions are still relevant for the bolstering of my design framework, since the insights made, do not overlap directly with the old or new insights of Norman (2013), but instead expand the research field.

1.2.1 Feedforward

Feedforward is the information an object gives before an interaction, about what the consequences of an action will be. This is given both by the way the object looks, but also the action that it requires (Wensveen et al., 2004). It adds on perceivable affordances in the way that feedforward also informs about what the results of a user's action will be, i.e. the purpose of an action (Vermeulen et al., 2013). To further describe the concept of feedforward, Wensveen et al. (2004) divide the concept into three subdivisions: inherent, augmented and functional.

Inherent Feedforward Resembles perceivable affordances (Norman, 2013) in the sense that it communicates the action possibilities of the design through the relationship between the user and the design. Additionally, inherent feedforward communicates how this action can be made (rotating, pushing, pulling, etc.) and what the consequence of that action will be (Wensveen et al., 2004). It is, importantly, part of the interaction, thereby making the information inherent to the interaction. This will mean that the information is also stemming from the location of the interaction. As a consequence of it being inherent to the physical interaction, it appeals to the perceptual-motor skills of the user (Wensveen et al., 2004).

Augmented Feedforward Communication about the action possibilities and the purpose of the action coming from an additional source (Wensveen et al., 2004). As an example, a lit button next to an elevator shaft communicates to the awaiting future passengers that the car will make a stop at this floor. The light inside or next to the button would be augmented feedforward since it is remote from the actual elevator car, but gives information about the goal of the future passengers: to enter the elevator. This kind of information, thusly, relies on the user's cognitive abilities since it is the user that needs to know that the light near or on the button indicates that the elevator will stop at his or her floor. This, Norman (2013) describes as a signifier.

Functional Feedforward Functional feedforward communicates the general purpose of the design, i.e. why to do the action (Wensveen et al., 2004). Functional feedforward can utilise the concept of *product semantics* (Krippendorff & Butter, 1984), where the user's previous experience is relied upon for her to find meaning in the design. Additionally, as described in the scissor example from earlier, functional feedforward can describe the communication that happens when the operating parts are visible to the user, thereby making the function clear (Wensveen et al., 2004).

In Djajadiningrat et al. (2002), the application of feedforward is explained as follows: The designer must create meaning for the user, and for this, there are two approaches: the semantic approach and the direct approach (Djajadiningrat et al., 2002). These two approaches are what later in Wensveen et al. (2004) can be described as providing functional information through augmented information and inherent information. The semantic approach providing augmented information and the direct approach providing inherent information. More on this will be discussed in the coupling section. The semantic approach relies on the user's previous experiences and applies that to inform the user of its own resemblance to that previous experience. It often benefits from the use of iconography and symbols (Djajadiningrat et al., 2002). This approach resembles signifiers, and a product of this approach could presumably be interpreted as both a signifier and augmented feedforward. 2) The direct approach instead, relies only on bodily and perceptual skills and the intention being that meaning should be created in the interaction. Since perceptual and bodily skills are relied upon, the approach requires tangible interaction (Djajadiningrat et al., 2002). The approach utilises the concept of natural mapping because of the way the spatial layout of a design can communicate the purpose of an action. Spatial layout, however, is just one utilisation of this approach. Djajadiningrat et al. (2002) describe an example of this approach where part of a design is used to silence the sound it emits: The operating part is placed on top of where a loudspeaker is emitting the sound from, and the loudspeaker is thereafter silenced. The purpose of this action is communicated naturally since it is common knowledge that placing a physical object on top of something that emits sound, obstructs the sound being emitted.

For applying feedforward in a design, Djajadiningrat et al. (2002) argue that the direct approach should be prioritized. It takes behaviour and action as its starting point and instead of focusing on semantics where cognitive skills are relied on to find meaning in resemblance, the authors believe that meaning is created in the interaction and, thereby, relying on perceptual and bodily skills put less strain on the user. An argument that is echoed later in Wensveen et al. (2004).

1.2.2 Feedback

The definition of feedback in Wensveen et al. (2004) is similar to that of Norman (2013). Similarly to feedforward, Wensveen et al. (2004) divides feedback into the three subdivisions of functional, augmented and inherent.

Functional Feedback The feedback the user receives concerning the desired functionality from a design (Wensveen et al., 2004). If the user flickers a light switch to turn on a light, a light turning on would be the functional feedback.

Augmented Feedback This is feedback coming from an additional source (Wensveen et al., 2004). In the elevator example from earlier, the button that lights up when pressed would be augmented feedback, communicating that the car will stop on the indicated floor. The actual consequence of the car stopping on the desired floor would be functional feedback.

Inherent Feedback Inherent feedback means that the performed action and the feedback it gives are closely coupled. The inherent feedback of an action acts as an innate consequence of that action. Unlike augmented feedback, inherent feedback comes from the action itself. The feedback appeals to the perceptual-motor skills of the user and can be received visually, auditorily and haptically (Wensveen et al., 2004).

1.2.3 Coupling

Consider the scissor example from earlier once more: When operating a scissor the feedback the user receives is through all of her perceptual motor skills: The incision point of the blades and the paper is visible, the sound of the paper splitting is heard, the haptic feel of the resistance is felt and the blades follow the motion of your hand and fingers. This close coupling of action and meaning is logically always apparent in mechanical products and makes them intuitive because action and meaning are unified on the six aspects of time, location, direction, dynamics, modality and expression through inherent information (Wensveen et al., 2004) (Stienstra et al., 2012):

- *Time*: The action and meaning take place at the same time.
- *Location*: The action and meaning take place at the same place.
- *Direction*: The direction of the action and meaning is the same.
- *Dynamics*: The speed, acceleration and force of the action is closely coupled to the speed, acceleration and force of the meaning.
- *Modality*: The sensory modalities (appearance, sound, taste, feel, etc.) of the action are mirrored in the meaning.
- *Expression*: Any expression is apparent in both the action and the meaning.

Electronic products, Wensveen et al. (2004) argues, can take advantage of these six aspects of coupling to make the interaction more intuitive by coupling the action and function through augmented and inherent information. What electronic products lack, is the direct coupling between action and function through inherent information that a scissor as an example would have. To illustrate how a design can be regarded through these six aspects, I will return to the elevator setting, instead, now the user is inside the elevator car. Here the action would be the pushing of a button with the intent of directing the elevator car to the indicated floor, and the function, being transported to that floor.

Time The action of pushing the button and actually arriving at that floor does not take place at the same time, however, as is often the case in elevators, augmented information is used to indicate the compliance of the desired function; this is often done by lighting a light near or on the button and this occurs at the same time as the action. Action and meaning are therefore coupled with the aspect of time through augmented information.

Location The action of pushing the button and the destination floor is not at the same location, however, a light that lights up on the button to indicate its compliance, is in the same location as the action. Action and meaning are therefore coupled with the aspect of location through augmented information. As Wensveen et al. (2004) also mentions, the aspect of location being communicated through augmented information is the equivalent of mapping from Norman (1988).

Direction The direction of the button push and the transportation direction is not the same: One is horizontal, the other vertical. Here, the augmented information offers no coupling, and thusly, action and meaning are not coupled on the aspect of direction. One way of providing a coupling on this aspect would be to replace the button interface with an interface that allows for swiping gestures; then instead of pushing the desired button, a user would swipe from a graphic representing the current floor to a graphic representing the desired floor. The action, i.e. the swipe, would then be in the same direction as the transportation, thereby coupling action and function through augmented and inherent information. Inherent because the information about the directions stems from the action itself, and augmented because the action takes place at an additional source (the interface).

Dynamics The speed, acceleration and force of the button push are not apparent in the speed, acceleration and force of the transportation. Augmented information also does not offer any coupling, and action and meaning are thusly not coupled on the aspect of dynamics. An inspiration for a possible iteration, to couple action and meaning on this aspect, could be taken from the real world, where a rushed user can be seen rapidly pushing a button with the hope that the rapid pushes can accelerate the transport. If the proposal of the busy elevator user were to be implemented, the elevator would be coupled on the aspect of dynamics through augmented and inherent information. Inherent because the information about the dynamics stems from the action itself, and augmented because the action takes place at an additional source (the elevator car).

Modality The sensory modalities of the button push are not mirrored in the transportation. There is little to no link between the appearance, sound, feel, etc. of the action and the function of an elevator. A vague argument can be made that having square buttons could resemble the shape of the elevator car, thereby coupling action and meaning on the aspect of modality (the appearance) through augmented information. A stronger coupling could be made with for example sound: Pushing a button emits a specific tone; the higher the floor, the higher the tone. The elevator car constantly hums a tone; the higher the floor it is on, the higher the tone. Then, as the elevator progresses the floors toward the desired floor, the hummed tone nears the tone from the button press i.e. the tone of the floor.

Expression No expression is apparent in both the button push and the transportation. No matter how furiously you hammer the button, the elevator car will transport you the same way as if you had playfully tickled the button. The elevator offers no coupling between action and meaning on the aspect of expression. However, using the hurried elevator user from earlier, it is apparent that such a design is possible. The expression of the user's rapid button press, with the desire for the transportation to hurry, is a hectic, frantic one. A way for the transportation to reflect this is to first transport the user at a hurried pace, but also more imprecise. The doors could open asynchronously or the elevator car can stop at a point that is less level with the floor than we would otherwise expect. With this design implemented the elevator would be coupled on the aspect of expression through augmented and inherent information. Inherent because the information about the expression stems from the action itself, and augmented because meaning takes place at an additional source (the elevator doors and car).

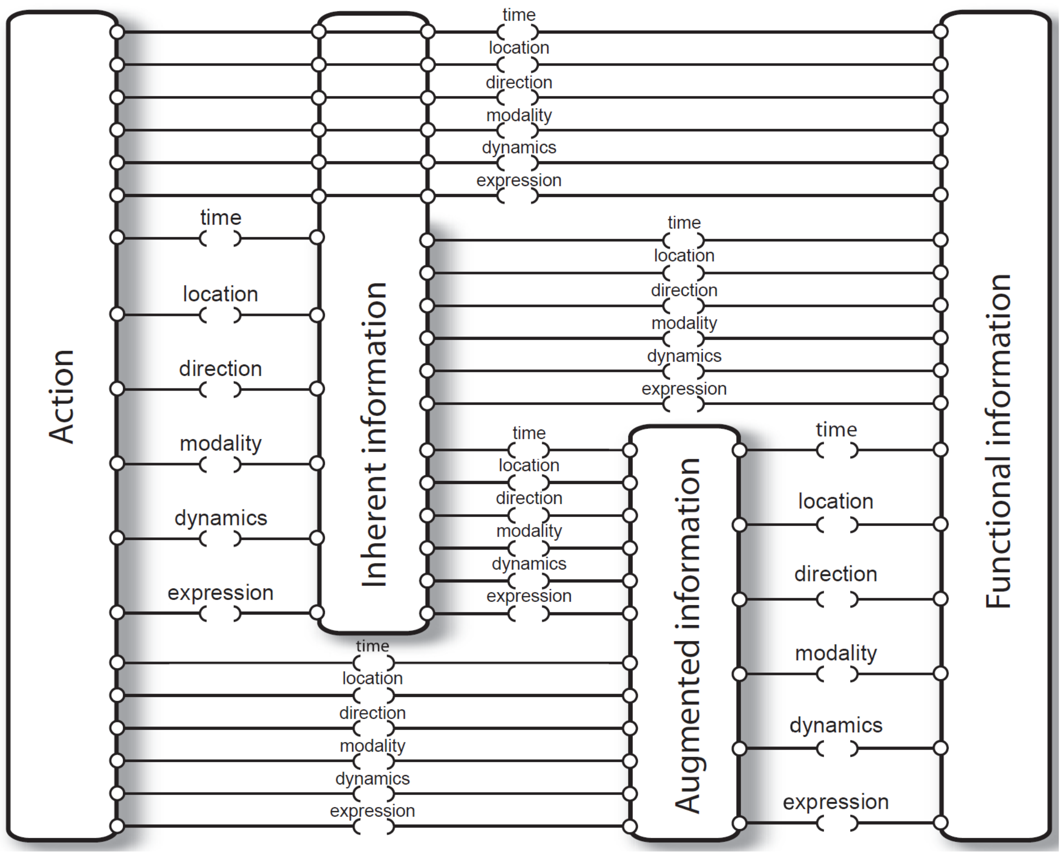


Figure 1.2. The Frogger Framework

From these two information directions (feedforward and feedback) with three subdivisions (functional, inherent and augmented) and six aspects to couple them on (time, location, direction, modality, dynamics and expression), Wensveen et al. (2004) formulated a framework called the Frogger Framework (see figure 1.2). The framework is a "[...] A schematic interpretation of all the different coupling possibilities between the functional information and the user's action" (Wensveen et al., 2004, p. 6). This schematic approach has a high amount of complexity, which could explain why others have chosen to simplify the model (Chaboki et al., 2012) and why Stienstra et al. (2012), who include Stephan Wensveen, see an altered and simplified model as "[...] more useful" (Stienstra et al., 2012, p. 22). The altered and simplified version is also the version I will refer to henceforth (see figure 1.3).

