2K-Reality: Designing a Compliant Sports Augmentation for Pickup Basketball

A thesis submitted in fulfilment of the requirements for the degree of
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DECLARATION

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

I acknowledge the support I have received for my research through the provision of an Australian Government Research Training Program Scholarship.

Timothy P. Ryan
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ABSTRACT

This dissertation details my design, evaluation and interpretation of a videogame-based sports technology called 2K-Reality that I designed to augment the experience of playing and watching pickup basketball. 2K-Reality blends a sports videogame with pickup basketball by remediating sounds appropriated from the NBA 2K12 basketball videogame. Installed next to a basketball court, 2K-Reality invites people to actuate a tablet-based digital audio sampler housed in a kiosk connected to public address (PA) speakers. Pickup basketball spectators adopt the role of a make-believe National Basketball Association (NBA) arena-deejay to perform interpretive NBA-themed soundscapes that articulate and amplify the action of pickup basketball games. The soundscapes create a make-believe NBA experience by immersing players and spectators in a mix of broadcast-style commentary, arena-style crowd sound effects and contemporary music break beats.

Physical inactivity is one of the leading causes of mortality worldwide. International public health and sports management reports, including the recent World Health Organization Global Action Plan On Physical Activity 2018-2030, recommend utilising grassroots sports and digital innovations to encourage physical activity. My research project responds to these recommendations by designing a videogame-based digital platform that promotes fun to enhance the affective benefits of physical activity in public playspaces.

Pickup basketball presents a unique opportunity for designing a sports technology innovation that responds to the physical inactivity issue. Played by millions around the world, pickup basketball is an autonomous social sports activity motivated by fun and immediate gratification. Accordingly, my practice-based research project addresses the design question: How can I design a videogame-based sports technology innovation for pickup basketball, that is compliant with the social practice and the spatiotemporal norms of the sport? My response employs a meaning-driven innovation method theorised by Donald Norman and Roberto Verganti, and a playful design approach guided by a personal design hypothesis I call compliant sports augmentation.

My research project contributes to Games Studies perspectives that seek to augment everyday activities with new digital elements to afford playful and creative experiences. 2K-Reality demonstrates how a playful design can augment grassroots sports make-believe in public playspaces. Based on participant-observer interpretations, I argue that 2K-Reality changes the meaning of playing and watching pickup basketball without impeding the norms of the practice. Spectators using 2K-Reality actively participate in pickup basketball games and provide players with an opportunity to perform on the ‘big stage’—a universal and motivating sports fantasy.

My original contribution to knowledge is the 2K Reality sports technology design artefact and my Compliant Sports Augmentation Framework, which offers perspectives for designing sports technology that respects and cultivates the existing norms and values of casual grassroots sport.
Contemplating, conducting and completing this PhD research project would not have been possible without the support of many people.

Special thanks to Dr Jonathan Duckworth, my supervisor. I’m incredibly grateful for his support, patience, flexibility and understanding. Thanks also to my co-supervisor Dr Lisa Dethridge, who assisted me greatly during the later stages of my project. And thanks to Edward Caruso for his editorial assistance.

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Creating 2K-Reality would not have been possible without the inspiration and support I received from my great friend, the late David J. Rule (1969-2019). My research project is dedicated to Dave.

Developing the 2K-Reality iOS App was made possible thanks to the incredibly generous contribution made by my friend and colleague—software engineer 黃一葦 (Vincent Huang). Evaluating 2K-reality in Taipei was greatly assisted by much-appreciated support from 朱旭建 (Hsu-Cheng Chu) and 丑宛茹 (Wan-Ru Chou) from Shih Chien University’s Department of Industrial Design; and the fantastic Shih Chien University students who worked with me as research assistants: 林寬祐 (Edward Lin), 羅峥榮 (Ron Lo), 洪嘉懋 (James Hung), 鄭雅琦 (Nessie Zheng), 任懋君 (Alex Ren), and 楊郁謙 (Kent Yang). Furthermore, special thanks to Edward, Ron and James for collaborating to produce the 2K-Reality ISEA2015 exhibition kiosk and poster.

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Who hasn’t been a sports star, at least once in their lifetime, even if it’s only in their own mind? In the playground, in the backyard, in suburban sports halls, we’ve all been a star, feeling the cheering of the crowds, the rush of adrenaline of knowing we’re the best, and any challenge out there against us will be just too easy. Playing sports casually, and playing sports videogames, are about performing the impossibilities of professional sports, letting us dream the possibilities of being our heroes (Sicart, 2013, p. 32).

Miguel Sicart
A Tale of Two Games
Chapter 1: Introduction

1.1 PROJECT DESCRIPTION

I have designed an acoustic-augmented reality installation called 2K-Reality to enhance the experience of playing and watching pickup basketball, a popular grassroots sport. 2K-Reality augments real-world pickup basketball games with amplified sounds appropriated from the NBA 2K12 (Visual Concepts, 2011) videogame.

In the world of basketball, ‘2K’ is shorthand for the basketball videogame series NBA 2K published by 2K Sports. The name 2K-Reality signifies bringing sounds from the NBA 2K virtual world into real-world basketball playspaces.

2K-Reality creates NBA-themed soundscapes that immerse basketball players and spectators in a make-believe acoustic atmosphere reminiscent of NBA arenas, NBA television broadcasts, NBA sports videogames and NBA amusements.

2K-Reality can be experienced in three ways: i) as a pickup basketball player, ii) as a spectator or bystander, or iii) as a make-believe NBA-arena-deejay—a performative soundscape orchestrator who interacts with the 2K-Reality interface.

My research project may demonstrate how sports technology can enhance the enjoyment of playing and watching grassroots sports by encouraging elite sports mimicry and make-believe.
2K-Reality is designed to be installed in public basketball playspaces and privately owned public spaces (POPS) such as recreation facilities. Figure 1 illustrates a 2K-Reality installation in an urban pickup basketball playspace with a detail that magnifies the kiosk and orchestrator.


Installed next to one end of a basketball court; 2K-Reality comprises a tablet-based digital audio sampler housed in a kiosk connected to public address (PA) speakers. Pickup basketball spectators are invited to adopt the role of a make-believe NBA-arena-deejay to perform NBA-themed soundscapes that portray the pickup basketball games they observe. The soundscapes immerse the court and surrounding playspace in a mix of broadcast-style commentary, arena-style crowd sound effects and contemporary music break beats. The soundscapes create a make-believe NBA experience: a videogame-based acoustic-augmented reality experience that blends the NBA 2K videogame series with real pickup basketball.
As shown in Figure 2 below, the 2K-Reality tablet-based digital audio sampler comprises an iPad 2 running a custom-designed 2K-Reality iOS App. The App interface is designed for activating and mixing 138 discreet commentary samples, three crowd sounds, and twenty-four break beats.

**Figure 2.** The 2K-Reality iOS App interface. The top three rows of buttons active broadcast-style commentary sounds. The bottom row of buttons activates atmospheric sounds—the red button activates music break beats and the aqua buttons activate arena-style crowd sound effects.

Top row; L - Layup; S - Shoots; M - Misses; H - Hits.
Second row; SA - Shots Again; S3 - Shoots 3; M3 - Misses 3; H3 - Hits 3.
Third row; GP - General Play; O - Offence; D - Defence; X! - Exclamation.
Bottom row; B - Beats; CB - Crowd Boos; C - Crowd; CC - Crowd Cheers.
Table 1 lists the components of the 2K-Reality prototype installation systems deployed during my research project.

Table 1.

<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>2K-REALITY INSTALLATION SYSTEMS</th>
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<tbody>
<tr>
<td></td>
<td>RAPID PROTOTYPE</td>
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<tr>
<td>KIOSK</td>
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<tr>
<td>SAMPLER USER INTERFACE</td>
<td>Maschine Mikro MK2 Sampler</td>
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<tr>
<td>GRAPHIC USER INTERFACE</td>
<td>16 Illuminated Buttons, Colour-coded &amp; Labelled</td>
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<td>CPU HARDWARE</td>
<td>Apple MacBook Air</td>
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<td>AUDIO INTERFACE</td>
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<td>SOFTWARE PROGRAM</td>
<td>MacOS Maschine 2</td>
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<tr>
<td>NBA 2K12 COMMENTARY</td>
<td>61 Samples</td>
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<tr>
<td>NBA 2K12 CROWD SOUNDS</td>
<td>3 Samples</td>
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<tr>
<td>BREAK BEATS MUSIC</td>
<td>20 Samples</td>
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<tr>
<td>CONTENT RANDOMISATION</td>
<td>Manual Switching 20 Maschine 2 Project Files 20 x 5 Interface Sample Groups</td>
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<td>TRAJECTORY CONTROLS</td>
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</tr>
<tr>
<td>PA SYSTEM</td>
<td>2 x Behringer B300 Powered 300w Loudspeakers</td>
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1.2 BACKGROUND TO RESEARCH

To conduct my research project, I need to study the cultural practice of pickup basketball and know more about playful design and make-believe within the discipline of Game Studies. I also need to learn about Design Studies perspectives that view design and innovation as a hermeneutic practice.

Pickup basketball is a casual grassroots sport and an exemplary form of ‘deliberate play’; a definition of play proposed by sports psychologist Jean Côté (1999). Deliberate play refers to voluntary modified-rule-based sports activities such as pickup basketball, backyard cricket and street football. Deliberate play participants are intrinsically motivated, and they peer-regulate activities to mimic organised sports and maximise enjoyment. Understanding the characteristics of deliberate play may support the design of meaningful sports technology innovations for the increasing amount of people that participate in casual grassroots sports. Furthermore, designing sports technology that acknowledges and maintains the characteristics of deliberate play is an appropriate ethical approach, according to sports philosopher and sports technology ethicist Sigmund Loland (2002).

Playful design presents an approach to augmenting the characteristics of basketball deliberate play that lead to fun and immediate gratification. Games and play scholars Steffen P. Walz and Sebastian Deterding define the concept of ‘playful design’ as the augmentation of everyday activities with new digital elements or qualities to afford playful experiences (Walz & Deterding, 2015). The concept of playful design includes approaches encouraged by design theorists such as Bill Gaver and play scholar Miguel Sicart, who advocate technology design strategies that prioritise enhancing experiences rather than increasing productivity and efficiency (Gaver, 2008; Sicart, 2015). For example, Sicart argues that Gaver’s notion of ludic design can be employed to support eudaimonia—the good life. Sicart reflects on the act of running to explain that the experience goes well beyond number crunching; and suggests sports technology designers can adopt a ludic design attitude to focus on autonomy, agency and creativity, rather than quantifiable outcomes such as distance and pace (Sicart, 2015).

I situate my research project within playful design and relational art practices. Game theorist Mary Flanagan argues that playful design is related to historical artistic practices that sought to expand, enhance, examine and question everyday experiences. Flanagan cites the Fluxus community of experimental artists as a prime example (Flanagan, 2009). Fluxus artists provide me with an analogue precursor for both playful sports technology design and videogame art. According to game theorist Celia Pearce, Fluxus artists appropriated games and sports as ‘ludus populi’—“a play of the people that provided the perfect platform for bringing art to a mass audience” (Pearce, 2006, p. 72). Fluxus members, including George Maciunas, Larry Miller and Bici Hendricks, altered the ready-made structure of sports to promote playfulness; for example, Hendricks introduced stilts into football. Furthermore, Pearce explains that contemporary digital game art, including videogame art, employ techniques to create participatory co-creation experiences that expand Fluxus game art practices (Pearce, 2006).
Digital game art practices include the new forms of games that augment everyday life with digital technology, generally referred to as Pervasive Games. Many of these games employ make-believe (Deterding, 2016). Deterding identifies four design aspects of make-believe; “theming; storification [or narrative]; scripting, ruling, and framing; and role-playing” (Deterding, 2016, p. 109). Deterding suggests that unifying the design aspects of make-believe can create sophisticated and compelling augmented experiences (Deterding, 2016). Analysing how make-believe can behave as “a potent ‘active ingredient’ of play and games” (Deterding, 2016, p. 117) is vital to my research; it provides a way to understand how my sports technology design acts as a make-believe prop to augment the enjoyment of playing and watching pickup basketball.

According to interaction design theorists, Falk, Redström and Björk, ‘amplified reality’ enhances expressions with embedded technology to produce shared public experiences (Falk, Redström & Björk, 1999). Using amplified reality as a playful design medium may help identify the potential of auditory augmented reality for grassroots sports (Falk et al., 1999). This concept allows us to comprehend the design features of computer-augmented environments that prioritise expression and social experiences.

### 1.3 RATIONALE

The World Health Organization’s *Global Action Plan On Physical Activity 2018-2030* suggests that “there are opportunities for digital innovations to promote and support people of all ages to be more active” (WHO, 2018, p. 7). Likewise, the *Designed to Move: A Physical Activity Action Agenda* report recommends embracing technology for encouraging physical activity. The report calls for fun digital innovations that can compete with popular sedentary activities (MacCallum, Howson & Gopu, 2012). My research project responds to this call by aiming to encourage physical activity with a videogame-based digital platform; “to enable and inspire participation and creativity in physical activity” (MacCallum et al., 2012, p. 40). I seek to enhance the fun and joy of grassroots sports, the primary motivation for participation (Wiium & Säfvenbom, 2019; Allender, Cowburn & Foster, 2006; Seippel, 2006; Henderson, Glancy & Little, 1999).

The design question that emerged from my design practice and frames my research project is: **How can I design a videogame-based sports technology innovation for pickup basketball that is compliant with the social practice and the spatiotemporal norms of the sport?** This question reflects those posed by leading mental health and media researcher Cheryl Olson, who asks:

“Is there any evidence that videogames can support real-world sports?” (Olson, 2015, p. 282), and; “how might we use commercially available sports videogames to influence the variables necessary to encourage physical activity?” (Olson, 2015, p. 287).

Encouraging physical activity is an important issue for public health and sports management (Eime et al., 2015). In 2012, physical inactivity was declared a global pandemic (Kohl 3rd et al., 2012). Accordingly, interdisciplinary researchers that contribute to the Lancet Physical Activity Series urge all sectors of government and society in all countries to take immediate action.
to get people moving (Reis et al., 2016). In response, public health researchers advise that prioritising investments in enjoyable grassroots sports (GAPA, 2011), improving urban spaces for recreation (Sallis et al., 2016), and adopting innovative technology can potentially make significant contributions to increasing physical activity (WHO, 2018).

Pickup basketball presents a unique situation for designing a sports technology innovation that encourages physical activity by enhancing enjoyment. According to the Basketball All-Party Parliamentary Group in the United Kingdom, “there is no more efficient sporting vehicle than basketball to improve outcomes for individuals and communities” (Basketball All-Party Parliamentary Group, 2014, p. 1).

Recent sports technology innovations designed for grassroots participants are primarily quantified-self products—personal sensor-augmented devices that track performance metrics and provide analytical data as feedback on smartphones. Innovation and entrepreneurship scholar Vanessa Rattan argues that the field of sports management needs to adopt a more creative and interdisciplinary approach to design emerging technology applications for casual grassroots sports (Ratten, 2018). Playful design strategies informed by art and design practices such as Fluxus and ludic design present an alternative approach to designing sports technology for grassroots sports.

Interpreting the enjoyment inherent to playing and watching pickup basketball invites the consideration of designing a sports technology innovation that supports mimicry and make-believe. As sports historian Andrew D. Morris and sports philosopher Tim Elcombe note, pickup basketball players often mimic NBA athletes and pretend to be NBA stars by performing exciting play scenarios in an imaginary world (Morris, 2002; Elcombe, 2007). And as Sicart explains in the epigraph of this dissertation, mimicry and make-believe occur when playing pickup basketball and when playing basketball videogames (Sicart, 2013).

When pickup basketball players and NBA videogame players employ make-believe, basketball courts and the basketball videogames act as make-believe props. Philosopher Kendall Walton describes this phenomenon as prop oriented make-believe; whereby make-believe emerges from the interaction with objects (Walton, 1993). Game design theorist Sebastian Deterding finds from a survey of empirical research and design literature that designing playful technology to support make-believe in real-world situations has been neglected (Deterding, 2016). Deterding’s findings suggest that an opportunity exists for playful design props that support other forms of NBA make-believe.

Applied cognitive scientist Donald A. Norman and innovation management scholar Roberto Verganti argue that design research based on interpretation is capable of producing meaning-driven innovations (Norman & Verganti, 2014). Building on design theorist Klaus Krippendorff’s view that design artefacts are a medium for communicating meanings (Krippendorff, 1989), the meaning-driven innovation concept prioritises the novel interpretation of sociocultural models while exploring new technologies without initial concern for practical implementation. It consequently asks designers to ‘envision new meanings’ in the context of a specific design situation (Norman & Verganti, 2014).
My research project applies Norman and Verganti’s Design Research Quadrangle framework to propose a sports technology meaning-driven innovation that functions as a make-believe prop. By blending NBA videogames with real pickup basketball to create a shared mixed reality experience, I seek to contribute to the playful design and make-believe discourse in the field of Game Studies. In particular, by illustrating how ‘amplified reality’ can unify the design dimensions of make-believe to enhance real-world grassroots sports; in a manner compliant with existing social practices and spatiotemporal norms.

1.4 METHODOLOGY

I am a practitioner-researcher and my PhD research project is practice-based. My project applies the ‘model of practitioner research’ recommended by Edmonds and Candy (2010). My dissertation describes and analyses the 2K-Reality sports technology design artefact and audience experience to demonstrate critical reflection, provide a basis for my claims of originality, and share the outcomes of my research project.

As illustrated in Figure 3, my research project implements five components of Edmonds and Candy’s model of practitioner research to link practice, theory and evaluation: i) I develop a practitioner framework to establish design criteria that guide the conceptual development of my sports technology design artefact; ii) I describe the creative process I used to design the 2K-Reality sports technology design artefact; iii) I report the studies I used to evaluate the use of 2K-Reality and the audience experience; vi) I apply theory to interpret and understand the 2K-Reality design; and v), based on the results of my project, I formalise my practitioner framework to produce a sports technology design framework for grassroots sports.

Figure 3. Model of practitioner research: 2K-Reality project trajectory.
In Chapter 2, I review a selection of literature relevant to my research project. I will begin by introducing the cultural practice of pickup basketball. I discuss the aspects of the sport that present a design opportunity and influence my practitioner framework. I examine playful design theory and associated concepts—videogame art creative strategies, augmenting everyday activities with make-believe, and visions held by scholars for ubiquitous computing and augmented reality. I will also examine the Design Research Quadrangle framework, which I applied to design 2K-Reality. The four components of the framework are: vision-driven research, bricolage, design-driven research, and human-centred design research (Norman & Verganti, 2014).

Following Edmonds and Candy’s model of practitioner research, my research questions emerged from my design practice and my design objective—to design a videogame-based sports technology innovation for the practice of pickup basketball. I will discuss my research project by addressing three research questions:

**Research Question One:** How can the Design Research Quadrangle framework be applied to design a sports technology innovation for pickup basketball?

I address Research Question One in Chapter 3. To answer the question, I develop a practitioner framework and use Norman and Verganti’s Design Research Quadrangle framework to recount how I designed two 2K-Reality prototypes. Norman and Verganti devised the framework to link interpretive design research with innovation; they argue that integrating the quadrangle’s design approaches can lead to the design of meaning-driven innovations (Norman & Verganti, 2014).

**Research Question Two:** What can we learn from evaluating the 2K-Reality in context?

I address Research Question Two in Chapter 4. To answer the question, I use human-centred design research to evaluate 2K-Reality in situ. I use ‘urban probes’ to conduct participant-observer research and collect participant feedback in pickup basketball playspaces located in Melbourne, Taipei and Vancouver. Paulos and Jenkins proposed the urban probe research method by drawing upon ‘cultural probes’ (Paulos & Jenkins, 2005); an approach first introduced by interaction design researchers Bill Gaver, Tony Dunne, and Elena Pacenti. Accordingly, my evaluation of 2K-Reality employs an ethnographic approach that Gaver et al. describe as ‘probology’, which “values uncertainty, play, exploration, and subjective interpretation” (Gaver, Boucher, Pennington & Walker, 2004, p. 53).

**Research Question Three:** How may we interpret and understand 2K-Reality?

I address Research Question Three in Chapter 5. To answer the question, I apply theory discussed in previous chapters to interpret the 2K-Reality design, so we may understand the 2K-Reality experience. I will analyse how 2K-Reality functions as a make-believe prop by examining 2K-Reality through Deterding’s four design aspects of make-believe; “theming; storification [or narrative]; scripting, ruling, and framing; and role-playing” (Deterding, 2016, p. 109). I will also discuss how 2K-Reality unifies the design aspects of make-believe.
In Chapter 6, I will conclude my research project by synthesising my research findings. I will identify the attributes of 2K-Reality that may contribute to Game Studies by discussing the two outcomes my project produced: i) the 2K-Reality sports technology meaning-driven innovation, and ii) the Compliant Sports Augmentation Framework (CSAF). I will suggest that using sports videogame sounds to amplify the mimicry and make-believe inherent to grassroots sports is a novel approach to sports technology design. And I discuss how this playful design strategy may contribute a response to contemporary issues facing public health and sports management organisations. I will also suggest that my CSAF may assist the design of digital sports technology for grassroots sports. The framework presents perspectives that promote the design of digital sports technology for deliberate play rather than deliberate practice. I will complete my dissertation by discussing future design research directions and the broader applications of the 2K-Reality playful design.
Chapter 2: Review of Literature

Design Question
How can I design a videogame-based sports technology innovation for pickup basketball that is compliant with the social practice and the spatiotemporal norms of the sport?

2.1 INTRODUCTION

In this chapter, I will review a broad range of literature concerning the intersecting domains relevant to my research project.

In Section 2.2, I introduce the cultural practice of basketball and define pickup basketball. I will identify the characteristics of the sport that present the design opportunity for my research project. I will also discuss the issue of physical inactivity that provides a social context for my research project beyond my design practice.

In Section 2.3, I discuss the theoretical perspectives that inform a playful design approach to augmenting everyday experiences. I will also discuss the strategies employed to create videogame art, theories that support make-believe playful designs, and the medium of amplified reality.

In Section 2.4, I discuss the design research and innovation concepts that support practice-based research and meaning-driven innovation—the ideas and theories that help reveal the hermeneutic philosophy that underpins my design practice; and describe the development of the method I adopted to conduct my research project.

In Section 2.5, I provide an overview of Norman and Verganti’s Design Research Quadrangle framework. I discuss each component of the framework: vision-driven research, bricolage, design-driven research, and human-centred design research. To develop a clear understanding of how I can employ the framework as a practice-based research method, I introduce established design theory developed by other theorists.

2.2 PICKUP BASKETBALL DESIGN SITUATION

2.2.1 Basketball

Thomas McLaughlin, author of Give and Go: Basketball as a Cultural Practice, cultural studies scholar and lifelong pickup basketball player, describes basketball as a “significant and powerful cultural practice” (McLaughlin, 2008, p. 2, emphasis in original). Invented in 1891 by Canadian-American Dr Jim Naismith, basketball is now the number two sport globally. According to the International Basketball Federation (FIBA), over 450 million people play the game regularly and 213 countries participate in basketball internationally (FIBA, n.d.a). “For many of those millions the game is a central part of their identity” (McLaughlin, 2008, p. 2).

Although governed by FIBA, it is the NBA of the United States that influences the culture of both organised and unorganised basketball. According to sports sociologist David L. Andrews, the
NBA has created a global basketball culture by arguably becoming the quintessential exemplar of the sports entertainment media industry (Andrews, 2006). As McLaughlin explains, "the game is bigger and richer than its representation, but its representation plays a bigger role in our culture" (McLaughlin, 2008, p. 193).

While the number one global sport, football, rightfully retains the title of the ‘beautiful game’, the sports philosopher Tim Elcombe argues that from an experiential perspective “basketball uses lived space better than any other sport” (Elcombe, 2007, p. 215), making it the ‘phenomenal game’, “the richest sport for human experience” (Elcombe, 2007, p. 217). In addition to it’s appealing experiential quality, basketball’s grassroots popularity can in part be attributed to its minimal equipment requirements (Smart, 2005; Elcombe, 2007) and the ease of weaving the spatial requirements of basketball into the urban fabric of cities (Smart, 2005; Rabinovitch, 2009).

### 2.2.2 Pickup Basketball

Pickup basketball is a term used to describe the casual grassroots version of basketball, played in public playspaces and POPS (Privately Owned Public Spaces) without the institutional constraints imposed by organised basketball. Thomas McLaughlin describes it as thus:

“Pickup basketball is made up in the moment, by the players themselves, with no one to tell them how to do it, what decisions to make or how to relate to each other. They have to improvise it all, in the real-time experience of the game… Pickup basketball is a rough democracy, created by the players and for the players, and in that sense, the game finds its purest expression on the schoolyard, in the driveway, in the church hall, or at the Y, not at Madison Square Garden or the Staples Centre. Almost all players, even at the NBA level, would agree with this assessment, romantic as it seems” (McLaughlin, 2008, pp. 16–17).

The impromptu and improvised nature of pickup basketball means the term can also represent a range of basketball trajectories. The magic number for pickup basketball is considered to be six, which allows players to play 3-on-3; however, pickup basketball can be played by two people as 1-on-1, by four as 2-on-2 etc. Pickup basketball also includes shooting hoops, the act of playing solo basketball; and basketball folk games, such as H.O.R.S.E., whereby players take turns emulating each other’s shots from different positions on the court.

Many pickup basketball trajectories may be considered ‘deliberate play’ (see Section 2.2.4 below). However, it must be noted that pickup basketball can be as serious as any organised competitive game, if not more so (McLaughlin, 2008). In the United States, disputed foul calls in games of pickup basketball have prompted murders (Evans, 2015; West, 2016). The ‘rough democracy’ created by players is dependent upon many factors, so the character of the game can vary greatly; “pickup basketball is a living culture that responds to the local circumstances and personal histories of its players” (McLaughlin, 2008, p. 2). The country, the location, the time of day at a particular court, the quality and number of players etc. can influence norms, the negotiation of rules and the intensity of play.
The many trajectories of pickup basketball imply that a sports technology innovation designed for the practice needs to adapt to a broad range of possible playing styles and gameplay forms.