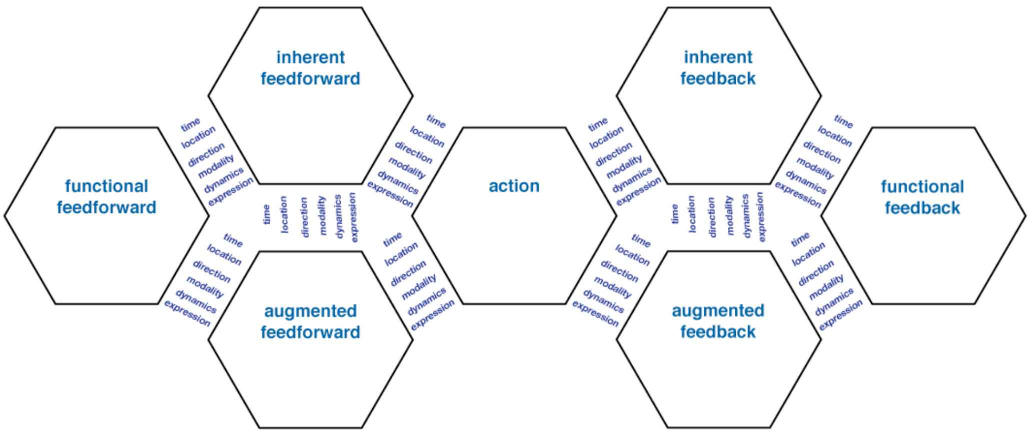


Figure 1.3. The Alternate Frogger Framework

2 Into the Void

"To open the time portal, simply stand on a button and then jump into the portal. Good luck"

Aku Aku

Crash Bandicoot 3: Warped (Naughty Dog, 1998)

The Frogger Framework is not limited to electronic products: In Wensveen et al. (2004) a mechanical product is analysed through the framework and in Stienstra et al. (2012) it is explained how a speed-skate experience is augmented as a result of using the framework. The limit of the framework is, perhaps purposefully, left unclear and its use is described as "[...] to explore and create intuitive and aesthetic interaction" (Stienstra et al., 2012, p. 22). Also, the initial formulation of feedforward and inherent feedback in Djajadiningrat et al. (2002) was done with the belief that meaning is of highest priority when designing: "We argue that the creation of meaning in interaction is the key to making abstract concepts in consumer electronics accessible" (Djajadiningrat et al., 2002, p. 2). This interest with meaning is shared in the game design community: "The goal of successful game design is the creation of meaningful play "(Salen & Zimmerman, 2003, ch. 3, p. 3). This conclusion is furthermore derived from (Huizinga, 1980): "In play there is something 'at play' which transcends the immediate needs of life and imparts meaning to the action. All play means something" (Huizinga, 1980, p. 1). The difference between the approaches would be the use of the words *interaction* and *play*. With respect to differing and expansive definitions of what play is (Huizinga, 1980; Sicart, 2014; Salen & Zimmerman, 2003), I will regard it within the narrow scope of *game play*, since I am operating in the field of game design. With this in mind, play can be regarded as a form of interaction: "Game play is the formalized interaction that occurs when players follow the rules of a game and experience its system through play" (Salen & Zimmerman, 2003, ch. 22, p. 3). Returning to the Frogger Framework: While the use of the framework may be unclear, it is clear that Wensveen et al. (2004) operates within the field of *embodied interaction* (Stienstra et al., 2012). A possible intention for use of the framework can, therefore, be regarded as within the field of embodied interaction. Following previous notions, embodied interaction is also defined as being dependant on meaning (Dourish, 2004, p. 126). Although similar interests of meaning are prevalent in designing for games (Salen & Zimmerman, 2003) and embodied interaction (Dourish, 2004), an assumption that this would make the two correlatives would be frail. So, a further analysis of embodied interaction is needed.

2.1 Embodied Interaction

Since embodied interaction relies heavily on the definition of *embodiment*, I will shortly delve into the phenomenological tradition of Husserl, Heidegger and Merleau-Ponty, all of whom helped better the understanding of embodiment, as deduced by Dourish (2004). To ensure focus, I will adhere to Dourish's (2004) analysis of the three phenomenologists' works.

Husserl Edmund Husserl was the first to define phenomenology. He found that current sciences of his time (1859-1938) was diverting from the physical everyday world with practical appliances into an idealised one which was not experienced but only theorised. A student of Franz Brentano, he embraced Brentano's notion of *intentionality* which describes the relationship between the external reality and one's thoughts about it, i.e. the relationship between the chair you might be sitting on and your thoughts about it. Husserl imagined phenomenology as a rigorous science for examining the nature of intentionality.

For this methodology he terms (1) *noema* and (2) *noesis* as being representations of (1) objects of intentionality and (2) our mental experiences of those objects. To ensure the methodology being rigorous Husserl defines the objective of phenomenology as to explain how we perceive objects as simply existing without question, i.e. explaining how a *natural attitude* arises. This world of natural attitudes, Husserl later defines as the *lebenswelt* (or *life-world*). "The life-world is the intersubjective, mundane world of background understandings and experiences of the world. It is the world of the natural attitude and of everyday experience" (Dourish, 2004, p. 106). Husserl further argues that there is a parallelism in the objects one perceives and the act of perceiving them. When an object is perceived, the act of perceiving it is also implied. Otherwise, real-world perceptions would be indistinguishable from imaginings. This also means that fantasising or memorising can be individual experiences.

Lastly, Husserl makes a distinction between the immediate everyday sense-impressions and the recognition of the object in front of us as being a chair. The distinction is deduced as moving from the everyday world towards the formal world. Recognising the object as a chair is recognising the object's *essence* (Dourish, 2004).

Heidegger Martin Heidegger, a student of Edmund Husserl, departs from Husserl's mentalistic approach. While Husserl adopted Descartes' *cartesian dualism*, which dictates that "[...] we 'occupy' two different and separate worlds, the world of physical reality and the world of mental experience" (Dourish, 2004, p. 107), Heidegger was concerned with the lack of attention from Husserl and his peers to the world of physical reality and argued that being comes before thinking: In order to think one has to be. Therefore, Heidegger rejected this dualism and argued that being and thinking are intertwined and cannot be separate from the other. Heidegger's development of phenomenology was roughly a shift from an epistemological approach to an ontological one, i.e. instead of focusing on how we obtain knowledge of the world, we should focus on how the world presents itself to us: "From his perspective, the meaningfulness of everyday experience lies not in the head, but in the world" (Dourish, 2004, p. 107).

Intentionality, as Husserl defined it, was for Heidegger too passive. For Heidegger, intentionality is not only concerned with perception but is of a practical nature. It is based on our concern for utilisation and how we can manipulate something, i.e. a chair is a chair because we can sit on it. This meaning, according to Heidegger, already exists in the world, we, as beings, merely interpret it. This interpretation is what Heidegger is concerned with.

From Heidegger's work, two concepts are of most importance for the context of this thesis: (1) *Dasein*, (or *being-in-the-world*) and (2) *das Zeug* (or *equipment/tools*) (Heidegger, 1962). (1) Dasein explains the experience of being in the world, and sometimes as exemplified in an entity experiencing the world as we do. Specifically, it is the relation between the being and the world, which in turn are inseparable. For Heidegger, Dasein is active and with a practical approach. The world is perceived as objects to be used or manipulated, but also a medium through which to act. More concretely, Dasein often perceives the world with the intention of accomplishing goals. (2) For Dasein to accomplish these goals there are Zeug. Heidegger sums up Zeug as being something in-order-to, meaning that the Zeug is always linked to a task. While being linked to a task, Zeug is also linked to other Zeug in ways that it "[...] relies upon, works with, suggests, is similar or dissimilar to, or is otherwise related to other equipment" (Dourish, 2004, p. 109). Heidegger's Zeug also plays a particular important role within the context of this thesis with his distinction between *zuhanden* (ready-to-hand) and *vorhanden* (present-at-hand) (Heidegger, 1962). To explain the distinction I will exemplify it with a regular pencil as the Zeug. You pick it up and position it between your fingers. As you align the pencil to your preference, the pencil is vorhanden: You have to account for weight and balance it, hence its presence is obvious to you. When you have positioned the pencil you start drawing. Quickly, the pencil is absorbed into your being, it becomes zuhanden: You no longer actively consider the weight or balance of the pencil, but instead you act through the pencil producing pencil strokes. In a sense, you have become a *being capable of drawing*, instead of a *being holding a pencil*. To elaborate, Heidegger suggests that the pencil is only objectively present to us because of its possibility of becoming vorhanden, and as soon as it becomes zuhanden it withdraws from the world as an individual object and is instead incorporated in the being. Should you perhaps find this absurd and check your hand to affirm that the pencil is indeed still there, you will find that the pencil has returned to the state of vorhanden, and is therefore present independent of your being (Dourish, 2004).

Merleau-Ponty Maurice Merleau-Ponty was particularly concerned with the body's role in perception, and his work is central when discussing embodiment. For Merleau-Ponty, the body was the key to bridging the work of Husserl and Heidegger, which he thought was addressing the same problems but from different perspectives (Merleau-Ponty, 1962). Merleau-Ponty argued that the body can be considered as more than just psychophysical: That, in relation to the senses of the body, it can be considered the medium through which the external reality is perceived. The body, therefore, is what connects Husserl's ideas of perception and Heidegger's concern with being-in-the-world (the external reality). This, in turn, means that the body is both subject and object: The perceiver's body being subject, and the perceived body being object. This addition from Merleau-Ponty of a body acting as a mediation between Husserl and Heidegger, is what defines his concept of embodiment. The concrete definition is three-fold: "The first is the physical embodiment of a human subject, with legs and arms, and of a certain size and shape; the second is the set of bodily skills and situational responses that we have developed; and the third is the cultural 'skills', abilities, and understandings that we responsively gain from the cultural world in which we are embedded" (Dourish, 2004, p. 114).

Building on these four perspectives of embodiment, Dourish (2004) draws a definition: "Embodiment is the property of our engagement with the world that allows us to make it meaningful" (Dourish, 2004, p. 126). With this definition, he then goes on to define embodied interaction: "Embodied Interaction is the creation, manipulation, and sharing of meaning through engaged interaction with artifacts" (Dourish, 2004, p. 126).

Then, I return to the question of whether or not to game design can be to design for embodied interaction. Dourish (2004) believes that this is not the case: "Even in an immersive virtual-reality environment, users are disconnected observers of a world they do not inhabit directly. They peer out at it, figure out what's going on, decide on some course of action, and enact it through the narrow interface of the keyboard or the data-glove, carefully monitoring the result to see if it turns out the way they expected. Our experience in the everyday world is not of that sort" (Dourish, 2004, p. 102). Dourish (2004) argues that video games use the physical world as a metaphor for interaction to convey meaning to the player and that this is not compatible with the embodied interaction we encounter in the real world. While not directly disagreeing, I will provide a perhaps more nuanced argument on how talking about embodiment in video games can be constructive.

2.2 Embodiment in Video Games

As previously discussed, intentionality describes the relationship between action and meaning, i.e. the intention of an action. Now, imagine playing a video game with a 3D simulated world wherein you come upon a challenge of pressing a button to open a door. You manoeuvre your avatar up to the button and press it with the intention of opening the door. For the door to be intentionally opened by you, a chain of couplings (Dourish, 2004) need to be made: First the input of your finger on the relevant key of the device running the game, then the in-game agent's push of the button and finally the door opening. You do not act directly on the door, but your intention is still directed towards the door.

This notion of coupling is not dissimilar to the one discussed in Wensveen et al. (2004) albeit this definition from Dourish (2004) is not confined to the six aspects of time, location, direction, dynamics, modality and expression. Instead, Dourish (2004) argues that when you experience a tool as Heidegger's zuhanden, the tool and you are coupled. Furthermore, as is clear from the previous example, the coupling can cover distances and thereby be remote from a local action, a fact that is also addressed in Wensveen et al. (2004) when discussing coupling on the aspect of location: "One can argue that the location of your fingers and your hand do not coincide with the cut of the paper. But because the scissors become an extension of your hand when cutting the paper (Heidegger's concept of 'ready-to-hand' or 'zuhanden'), you act through the scissors at the same location as the paper is being cut" (Wensveen et al., 2004, p. 2). So, when a tool becomes zuhanden, local actions can have remote intentions.

Combining this observation with the fact that couplings can also be made with abstract representations (Dourish, 2004), there are grounds to explore whether or not input devices for video games can be considered tools able to become zuhanden.

2.2.1 Internalisation

Calleja (2011) argues that *involvement* is the key prerequisite to presence in video games. Involvement consists of six dimensions: kinaesthetic, spatial, shared, narrative, affective and ludic. On the topic of zuhanden, Calleja's (2011) definition of in-game kinaesthetic involvement is of clear relevance. Kinaesthetic involvement relates to the way a game translates input from the player to the allowed *agency* within the game context through an *avatar* or *miniatures* (Calleja, 2011). Agency within games pertains to the effect the player is able to assert in the game context. It is not referring to any intentions the player may have but is instead the ability to perform intention-carrying actions. The avatar and the miniature are one or more entities that carry out the actions dictated by the player. The distinction between the two is that the avatar works as a representation of the player in the game world and is operated independently. Kinaesthetic involvement, then, is the involvement required to control an avatar or miniature (Calleja, 2011).