### 2.2.3 Pickup Basketball Research

Sociologist Kenneth Sean Chaplin notes in his Doctoral Dissertation: *Culture, Structure, and Race in Pick-Up Basketball: Everyday Hoops Inside a Predominantly White University Student Recreation Center*, that sociological studies of pick-up basketball remain few; most of the literature regarding basketball has focused on organised basketball (Chaplin, 2015). Of the research that has explored pickup basketball, the majority of scholars have concentrated on pickup basketball played in the United States, and often focus on race, masculinity and identity issues (Chaplin, 2015; DeLand, 2018; DeLand, 2014; DeLand, 2012; Jimerson, 1999; Anderson & Millman, 1998; Ballard, 1998). Likewise, McLaughlin’s extensive investigation into the culture of pickup basketball is focused on pickup basketball in the United States (McLaughlin, 2008). My research project was, however, inspired by pickup basketball experiences in China, Taiwan and Australia; where the specific cultural variations evident in each location differ significantly from pickup basketball in the United States. Additionally, sociologist Jason Jimerson argues that survey research, including his own, that has explored the reasons for playing pickup basketball in the United States has decontextualised the most important stated reason for playing; that being, fun (Jimerson, 1999).

Asia’s sports historian Andrew D. Morris wrote about pickup basketball in China in his 2002 paper: *I Believe You Can Fly: Basketball Culture in Post-socialist China*. Although written some time ago, his work is a unique English language insight into the influence the NBA has on the culture of basketball in China; where an estimated 300 million people play the game (Cottrell, 2015). Morris contends that the NBA basketball culture Chinese youth are exposed to makes basketball much more than a sport. For many it is an avenue “for the very creation and redefinition of personal identities” (Morris, 2002, p. 26). Morris highlights survey responses that demonstrate the importance of performative expression for post-socialist Chinese pickup basketball players; the game provides a platform for showing off individual style and making more people aware of who they are (Morris, 2002).

Morris’ findings are particularly relevant to my research project. Chinese pickup basketball players share a desire to show off—to play with style, to ‘perform”; just as inner-city youths do in the United States (Ballard, 1998). Celebrating expressive performance rather than enhancing athletic performance became a distinguishing feature of my research project.

My search for pickup basketball sports science literature uncovered one paper that identifies the skills and performance patterns of regular pickup basketball players. Physical education scholars—Jianyu Wang, Wenhao Liu and Jeffrey Moffit—analysed the performance of sixty-five players during pickup basketball games. All of the participants in the study played pickup basketball regularly, for at least forty minutes a week. When surveyed, most of the participants (58.9%) rated their basketball skill level as good or excellent; and nearly half of the participants (48.8%) reported learnt the basketball skills they performed by themselves, or by playing with
family and friends (Wang, Liu & Moffit, 2010). The study assessed four skill indicators: passing, dribbling, shooting and rebounding, and found that “almost all the frequently used skills and tactics are basic” (Wang et al., 2010, p. 45). This finding supports my historical observations of the aesthetics of pickup basketball that my research project seeks to celebrate.

My search for pickup basketball oriented research projects highlighted the work of exertion games researchers Alan Chatham and Florian ‘Floyd’ Mueller. Their *Half-court Show* research project demonstrates how adding a digital display to a public basketball playspace can stimulate performative play, increase exertion levels, and enhance social interaction (Chatham & Mueller, 2013). *Half-court Show* employed an LED screen that mimicked the form of ‘shot clocks’ used in elite basketball. The screen displayed scrolling pre-authored ‘trash talk’ comments and data collected by a sensor (Chatham & Mueller, 2013). This project suggests an opportunity for introducing other forms of trickle-down technology into grassroots sports playspaces to enhance enjoyment.

### 2.2.4 Deliberate Play and Deliberate Practice

‘Deliberate play’ is a definition of play proposed by sports psychologist Jean Côté (1999). The term ‘deliberate play’ was initially chosen to differentiate activities such as pickup basketball, street hockey and backyard soccer etc. from other forms of childhood play in the early sampling years of playing sports (Côté, Lidor & Hackfort, 2009). The term ‘deliberate play’ has since been used more generally to refer to unstructured play in sport (Baker & Young, 2014). Deliberate play activities are intrinsically motivated, peer-regulated sports activities that mimic organised sports to maximise enjoyment and provide immediate gratification (Berry, Abernethy & Côté, 2008).

Deliberate play activities are distinct from ‘structured practice’ activities associated with organised sport, and ‘deliberate practice’ activities. Deliberate practice, a theory developed by expert performance psychologist Anders Ericsson (Ericsson, Krampe, & Tesch-Römer, 1993), is an example of cognitive approaches applied to the acquisition of expertise in sports (Côté et al., 2009). Deliberate practice describes highly structured sports activities, such as shooting drills, that are “motivated by the goal of improving performance rather than inherent enjoyment” (Côté et al., 2009, p. 8).

Table 2 shows the dimensions of sports play and practice. My research project is primarily concerned with basketball deliberate play, players for whom fun and immediate gratification are the primary motivation for playing, and who are not concerned with immediately correcting or improving their performance. Figure 4 shows a typical example of basketball deliberate play in China. Figure 5 shows an exaggerated form of basketball deliberate practice in China.
Table 2.
Sports Play and Practice

<table>
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<th>DIMENSIONS</th>
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<th>STRUCTURED PRACTICE</th>
<th>DELIBERATE PRACTICE</th>
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<td>GOAL</td>
<td>Fun</td>
<td>Improve Performance</td>
<td>Improve Performance</td>
</tr>
<tr>
<td>PERSPECTIVE</td>
<td>Process</td>
<td>Outcome</td>
<td>Outcome</td>
</tr>
<tr>
<td>MONITORED</td>
<td>Loosely Monitored</td>
<td>Monitored</td>
<td>Carefully Monitored</td>
</tr>
<tr>
<td>CORRECTION</td>
<td>No Focus On Immediate Correction</td>
<td>Focus On Correction</td>
<td>Focus On Immediate Correction</td>
</tr>
<tr>
<td>GRATIFICATION</td>
<td>Immediate</td>
<td>Immediate and Delayed</td>
<td>Delayed</td>
</tr>
<tr>
<td>SOURCE OF ENJOYMENT</td>
<td>Predominantly Inherent</td>
<td>Predominantly Extrinsic</td>
<td>Extrinsic</td>
</tr>
</tbody>
</table>


Figure 4. Pickup basketball: Deliberate play in China.

Figure 5. Pickup basketball: Deliberate practice in China.
Designing a sports technology innovation for basketball deliberate play, as opposed to deliberate practice, may be a useful approach for encouraging physical activity. Côté and colleagues posit that deliberate play in the early years of development establishes a foundation for intrinsic motivation that proves important for sports participation later in life (Côté et al., 2009). Research also finds that deliberate play engages participants for longer periods of time than structured activities (Côté, Baker & Abernethy, 2007). Furthermore, Côté et al. suggest that current trends in organised youth sports that overemphasise deliberate practice may not be optimal for encouraging lifelong participation in sport, let alone elite success (Côté et al., 2009).

2.2.5 Grassroots Basketball Sports Technology

“Technology makes sport possible” (Loland, 2007, p. 279). In general terms, sports technology refers to equipment used during sports competition and training (Loland, 2007). Basic grassroots basketball sports technology includes basketballs, backboards and hoops, and basketball shoes. However, in recent years numerous ‘smart’ sensor-enhanced sports equipment products have been marketed as training devices for individuals; in other words, devices that augment deliberate practice. Most of these devices disrupt the spatial and temporal qualities of pickup basketball; players stop playing to consult display-based technology, and at times leave the court to do so. They also run counter to one of the reasons the sport is so popular; that being, its comparative lack of reliance upon technology, whereby players run, jump and shoot mostly without the aid of technological devices (Elcombe, 2007).

Some notable contemporary examples of ‘smart’ devices for basketball include the SOLIDshot shooting sleeve (Gartenberg, 2016) (Figure 6); ‘smart’ basketballs such as the Wilson X Connected Basketball (O’Kane, 2015) (Figure 7); and the HomeCourt smartphone App (HomeCourt, n.d.) (Figure 8). Each of these devices measures the act of shooting a basketball into a hoop. They use different types of sensors to record data for display on a smartphone App. The SOLIDshot shooting sleeve is wearable technology that incorporates three motion sensors to measure the position of a player’s arm when shooting. LED lights and a speaker are embedded into the sleeve to complement a smartphone App. Feedback from the system instructs players to correct their shooting form and analyses training sessions. The Wilson X Connected Basketball contains sensors that connect to a smartphone App with Bluetooth. The App calculates data to display the percentage of successful shots. The HomeCourt smartphone App uses artificial intelligence to video capture basketball workouts. The App presents training drills and provides a broad range of captured data; including shot type, release time and angle, leg angle, speed of movement, and vertical leap.
My review of grassroots basketball sports technology indicates that designing a sports technology innovation for deliberate play is a counter-strategy to current approaches, and that creating a system that does not utilise sensors would constitute a novel approach to augmenting grassroots sports. My review of sports technology and sports sociology literature also indicates that a significant untapped market may exist for sports technology innovations designed for grassroots sports.

For example, recent literature suggests that grassroots sports technology applications are rarely the focus for sports startup businesses. Both the 2019 European and North American Sportstech Reports; which present insights, data and trends for the sports technology industry,
include few grassroots sports technology innovations. The SportsTech Framework categorises sports technology developments into activity and performance, management and organisation, fans and media, and esports. The only references to grassroots sports in these reports concern apps for smartphones that assist the management of playspace facilities (Sportstechx, 2019a; Sportstechx, 2019b).

Furthermore, the Australian Sports Technologies Network asserts that opportunities to commercialise grassroots sports technology applications have been under-utilised (ASTN, n.d.). And according to the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Sports Commission, casual (non-organised) grassroots sport in Australia has higher and increasing participation rates than organised sports (Hajkowicz, Cook, Wilhelmseder & Boughen, 2013). Sports sociologists have also identified this trend occurring in Europe (Deelen, Ettema, & Kamphuis, 2018).

2.2.6 Promoting Physical Activity with Grassroots Basketball Sports Technology

Physical inactivity is a global pandemic (Kohl 3rd et al., 2012) that causes over 5 million deaths annually, making it the fourth leading cause of mortality worldwide (Sallis et al., 2016; Kohl 3rd et al., 2012). While public health researchers recognise that there is no single solution to increasing physical activity, international reports recommend consistent strategies to tackle the problem that provide a social context for my research project, beyond my creative design practice. For example, the World Health Organisation (WHO) identifies sport as an essential yet underutilised catalyst for increasing physical activity among people of all ages (WHO, 2018). And researchers highlight that opportunities exist for digital innovations to support increases in grassroots sports participation and physical activity, particularly among young people (WHO, 2018; The Aspen Institute, 2015; The Aspen Institute, 2014; Hajkowicz et al., 2013; Kahn & Norman, 2012; MacCallum et al., 2012).

Physical recreation scholars Henderson, Glancy and Little argue that the affective benefits of participating in sport rely on fun, joy and a sense of happiness. They advise that abandoning the overused systems of evaluation and measurement that devalue the benefits of participation can make fun and enjoyment possible. Accordingly, they recommend improving our ability to create opportunities that promote fun and memorable experiences as a strategy for enhancing the affective benefits of physical activity (Henderson, Glancy & Little, 1999). Furthermore, they highlight the attraction of deliberate play by stating that: “Sport can lose its joy if it becomes too over-organized, professionalized, and bureaucratized, hence the continuing appeal of a pick-up basketball game” (Henderson et al., 1999, p. 45).

In 2014, the Basketball All-Party Parliamentary Group (APPG) in the United Kingdom recognised that the sport of “basketball is exceptional” (Basketball APPG, 2014, p. 3). They concluded that “there is no more inclusive and impactful sporting vehicle than basketball” (Basketball APPG, 2014, p. 8) for meeting health and social objectives, and that “the potential for the sport to make a much bigger contribution is vast” (Basketball APPG, 2014, p. 3). The group’s report also advised that basketball is likely to deliver public and private organisations investing in grassroots
sport the best “bang for their buck” (Basketball APPG, 2014, p. 8). Although the inquiry focused on basketball in the United Kingdom, the findings resonate in other countries. For example; “the findings on the role of basketball are considered directly relevant to New Zealand” (Basketball New Zealand, 2015).

The Basketball APPG Inquiry Report, therefore, suggests that grassroots basketball may be an ideal vehicle for designing a sports technology that responds to the calls made by international public health and sports management organisations. Basketball’s strong connections to music and lifestyle cultures (Basketball APPG, 2014) presents a basis for designing sports technology that complements physical activity with a meaningful creative activity; a call made by the Designed to Move: A Physical Activity Action Agenda report (MacCallum et al., 2012). Basketball’s potential to attract investment—considered an essential attribute for supporting grassroots sports development (Andreeva et al., 2016; MacCallum, Howson & Gopu, 2012; Kahn & Norman, 2012)—presents an opportunity for subsidising the delivery of sports technology designed to encourage participation and physical activity.

### 2.3 PLAYFUL DESIGN

To design a sports technology innovation for pickup basketball my research project employs ‘playful design’—broadly defined as an approach to augmenting existing activities with new digital elements or qualities to afford playful experiences (Walz & Deterding, 2015). In doing so, I align myself with the perspectives held by interaction design theorists Bill Gaver and Anthony Dunne; game and play scholars such as Miguel Sicart, Kars Alfrink, Jane McGonigal and Mary Flanagan; members of the Fluxus art community; and artist Allan Kaprow.

Ludic design, a notion developed by Bill Gaver, suggests designers draw upon personal experiences to create systems that encourage ‘interpretative appropriation’—technology that people can explore and appropriate to produce meaning (Gaver, 2008; Gaver et al., 2004). Dunne advocates for designers to explore the potential of electronic devices that appeal “to the senses and imagination rather than the intellect” (Dunne, 2005, p. 147), and encourage meaningful reflections on the aesthetics of everyday life (Dunne, 2005).

Sicart appeals for technology that supports autonomy, agency and creativity in the pursuit of eudaimonia, or the good life—to let people play by expressing who they are “while taking over a situation, a context, a technology” (Sicart, 2015, p. 239). Alfrink argues that playful design concerned with improving the built environment should first ask “what makes a space enjoyable?” (Alfrink, 2015, p. 535); and, like Gaver, stress the importance of facilitating appropriation (Alfrink, 2015). McGonigal maintains that Rich Gold’s vision for computer-augmented environments concerns constructing opportunities for play and performance, and informs the design of ubiquitous computing games (McGonigal, 2006). Through the lens of art history, Flanagan developed the concept of ‘critical play’ to encourage the design of avant-garde games that reach beyond entertainment into the realms of creative expression and social activism (Flanagan, 2009).
Although the Fluxus group of artists worked across a broad domain, Fluxus art historian and interactive media artist Owen Smith explains that:

“Fluxus ‘implies,’ even demands, a creative playful interaction in which the viewer not only moves from a passive to an active role, one in which the viewer also becomes the producer of works” (Smith, 2005, p. 230).

In addition to demanding audience participation in the construction of enriched experiences (Higgins, 1968), Fluxus artists “directed their audiences’ attention to concrete everyday stuff” (Higgins, 2002, p. 62). For example; Fluxus artists utilised popular sports as ready-made structures for creating Flux Sport participatory art experiences. Figure 9 shows images of Flux Sports at the Flux-Olympiad held at the Tate Modern in 2008, which included versions of Maciunas’ modified sports equipment—ping pong paddles and tables; Miller’s Balloon Dash running race; and Hendricks’ Stilt Soccer.

Figure 9. Flux Sports.
Tom Russotti and Larry Miller: Flux-Olympiad 2008 © Tate Modern
To close the loop, Bill Gaver repeatedly cites the artist Allan Kaprow when writing about ludic design (Gaver, 2008; 2015). Kaprow suggests that; “Play … offers satisfaction, not in some stated practical outcome, some immediate accomplishment, but rather in continuous participation as its own end” (Kaprow, 1993, p. 122). Kaprow also identifies that the media and leisure industries are unlikely to foster play; their dominant concern is quick profits, and the industries often develop technologies without imagination (Kaprow, 1993). This sentiment is shared by game theorist Rilla Khaled, who points out that gamification applications already exhibit a high degree of homogeneity by reappropriating and parroting familiar designs (Khaled, 2015).

Accordingly, adopting a playful design approach may produce novel sports technology applications for deliberate play, and provide alternative augmented experiences to those generated by deliberate practice devices.

### 2.3.1 Videogame Art

Videogame art, or Game Art as game scholars Celia Pearce and Matteo Bittanti term it, may be defined as “art that refers knowingly or explicitly to videogame culture, iconography, etc.” (Mitchell & Clarke, 2003, p. 339), or “any art in which digital games played a significant role in the creation, production, and/or display of the artwork” (Bittani, 2006, p. 9).

Grethe Mitchell and Andy Clarke, the editors of *Videogames and Art*, identify four overlapping appropriation strategies employed by videogame art: remixing, reference, reworking and reaction. According to Mitchell and Clarke, remixed videogame art appropriates elements from a videogame for use in a different medium. Reference works retain recognisable gameplay but replace audio-visual content to convey new meaning. Reworking refers to code alterations that expand the scope of a game. And reaction describes artistic interventions in game worlds, such as role-playing performances in online 3D videogames (Mitchell & Clarke, 2003).

Game researcher Celia Pearce points out that Videogame Art, or Game Art, is an interactive genre “that is being harnessed in much the same way Fluxus art harnessed analog games” (Pearce, 2006, p. 73); in other words, the appropriation of games and sports by Fluxus artists presents a historical precursor for videogame art. For example; if we apply Mitchell and Clarke’s appropriation strategies to an analysis of Maciunas’ Prepared Ping Pong, the work demonstrates a combination of reference and reworking techniques. Maciunas retains ping pong gameplay mechanics, yet expands the scope of the game by altering the ready-made structure to produce new aesthetic content; put simply, physically modified ping pong paddles and tables create new ping pong play experiences.

Pearce argues that Fluxus art techniques, beyond hijacking popular analogue sports and games, are evident in videogame art. For example; Pearce identifies the presence of Fluxus concepts such as ‘score’ and ‘chance’ in videogame artworks that invite participation and co-creation. Pearce describes videogame art software code as a digital manifestation of a Fluxus score—a set of instructions, or a script, for people other than the artist to interpret and manipulate. Pearce also argues that videogame art and Fluxus share the use of ‘chance operations’ as a strategy for creating indeterminate experiences with no specific objectives or outcomes (Pearce, 2006).
Appropriating videogame sounds to augment deliberate play activities reflects practices that concern the emerging field Sonic Interaction Design (SID); which, according to SID theorist Davide Rocchesso, “explores ways in which sound can be used to convey information, meaning, aesthetic and emotional qualities in interactive contexts” (Rocchesso, 2011, p.3). Daniel Hug, a noted SID practitioner and theorist, suggests that “an important source of inspiration for designing semantically and aesthetically rich sounds for interactive objects is fictional media” (Hug, 2013, p. 353). He also identifies narrativity and performativity as being conceptually fundamental to how SID artefacts are designed, and how their meanings are understood (Hug, 2010a; Hug & Kemper, 2014). Furthermore, Hug suggests that sound designers need to integrate “complex cultural practices of creation, re-mix, cross-reference, and appropriation” (Hug, 2010b, p. 407). Hug’s SID strategies appear to correlate with the videogame art appropriation strategies identified by Mitchell and Clarke.

### 2.3.2 Prop-oriented Make-believe

Augmenting everyday life with digital technology has given rise to a new forms of games, generally referred to as Pervasive Games, but distinguished by a plethora of names; for example, alternate reality games, augmented reality games, big games, context-aware games, immersive games, location-based games, mixed reality games, mobile games, pervasive games, reality games, ubiquitous games, urban games etc. (Montola, Stenros & Waern, 2009). Many of these games involve make-believe, which play and game theorists such as Huizinga (1950), Caillois (2001) and Deterding (2016) identify as “a fundamental form and aspect of human play and its appeal” (Deterding, 2016, p.102). Pervasive games that employ make-believe use digital technology as props, which according to make-believe scholar Phil Turner; “stimulate our imagination and provide for exciting or pleasurable or interesting engagements with fictional worlds” (Turner, 2016, p. 151).

Kendall Walton’s make-believe theory of representation is a highly regarded philosophical contribution to understanding the role that imagination plays when people engage with artefacts; such as books, toys, works of art and digital technology. Walton distinguishes two forms of make-believe that can operate together—prop-oriented make-believe and content-oriented make-believe. Walton argues that prop-oriented make-believe emerges from interaction with external objects and representations, whereas content-oriented make-believe occurs within the fictional worlds we imagine (Walton, 1990). For example, a rolled up piece of paper and a garbage bin may prompt prop-oriented make-believe; that being, you imagine to shoot a basketball into a hoop. Corresponding content-oriented make-believe, in this case, could be that you imagine being LeBron James attempting a buzzer-beater to win a tied game in the NBA finals.

Walton asserts that make-believe is subject to the “principles of generation” that frame the context for individual, or agreed and shared imagination (Walton, 1990). Game designer and theorist Chris Bateman interprets Walton’s theories for videogame design and explains that principles of generation are “socially embodied in the community of game players and game makers” (Bateman, 2010, para. 10); and they lie somewhere between Walton’s ‘Reality Principle’ and ‘Mutual Belief Principle’ (Bateman, 2011; Walton, 1990). The Reality Principle represents
strategies for creating fictional worlds that reflect the real world as closely as possible (Walton, 1990). Props that apply the Reality Principle are “wed to the appreciator's understanding of the world” (Bateman, 2011, p. 146) and can afford “richer and more natural participation in … games of make-believe” (Walton, 1990, p. 160). The Mutual Belief Principle accounts for real-world cultural assumptions but asks appreciators to share the alternative fictional beliefs of a creator.

Deterding notes that using the medium of audio is common in pervasive games (Deterding, 2015); audio is “an inexpensive and unobtrusive means to layer an additional atmosphere and information stream into everyday life” (Deterding, 2015, p. 30). Bateman also acknowledges the potential of sound to induce make-believe by stating that “in creating props to assist players in imagining, outstanding sound design can make a vast difference” (Bateman, 2011, p. 114). Furthermore, Walton argues that “words are well suited for use in make-believe. They come built-in semantic and syntactic properties whereby they can be combined in innumerable ways to indicate a wide range of propositions” (Walton, 1990, p. 353). This indicates that speech is a useful medium for depicting make-believe scenarios designed to augment everyday life.

Designing a speech-based acoustic prop for games of make-believe may need to consider “narrative in a play-centric context, rather than a ‘storytelling’ context” (Pearce, 2004, p. 144). Pearce argues that narrative in the context of games operates in a fundamentally different way to other media (Pearce, 2004). Pearce identifies six narrative ‘operators’ that can coexist in games to influence the nature of a make-believe game experience: i) the experiential, ii) the performative, iii) the augmentary, iv) the descriptive, v) the metastory, and vi) the story system.

Deterding identifies four design dimensions of make-believe that may assist an understanding of an acoustic prop that incorporates speech: “theming; storification [or narrative]; scripting, ruling, and framing; and role-playing” (Deterding, 2016, p. 109). Deterding argues that make-believe remains neglected in the field of game studies, and suggests future research can utilise the four design dimensions of make-believe to identify the ‘active ingredients’ that give rise to playful design make-believe experiences (Deterding, 2016). Additionally, Deterding argues that playful designs that unify the design dimensions of make-believe “represent the most sophisticated and compelling make-believe designs” (Deterding, 2016, p. 116).

2.3.3 Amplified Reality

In 1993, Pierre Wellner, Wendy Mackay and Rich Gold used the term ‘computer-augmented environments’ to describe the similar visions held for ubiquitous computing and augmented reality—to enhance daily activities conducted in the real world with appropriate computing tools (Wellner, Mackay & Gold, 1993). In 1994, Paul Milgram and Fumio Kishino famously developed the virtuality continuum and used Augmented Reality “to refer to any case in which an otherwise real environment is “augmented” by means of virtual (computer graphic) objects” (Milgram & Kishino, 1994, p. 1322). They importantly pointed out that the concept also applied to auditory augmented reality (Milgram & Kishino, 1994), an often overlooked consideration. In 1999, Falk, Redström and Björk complemented the concept of augmented reality by introducing Amplified
Reality (Falk, Redström & Björk, 1999)—a concept that more accurately describes the potential for computer-augmented environments created with auditory augmented reality.

The Amplified Reality concept:

“differs from augmented reality, in that it emphasizes the importance of the shared experiences that result from publicly available properties of objects … while augmented reality is about enhancing our impressions of everyday objects in our surrounding, amplified reality is about enhancing the expressions of objects and people in the world” (Falk et al., 1999, pp. 275–276).

The difference between the augmented reality and amplified reality mediums is illustrated in Figure 10.

The amplified reality concept highlights the technological limitations of the many augmented reality experiences that rely on personal head-mounted displays. Whereas conventional augmented reality combines real and virtual spaces in real-time by superimposing pre-produced impressions of the world experienced using personal or private computing devices, amplified reality emphasises enhancing the expressions of people and objects for shared public experiences using physically embedded computational resources (Falk et al. 1999).

Falk et al. state that the domain of music inspired their amplified reality concept. They adopted the term amplified to reflect the impact microphones and amplifiers had on performing and experiencing live music in the early 1950s. Embedded amplification augmented the expressions of singers and musicians for shared appreciation by larger audiences (Falk et al. 1999).