The varying amount of conscious effort kinaesthetic involvement may take up is dependant on the player's attention. A new player as an example may require a large amount of attention to the controls, and as she progress, less attention is needed, in turn minimising the effort required for kinaesthetic involvement. Calleja (2011) describes the state of minimal or no attention towards involvement as the involvement being *internalised*. This diminishing attention is similar, if not identical, to Heidegger's notion of equipment withdrawing from the world to become zuhanden: "The internalization of kinesthetic involvement describes a situation in which the controls are learned to such a degree that the on-screen movement of avatars and miniatures feels unmediated" (Calleja, 2011, p. 68) and "[...] players must be able to 'think with their fingers' to the point at which the player feels like an extension of the game or the game feels like and [sic!] extension of the player" (Morris (2002) in Calleja (2011, p. 68)). So, admitting that the phenomenological discussion on the matter can be much more nuanced and complex, for the sake of keeping focus, I will from this point forward consider game controls on the same level as Heidegger's equipment, thereby also considering them as capable of becoming zuhanden.

Dourish (2004) describes the embodied interaction of acting on a classical WIMP (windows, icons, menus, pointers) interface with a mouse and keyboard through coupling. Because of the similarity between this form of interaction and that of using an input device to play video games, I could describe the interaction with said input device in the same way as Dourish (2004) does. Because of this alignment, I would be able to use the Frogger Framework (Wensveen et al., 2004) to analyse a player's interaction with an input device. This would, however, limit the intricate detail that is present on the other side of the screen, e.g. the 3D environments of *The Witcher 3:*

Wild Hunt (CD Projekt Red, 2015). It is the assumption that detail of value is present in the game world, so addressing this world would be paramount for my framework. How, then, to address this detail will be the topic of the next section.

2.2.2 Ludic Subjectivity

The notion of kinaesthetic involvement is, as discussed, part of the more general term of involvement and as internalised involvement intensifies and the six dimensions (kinaesthetic, spatial, shared, narrative, affective and ludic) start to blend, the experience of the player moves towards an experience of *incorporation* (Calleja, 2011). Incorporation is thusly defined as "[...] the absorption of a virtual environment into consciousness, yielding a sense of habitation, which is supported by the systemically upheld embodiment of the player in a single location, as represented by the avatar" (Calleja, 2011, p. 169).

Vella (2016) believes that this embodiment of the player in the game world can be described as the *embodied ludic subject* which implies a point within this world from which the player can relate: "[...] the player's incorporation in the form of the playable figure grants her a spatial standpoint within the gameworld – an origo or point of origin to which deictic terms like 'here,' 'there,' 'ahead' or 'to the left' relate" (Vella, 2016, p. 4). This is in congruence with the notion of spatial involvement from Calleja (2011), which, like kinaesthetic involvement, implies a necessity of internalisation before the player can be incorporated. This means that an incorporated player inhabits a point within the game world through an avatar or miniature from which the player relates this internal environment including visual and auditory information.

Following the definition of embodiment, a being's capability to act upon the world is central (Merleau-Ponty, 1962). Vella (2015) argues that this capability is determined by the representation of the player within the game world. The player's capability is thus defined and limited by e.g. an avatar. This sense of what 'I can' and 'cannot' do is what shapes the world around us.

Remembering Heidegger (1962), the objects of the world is only present to us in the way that they are able to be acted upon by us. The fact that we, when stumped in solving a challenge in a video game, can counter 'I cannot make that jump' to a spectator suggesting that we 'just jump', bolster the argument that what is occurring on a mental level of the incorporated player is not an 'I think that my avatar is able to' but an 'I can' (Vella, 2016). Furthermore, just as embodiment requires an ability to act upon the world it also requires the reverse: for the world to act upon the body (Merleau-Ponty, 1962). Vella (2015) terms games' ability to act upon the embodied ludic subject as *passion*, but not in the word's popular definition, but as the inverse of the word *action* (Vella, 2015). The term concerns the way the game world or agents in it can act upon the ludic subject and in turn how the player experiences this possibility. When I, for example, sneak around in Kojima Productions (2008) I embody the fear of being discovered.

Summing Up

Returning then, to the conclusion of Dourish (2004): "Even in an immersive virtual-reality environment, users are disconnected observers of a world they do not inhabit directly. They peer out at it, figure out what's going on, decide on some course of action, and enact it through the narrow interface of the keyboard or the data-glove, carefully monitoring the result to see if it turns out the way they expected. Our experience in the everyday world is not of that sort" (Dourish, 2004, p. 102). From this citation, I can extract three arguments: (1) virtual game environments cannot be inhabited, (2) actions within a game world are mediated and require high attention and (3) experiences in the everyday world are dissimilar to the ones in a game world.

Through the theories presented in this chapter, I deem there to be substantial evidence countering these arguments. Dourish's (2004) first argument of virtual environments being uninhabitable I have provided counter-arguments to by referencing Vella's (2015) notion that a player's incorporation (Calleja, 2011) establishes an embodied ludic subject with a spatial point within the game world from where the player inhabits said world. The second argument that actions in the game world are mediated and necessitates high attention I have provided counterarguments to by referencing Calleja's (2011) concept of involvement (especially kinaesthetic involvement) where a player's continuous involvement leads to an internalisation of controls which minimises the required attention of the player. Additionally, Vella's (2015) arguments for embodied ludic subjectivity opposes the idea that games are mediated in the context of embodiment. The third argument that experiences in the everyday world are dissimilar to the ones in a game world can thus be said to be misdirected. Following the other two counterarguments, the game world can be considered incorporated into the player's lebenswelt and the playable figure becomes an extension of the player. In other words, the playable figure becomes part of the player's *body schema* (Vella, 2016), which Haans and Ijsselsteijn (2012) defines as the following: "The body schema can, thus, best be described as a dynamic distributed network of procedures aimed at guiding behavior" (Haans & Ijsselsteijn, 2012, p. 213).

3 | A Framework for Analysis

"You clearly know there are many other worlds apart from the one where we now stand. They are linked by passages, hidden gateways that afford travel from one world to another"

Avallac'h

The Withcer 3: Wild Hunt (CD Projekt Red, 2015)

3.1 A Visual Representation

Through the discussed theory I have formulated a framework (see figure 3.1) which takes influence from the Frogger Framework (Wensveen et al., 2004) and is adapted into a game analysis context. The notions of augmented, inherent and functional information are transferred as they were as well as the six aspects of time, location, direction, dynamics, modality and expression. A few aesthetic distinctions have been made to the visual representation of the framework to improve readability and functionality. As an example, the horizontal division represents the division between feedforward on top and feedback at the bottom. This is done to avoid confusion that may arise when trying to discern if a coupling is through feedforward or feedback, which has arisen in other adaptations of the Frogger Framework (Chaboki et al., 2012). What follows here, however, addresses the changes made to the framework itself and not the aesthetic changes of a model.

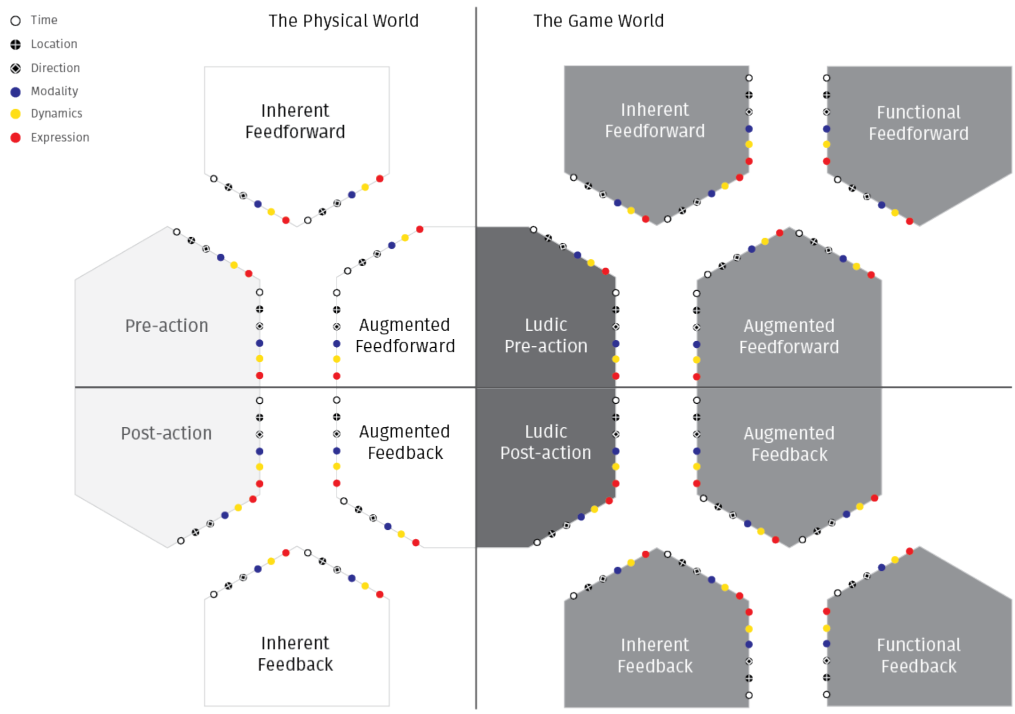


Figure 3.1. The Framework

3.2 The Ludic Heterocosm

The framework is divided into two axes. The horizontal division, as discussed above, separates feedback from feedforward. The vertical division represents the division between the physical world and the game world. All things only existing in the physical world operates on the left side, and everything diegetic to the game world, i.e. what can be seen, heard, felt, tasted, smelled, touched, etc. by an entity in the game world, operates on the game world side (Bordwell & Thompson, 2012). Vella (2015) describes this world as the *ludic heterocosm*. What is important to note about the ludic heterocosm is that it extends beyond what is visible on the screen at any one moment. It is an imagined world created in the player's mind. As an example, when meeting a travelling salesman of the Khajiit race in *The Elder Scrolls V: Skyrim* (Bethesda Game Studios, 2011), the player may include the salesman's homeland of Elsweyr into her ludic heterocosm even though it is never visited in the game.

Even though both the game world and the physical world can be said to operate within Husserl's lebenswelt, a distinction has been made to address the detail that exists on both sides of the screen mediating a video game. On the physical side it can be the button layout of a Game Boy and on the game side it can be the shape of the incoming tetromino moving from top to bottom in *Tetris* (Bullet-Proof Software, 1989). With inherent and augmented information in the physical world being identical to the formulation in the Frogger Framework, what then becomes relevant to discuss is how augmented and inherent information is experienced in the ludic heterocosm.

The Frogger Framework definition uses concrete delimited design examples like scissors and a DVD-player (Wensveen et al., 2004) but has also been used to improve experiences like the Augmented Speed-skate Experience (Stienstra et al., 2012). This is indicative of how the entire interaction experience is included in the framework, which is also imperative in a video game context. When playing a video game, all the models and the environment within the game world is designed with intent. The developers behind the particular game have made decisions on all levels of what is presented to the player. Some more deliberate than others, yet all of them stem from a decision. This means, among other things, that augmented information in the game world can originate from unconventional places compared to the physical world because of the delimited context the developers are able to control. One could argue that a semantic constraint is able to involve the entire game world. For example, when I enter a dungeon in *The Legend of Zelda: A Link to the Past* (Nintendo EAD, 1991), I trust that most signifiers and perceivable affordances within the dungeon are there to guide me towards attaining the key item and defeating the boss. In the physical world, there is noise. Experiences in the physical world are not granted the benefits and hindrances from being inside the vacuum of a designed simulation; game worlds are. Therefore, designing for *usability* in level design, i.e. using level design as a method for teaching, can be an opportunity for strengthening a coupling through augmented information (Totten, 2014). This is, however, not to say that augmented information in the game world is different from augmented information in the physical world, but merely to address the possibility of uncommon expressions of augmented information in the game world.

While on the subject of augmented information regarding my framework, I will provide an example to make the distinction between augmented information in the game world and augmented information in the physical world clear. A head-up display (HUD) is sometimes not diegetic to the game world and, as a consequence, not existing for any agent within the game world. It can thus be said to provide meaning for the actions of the player and not the ludic subject, and therefore a HUD would usually be influential in regards to the augmented information of the physical world.

Inherent information in the game world is not inherent from the action of the player but instead from the action of the playable figure. In *The Legend of Zelda: Skyward Sword* (Nintendo EAD, 2011) the direction a sword is swung is critical. Some directions will result in negating the desired effect or even losing health points. How the correct direction is communicated then, is through inherent information. As an example, the enemy type called Deku Baba will take damage from a sword if the sword is swung on the same axis as its jaw is opened (see figure 3.2). The enemy model effectively communicates this inherent information because it informs which actions are possible (slicing) and how to carry them out (slicing directions).

3.3 Applying the Framework

The framework's distinction between the physical world and the game world is an attempt to mirror the notion of involvement (Calleja, 2011). It can, however, not be said to integrate all six dimensions of involvement. The dimensions relevant to this framework is spatial involvement and kinaesthetic involvement. Spatial involvement is relevant because of the spatial point that is inhabited in the game world, and from this point, the framework's aspects of location and direction relate. Kinaesthetic involvement is relevant because it is integral to a sense of control for the player and the fact that a close coupling

Figure 3.2. The enemy type Deku Baba from The Legend of Zelda: Skyward Sword, will take damage from a sword if the sword is swung on the same axis as its jaw is opened

on the six aspects of this framework leads to intuitive interaction (Wensveen et al., 2004) should also lead to a higher degree of internalisation on the dimension of kinaesthetic involvement since it requires less attention as is also argued by (Calleja, 2011):

> In the kinesthetic involvement dimension, conscious attention is generally dedicated to learning the controls of the game during a player's early sessions of playing. This includes following on-screen instructions relating to avatar control or looking up and reassigning keys and buttons to the desired controls and then testing how these feel in the game. As players find the control setup that feels most intuitive to them or gets used to the one supplied by the game, their conscious attention moves away from the basic controls to other aspects of the game. [...] In such cases, we can say that the player has 'internalized' the controls: she has reached a level of kinesthetic involvement that requires little or no conscious effort (Calleja, 2011, p. 45).

Keeping in mind that any practical use of the framework in regards to analysis has the goal of illustrating intuitiveness of interaction, the framework's intended use case is when a game introduces a *kinaesthetic challenge* that is to be engaged through a *game mechanic*. In the following, definitions of kinaesthetic challenge and game mechanic are described.

Kinaesthetic challenges are defined by making the distinction between it and its counterpart nonkinaesthetic challenges:

> In kinesthetic challenge the required nontrivial effort is at least partly psychomotor, whereas in nonkinesthetic challenge the required nontrivial effort is solely cognitive. If altering the input device alters the required nontrivial effort, the challenge is kinesthetic. Kinesthetic challenge entails time-critical performance, and nonkinesthetic challenge entails time-free performance, both in either time-critical or time-free frameworks (Karhulahti, 2013).

Some detail must be added to fully understand the definition provided by Karhulahti (2013). First, a nontrivial effort is characterised by its outcome in the way that in the scope of a challenge the ability required to engage in the challenge makes the outcome of the challenge uncertain. As an example, picking up a pair of scissors to cut out a predefined shape requires the trivial effort of picking up the scissors and the nontrivial effort of cutting out the exact predefined shape. Of course, differing capabilities of humans make for differing distinctions between what is trivial and nontrivial, but as Karhulahti (2013) puts it: "Something trivial for you may be nontrivial for me; regardless, triviality and nontriviality remain operational" (Karhulahti, 2013). Next is the notions of time-critical and time-free as a factor in performance or as a framework for performance. For kinaesthetic challenges, time is always a critical factor for performance. This means that an outcome of an action is dependant on the time it was made. As an example, in the first level of *Super Mario Bros.* (Nintendo Creative Department, 1985) the time at which a jump is executed is significant for whether or not Mario is hit by an approaching Goomba or if he successfully stomps it. Additionally, in *Super Mario Bros.*

(Nintendo Creative Department, 1985), there is also a time limit for each level, meaning that the challenge of completing the level is within a time-critical framework. This is not the case in nonkinaesthetic challenges like the ones in *Sid Meier's Civilization IV* where the timing of a nontrivial effort, like clicking the card that represents the initialisation of researching irrigation, plays a less important role and there exists no time limit, i.e. the challenges are nonkinaesthetic with no time pressure.

Game mechanics can be defined in various ways, but for the context of this framework, the one offered by Sicart (2008) is satisfactory: "Game mechanics are methods invoked by agents, designed for interaction with the game state" (Sicart, 2008). Sicart (2008) is borrowing from the terminology used in the field of object-oriented programming when he uses the word 'methods', but to clarify, he argues that these methods can be considered as verbs describing the action that is possible to be utilised by an agent. As an example, the player is able to ride a horse in *The Witcher 3: Wild Hunt* (CD Projekt Red, 2015), which when considering methods as verbs makes *riding* a game mechanic. In *The Witcher 3: Wild Hunt* (CD Projekt Red, 2015), however, riding could be said to be comprised of several mechanics such as *speeding*, *slowing* and *halting*. Sicart (2008) categorises these inclusive game mechanics as *compound game mechanics*.

In regards to granularity and the framework, the smaller the scope, the better the effect. If a compound game mechanic were to be described in the framework, the complexity created by the different sub-mechanics would in many cases lead to contradiction on the six aspects and the three types of information. Similarly, an overly inclusive definition of a kinaesthetic challenge would lead to contradiction. It seems that narrowing the scope of a kinaesthetic challenge to only require the use of a single game mechanic will provide the most constructive information. Therefore, instead of addressing the kinaesthetic challenge of *riding on a horse* in *The Witcher 3: Wild Hunt* (CD Projekt Red, 2015), the scope should instead initially be the kinaesthetic challenge of *getting on a horse* through the game mechanic of *mounting a* *horse.*

Figure 3.3. Top: Feedforward of encountering a Deku Baba in The Legend of Zelda: Skyward Sword. Bottom: Feedback of attacking a Deku Baba in The Legend of Zelda: Skyward Sword.

3.3.1 Multivalence

Another element to consider is the multiple interpretation possibilities of the framework. Because of the complexity of gameplay, actions can be interpreted with multiple foci. As Calleja (2011) puts it: "Gameplay includes actions ranging from moving a piece on a game board, pressing a sequence of buttons on a controller, or sprinting, ball in hand, toward a distant white line" (Calleja, 2011, p. 8). To try and find universal tools for analysing gameplay seems doomed to fail in including everything that can be interpreted as games. But, as (Calleja, 2011) acknowledge, these attempts still help us in identifying the multiple perspectives that arise. Using the board game example, the action can both be analysed as moving a piece and moving a piece on the game board. The context of the action is always relevant. Could the game board be instructive in how to grasp the game piece? Does the game piece afford grasping? Both are relevant questions, but require different approaches to answer. That is why this framework embraces multiple interpretations. Several may be possible but two have been selected as indispensable to analyse intuitiveness of control. For purposes of consistency, through my delimiting of the two, I will use the previous example from *The Legend of Zelda: Skyward Sword* (Nintendo EAD, 2011) where the playable figure, Link, encounters an enemy agent, the Deku Baba (see figure 3.3). The kinaesthetic challenge has been identified as *damage the enemy agent* and the game mechanic to overcome this challenge has been identified as *swinging the equipped sword*. The game mechanic is controlled mimetically in the way that the dominant hand of Link is mapped to the position and acceleration of the input device (a Wii controller).

Challenge Focus Interpretation With the challenge as focus, the point of interest is directed at the Deku Baba. This means that anything functional is regarding the player's intention of dealing damage to the Deku Baba, anything inherent stems from interacting with the Deku Baba directly and anything augmented is coming from sources remote from the Deku Baba. With this in mind we can analyse the kinaesthetic challenge engaged with the game mechanic (see figure 3.4) [1].

[1] From first glance it is clear that feedback offers more couplings than feedforward. This is not a unique case, as will also be clear from further examples. A reason for this is up to interpretation but one possible reason is that feedback has an advantage in responding to an action, where feedforward has no information pool to respond to. With that said, cases of feedforward providing just as many couplings or more than the feedback is conceivable. Finally, quantity does not necessarily trump quality; a design with few strong couplings can be perceived as more intuitive than a design with many weak couplings.

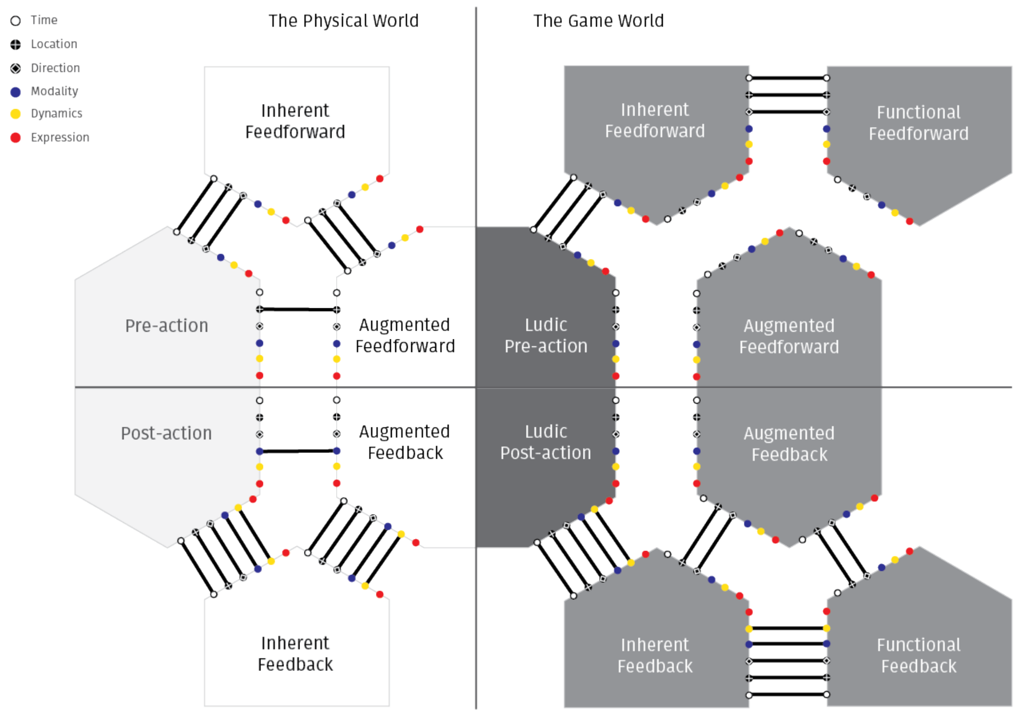


Figure 3.4. Damaging the Deku Baba by swinging the equipped sword in The Legend of Zelda: Skyward Sword as analysed through the challenge focus interpretation of the framework

Starting with feedforward, the Deku Baba can be said to communicate when to strike by opening and closing its mouth, thereby establishing a coupling from functional feedforward through inherent feedforward to the ludic pre-action. It is coupled through inherent feedforward because it is inherent to the Deku Baba and is not communicated remotely. From the ludic pre-action, the coupling continues through the augmented feedforward of the physical world through inherent information to the player's pre-action. The same kind of coupling is made on the aspect of location, where to strike, and direction, what direction to strike. Where to strike is communicated by the distinction between what appears to be a hard shell and a soft inner core and the properties of Link's sword. Link's sword, which has sharp edges, and the soft core of the Deku Baba combined, afford cutting, and thus a location for cutting exists. What direction to strike is similarly communicated through the relationship between Link's sword and the Deku Baba core. To be most effective in asserting force, a sword must be swung, which in turn implies a direction. Such direction can be interpreted from the mouth opening of the Deku Baba as discussed earlier. Lastly, a different kind of coupling is made outside of the game world on the aspect of location. On the screen, there is a small yellow/orange arrow pointing towards the head of the Deku Baba, communicating where to generally act. This arrow is what provides the coupling. It is outside of the game world because it is not diegetic to the game world and does therefore not exist in the ludic heterocosm. It is coupled from augmented feedforward directly to the player's pre-action because it is information coming from a different source and it uses semantics which relies on cognitive skills of the player.

On the feedback side of things, if the Deku Baba is struck correctly, the top portion of its head responds by, at the time of impact, jerking back from the point of impact in the direction it was struck with the same force as the blow and emitting an impact sound, thereby establishing a coupling on the four aspects of time, location, direction and dynamics from functional feedback through inherent feedback to the ludic post-action because of the inherent nature. In the physical world, the player has swung the input device at the same time as the Deku Baba is hit, and the location and direction are mapped to the swing in the game world, thereby establishing a coupling on the three aspects of time, location and direction. The impact sound is thusly not inherent to the action in the physical world, it is instead augmented because it is coming from the TV speakers instead of a mapped location in the physical world. The force, however, remains inherent because of the rumbling of the input device at the time of impact, mirroring the impact force that would be felt by a sword hitting something solid and therefore, there is additionally a somewhat weak coupling on the aspect of modality because the effect on the Deku Baba can, in a limited way, be felt. Lastly, visual effects appear at the moment of impact. One is a large flash of light and the other a streak. These combined, communicate where the Deku Baba is hit and the direction of the sword going through it, effectively coupling location and direction through inherent feedback in the game world. Unlike the arrow on the feedforward side, these two effects can be argued to exist within the game world because they utilise our semantic memory of explosions emitted from exerts of force and the fact that glowing objects, from e.g. heat, can draw lines in the air if moved fast enough.

Game Mechanic Focus Interpretation With the game mechanic as focus, the point of interest is now Link's sword. This means that anything functional regards the player's intention of swinging the sword, anything inherent stems from interacting with the sword directly and anything augmented comes from sources remote from the sword. The analysis of the game mechanic can be seen on figure 3.5.