In the realm of sport, using sound technology to amplify the physical expressions of athletes and the interaction of sports objects has a long history. For example, media representations of
elite sports have used sound design to enhance spectator experiences since the ‘synthetic’ radio broadcasts of the 1930s, when cricket commentators performed the sounds of matches according to international cable reports (Andrewes, 2000; Stewart, 2002). Similarly, television sound designers and foley artists continue to add extra ‘synthetic’ sounds to broadcasts to accentuate the sound of sports action that is difficult to capture with microphones (Andrews, 2011). By using pre-recorded sounds to amplify and share the physical expressions of athletes and the interaction of sports objects, radio and television sports broadcasts epitomise the emphasis of amplified reality (Falk et al., 1999). Accordingly, designing an acoustic amplified reality application for grassroots sports can build on the traditions established by sports broadcasts.

2.4 DESIGN RESEARCH AND INNOVATION

2.4.1 Practice-based Research

My research project adopts Edmonds and Candy’s model of practitioner research—a model that accommodates the personal goals and intentions of practitioner-researchers and their subsequent influence on the relationship between practice, evaluation and theory (Edmonds & Candy, 2010). According to Edmonds and Candy, practitioner-researchers enhance their practice and contribute to the broader community by focusing on the design of an interactive digital artefact; and by conducting research to understand how audiences engage with interactive experiences. Research questions emerge from the candidate’s reflection upon their creative practice (Edmonds & Candy, 2010).

The model of practitioner research brings together reflective practice and evidence-based research (Edmonds & Candy, 2010). Practitioner-researchers employ Donald Schön’s concept of ‘reflective practice’ to make explicit the tacit knowledge embedded in the action of making artefacts (Schön, 1983). Social science research methods are employed to collect evidence for evaluating the effects an interactive system may have upon an audience. Theory, in the context of the model, “is likely to consist of different ways of examining, critiquing and applying areas of knowledge considered relevant to the individual’s practice” (Edmonds & Candy, 2010, p. 471).

Edmonds and Candy’s research model is similar to other practice-based design research approaches centred on making artefacts; in particular, some elaborations of Christopher Frayling’s concept of ‘research through art and design’ (Frayling, 1993). For example, in Design Research Through Practice: From the Lab, Field, and Showroom, Koskinen et al. use the term ‘constructive design research’ for design research “in which construction—be it product, system, space, or media—takes center place and becomes the key means in constructing knowledge” (Koskinen, Zimmerman, Binder, Redström & Wensveen, 2011, p. 5).

Bill Gaver and Anthony Dunne also advocate an approach to design research similar to Edmonds and Candy. Gaver argues that ludic designers need to complement scientific approaches with idiosyncratic personal ones that draw on their own experiences (Gaver, 2008). Dunne suggests that academia can provide a space outside commercial practice for designers to develop techniques and ideas or “hypotheses for action” (Dunne, 2005, p. xvi). This personal approach to design research is also supported by design theorists Harold G. Nelson and Erik Stolterman, who
suggest there is no scientific approach for creating a specific design; they argue that design is a process initiated by will, directed by intention, and guided by judgement—designers transform and unify relevant scientific knowledge with other forms of knowledge by conducting inquiries in the context of a specific design situation (Nelson & Stolterman, 2012).

According to Edmonds and Candy’s model, practitioner-researchers may choose to develop a personal conceptual structure, called the ‘practitioner framework’, to inform the development and evaluation of their practice and the artefacts they design (Edmonds & Candy, 2010). Based on Edmonds and Candy’s model, my practitioner framework is an untested design hypothesis or personal “theory-in-action” (Edmonds & Candy, 2010, p. 472), which I will use to establish the design criteria for my sports technology artefact, and develop to produce a research outcome.

2.4.2 Hermeneutic Design and Innovation

Design and innovation scholar Marcus Janke recognises that new understandings may emerge from designers inspired by situations and phenomena that don’t present problems in need of a solution (Jahnke, 2012). Klaus Krippendorff concurs by stating that “rational problem solving is just one way of designing” (Krippendorff, 2007, p. 70). For Krippendorff, the primary motivations for designers include the identification of opportunities not seen by others and the possibility to introduce variations unrealised by others (Krippendorff, 2007). Likewise, Lloyd, Hekkert and van Dijk, promote the idea of ‘Vision in Product Design’ that seeks to identify future possibilities rather than solve existing problems (Lloyd, Hekkert & van Dijk, 2006). These views are shared by design theorists Adrian Snodgrass and Richard Coyne, who argue that “design is an interpretative activity, one of understanding a design situation rather than of solving a problem” (Snodgrass & Coyne, 1996, p. 82). This common perspective places design within the domain of hermeneutics—the “art of interpretation” (Inwood, n.d., para. 1).

Building on the work of Snodgrass and Coyne (1996), who advanced the understanding of design as a hermeneutic process, Jahnke brought together the hermeneutic concepts expressed by Gadamer (1989) and Ricoeur (2008) with the protocol studies of Schön (1983). He concluded that design as a process of interpretation can lead to new meanings and ingenious practical solutions (Jahnke, 2012). This conclusion correlates with Krippendorff’s precept that design is meaning-making. Approaching design with a philosophically hermeneutic and semantic background, Krippendorff interprets the etymology of ‘design’ as “design is making sense (of things)” (Krippendorff, 1989, p. 9); he then reinterprets the phrase into “the products of design are to be understandable or meaningful to someone” (Krippendorff, 1989, p. 9). Therefore, a design artefact is a medium for communicating meanings. Krippendorff explains that while designing a new artefact demands innovation, for the artefact to make sense, it requires historical continuity (Krippendorff, 1989).

Innovation management scholar Roberto Verganti adopted Krippendorff’s definition of design and extended Krippendorff’s semantic perspective to propose the theory of Design-Driven Innovation—“the radical innovation of a product’s meaning” (Verganti, 2008, p. 437). Verganti joined with researcher Åsa Öberg to refine this alternative theory for innovation by citing the
research of Marcus Jahnke (2012) and the work of innovative designers and companies. Verganti and Öberg linked the design of product meanings to radical innovation through the philosophical lens of hermeneutics. They determined that interpreting and envisioning—"envisioning new meanings" (Verganti & Öberg, 2013, p. 94, emphasis in original) is an act of innovation different to prevailing innovation management theories. From a design perspective “meaning making is essentially the creation of relationships of understanding” (Nelson & Stolterman, 2012, p. 60). Therefore, ‘envisioning new meanings’ requires a designer to create new relationships of understanding for interpretation by people who engage with a designed product or experience.

Verganti and Öberg argue that organisations should engage external interpreters with a critical stance from outside customary networks; to contribute novel interpretations, knowledge and solutions through continuous dialogue (Verganti & Öberg, 2013). In the realm of sports management, engaging external interpreters to stimulate innovation is a strategy recommended by entrepreneurship and innovation scholar Vanessa Ratten, who states that sports entrepreneurship “needs to gain legitimacy by developing research from different contexts in order to point out subtleties” (Ratten, 2018, p. 14). Ratten suggests that a more interdisciplinary approach is needed to develop creative technology applications for the increasing amount of people that “want to experience sport in a casual form without any kind of commitment” (Ratten, 2018, p. 2).

Acknowledging both design and innovation as interpretative activities is key to understanding my research project. I did not seek to solve a problem within the cultural practice of pickup basketball; a phenomenological experience prompted my identification of a design opportunity. My research project involves creating an innovative sports technology artefact that makes sense to a community of practice influenced by the historical continuity of the NBA. By acting outside the customary organisational networks that shape the culture of pickup basketball, I sought to ‘envisage a new meaning’ for pickup basketball players and spectators different to prevailing approaches.

2.4.3 Design Research and Meaning-driven Innovation

A theoretical implication for interpretive design research was derived from Verganti and Öberg’s work when renown applied cognitive scientist and design theorist Donald A. Norman worked together with Roberto Verganti to create a link between interpretive design research and radical innovation (Norman & Verganti, 2014). After Norman, an originator of Human-centred Design (HCD), acknowledged that “every radical innovation he investigated was done without design research” (Norman & Verganti, 2014, p. 79), he joined with Verganti to reframe the discourse surrounding design and innovation by asking “can design research ever lead to radical product innovation?” (Norman & Verganti, 2014, p. 95).

In response to this question, Norman and Verganti developed two frameworks. The first, shown in Figure 11, maps a relationship between technology, meaning and innovation, to argue that both technical and social determinism combine to create incremental and radical change (Norman & Verganti, 2014). The framework uses the dimensions of technology and meaning to identify four types of innovation: technology-push, market-pull, meaning-driven and technology epiphanies (Norman & Verganti, 2014).
According to Norman and Verganti, meaning-driven innovation is primarily “an example of social determinism” (Norman & Verganti, 2014, p. 81). The process starts with comprehending and interpreting “subtle and unspoken dynamics in sociocultural models” (Norman & Verganti, 2014, p. 90); and leads to innovations that denote a radical change in product meaning with little or no change in technology (Norman & Verganti, 2014).

<table>
<thead>
<tr>
<th>TECHNOLOGY</th>
<th>MEANING</th>
<th>TECHNOLOGY-PUSH INNOVATION</th>
<th>TECHNOLOGY EPIPHANIES</th>
</tr>
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<tr>
<td>RADICAL CHANGE</td>
<td>MEANING-DRIVEN INNOVATION</td>
<td>MARKET-PULL INNOVATION</td>
<td>HUMAN-CENTERED DESIGN</td>
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<td>INCREMENTAL CHANGE</td>
<td>INCREMENTAL CHANGE</td>
<td>RADICAL CHANGE</td>
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*Figure 11. Technology and meaning-driven innovation.*

The second framework Norman and Verganti developed to link interpretive design research with innovation is the Design Research Quadrangle (DRQ), shown in Figure 12. The dimensions of the DRQ framework are based on Pasteur’s Quadrant—developed by Donald Stokes to visualise the connections between pure and applied research, characterised by the quest for understanding and considerations of use (Stokes, 1997).

The DRQ framework integrates four approaches to interpretive design research along two dimensions: “the quest for a novel interpretation of meaning, and the quest for practicality” (Norman & Verganti, 2014, p. 91). The four approaches are: vision-driven research, bricolage, design-driven research and HCD research. According to Norman and Verganti, integrating these approaches can lead to meaning-driven innovations (Norman & Verganti, 2014).
Although Norman and Verganti developed the DRQ framework to link interpretive design research to innovation as opposed to advancing knowledge (Norman & Verganti, 2014), the framework does support a reflective design process and the evaluation of audience responses—the focus of practice-based research for the interactive arts. Furthermore, design theorist Pieter Jan Stappers believes that “it is in Pasteur’s quadrant where designer’s research can be at the most fruitful” (Stappers, 2007, p. 86).

### 2.5 THE DESIGN RESEARCH QUADRANGLE

I adopted the DRQ framework as a method for conducting practice-based design research to promote a link between practice-based design research and innovation. As design and innovation scholar Leon Cruickshank notes, because design engages with innovation in ways not easily quantifiable, design is underrepresented in innovation studies, and “much of innovation studies concentrates on the effects of innovation rather than on the act of innovation directly” (Cruickshank, 2010, p. 24). Accordingly, practice-based design and innovation research projects that present conceptual frameworks, reflect on design processes and report the evaluation of design innovations, may potentially contribute to both Design Studies and Innovation Studies. However, I do acknowledge that adopting the DRQ framework to design a meaning-driven innovation within the constraints of a doctoral process will only result in an innovation proposal.

The DRQ framework presents a rich foundation for practice-based design research by associating different theoretical approaches to design. As Stolterman suggests, designers are inclined to

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**Figure 12. The Design Research Quadrangle.**


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<tr>
<th>NOVEL INTERPRETATION OF MEANING?</th>
<th>VISION-DRIVEN RESEARCH</th>
<th>DESIGN-DRIVEN RESEARCH</th>
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<td>YES</td>
<td>BASIC DESIGN RESEARCH</td>
<td>RADICAL INNOVATION</td>
</tr>
<tr>
<td>NO</td>
<td>BRICOLAGE</td>
<td>HUMAN-CENTRED RESEARCH</td>
</tr>
<tr>
<td></td>
<td>TINKERING</td>
<td>INCREMENTAL INNOVATION</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>CONSIDERATION OF PRACTICALITY?</th>
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<tbody>
<tr>
<td>NO</td>
</tr>
<tr>
<td>YES</td>
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</table>
appreciate and use high-level theoretical approaches that acknowledge the complexity of design and expand design thinking, without prescribing design actions (Stolterman, 2008). Importantly, however, Norman and Verganti offer few insights into the interpretive design approaches the DRQ framework integrates.

Furthermore, three years after Norman and Verganti published the DRQ framework, Verganti made a vital contribution to understanding the meaning-driven innovation process, and therefore the application of the DRQ framework. In his book Overcrowded: Designing Meaningful Products in a World Awash with Ideas (Verganti, 2017), Verganti explains the role of personal attitudes and motivations in the creation of meaning-driven innovations. Verganti argues that the innovation of meaning is an inside-out process that begins by envisioning a personal hypothesis based on reflection and self-criticism (Verganti, 2017). This further contribution is crucial for understanding how I apply the DRQ framework. In Section 3.2, I will discuss my personal design hypothesis, which I developed before adopting the DRQ framework as a method for designing a sports technology innovation.

In the following subsections, I will discuss each of the four approaches the DRQ framework integrates: vision-driven research, bricolage, design-driven research and HCD research. I affiliate and supplement each approach with design theory developed by other theorists to clarify the DRQ framework and indicate how I apply the framework to my research project.