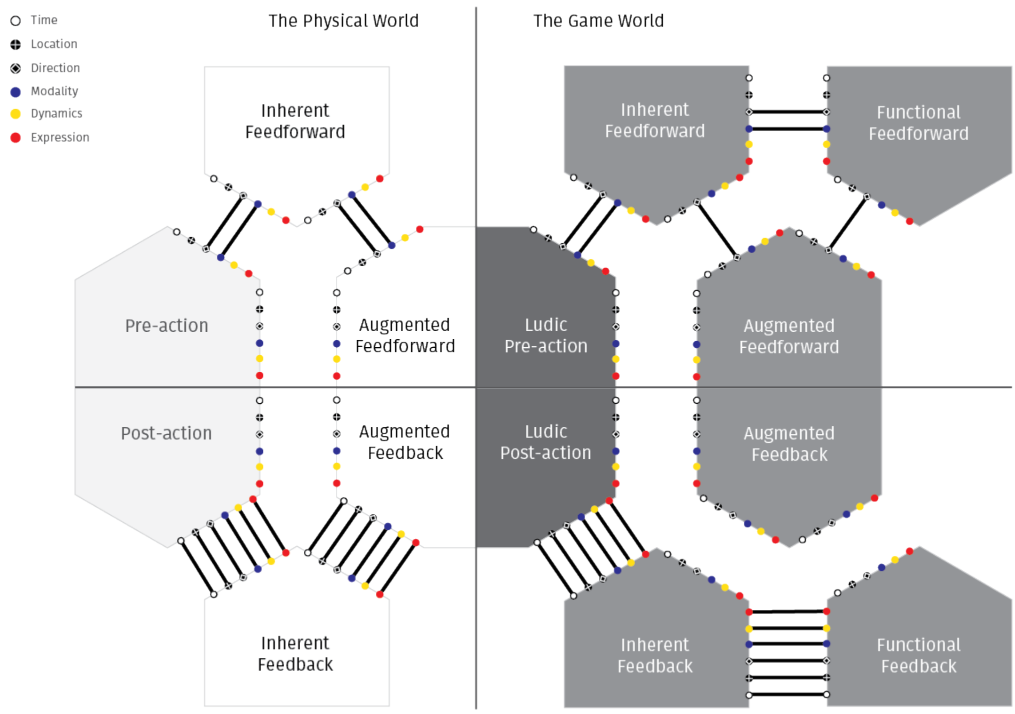


Figure 3.5. Swinging the equipped sword in The Legend of Zelda: Skyward Sword as analysed through the game mechanic focus interpretation of the framework

On the feedforward side there exist two couplings. One of direction and one of modality. The aspect of modality is coupled through inherent information because of the tactile resemblance between the input device in the physical world and the grip of Link's sword in the game world. The aspect of direction is coupled both through augmented and inherent information. This is because there are two sources of information regarding direction: One is the mouth of the Deku Baba, informing of the action possibilities of swinging horizontally or vertically, and the other is the parallelism between the direction of the input device and the sword. It is important to note that the augmented information is coupled through inherent information to the ludic pre-action because of the perceivable relationship between the sword and the Deku Baba. Had the information come from e.g. a sign next to the Deku Baba, the information would have been coupled directly to the ludic pre-action because of the lack of relevant affordances between the swinging of the sword and the sign.

When seeing the coupling on the feedback side (see figure 3.5) it is clear that there is a close coupling since all aspects are coupled through inherent information. This is because of the mimetic nature of the controls in *The Legend of Zelda: Skyward Sword* which was briefly mentioned previously. Mimetic controls imply that part of the player's movement in the physical world is mapped directly in the playable figure (Calleja, 2011). This kind of control allows for a high degree of freedom of interaction and when the mapping is assistive for the intentions of the player it results in this close coupling. A similar result can be seen with symbiotic controls where all of the player's movements are mapped in the game world. As will be prevalent in a later example, for symbolic controls, like keyboard keys and controller buttons, the opposite will be true because of the disparity between the action of input in the physical world and the action performed in the game world.

Merging With two separate visual representations of two distinct analyses, it is perhaps unclear how to get an overall visual representation of the intuitiveness of Link's encounter with the Deku Baba. For this, I suggest a consolidation of overlaying the two representations on top of each other, thereby combining the two in an overall visual representation (see figure 3.6). Appropriately, this method also allows for several more interpretations to contribute to a more holistic analysis.

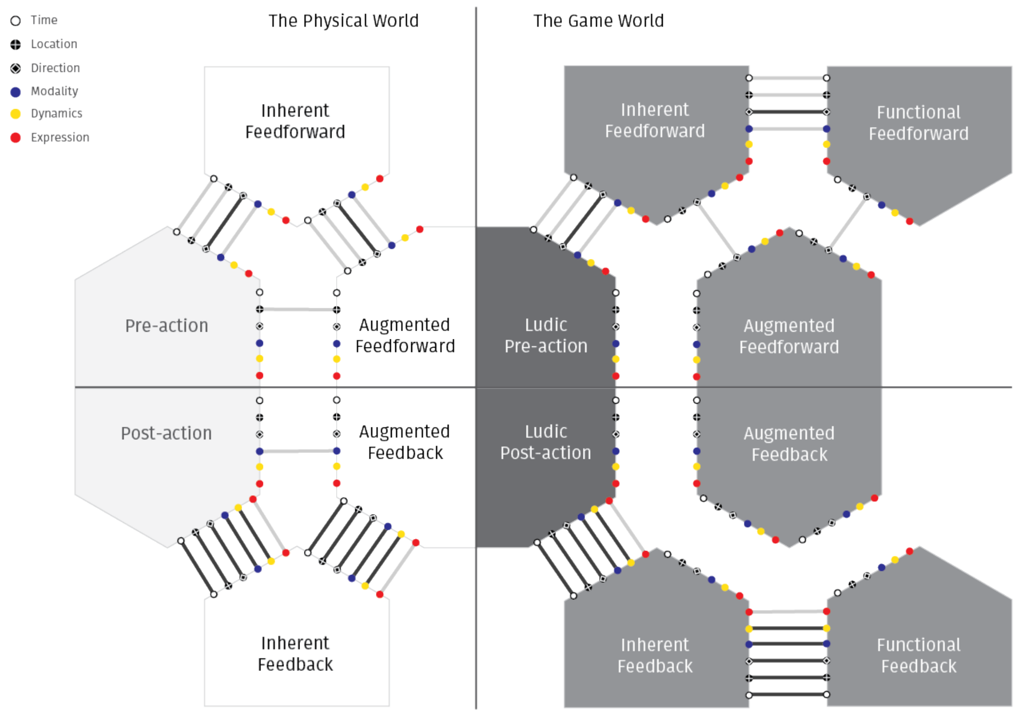


Figure 3.6. The two analyses combined. The grey couplings represent the couplings where only one of the two analyses provided a coupling and the black where both did

3.3.2 Further Examples

To employ the benefit of analogy, I will analyse a similar context in an older game in the same series: *The Legend of Zelda: A Link to the Past* (Nintendo EAD, 1991). This game is not controlled mimetically, something that becomes apparent when analysing it. The analysed context is of the playable figure, Link, encountering an enemy agent, the Octorok (see figure 3.7). The kinaesthetic challenge has been identified as *damage the enemy agent* and the game mechanic to overcome this challenge has been identified as *swinging the equipped sword*, identical to the previous analysis. I have chosen this context for analysis because its similarity to the previous context illustrates how symbolic controls can minimise couplings in the physical world. The sword control is operated by pushing down a button in the physical world, which means that the only aspect that is coupled inherently in the physical world, is the aspect of time: The sword is swung at the same time as the button is pushed.

In the game world, the Octorok acts in the same way as the Deku Baba: It is jerked back with the same amount of force as is acted upon it and in the direction of the swing of the sword relative to the point of impact, and an impact sound is heard. In addition to this impact sound, which is represented in the coupling of modality in the physical world through augmented feedback, the Octorok also flashes red and a cross animation is played on top of its representative sprite to indicate that it has been hurt. The red colour and the cross could appeal to the player's cognitive ability to make the semantic conclusion that the action dealt damage to the Octorok. Furthermore, I have interpreted the effect as being non-diegetic to the game world, i.e. this consequence does not play out in the ludic heterocosm in my imagination. Instead I see it as an added layer, constructed by the game developers to communicate the damaging of the Octorok, and therefore I interpret this as being augmented information in the physical world.

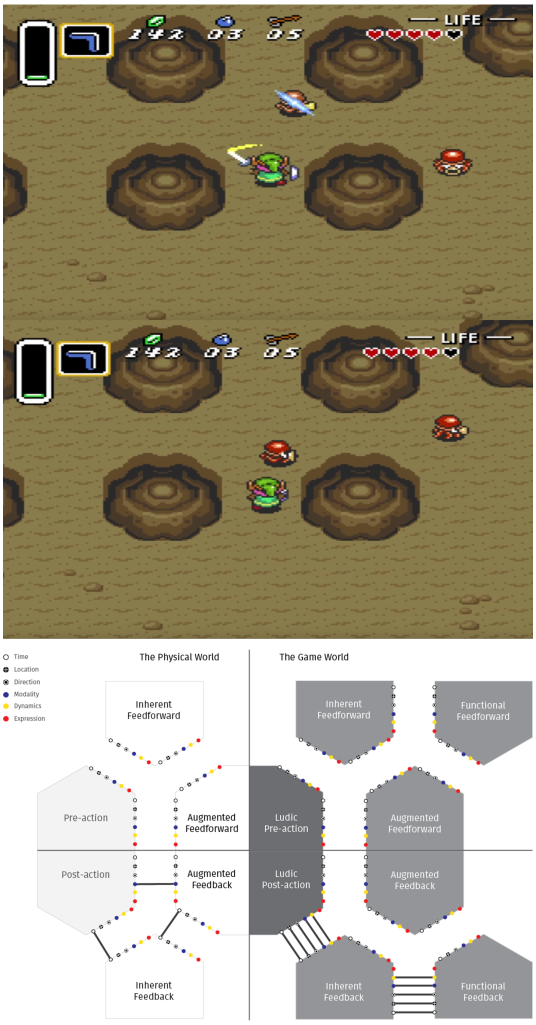


Figure 3.7. Damaging the Octorok by swinging the sword in The Legend of Zelda: A Link to the Past as analysed through the game mechanic focus and the challenge focus interpretations combined

Finally, to demonstrate that the framework is not limited to games in the Zelda-series, I will provide an analysis of the video game *Portal 2* (Valve Corporation, 2011). Here, the context is that of the playable figure, Chell, entering a chamber with a number of lights on the floor, a closed door, a sizable push-button and a similar sized cube (see figure 3.8). The kinaesthetic challenge is then to *exit through the door* and the appropriate game mechanic for overcoming this is *positionally manipulating the cube*. The door is also opened by positioning the playable figure on top of the button, but since the button needs to be held down in order for the door to remain open, the cube is needed.

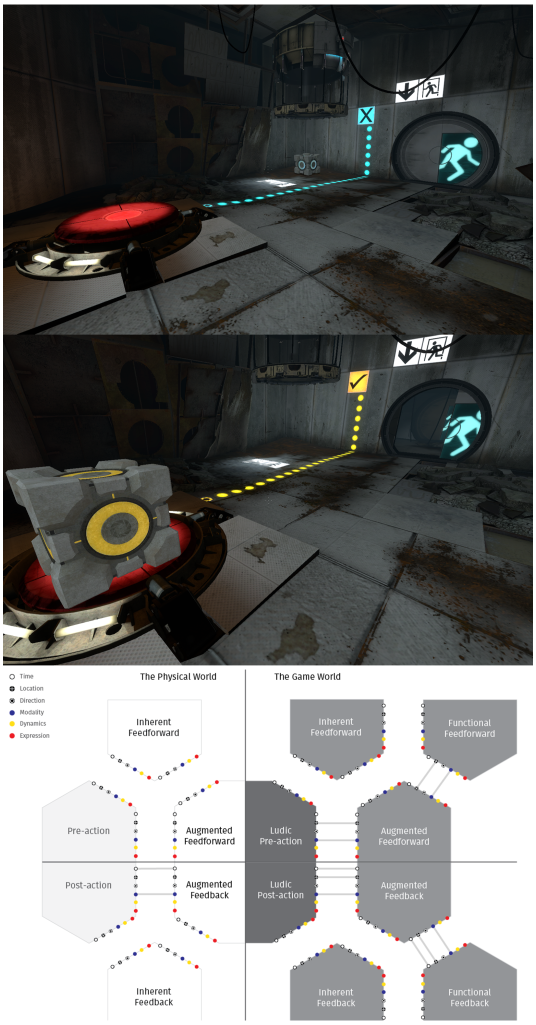


Figure 3.8. Damaging the Octorok by swinging the sword in The Legend of Zelda: A Link to the Past as analysed through the game mechanic focus and the challenge focus interpretations combined

By considering the game mechanic as *manipulating the cube* it is implied that the actions of picking up and placing the cube are needed. This is an important consideration since to overcome the challenge, a compound game mechanic, *manipulating the cube* needs to be performed. Remembering the discussion on compound mechanics creating contradiction, I would need to discern the game mechanics that constitute the compound game mechanic, of which there are two: *picking up the cube* and *placing the cube*. For this analysis, I have consequently chosen to combine three analyses: (1) an analysis with the game mechanic focus for *picking up the cube* and the kinaesthetic challenge being *picking up the cube*, (2) an analysis with the game mechanic focus for *placing the cube* and the kinaesthetic challenge being *exiting through the door* and (3) an analysis with the challenge focus of *exiting through the door* by using the game mechanic of *placing the cube on the button*. The context and analysis illustration can be seen in figure 3.8.