### 2.5.1 Vision-driven Research

According to Norman and Verganti, the aim of vision-driven or basic design research is to explore new meanings without considering their specific use in the design of radically new products (Norman & Verganti, 2014). This research process equates with ‘explorative interpretation’, which, according to Nelson and Stolterman is conducted to ‘find meaning’ (Nelson & Stolterman, 2012). Vision-driven research merely asks the obvious of designers—“to create and introduce new designs into the real world, designers must adequately know the world that already exists, at a level that makes meaningful design possible” (Nelson & Stolterman, 2012, p. 119). In addition to articulating reflections and observations, and reviewing literature and media, design theorists Jonas Löwgren and Erik Stolterman argue the essential need for thoughtful and reflective interaction designers to analyse a repertoire of example artefacts related to the design situation they are addressing (Löwgren & Stolterman, 2004). They state that:

“for interaction design … it is essential to address examples of artifacts and their qualities. This holds true not only for the discipline as a knowledge construction system, but also for the individual designer who needs to develop a repertoire of examples that are exemplary in some sense” (Löwgren & Stolterman, 2004, p. 166).

In Section 3.3, I discuss my explorative interpretation of pickup basketball sociocultural factors and the NBA basketball media artefacts designed to appeal to the pickup basketball community of practice—the process I conducted to find a meaning that could support the design of sports technology for basketball deliberate play.
2.5.2 Bricolage

Norman and Verganti refer to playing with products or technology with no regard for enhancing meaning or practicality as tinkering, a term they associate with Claude Levi-Strauss’ notion of bricolage (Norman & Verganti, 2014). According to design historian Catharine Rossi, bricolage is a metaphor for a design activity that occurs when designers remix only the things at hand into “new sociocultural configurations” (Rossi, 2013, p. 75). According to computer scientist Panagiotis Louridas, “bricolage is the creation of structure out of events” (Louridas, 1999, p. 520). Nelson and Stolterman describe this type of design activity as ‘generative interpretation’ for creating ‘possible meanings’—the interpretation of present realities in relation to possible futures (Nelson & Stolterman, 2012). While Norman and Verganti claim that the new products and brilliant insights that can emerge from bricolage are completely accidental (Norman & Verganti, 2014), Nelson and Stolterman assert that a generative interpretation creative process is always related to the meanings disclosed by explorative interpretation (Nelson & Stolterman, 2012).

When designers play with products or technology, they enter into a dialogue with the objects. This bricolage process can stimulate meaningful connections; what cognitive scientist Gilles Fauconnier calls conceptual integration or ‘blending’. Conceptual integration describes the process of selective projection, what Nelson and Stolterman call judgement (Nelson & Stolterman, 2012), and Verganti calls criticism (Verganti, 2017); which plays a fundamental role in the construction of new meaning (Fauconnier, 2001).

Employing selective projection to blend media technologies that construct new meanings reflects Dick Higgins’ ‘intermedia’ Fluxus concept. According to Higgins, intermedia works exercise a conceptual fusion—intermedia art forms are hybrids that draw upon different media, yet exist between known types of media (Higgins, 2001; Friedman, 1998).

In Section 3.4, I describe how conducting vision-driven research can lead to a bricolage event—how exploring or tinkering with media artefacts can prompt a generative interpretation process that produces a hybrid medium.

2.5.3 Design-driven Research

Design-driven research aims to envision new meanings for practical application in products or experiences (Norman & Verganti, 2014). Nelson and Stolterman refer to this type of process as ‘compositional interpretation’ for ‘making meaning’. Compositional interpretation takes the form of compositional assembly, connecting found meanings and possible meanings to form a unified system—a designed artefact (Nelson & Stolterman, 2012).

When drawing upon bricolage as a design approach, particularly when dealing with digital technology, the subsequent compositional assembly process may be associated with ‘hacking’. As design theorists Otto von Busch and Karl Palmås explain, hacking has roots in critical and playful activities associated with the do-it-yourself and maker movements that circumvent the limitations of products (Palmås & Von Busch, 2006). To Richard Coyne “all design has the character of a hack” (Coyne, 2010, p. 5). In discussing the ‘tuning’ of space with technology, he suggests that
the hacking, modification and adaptation of hardware and software are acts of opportunism that capture the essence of much design: digital bricoleurs use what is at hand to align things with conditions (Coyne, 2010).

In the art world, art historian Roger Rothman suggests that “almost everyone involved in Fluxus contributed to the culture of the hack” (Rothman, 2015, p. 795). Rothman points out that Fluxus emerged simultaneously with the earliest computer hackers from M.I.T. (Massachusetts Institute of Technology) and promoted similar counter-cultural notions. Rothman cites Maciunas’ modifications to the sport of ping pong and Nam June Paik’s rewiring of televisions as contemporaneous hacking examples. Additionally, media studies scholar Angela Krewani argues that Fluxus public art actions established a tradition for artistic urban hacking (Krewani, 2017). Krewani cites the Blast Theory collective as an example; specifically the British collective’s work Uncle Roy All Around You (2003) that creates hybrid spaces by blending virtual worlds and urban spaces. And lastly, as discussed in Section 2.3.1, appropriating or ‘hacking’ elements from videogames to create participatory art experiences reflects Fluxus art traditions.

In Section 3.5, I describe bricolage-inspired design-driven research—the compositional interpretation or interpretive ‘hacking’ design process I use to assemble a rapid prototype. Similarly, in Section 3.7, I describe the compositional assembly of a second prototype, a process informed by HCD research.

2.5.4 Human-centred Design Research

HCD research involves the iterative testing of prototypes to ensure design solutions are usable and understandable; and meet the needs of people in ways that achieve a positive and enjoyable experience (Norman, 2013). HCD research requires interpretative evaluation; the qualitative interpretation of designed meanings using objective and subjective methods (Nelson & Stolterman, 2012; Suri, 2003; Lawson, 1980/2005).

Norman and Verganti equate HCD research to incremental innovation—the process of improving existing products typically informed by user-centred observations and applied ethnography methods (Norman & Verganti, 2014). Coyne differentiates the stance a designer takes from a sociologist or ethnographer when investigating ubiquitous technologies. In addition to ‘standing back’ to examine how people use technology and interact with each other, a designer advances understanding by engaging with the technology being studied by “making, building, and tuning in order to learn” (Coyne, 2010, p. 3). For the designer, each prototype iteration contributes to a clearer understanding of the design situation and a more definite and determined design vision (Snodgrass & Coyne, 1996). Accordingly, designing sports technology to be used in public playspaces presents a design situation that may benefit from ‘urban probe’ fieldwork.

Proposed by urban computing researchers Eric Paulos and Tom Jenkins, urban probes are deployed to understand the impact of novel artefacts designed to intervene in urban life (Paulos & Jenkins, 2005). Urban probe research employs “deep observation coupled with experimentation and concrete interventions in urbanism” (Paulos & Jenkins, 2005, p. 343), and embraces the full range of emotional responses to intervention experiences.
The urban probe HCD research method draws upon the ‘cultural probe’ approach introduced by Gaver, Dunne and Pacenti (Paulos & Jenkins, 2005; Gaver, Dunne & Pacenti, 1999). Cultural probe research, or ‘probology’, encourages empathetic interpretation and “values uncertainty, play, exploration, and subjective interpretation” (Gaver, Boucher, Pennington & Walker, 2004, p. 53). The approach is openly subjective; it reflects an artist-designer philosophical tradition and embraces an ethnographic method aligned to ethnomethodology (Hemmings, Crabtree, Rodden, Clarke, & Rouncefield, 2002). Furthermore, the approach was proposed as an alternative to prevailing user-centred methods employed in the field of Human-Computer Interaction (HCI) and was specifically developed to inspire the process of design (Koskinen et al., 2011).

Like Paulos and Jenkins, I adopt the interpretive evaluation stance proposed by the original cultural probe proponents. I try to understand the full range of audience responses to urban probes, so I can improve prototype designs and understand the meaning of the intervention experience. In Section 3.6, I describe how my interpretive evaluation of rapid prototype urban probes informed the design of a second prototype. In Chapter 4, I recount how urban probe participants responded to the prototype interventions I conducted in urban playspaces.

2.6 REVIEW CONCLUSIONS

In this chapter, I introduced the significant cultural practice of pickup basketball; which, according to Côté et al., is an archetypal form of deliberate play—an activity primarily motivated by fun. Although pickup basketball is played by millions for enjoyment, little research has been conducted into the primary motivation for participation in the practice. Fun has been largely overlooked by basketball researchers and sports technology designers. Accordingly, designing a sports technology innovation to enhance the enjoyment inherent to pickup basketball presents a unique design situation for my research project to address. The findings and outcomes of which may demonstrate an approach to implementing the recommended strategies for encouraging physical activity, by promoting the affective benefits of participating in casual grassroots sports.

My review of theoretical perspectives that concern augmenting everyday activities with playful digital technology suggests that playful design complements the characteristics of deliberate play, and presents a counter-strategy to the gamification of deliberate practice. Both playful design and deliberate play activities focus on processes rather than outcomes, and prioritise autonomy, experimentation and expression (Sicart, 2015; Côté et al., 2007). By examining the augmentation of games and sports, I found that theorists, such as Celia Pearce, link Fluxus art practices that promote playfulness in sports with videogame art appropriation strategies (Pearce, 2006); the two spheres of play I seek to combine.

I also found evidence that games designed to augment everyday life with digital technology often employ make-believe (Deterding, 2016); which Deterding suggests is a fundamental aspect of play that has been relatively neglected by the Game Studies discipline (Deterding, 2016). This also appears to be the case in the realm of grassroots sports. Although make-believe is readily apparent in deliberate play activities (Sicart, 2013; Elcombe, 2007), and thoroughly acknowledged in pickup basketball, as I will discuss in Section 3.3.1, I could not find research that explicitly focuses on the subject.
By investigating the field of mixed reality, I discovered Falk, Redström and Björk’s rarely cited concept called ‘amplified reality’ (Falk et al., 1999), which describes a physically embedded, expressive and social form of mixed reality. The amplified reality concept not only reflects sports media sound design traditions, it presents a vision for playful and social computer-augmented environments that share digitally enhanced expressions of people and objects.

My review of Game Studies and Design Studies literature identified theoretical perspectives relevant to my design practice; viewpoints that endorse developing a personal design hypothesis to make artefacts for constructing knowledge and producing meaning. These perspectives indicate how my research project can combine a practice-based research model with a hermeneutic design and innovation method, and a playful design approach—the model of practitioner research (Edmonds & Candy, 2010), meaning-driven innovation (Norman & Verganti, 2014), and an approach that reflects Fluxus art traditions and design practices such as ludic design (Gaver et al., 2004).

Whereas Norman and Verganti ask “can design research ever lead to radical product innovation?” (Norman & Verganti, 2014, p. 95), I expand this question by implicitly asking: can practice-based design research lead to radical product innovation? I adopted meaning-driven innovation as a practice-based design research method to promote the link between design research and innovation within the constraints of a doctoral research process. However, I needed to supplement the DRQ framework that Norman and Verganti argue can lead to meaning-driven innovations. I found that Nelson and Stolterman and other design theorists can provide clarity for interpretive designers who choose to apply the DRQ framework.

Furthermore, Verganti himself clarifies the starting point for using the DRQ framework by arguing that the innovation of meaning begins by envisioning a personal design hypothesis (Verganti, 2017). Verganti’s additional contribution implies that applying the DRQ framework actually starts with the articulation of an idiosyncratic design-driven research intention: the desire to design a radical innovation within a specific context. Such an approach would frame the search for a new breakthrough meaning, that Norman and Verganti argue “must avoid becoming trapped by the prevalence of existing products and use” (Norman & Verganti, 2014, p. 95).

In this chapter, I have reviewed a selection of literature relevant to my design question and my design practice. In the next chapter, I describe how I applied Norman and Verganti’s DRQ framework to design the 2K-Reality sports technology meaning-driven innovation.
Chapter 3: Designing 2K-Reality

Research Question One
How can the Design Research Quadrangle framework be applied to design a sports technology innovation for pickup basketball?

3.1 INTRODUCTION

2K-Reality is an acoustic-augmented reality installation that immerses pickup basketball players and spectators in NBA-themed soundscapes. As illustrated in Figure 13 and shown Figure 14, 2K-Reality is designed to be installed in pickup basketball playspaces. A pickup basketball spectator operates a tablet-based digital audio sampler housed in a kiosk connected to public address (PA) speakers. The operator adopts the role of a make-believe NBA-arena DJ to perform NBA-themed soundscapes that portray the pickup basketball games they observe. The soundscapes immerse the court and surrounding playspace in a mix of broadcast-style commentary, arena-style crowd sound effects and contemporary music break beats.

Figure 13. 2K-Reality urban basketball playspace scenario.

Figure 14. 2K-Reality urban probe installation in Vancouver.
In this chapter, I will describe how I designed 2K-Reality. I recount and discuss my creative process to respond to my first research question: How can the Design Research Quadrangle framework be applied to design a sports technology innovation for pickup basketball? I describe how I applied Norman and Verganti’s four types of interpretive design research: vision-driven research, bricolage, design-driven research and HCD research (Norman & Verganti, 2014). These were introduced in Section 2.5.