The first major consideration is from the first and second analysis where there is no couplings present. The way to pick up the cube in *Portal 2* is to be near and pointing the field of view towards the cube and then pressing the 'E' key on the keyboard (given that one is playing on a PC). There is no information from the physical world as well as the game world describing this. In the third analysis, the lighting is a particularly interesting information source. First, there is the spotlight directed towards the centre of the button, indicating a location of interest. Second, in the direct vicinity of the button, a blue dotted line of light originates and ends near the door the player is attempting to open. This creates an almost tangible coupling on the aspect of location through augmented feedforward in the game world. Furthermore, the cube, the line of light and the door is coloured identically creating a coupling on the aspect of modality by appearance through augmented feedforward, a coupling that becomes relevant again when the cube is placed on the button where the cube and line changes colour to orange. Other things to note are the signs providing augmented feedforward through appearance and the affirming sound that is heard when the button is pressed down.

What is evident from figure 3.8 is that there do not exist as many couplings as have been illustrated previously, despite the illustration representing three analyses. Even so, I will go out on a limb and say that most people familiar with games from Valve Corporation (2011) consider this challenge effortless. I consider this to be attributed the application of constraints in the challenge. To be exact, the use of logical constraints are apparent. The logical constraint is apparent in the lack of options inside the chamber. Space is limited and there are only objects situated that relate to the challenge, drawing players to the logical conclusion of positioning the cube on the button. This suggests the possibility of using constraints to make a challenge intuitive, this is, however, not within the scope of the framework as it only considers intuitiveness of interaction.

3.4 A Starting Point

The proposed framework will need to be tested rigorously to pinpoint strengths and weaknesses. So far, I have applied the framework in three different contexts with promising results, but to say that these three contexts provide a comprehensive representation of possible contexts in video games would be naïve. For the time being, the framework is delimited by having kinaesthetic challenges be the backdrop for the utilisation of game mechanics, but it is possible that further experimentation will prove that further delimitation is necessary. By that, the universality of the framework would diminish, but in turn, it would provide a more solid foundation. Having described the strengths in the previous sections, I will now consider the weaknesses of the framework.

First of all, the visual representation of an analysis can seem cryptic. In its current state, there is no way of distinguishing between couplings made on the same aspect. As an example, if a coupling is made visually and audibly they are both represented on the aspect of modality as was the case in the *The Legend of Zelda: Skyward Sword* (Nintendo EAD, 2011) analysis, where a coupling on the aspect of modality was both made with the impact sound and the tangible sensation of hitting the Deku Baba. Furthermore, it is unclear if a coupling is only present in one of the two worlds. This is because there is no way of indicating the start and end of a coupling. In a situation where one coupling is exclusive to the game world and another on the same aspect is exclusive to the physical world, it can be disorientating because they are visually represented in the same way as a single inclusive coupling. Lastly, the strength of a coupling is not illustrated in the current state, which could be beneficial.

What is important to keep in mind though, is that a visual representation of an analysis should never stand alone. What I consider the critical contribution of this framework is a proposed universal language to analyse kinaesthetic challenges and how they are overcome by employing game mechanics through controls. This means that analyses can be compared and conclusions can be made about intuitiveness, something less conceivable of approaches that strive to describe elements and characteristics of games like Lankoski and Björk (2015) and Elias, Garfield, and Gutschera (2012). However, as is a fundamental characteristic of analysis, it is subjective, and one analyser may produce an analysis dissimilar to another even though the analysed is identical.

With this in mind, it is of interest to position the proposed framework in relation to the notions of *reliability* and *validity* (Cresswell, 2009). Any framework for analysis should consider its ability to cultivate consistency in the analyses produced from it, i.e. it should be reliable. Furthermore, the accuracy of any findings coming from a result of an analysis is of utmost importance in determining the validity of results, and so any framework for analysis should encourage this. Now, to asses this, I will consider the analyses provided in this chapter. Being a new framework assessing reliability by conducting comparative research with the focus on consistency between researchers will be insufficient, however, I can compare analyses made with the original framework provided by Wensveen et al. (2004). Here, a comparison between their scissor analysis and my analysis of the playable figure swinging a sword in *The Legend of Zelda: Skyward Sword* (Nintendo EAD, 2011) indicate consistency as the couplings are identical.

The validity of results is more complex to asses since no results were gathered from the analyses because of the intention was to provide insight in the application of the framework not to draw any conclusions from the three contexts. Even so, I will consider the side-product of finding that mimetic controls in video games can inherently provide coupling on all aspects. A reason why I could pronounce that this result has validity is because I have utilised Cresswell's (2009) two strategies of (1) *triangulating* data and (2) providing *rich description*: (1) I have analysed several sources (three), and (2) in communicating the findings, I have in detail described couplings and provided explanation for their existence and their path.

What I have not done yet, and what can prove the biggest critique, is to address my *bias* (Cresswell, 2009). I am the producer of the framework and therefore I possess the clouding presumption that my framework is a positive contribution to the field. The quality of the framework will not be determined in this thesis. It will require peer review and will need to be applied in a myriad of contexts to asses validity.

4 | A Method for Application

"I hate portals"

Geralt of Rivia

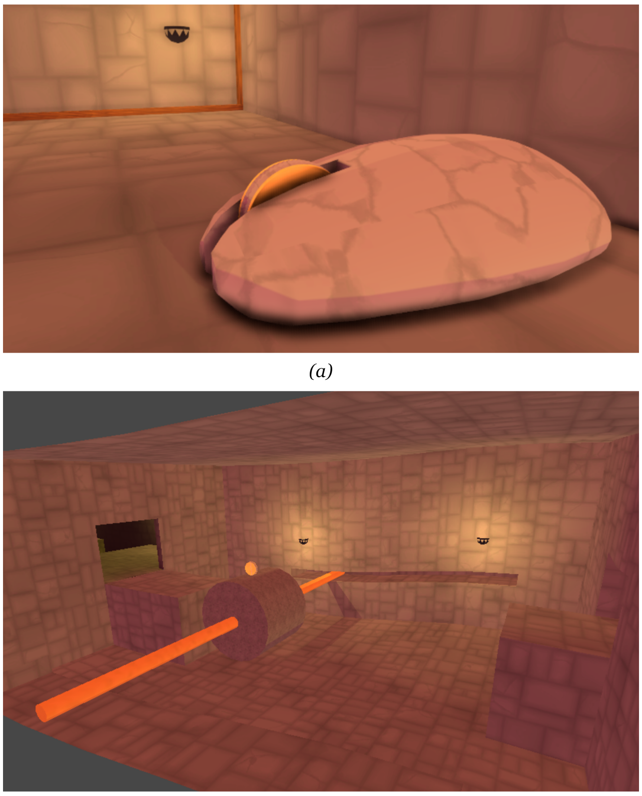
The Withcer 3: Wild Hunt (CD Projekt Red, 2015)

4.1 A Delegation of Effort

When having used the framework for analysis, it is clear that use in a design context would not be constructive, since the complexity necessitates a high degree of absorption and, most importantly, loads of time. Therefore, for the creation of a practical method, I decided to delegate the effort into two parts taking place during well-known processes in game development: playtesting and ideation. To test the effectiveness of the proposed method, I gathered a group of experienced game developers who, importantly, have not undertaken the same education specialisation as me, which assisted the developing of a universal method, and avoided the method specifying into a narrow school of thought. Another benefit of the test group was that they had previously worked on games together which limited the amount of noise arising from not knowing each others' approaches to game development, and assuring a solid baseline for comparison to previous development situations. The testing was separated into three phases corresponding to the two processes of playtesting and ideation. The first phase consisted of a playtesting situation with a prototype video game made by me specifically for the test following the ideas presented in Houde and Hill (1997). I, then, acted as the interviewer and each group member acted in turn as the playtester. The second phase consisted of the group being presented with a drawn model on a whiteboard representing the simplified framework and the data I had gathered from the playtest. The third and last phase consisted of a semi-structured focus group interview (Cresswell, 2009) where the participants had a chance to discuss their impressions. The method for gathering qualitative data was chosen to be a focus group. This method was chosen because it is effective in gathering data from a group of respondents (Cresswell, 2009), and since the target group for the method is a game development team, this was deemed suitable.

The main goal of the prototype video game was for it to be used as a tool for evaluating the proposed method, so the most important aspect was identified as the prototype aspiring to be as original as possible. The intent of this was to disconnect previous experiences the test participants might have had if the prototype had been similar to a game they had played previously, thereby optimistically limiting unknown variables in the evaluation. Realising that creating something original is a perilous task, an emphasis was simply put on implementing as few as possible conventional game mechanics such as using the W, A, S and D key for movement. Consequently, movement in the prototype is controlled by a mouse-wheel with the playable figure also resembling this wheel (see figure 4.1). The prototype consists of three minor challenges to ground the player in the control scheme and one integral kinaesthetic challenge as the focus of the test. This kinaesthetic challenge can be seen in figure 4.1. It consists of two doorways, one from which the player enters and the other through which the player needs to exit. Between the two doorways is a lowered area creating a gap between the two which makes travelling from one doorway directly to the other impossible since the playable figure cannot inherently move vertically. Leaning on the pathway leading into the room is a large barrel oriented horizontally which is suspended off the lower ground by a round beam going through the barrel's centre. The beam is held up by its extremities lying in two grooves in the walls perpendicular to the doorways. Lastly, the room is sloping toward the entrance making the entrance level slightly lower than the exit. The intended strategy to get to the other side is then to position the playable figure, a wheel, on top of the barrel and then use the weight of the wheel to rotate the barrel, which rotates the beam that progresses everything forward towards the exit where the player can climb off the barrel and exit.

Summing up, the described challenge acted as the focal point of the application phases of playtesting and ideation while the method as a whole was the focus of the last evaluation phase with the focus group interview. The next two sections will address the substance of the proposed method and the relevant findings during the two first phases of application and the impressions of the participants from the last evaluation phase. They will be divided into sections representing the context of their use: playtesting and ideation.



(a)

(b)

Figure 4.1. (a) In-game photo of the prototype as it is presented to a new player (b) The kinaesthetic challenge in focus

4.1.1 A Playtest

The workload of identifying relevant information regarding the six aspects of time, location, direction, modality, dynamics and expression from the framework has been delegated to a playtesting phase in the simplified method. The way this is done is that the interviewer conducting the playtest adhere to a number of questions during the playtest. The questions are divided into two parts: before the identified challenge is attempted and right after. These two phases reflect the phases of pre-action and post-action in the framework and are thereby related to perceivable feedforward and feedback. The questions have been formulated to echo the six aspects in a feedforward setting and a feedback setting and are preluded by a contextual question limiting the scope of the following questions totalling the questions to 14. Each question is, additionally, asked with relevance to both the physical world and the game world, so each question can be said to be two-fold, thereby covering the two dimensions of the framework.

1. **Feedforward**
   (a) What action would you invoke to overcome the challenge?
   (b) When would you apply this action and when would you stop?
   (c) Where would you apply this action?
   (d) In what direction would you apply this action?
   (e) Is there something visually, audibly or tangibly that instructs you how to apply this mechanic?
   (f) How much force, speed or acceleration do you think you need to apply?
   (g) Do you think you need to apply a certain kind of attitude when applying the action?
2. **Feedback**
   (a) Now that you have invoked the action, do you feel it was effective in overcoming the challenge?
   (b) Did you feel that the action and the effect happened synchronously?
   (c) Did you feel that the action and the effect happened at the same location?
   (d) Did you feel that the direction of the action was parallel to the direction of the effect?

(e) Did you feel that there was any visual, tactile or audible feature that arose as a consequence of your action?

(f) Did you feel that the amount of force/speed/acceleration from your action was apparent in the effect?

(g) Did you feel that the attitude you applied in your action was apparent in the effect?

As the questions were formulated they were evaluated by using them in the context they were created for: a playtest. The focus of the playtest was, as discussed earlier, the challenge in the constructed prototype. The way the playtesting was conducted was that I sat down with each participant separately and let them play through the first three minor challenges without instructing them in anything other than letting them know that at a point, I would stop them and ask them some questions. As the playtesting participant reached the challenge in focus I asked them to halt the movement of the playable figure and allowed them to look around in the game world without progressing the challenge. With the game still running, I went through the first seven questions in the given order, waiting for the participant to answer each accordingly. Each question was additionally followed up by a request for elaboration, mostly by asking why they answered what they did. As the participants answered, I wrote down their answers in the form of notes to be used as collected data in the ideation phase. As the final question was discussed I gave back the reins with the encouragement of applying the action they answered the first question with. If the action was successful in overcoming the challenge I carried on with the last seven questions, if not I asked the first seven questions once more, this time with the participant having gained new knowledge.