In Section 3.2, I will begin by describing the evolution of my practitioner framework. I discuss how my design practice and stance towards grassroots sports technology generated the design criteria and the design question that frames my research project.

In Section 3.3, I will discuss my vision-driven research. I document the pickup basketball sociocultural factors that emerged from my explorative interpretation process to influence my design of 2K-Reality.

In Section 3.4, I will describe and discuss my application of bricolage, which emerged from my vision-driven research and proved to be the breakthrough event in my practical design process.

In Section 3.5, I will explain my design-driven research; the ‘hacking’ design process I used to assemble the 2K-Reality rapid prototype. I describe this process in some detail in Appendix B.

In Section 3.6, I will discuss the first aspect of my urban probe human-centred design (HCD) research, my interpretive evaluation of 2K-Reality rapid prototype functionality.

In Section 3.7, I will outline the process I used to design and develop the 2K-Reality exhibition prototype, my reapplication of design-driven research that addressed my urban probe HCD research findings. I detail this process in Appendix C.

Figure 15 represents my implementation of two components of the model of practitioner research, i) developing my practitioner framework to establish design criteria, and ii) describing the creative process I used to design two 2K-Reality design prototypes. The figure indicates how each section outlined above contributes to the trajectory of my research project.
3.2 **PRACTITIONER FRAMEWORK**

As noted in Section 2.4.1, candidates adopting Edmonds and Candy’s model of practitioner research may develop a personal conceptual structure called the ‘practitioner framework’ to guide their research projects (Edmonds & Candy, 2010).

3.2.1 Personal Design Practice

Playing individual and team sports has been a continuous activity throughout my life. My sporting credentials are modest: I am competent at many but champion at none. My knowledge...
of sports and my interest in the creative possibilities presented by grassroots sports has profoundly influenced my design practice. For example, before commencing my PhD, I conducted two practice-based Master of Arts projects: SIV: Surfing Interactive Video (Ryan, 2003) and SYLC: A Responsive Environment Skatepark (Ryan, 2007). Both projects blended sport, art, design and technology to create innovative and entertaining interactive media experiences for surfers and skateboarders, respectively. Furthermore, designing and developing my SYLC skatepark project motivated my interest in the notion of computer-augmented public playspaces.

The inspiration for conducting a design research project focused on pickup basketball originated during my time living and working and playing basketball in China, and then Taiwan—where basketball is "the most frequently played and watched sport" (Gau & Woodside, 2014, p. 40). Having played basketball extensively at high school and university, my understanding of the cultural practice of pickup basketball allowed me to interpret a design opportunity that combined real pickup basketball with NBA basketball videogames. Figure 16 shows a larger than average pickup basketball playspace in Taipei, an example of the location-based context for my research project.

Underlying my motivation to design a sports technology innovation for basketball deliberate play is a concern I hold for the impact that emerging technologies may have on the culture of grassroots sport. I believe the intervention of mobile and quantified-self technologies, in particular, may diminish the enjoyment inherent to existing pickup basketball practices. This concern is shared by noted sports philosopher Sigmund Loland who focuses on the ethics of technology in sport. Loland argues that information technology presents particular challenges due to its potential for "reducing the experiential qualities of sport and hence its value as a sphere for meaning and value" (Loland, 2007, p. 279).

3.2.2 Practitioner Framework: Compliant Sports Augmentation

Nelson and Stolterman, and design theorist Bryan Lawson, stress that designers do not approach new design situations with a blank mind. They begin by assessing the situation based on their character; their motivations, beliefs, attitudes and values (Nelson & Stolterman, 2012; Lawson, 1980/2005). They may decide on a list of ‘first intentions’ (Nelson & Stolterman, 2012) or what Lawson calls “primary generators or organising principles” (Lawson, 1980/2005, p. 47),
which can influence an entire design process and are detectable in the outcome. Accordingly, Nelson and Stolterman argue that first intentions are crucial to a design process, and suggest they may evolve from a stance taken by a designer (Nelson & Stolterman, 2012).

At the beginning of my research project I took a stance: to design a videogame-based sports technology artefact different to the products that have emerged from the self-quantification movement (Tóth & Lógó, 2018; Lupton, 2016; Sicart, 2015; Whitson, 2013). A playful design approach that augments existing pickup basketball practices with a new digital element to afford playfulness (Walz & Deterding, 2015). Articulating my stance produced my practitioner framework—a personal design hypothesis I call compliant sports augmentation[1]; a concept that reflects my stance and establishes my design criteria. The design question that frames my research project also emerged from my practitioner framework: How can I design a videogame-based sports technology innovation for pickup basketball that is compliant with the social practice and the spatiotemporal norms of the sport?

Table 3 summarises my compliant sports augmentation design criteria—the perspectives and attitudes that inform my practitioner framework.

Table 3.
Practitioner Framework: Compliant Sports Augmentation—Design Criteria

<table>
<thead>
<tr>
<th>PRACTITIONER FRAMEWORK</th>
<th>COMPLIANT SPORTS AUGMENTATION - DESIGN CRITERIA</th>
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<tbody>
<tr>
<td>1 SPATIAL</td>
<td>Consolidate existing playspaces</td>
</tr>
<tr>
<td>2 TEMPORAL</td>
<td>Avoid interrupting gameplay</td>
</tr>
<tr>
<td>3 PRACTICAL</td>
<td>Resist personal sports technology</td>
</tr>
<tr>
<td>4 SOCIAL</td>
<td>Promote social interaction and inclusion</td>
</tr>
<tr>
<td>5 TECHNOLOGY</td>
<td>Encourage agency and oppose surveillance</td>
</tr>
<tr>
<td>6 ACCESS</td>
<td>Extend public infrastructure</td>
</tr>
<tr>
<td>7 FUNDING</td>
<td>Attract public or private investment</td>
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</table>

My spatial, temporal, and practical design criteria concern the internal logic of sports. According to sports science researchers Arias et al., the internal logic of a sport is determined by the rules that establish dynamic relationships between structural and functional elements and players. The spatial boundaries, time, game equipment, and the form of interactions between players determine the character of a sport. Modifying the rules, or internal logic of a sport is a conventional method for changing the nature of gameplay (Arias, Argudo & Alonso, 2011).

[1] According to the English Oxford Living Dictionary: ‘compliant’ means “meeting or in accordance with rules or standards” (Compliant [Def. 2], n.d.); “sport” is “an activity involving physical exertion and skill in which an individual or team competes against another or others for entertainment” (Sport [Def. 1], n.d, emphasis added); and, to “augment” is to “make (something) greater by adding to it; increase” (Augment, n.d.).
Because participants in pickup basketball and other deliberate play activities modify and negotiate rules to maximise enjoyment in different spatial settings (Berry, Abernethy & Côté, 2008; Côté, Baker & Abernethy, 2007), my design criteria guide me towards preserving the forms of gameplay established by participants. Therefore, I try to consolidate the spatial organisation of existing playspaces—I attempt to avoid designing physical interventions that change the boundaries of play or affect spatial play patterns, or design structures that divert participants to a specific custom-designed playspace. I aim to avoid interrupting the temporal flow of gameplay. And I try to resist designing a personal sports technology device that may create competitive inequities or alter the forms of physical interaction between players. My aim to preserve existing forms of pickup basketball gameplay reflects a perspective held by sports scientists Møller and Møller who state that “technology … does not pose any serious threat to sport as such unless it threatens the internal logic of sport” (Møller & Møller, 2015, p. 436).

Casual team sports and deliberate play activities are social. As with many play activities, when individual pickup basketball players focus on maximising their own enjoyment, it is to the detriment of others playing the game (Kretchmar, 2007). Accordingly, my social design criterion prioritises contemplating experiences that enhance social interaction and inclusion, rather than experiences oriented towards individuals using personal devices. Furthermore, along with fun and enjoyment, social interaction is a primary motivation for participating in sport and physical activity (Allender, Cowburn & Foster, 2006).

My technology, access and funding design criteria concern functionality and provision. They reflect my stance against quantified-self sports technology designed for grassroots sports and emphasise my aim to create benign social sports technology that i) encourages creative agency for motivating physical activity, ii) is universally accessible and free and easy to use for all, and iii) has the potential to attract public or private sector investment.

I’m opposed to recording physical data on personal digital devices. I’m concerned about privacy—a particularly sensitive issue when considering the design of digital products for potential use by legal minors. I also have strong reservations about contributing to what author and scholar Shoshana Zuboff termed ‘surveillance capitalism’—the accumulation of ‘big data’ for corporate profit, behavioural prediction and control (Zuboff, 2015). As digital health sociologist Deborah Lupton notes, it’s difficult for users of quantified-self devices to avoid having their data exploited, because in most cases generated data becomes the property of the service provider developers (Lupton, 2016). For example, digital media sociologist Jennifer R. Whitson points out that data generated by the NikePlus quantified-self running platform is used for target marking (Whitson, 2013), and “Fitbit uses the information it collects to attract third-party advertisers” (Whitson, 2015, p. 351).

My stance against using personal digital devices and my inclination towards socially inclusive sports technology, guides my intention to design a conceptual extension of public infrastructure that currently provides universal access to casual sports participants. This approach aligns with the strategies recommended by international public health and sports management organisations, and requires me to contemplate possible funding structures that can potentially subsidise the
implementation and maintenance of a sports technology innovation that encourages participation and physical activity. Furthermore, according to Dale Leorke, author of *Location-Based Gaming: Play in Public Space*, the influence that economics has on playful designs for public spaces is often overlooked; he notes that a “shortcoming in the existing scholarship on location-based games is the lack of analysis of their funding structures and business models” (Leorke, 2018, p. 68).

In short, the stance I articulate in my practitioner framework equates with what Sigmund Loland describes as the ‘thick theory of athletic performance’—which considers sport a social practice with norms and values that “ought to be respected, protected, and cultivated” (Loland, 2002, p. 5). Hence my design question: How can I design a videogame-based sports technology innovation for pickup basketball that is compliant with the social practice and the spatiotemporal norms of the sport?

### 3.3 2K-REALITY VISION-DRIVEN RESEARCH

As noted in Section 2.5, vision-driven design research aims to challenge existing paradigms by exploring new meanings without considering their specific use in the design of radically new products (Norman & Verganti, 2014). As illustrated in Figure 17, I began my practical design research by applying the vision-driven research quadrant of the DRQ framework. I explored and interpreted pickup basketball sociocultural factors and NBA-themed products designed to appeal to the pickup basketball community of practice.

![Figure 17. The Design Research Quadrangle: Vision-driven Research.](adapted from Norman, D. A., & Verganti, R. (2014). Incremental and radical innovation: Design research vs. technology and meaning change. *Design Issues, 30*(1), p. 91.)
It is important to note that in addition to starting my practical design research by applying vision-driven research, this interpretive design process occurred throughout my research project. Much of my in-depth exploration and interpretation of the sociocultural factors I describe below occurred after the bricolage that generated my 2K-Reality idea; described in Section 3.4.

However, it is also important to note that I retained tacit knowledge of each of the following factors before my bricolage. My active membership in the global basketball community of practice furnished me with a broad personal knowledge of basketball culture, which influenced my research project and my design interpretations; what Nelson & Stolterman call ‘appreciative judgment’—deciding what was important or not to my design, based on my empathy for participants in my design situation (Nelson & Stolterman 2003; Vickers, 1965/1995). As Gaver et al. argue: “empathy and inspiration are invaluable in designing for everyday life. Scientific theory and empirical testing are useful for guiding interaction design, but they are neither necessary nor sufficient” (Gaver, Boucher, Pennington & Walker, 2003, p. 15).

Documenting my explorative interpretation makes my tacit basketball knowledge explicit. It provides us with a way to understand the underlying connections that informed the new meaning I envisioned for the cultural practice of pickup basketball and the judgment I employed to design the 2K-Reality prototypes. Furthermore, theoretical knowledge concerning the culture of basketball and the work of other designers who create products for the basketball community contributes to the refinement of my personal “theory-in-action”. Which results in an outcome consistent with the doctoral research process recommended by Edmonds and Candy (2010). The research I conduct by applying the DRQ framework transforms my untested hypothesis or personal “theory-in-action” into a framework of design criteria that may assist designers of digital sports technology for grassroots sports.

The notably relevant sociocultural factors that emerged from my explorative interpretation include; mimicry and make-believe, showing off, turn-taking, acoustic augmentation, hip hop culture, FIBA 3x3 basketball, and NBA-themed entertainment—in particular, NBA videogames and computer-augmented basketball environments.