What was clear from the perspective of the interviewer was that the universal nature of the questions led to some of the questions seeming trivial. As an example, when inquiring about the questions regarding time (1b and 2b), as an interviewer, I was awaiting an affirmative answer, not expecting any other reply, and as a consequence, a feeling of the question as being unconstructive arose. This same consideration was also voiced during the focus group interview. Here, the participants suggested that the playtesting interview should be conducted in a semi-structured way with the questions acting as a starting point, but as the interview goes on the interviewer follows the flow of conversation. This suggestion, in addition to a suggestion of digging even deeper in elaboration on some questions like dynamics and modality (1e, 1f, 2e and 2f), I welcome. What is apparent from the test is that the questions should be considered a checklist to be answered through relevant discussion between the interviewer and the playtester in no particular order other than the first question in each section being asked first.

With that said, this alteration requires diligence of the interviewer since the task of categorising the data becomes more complex, but most importantly keeping on-topic becomes of high importance. It is possible to disregard these two tasks, but let me provide one argument for each task for why they should not: (1) The task of categorisation should not be disregarded because the categorisation inherently provides information on where a weakness or a strength in the design lies and if disregarded can lead to designers focusing on coupling on an aspect that is inappropriate for what the playtester actually experienced. Vice versa, the task of categorisation could be given to the designers, leaving them to code the data (Cresswell, 2009). What is inappropriate with this approach is that tacit knowledge from the actual playtesting situation is lost (Cresswell, 2009).

Conclusively, I suggest that the categorisation task should be prioritised and should be conducted by the interviewer as close in time to the playtesting as possible. (2) The task of keeping on-topic should not be disregarded because the scope of the method is relatively narrow. What can happen if the subject matter is deprioritised is that the playtesting session can evolve into a general playtesting session with discussions concerning graphical glitches, similarities to other games, aesthetic qualities, etc. which can end up being irrelevant for the purpose of the playtest, which is to gather data on the intuitiveness of a kinaesthetic challenge.

One other interesting finding was the difficulty of the participants to express and identify what they felt and why they felt the way they did. This lead to interesting replies such as when asked how much force, speed or acceleration they thought they would need to apply in the context of scrolling the mouse wheel fast enough to use the barrel as a ramp for the playable figure, the participant answered that he thought he would need as much force as one would apply to get to the bottom of a webpage. This can be explained by the fact that the method, as well as the framework, is highly concerned with knowledge residing in the lebenswelt (Dourish, 2004): the intersubjective unconscious knowledge and understandings gained from experience. This knowledge is tacit knowledge in the way that it is hard to explain to another person. What makes this example so important is that intersubjectivity is used to answer the question in a way that many would understand because most have experienced the situation of wanting to scroll to the bottom of a page: It is forceful and fast. From this finding, I suggest that any utilisation of the proposed method include an explanation from the interviewer in the playtesting processes of the possibility of using past experiences as examples to identify what is felt and how it is felt.

4.1.2 An Ideation

After data has been collected, the task of plotting the data into a model to get a visual representation of what is perceived is undertaken in the ideation process of a development team or, in a bigger studio, the design team. The model for the proposed method has been considerably simplified relative to the framework. The most noteworthy simplification has been the collapse of the dimensions of feedforward and feedback. This was done as a consequence of wanting to adapt the framework into a nimble straightforward method that is accessible enough to use, that it can be a tool in a practical setting. This was done because I wanted to adapt the framework into a method for sketching (Buxton, 2007). Why that had to cost the distinction between feedforward and feedback is grounded in what was earned from the distinction. In the framework, the distinction makes it clear whether or not a challenge is feedforward or feedback heavy, the analytical gain of this should be obvious and the notion that Wensveen et al. (2004) themselves made distinctions mainly for the purpose of analysis (Vermeulen et al., 2013, p. 5) reassures my decision, because, as a tool for sketching, the purpose of sketching is not for the sake of analysis but to spark ideas and open up a design: “Their value lies not in the artifact of the sketch itself but in its ability to provide a catalyst to the desired and appropriate behaviors, conversations, and interactions” (Buxton, 2007, p. 113).

Additionally, being able to look at a design challenge holistically can create better products (Buxton, 2007), and this is counteracted if the designers were to make an incision at a point in the challenge and say from this point feedforward and feedback relates. With this said, there is value lost in the collapse. A value that is also relevant for a design team, and I leave it up to future interpretations to find a way to feed this value from the framework into the method. Perhaps a last analytical phase could be beneficial to a design team.

All other changes have been made to ease the drawing of a model to be used in the method, most importantly reducing the complexity of shapes. This decision should not be brushed off as just being a whimsical side note. When pen and paper sketching is such a wide-used method of sketching in a world with increasing technological gadgets promising to enhance the sketching experience, it is because grabbing a pen and a piece of paper is accessible. No app is needed, no processing power is required other than one’s own brain. This is why I have put effort into reducing the framework into three lines: they are fast to draw and do not require accurate brush strokes, meaning that they can hopefully be drawn over and over in the same sketching session without becoming a nuisance. The model can be seen in figure 4.2. Because of the model’s resemblance to a bending river I have chosen to name the method *the Four-Angled River Technique* (FART) for purposes of simple reference. From the top left in a clockwise order, the letters represent inherent information, functional information, augmented information, ludic action and action.

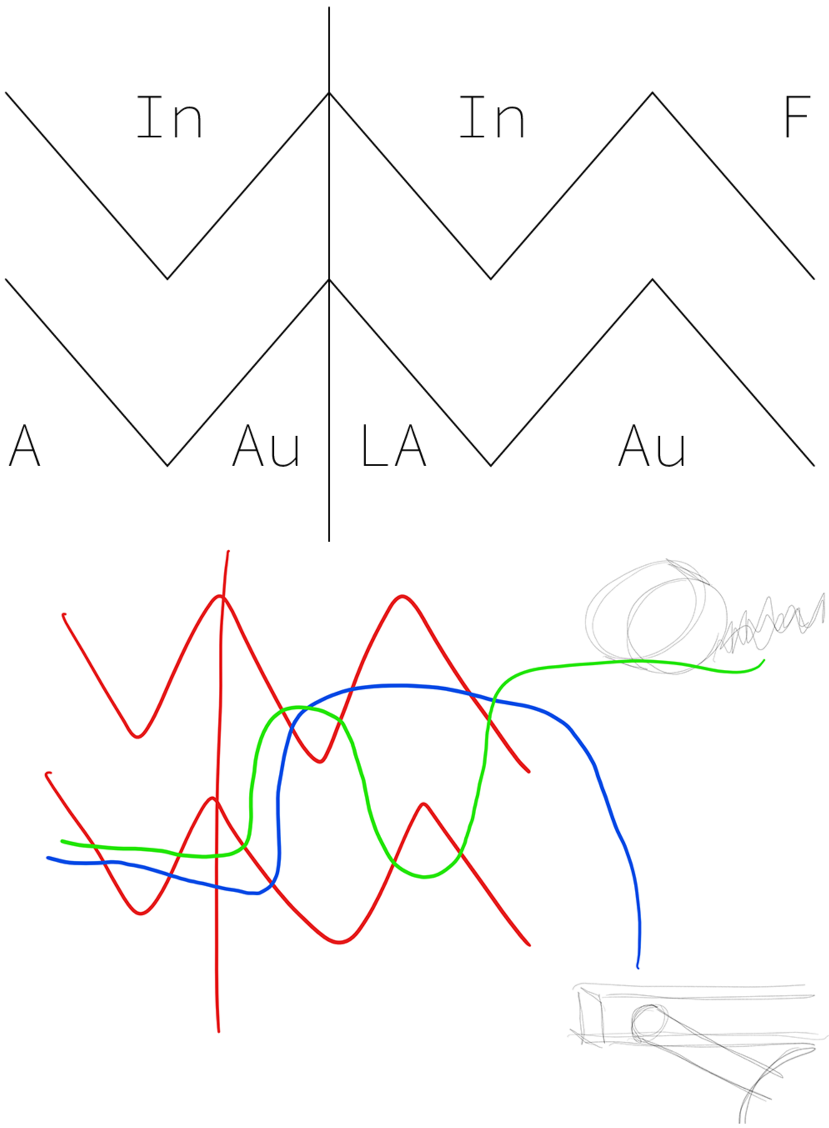


Figure 4.2. The Four-Angled River Technique. Above is the formal form and below is how it could look in practice

Before presenting the method to the participants I conducted a short lesson in the meaning of inherent, augmented and functional information. During the lesson I mirrored the notion of Wensveen et al. (2004) in saying that inherent information is preferred over augmented information because of the lesser effort needed for psychomotor tasks compared to cognitive tasks, which means a task requires less attention, thereby allowing for internalising the controls (Calleja, 2011). While promoting inherent information, a point was also made that should an inherent solution be too costly, augmented information is still preferred over no coupling, and may, in some situations, be more appropriate.

After the lesson, I presented them to the method and drew the model (see figure 4.2) on an adjacent whiteboard. I then provided them with the data I had gathered from the playtests and presented them with a task: With the data and their own impressions, they should come up with ideas to improve the design of the kinaesthetic challenge from my prototype using the method. In effect, they were to role-play as a design team tasked with improving a design.

What I noted when observing the participants was that an initial confusion of how the couplings were to be visually represented was slowly replaced by a more fluid workflow of discussion and drawing. One thing that stood out, was that no lines were connected to functional information and no couplings were made between augmented and inherent information. From this I draw two conclusions: (1) The identification of functional information becomes implicit in the context of focusing on conveying meaning of how to overcome a challenge. In a sense, all ideas with the intent of making the general purpose clear to the user can be labelled as ideas providing functional information (Wensveen et al., 2004). Therefore, starting a coupling from the visual representation of functional information can seem redundant, when in fact it is not. A coupling is made between action and meaning through inherent information and augmented information. This leads me to the second conclusion: (2) The lesson was insufficient in teaching the proper skills needed to take full advantage of the method. First, the lesson should have provided the information discussed in the first conclusion and the addition that couplings are made between action or ludic action and functional information through augmented and inherent information, not between individual information types. This way of thinking of a coupling as a stream of information travelling through delineating channels may be beneficial for the understanding of the value of the method. Secondly, the lesson, as it was, focused on augmented information, inherent information and how they are distinct from each other. It should have also provided information on, not just that it can, but **how** a coupling can travel through both types of information, as was the case in the analysed example from *The Legend of Zelda: Skyward Sword* where the affordance between the sword and the Deku Baba provided a coupling that travelled through augmented information and inherent information. Finally, the lesson should have provided an exemplary demonstration of how the method could be used with a dissimilar challenge to show the participants how the method is intended to be used, but with emphasis on the possibility of interpretation.

In the focus group interview that followed, granularity was a meaningful topic. One participant voiced the opinion that he would have preferred a way to label the couplings according to what the information was regarding in order to better compare different ideas. Other participants counterargued that this was against the purpose of a sketching tool, echoing the notion from Buxton (2007), as discussed earlier, with the sketch as an artefact having no value other than the inspirational value it provided in the creation of it. Agreeing with the majority of the participants, there still lies some truth in the one's suggestion since being able to discern the existing couplings would perhaps elevate the conversation by having recognisable couplings to relate to while sketching new ones. Again, I leave it up to future interpretations to explore the possibility of including a way of labelling information, however, using the words of Buxton (2007), when the pen reaches the end of a line representing a coupling, "if you can't afford to throw it away when done, it is probably not a sketch" (Buxton, 2007, p. 111). Other than the point of labelling, the participants considered the method as sufficient in its granularity and expressed that the level of detail should be kept to the current minimum for the method to be constructive in an ideation process.

5 An Essence and a Prospect

"Science isn't about why - it's about why not"

Cave Johnson

Portal 2 (Valve Corporation, 2011)

5.1 Conclusion

The goal of this thesis was to develop a method for creating intuitive interaction through game design. I started by exploring the foundational theories of Norman (2013) and used this knowledge to delve deeper into the critique and expansion by Djajadiningrat et al. (2002), Wensveen et al. (2004) and Stienstra et al. (2012). This was done in order to ground myself in the field of HCI which is the field of the identified framework created with the intention of assisting the design of intuitive person-product interaction.

Following the work of Wensveen et al. (2004), I explored their proposed Frogger Framework with a desire to improve and adapt this framework to a context of game analysis and design. I did this on the basis of the desire to further the academic research in the area of intuitive game design and with the intention of adapting said framework to a game context.

This lead to an exploration of embodied interaction, the identified branch of design that the Frogger Framework is based upon (Wensveen et al., 2004), and whether or not video games share enough similarities to be compatible. Dourish (2004), the author behind the definition of embodied interaction, explicitly states that video games do not belong in the branch of embodied interaction, because of the disconnection between the body and the game world (Dourish, 2004). Referencing Dourish's (2004) own notion of coupling, I voiced a possibility of being critical towards his argument. Then, being critical about his conclusion, I tested the credibility of his argument by exploring the rationale behind it, and at the same time analysing the nature of embodied interaction.

Exploring embodied interaction, this meant first exploring embodiment. For this, I positioned myself next to the phenomenological analysis of Dourish (2004), eventually reaching his definition of embodied interaction. Agreeing with the proposed definition, I argued against his exclusion of video games by referencing the same core phenomenological work of Husserl, Heidegger and Merleau-Ponty that he had analysed and the works of Vella (2015) and Calleja (2011). It was clear to me that there were unavoidable similarities between Heidegger's concept of zuhanden and Calleja's (2011) concept of internalisation of controls. Combining this with Vella's (2015) idea that a player's incorporation into the game world creates a point of origin, from where the player embodies the world, I finally made the argument that video games can be considered embodied interaction. This allowed me to establish a reworking of the Frogger Framework into a game context and to present a visual model.

The main difference from the Frogger Framework was presented as the distinction between the physical world and the game world. The distinction was made to address the detail that is to be found in interactions in the physical world and the game world and how they relate. The definition was first defined by the concept of diegesis (Bordwell & Thompson, 2012) and was further developed by drawing on the concept of the ludic heterocosm as described by Vella (2015). What was central in the drawing in of the ludic heterocosm was the defining characteristic of it not just being the world represented on the screen visualising the video game, but instead is the world imagined in the mind of the player, thereby being more vast and inclusive.

Then, continuing with the delimiting of this new framework, I delved into the concept of kinaesthetic involvement from Calleja (2011), putting emphasis on the relation between attention and internalisation of controls in video games. Here, I was concerned with finding the appropriate intention for the framework. The Frogger Framework is mainly focused on product design (Wensveen et al., 2004), and so far I had only argued for the possibility of its use in a general game context. Looking back at what notions made the adaptation possible, I realised that the appropriate focus was the application of control from the physical world into the game world, which is also the focus of kinaesthetic involvement (Calleja, 2011). With the intention of the Frogger Framework being to make intuitiveness of interaction clear (Wensveen et al., 2004), I too wanted the adaptation to have the intention of making controls clear, which Calleja (2011) would describe as being concerned with minimising the attention of the player towards kinaesthetic involvement and ultimately the internalisation of controls.

Next objective was then to delineate the appropriate context for the application of the framework, and for this, I needed a rigidly defined language. With the objective of defining the appropriate application context of the framework I first wanted to explore in what setting the framework would be most constructive. I looked for a way of defining the setting in which control can be asserted. For this, I used the definition of kinaesthetic challenges as provided by Karhulahti (2013). Briefly summarising the definition, Karhulahti (2013) describes kinaesthetic challenges as the required nontrivial effort at least partly necessitating the psychomotor skills of the player. This was identified as an appropriate setting since kinaesthetic involvement was identified as being implied in these types of challenges. Next, I looked for a definition of what I mean by asserting control. For this, I used the definition of game mechanics as methods invoked by agents, designed for interaction with the game state which was provided by Sicart (2008). Furthermore, I addressed the fact that if game mechanic is to be used in an analysis, it must not be considered a compound game mechanic, i.e. a game mechanic made up of several game mechanics, it should instead be broken up into the most basic form, as the complexity of analysing a compound game mechanic would lead to contradiction.

As an intermediate goal, I was able to propose and apply a comprehensive framework for analysing kinaesthetic challenges and game mechanics with results illustrating the intuitiveness of the context. With a framework for analysis, I set out to develop a method from said framework to be used in the context of game design. I identified the critical obstacle of this task to be the complexity of the framework, with it requiring an abundance of conscious effort. To solve this, I chose to divide the effort into the processes of playtesting and ideation. To test the constructiveness of the method, I gathered a group of possible users to act as both playtesters and designers and evaluate the method afterwards. The test revealed some problems with the structure of the interview during the playtest and some shortcomings in the preliminary instructions, both of which I have suggested possible solutions for. The overall result of the test did, however, show a desire from the participants to use the method in a design situation, revealing that the method can be constructive in designing for intuitive interaction in video games.

The proposed framework and method are both in their infancy and there is still work to be done. I consider this the inauguration of providing concrete methods for intuitive game design and hope for future research in this subject. Meanwhile, I end this thesis by identifying how the research presented here can be developed.

5.2 Perspective

As have been mentioned a few times by now, more needs to be done. The framework and the method should be applied in the intended situation; game analysis and game design, respectively. With the research presented here conforming to a mix of the practice of research as design studies (Fallman & Stolterman, 2010) and as research for design (Forlizzi, Zimmerman, & Stolterman, 2009), future research could be with the approach of research through design, a research approach that is gaining followers (Zimmerman et al., 2010; Forlizzi et al., 2009). The relevance of this approach can be seen in its defining productivity: "The work can result in the conceptual frameworks for design and evidence of the value of guiding philosophies for design. In addition, it can result in methods in support of conceptual frameworks and guiding philosophies" (Forlizzi et al., 2009, p. 2894). What would be the relevant result to have as a research goal, in this case, would be to prove, improve or disprove the proposed method. The straightforward concrete way to go about this would be to design a game and use the proposed method.

With this encouragement, I will provide two ideas for future research to act as starting blocks. One is an incentive to explore the proposed in-depth interview for games research method presented in Lankoski and Björk (2015) or similar interview techniques for a game context and combine relevant findings to the playtesting phase of the method. As was clear from the test of the method, the playtesting phase deserves critique and improvement, and this could be done by looking for inspiration in relevant methods in the area. The second idea is to explore supplementary frameworks and methods. The Mechanics Dynamics and Aesthetics (MDA) framework from Hunicke, LeBlanc, and Zubek (2004) is an example of a framework that can be used iteratively in a game design context. The authors explain how it can be used to tune a game's mechanics, dynamics and aesthetics (Hunicke et al., 2004), a process that complements the proposed method's process. Another relevant value of the MDA framework is its possibility to be used as a lens for looking at a game for both game designers and game players, which could be complementary for the two phases of the proposed method. Another source for relevant methods and approaches can be found in Järvinen (2008), where methods for identifying game mechanics, elements and goals are presented. Certainly, inspiration can be found here to formalise the identification of game mechanics and kinaesthetic challenges with the intention of analysis through the proposed framework or to assist the playtester in identifying critical game elements for later scrutiny by designers.

Finally, what has not been addressed is whether or not the six aspects of time, location, direction, modality, dynamics and expression is even suitable for a game context. What I have found is that especially the aspects of modality and expression rely highly on interpretation. What I would wish for further research is that effort is put in concretising what is of value in these six aspects.

References

Adams, E. (2014). *Fundamentals of game design.* Pearson Education.

Agustin, M., Chuang, G., Delgado, A., Ortega, A., Seaver, J., & Buchanan, J. W. (2007). Game sketching. In *Proceedings of the 2nd international conference on digital interactive media in entertainment and arts* (pp. 36–43). New York, NY, USA: ACM. Retrieved from `http://doi.acm.org/10.1145/1306813.1306829` doi: 10.1145/1306813.1306829

Bethesda Game Studios. (2011). *The elder scrolls v: Skyrim.* Bethesda Softworks.

Bordwell, D., & Thompson, K. (2012). *Film art: An introduction* (7th ed.).

Bullet-Proof Software. (1989). *Tetris.* Nintendo.

Buxton, B. (2007). *Sketching user experiences: Getting the design right and the right design.* Morgan Kaufmann.

Calleja, G. (2011). *In-game: From immersion to incorporation.* MIT Press.

CD Projekt Red. (2015). *The witcher 3: Wild hunt.* CD Projekt.

Chaboki, B., van Oorschot, R., Torguet, R., Wu, Y., & Yao, J. (2012). Interaction design feedback and feed forward framework: Making the interaction frogger tangible. *Proc. of SIDeR'12*.

Cresswell, J. W. (2009). *Research design: Qualitative, quantitative and mixed methods approaches.* SAGE Publications.

Djajadiningrat, T., Matthews, B., & Stienstra, M. (2007). Easy doesn't do it: skill and expression in tangible aesthetics. *Personal and Ubiquitous Computing*, *11*(8), 657–676.

Djajadiningrat, T., Overbeeke, K., & Wensveen, S. (2002). But how, donald, tell us how?: On the creation of meaning in interaction design through feedforward and inherent feedback.

Dourish, P. (2004). *Where the action is: The foundation of embodied interaction.* The MIT Press.

Elias, G. S., Garfield, R., & Gutschera, R. K. (2012). *Characteristics of games.* MIT Press.

Fallman, D., & Stolterman, E. (2010). Establishing criteria of rigour and relevance in interaction design research. *Digital Creativity*, *21*(4), 265–272.

Forlizzi, J., Zimmerman, J., & Stolterman, E. (2009). From design research to theory: Evidence of a maturing field. In *International assoc. of societies of design research conference.*

Fullerton, T. (2014). *Game design workshop: A playcentric approach to creating innovative games* (3rd ed.). CRC Press.

Game Freak Inc. (1996). *Pokémon blue version.* Nintendo.

Haans, A., & Ijsselsteijn, W. A. (2012). Embodiment and telepresence: Toward a comprehensive theoretical framework. *Interacting with Computers*, *24*(4), 211–218.

Heidegger, M. (1962). *Being and time, trans. j. macquarrie and e. robinson.* New York: Harper & Row.

Houde, S., & Hill, C. (1997). What do prototypes prototype? *Handbook of Human-Computer Interaction (2nd Ed.).*

Huizinga, J. (1980). *Homo ludens.* Routledge and Keagan Paul.

Hummels, C., Overbeeke, K. C., & Klooster, S. (2007). Move to get moved: a search for methods, tools and knowledge to design for expressive and rich movement-based interaction. *Personal and Ubiquitous Computing*, *11*(8), 677–690.

Hunicke, R., LeBlanc, M., & Zubek, R. (2004). Mda: A formal approach to game design and game research. *Proceedings of the AAAI Workshop on Challenges in Game AI (Vol. 4, No. 1, p. 1722).*

Järvinen, A. (2008). *Games without frontiers: Theories and methods for game studies and design.* Tampere University Press.

Karhulahti, V.-M. (2013). A kinesthetic theory of videogames: Time-critical challenge and aporetic rhematic. *Game Studies*, *13*(1).

Kojima Productions. (2008). *Metal gear solid 4: Guns of the patriots.* Konami.

Krippendorff, K., & Butter, R. (1984). Product semantics - exploring the symbolic qualities of form. *Departmental Papers (ASC)*, *3*.

Lankoski, P., & Björk, S. (2015). *Game research methods: An overview.* Lulu. com.

Merleau-Ponty, M. (1962). *Phenomenology of perception, trans. colin smith.* London: Routledge and Kegan Paul.

Morris, S. (2002). First person shooters: A game apparatus.

Naughty Dog. (1998). *Crash bandicoot: Warped.* Sony Computer Entertainment.

Nintendo Creative Department. (1985). *Super mario bros.* Nintendo.

Nintendo EAD. (1991). *The legend of zelda: A link to the past.* Nintendo.

Nintendo EAD. (2011). *The legend of zelda: Skyward sword.* Nintendo.

Norman, D. (1988). *The design of everyday things.* The MIT Press.

Norman, D. (2013). *The design of everyday things: Revised and expanded edition.* Basic Books.

Salen, K., & Zimmerman, E. (2003). *Rules of play: Game design fundamentals.* The MIT Press.

Schell, J. (2008). *The art of game design: A book of lenses.* Morgan Kaufmann.

Sicart, M. (2008). Defining game mechanics. *Game Studies*, *8*(2), 1–14.

Sicart, M. (2014). *Play matters.* MIT Press.

Stienstra, J., Alonso, M. B., Wensveen, S., & Kuenen, S. (2012). How to design for transformation of behavior through interactive materiality. *NordiCHI '12*.

Totten, C. W. (2014). *An architectural approach to level design.* CRC Press.

Valve Corporation. (2011). *Portal 2.* Valve Corporation.

Vella, D. (2015). *The ludic subject and the ludic self: Analyzing the 'i-in-the-gameworld'* (Unpublished doctoral dissertation). IT-University of Copenhagen.

Vella, D. (2016, August). Who am i in the game: A typology of the modes of ludic subjectivity. In *Digra fdg 3916 - proceedings of the first international joint conference of digra and fdg.* Digital Games Research Association and Society for the Advancement of the Science of Digital Games.

Vermeulen, J., Luyten, K., van den Hoven, E., & Coninx, K. (2013). Crossing the bridge over norman's gulf of execution: revealing feedforward's true identity. In *Proceedings of the sigchi conference on human factors in computing systems* (pp. 1931–1940).

Wensveen, S., Djajadiningrat, J., & Overbeeke, C. (2004). Interaction frogger: a design framework to couple action and function through feedback and feedforward. *DIS '04*.

Zimmerman, J., Stolterman, E., & Forlizzi, J. (2010). An analysis and critique of research through design: towards a formalization of a research approach. In *Proceedings of the 8th acm conference on designing interactive systems* (pp. 310–319).