3.3.1 Pickup Basketball Mimicry and Make-believe

Reflecting on my experience, shooting hoops alone revealed my frustration with self-determined play; although somewhat enjoyable, shooting hoops alone is far less enjoyable than playing pickup basketball with others. Recognising my frustration led to the contemplation of the most common strategy used to extend and maximise the enjoyment of shooting hoops: mimicry and make-believe. Sports historian Andrew D. Morris has observed pickup basketball players in China mimicking elite NBA athletes and their styles of play (Morris, 2002), a phenomenon sociologist Lou Antolihao has similarly observed in the Philippines (Antolihao, 2015). Morris also notes that some pickup basketball players can take their mimicry of NBA players to extremes, resulting in a constructed identity associated with the player they choose to emulate (Morris, 2002).
Pickup basketball players acquire the ability to mimic the moves performed by NBA players by watching television broadcasts (Morris, 2002) and playing videogames. Media researcher Cheryl Olson has recorded interviewees describing how children replicate moves seen in videogames, including basketball videogames, to improve their ability (Olson, 2013). Additionally, sports writer and professional athlete Eric Mochalski notes that mimicry plays a significant role in the evolution of basketball. Grassroots and NBA players alike develop their vocabulary of moves through observation, appropriation and adaptation (Mochalski, 2014). This mimicry behaviour is a typical characteristic of sports. Philosopher Colin McGinn notes that “sport exists largely because humans have the ability to mimic each other” (McGinn, 2012, p. 79).

Pickup basketball players not only mimic the moves of NBA players, they sometimes pretend to be NBA players. Elcombe describes how players use their imagination to adopt NBA personas and imagine fictional NBA gameplay scenarios; they dream of being an NBA star that overcomes a dominant defence while challenged by the clock and cheered on by a crowd (Elcombe, 2007). My reflections and observations of other people shooting hoops also revealed that these imaginary play situations are often vocalised with self-commentary and celebrated with physical gestures; for example, raising arms to salute adoring crowds, self-congratulatory fist pumping and sharing high-fives with imaginary teammates. These types of make-believe performances are also present in pickup basketball, most often during breaks between games. Players act out NBA personas and scenarios for the entertainment and amusement of their colleagues and themselves.

The expansive scope of NBA athlete mimicry and make-believe in grassroots basketball is both recognised and epitomised by the 1991 Gatorade television advertisement “Be Like Mike” starring Michael Jordan, a campaign that returned twenty-three years after its initial run. The first stanza of lyrics captivate the essence of an era of aspirational fantasy among grassroots basketball players:

> “Sometimes I dream that he is me,
> You've got to see that's how I dream to be.
> I dream I move, I dream I groove,
> Like Mike, If I could Be Like Mike,
> Oh if I could Be Like Mike”

The ubiquity of pickup basketball players mimicking and pretending to be NBA players reveals make-believe ‘principles of generation’ that are culturally significant. The imaginary connections pickup basketball players make with the NBA symbolised a compelling meaning that presented me with a design opportunity and became the basis of 2K-Reality. Augmenting performative NBA fantasies with NBA videogames appeared to be a strategy for enhancing the enjoyment of playing and watching pickup basketball that could potentially satisfy my design criteria.
In addition to enacting mimicry and make-believe, many pickup basketball players enjoy showing off their skills to other players and spectators, just like NBA players. As mentioned in Section 2.2.3, Morris highlighted the importance of performative expression to Chinese pickup basketball players. Likewise, in *Pickup Artists: Street Basketball in America*, authors Lars Anderson and Chad Millman repeatedly describe how pickup basketball players show off to spectators by showcasing their basketball skills (Anderson & Millman, 1998). The practice of showing off exposes a social dimension between players and spectators that presents a performative design opportunity.

**3.3.3 Turn-taking**

Readily apparent to any observer of the various forms of pickup basketball is the social practice of turn-taking. Pickup basketball players take turns shooting hoops when warming up to play games. Taking turns to shoot from the free-throw line is a method often used to determine who plays on what team. Restarting play after a basket requires turn-taking to be negotiated—will it be the team who scored or the team scored against? Turn-taking is also an essential element in folk-game variations of pickup basketball such as H.O.R.S.E.; a game in which players take turns to replicate each other's shots from different positions on the court. The most notable form of turn-taking, however, is the universal cultural practice often referred to in North America as ‘who’s got next’. That is—of the players or teams waiting to play, who will be next on court?

Understanding turn-taking is to appreciate that players become spectators and vice versa. Whether part of a game or waiting to play, spectating players have a personal investment in the progress of play. Their spectating attention levels may vary, but there is always a level of engagement with the game. Therefore, the social organisation of turn-taking presents a practical design opportunity for enhancing spectator involvement. A turn-taking sports technology design for pickup basketball might echo NBA-themed location-based amusements such as the *NBA Game Time* (Sega Amusements International, n.d.) arcade game and the *NBA Fastbreak* (NBA Fastbreak, n.d.) pinball machine, both shown in Figure 20, in Section 3.3.7 below.

**3.3.4 Basketball Acoustic Augmentation**

My observations of pickup basketball and my review of basketball literature and media exposed the presence of an existing technology-based augmentation in basketball playspaces. Introducing amplified music into basketball playspaces has a long cultural tradition. Pickup basketball players often bring personal music playing devices into a playspace, both speaker systems and headphones. As music journalist Alex Osborne recalls from the 1990s in the United States:

“people would walk around with their boom boxes and play music during the street ball games, and everyone would either be dancing, playing, or just hanging out” (Osborne, 2016, para, 3).
My more recent observations include seeing and hearing battery-powered karaoke speakers at the A’Beckett Urban Square basketball courts at RMIT University in Melbourne, and seeing people shooting hoops with headphones on.

Onaje X. Woodbine, ex-college basketball player at Yale University and author of *Black Gods of the Asphalt: Religion, Hip-hop, and Street Basketball*, recounts how giant speakers have been a fixture at street basketball events in Boston, and how:

“The playground became a new locus for the convergence of black expressive culture in hip-hop, with rap music, break dancing, and a “go hard or go home” style of basketball often performed simultaneously on the same court” (Woodbine, 2016, p. 42)

Woodbine also describes how the theatre of Boston street basketball includes MCs (master of ceremonies) at the centre of the drama. An MC performs a mediating role between the audience and the players:

“microphone in hand, he uses cunning, humor, and praise to signify on the latent meanings present in every crossover, shake and bake, and stutter step performed” (Woodbine, 2016, p. 24)

Chris Ballard, author of *Hoops Nation: A Guide to America’s Best Pickup Basketball*, reports how amateur play-by-play commentators can be heard on the sidelines of pickup basketball courts in California and New York (Ballard, 2014; Ballard, 1998); and how “all you hear is a primal roar” (Ballard, 2014, para. 4) from spectators when an impressive three-pointer or block is made.

The documentary *Doin’ It in the Park: Pick-up Basketball, New York City*, directed by Bobbito Garcia and Kevin Couliau, also documents how rappers, break-dancers and pickup basketball players often performed together on the same playgrounds in New York (Garcia & Couliau, 2013).

Professional basketball has adopted the music culture of hip hop. By 2012, twelve NBA teams employed official DJs to produce in-game beats to enhance the atmosphere for spectators in NBA arenas (Hernandez, 2012). As sports writer Jeff Beckham notes, NBA DJs reflect the latest NBA-arena sound design technique that “blends the human element and the latest in tech in a new way” (Beckham, 2013, para. 1). Once resistant to associate its image with hip hop culture in any form, the NBA organisation, NBA team owners, NBA broadcasters and NBA players now acknowledge that hip hop culture is part of the NBA, particularly the music (Broussard, 2005; McLeod, 2011). Figure 18 shows an example NBA-arena DJ.
My general awareness of sound augmenting the practice of pickup basketball influenced the generative interpretation of my 2K-Reality idea, described in Section 3.4. My in-depth exploration into the role of sound in different basketball playspaces reaffirmed my belief that my 2K-Reality design would ‘make sense’ to the pickup basketball community of practice, which is influenced by the NBA.

3.3.5 Basketball and Hip Hop Culture

My exploration of the historicity of basketball acoustic augmentation further revealed the close cultural association between basketball and hip hop culture, a relationship that connected the worlds of music, sport and fashion. In Young, Black, Rich, and Famous: The Rise of the NBA, the Hip Hop Invasion, and the Transformation of American Culture, critical studies scholar Todd Boyd explores the unique relationship between basketball and hip hop culture that evolved from the economic and social conditions that affected black urban communities in the early 1980s (Boyd, 2008). Music historian Ken McLeod argues that basketball is connected to music more than any other sport (McLeod, 2011). He highlights the link between the NBA and hip hop music by recalling that “NBA stars such as Shaquille O’Neal, Kobe Bryant, Chris Webber, and Allen Iverson, for example, have all recorded rap albums” (McLeod, 2011, p. 80). McLeod also quotes the rap artist Ice Cube, explaining that “the NBA without hip-hop is just a game. Hip-hop made Michael [Jordan] cool” (McLeod, 2011, p. 83).

Popular culture historian Thomas Turner describes how hip hop connected basketball to fashion and established ‘sneaker culture’. Run-D.M.C., one of the most influential hip hop groups in history, “became the first non-sports stars to formally endorse a sporting goods company” (Turner, 2015, p. 145). In 1986, adidas recognised the commercial potential of hip hop when Run-D.M.C. released a track called “My adidas” about adidas ‘Superstar’ basketball shoes; that all three members of the group wore to signify a connection to the street culture from which they emerged and represented (Turner, 2015). First launched in 1970, adidas ‘Superstar’ sneakers are still sold today.

Basketball’s close connections to hip hop culture indicated that my 2K-Reality idea might appeal to members of the pickup basketball community. Like NBA players, they may enjoy pretending to be a hip hop performer; as performance games researcher Kiri Miller writes, “in
contemporary youth cultures around the world, it’s not uncommon to hear that ‘everyone wants to be a DJ’ “ (Miller, 2013, p. 525).

3.3.6 FIBA 3x3 Basketball

Like pickup basketball communities and the NBA, FIBA, the International Basketball Federation, has appropriated the practice of augmenting basketball playspaces with hip hop culture. FIBA is currently attempting to transform pickup basketball into an organised commercial sport and promotes ‘3x3’, a derivative of pickup basketball; thus, “exciting, urban and innovative, 3x3 is inspired by several forms of streetball played worldwide and is considered the world’s number one urban team sport” (FIBA, 2017, para. 12). ‘3x3’, a new Olympic discipline that will debut at the Tokyo 2020 Olympics, “is typically accompanied by non-stop music, DJs and break-dancers” (Olympics News, 2007, para. 2).

As sports writer for The Ringer Rodger Sherman points out, 3x3 is likely to be all about money. Although basketball is massively popular worldwide, FIBA makes no money from people watching the NBA. Although 3x3 may look like pickup basketball, it is highly regulated (Sherman, 2017); FIBA has introduced officials and game specific rules, and a new ball—slightly smaller, but the same weight as a regular basketball.

FIBA’s appropriation of pickup basketball’s ‘street’ culture represents a similar strategy to that used in my research project. That is, FIBA employs DJs to enhance the atmosphere and elevate spectator participation during 3x3 games. However, FIBA uses basketball’s cultural associations to promote a structured and competitive version of grassroots basketball that is significantly different from real pickup basketball. Nevertheless, FIBA’s 3x3 event design reaffirmed my belief that 2K-Reality would ‘make sense’ to pickup basketball players and spectators. Figure 19 shows a DJ providing beats for a FIBA 3x3 competition in Changsha, China.

3.3.7 NBA Entertainment

The NBA influences the global culture of basketball. The NBA is a major global entertainment and consumer goods company with a “compendium of branded entertainment-oriented personas, products, and services” (Andrews, 2006, p. 96). NBA Commissioner from 1984 to
2014, David Stern, confidently equated the NBA with the Disney Corporation in 1991, saying that:

“They have theme parks … and we have theme parks. Only we call them arenas. They have characters: Mickey Mouse, Goofy. Our characters are named Magic [Johnson] and Michael [Jordan]. Disney sells apparel; we sell apparel. They make home videos; we make home videos.” (Swift, 2001, para. 46)

As Andrews highlights, the NBA spectacle in Debord’s terms “covers the entire globe, basking in the perpetual warmth of its own glory” (Andrews, 2006; Debord, 1967/1994, p. 15). In addition to NBA mass-mediated representations—television broadcasts and videogames—NBA Properties license the NBA brand extensively to businesses that design products for enjoyment in public, private and privately owned public spaces; from toys and action figures to location-based amusements.

Figures 20. show examples of NBA-branded location-based amusements, which I previously mentioned in Section 3.3.3—the NBA Game Time arcade game and the NBA Fastbreak pinball machine.

NBA-branded amusements provide examples of how location-based entertainment exploits NBA make-believe principles of generation—how the products are designed to motivate basketball mimicry and create NBA-themed gameplay experiences. For instance, both NBA Game Time and NBA Fastbreak utilise sound design to connect significantly different play experiences with the NBA.

NBA-branded entertainment is notably absent in almost all grassroots basketball playspaces. Almost, because there is evidence that NBA-branded videogames are present in a privately owned basketball facility in France called Hoops Factory. And the ubiquitous nature of smartphones suggests NBA videogame Apps are likely to be played by some people in public basketball playspaces. Figure 21 shows grassroots basketball players playing the NBA 2K17 videogame at the Hoops Factory in Paris.
The absence of NBA-branded entertainment in grassroots basketball playspaces suggests a sports marketing opportunity, the exploitation of which may support grassroots sports technology innovations that have the potential to attract private investment. As mentioned in Section 2.2.6, international public health and sports management reports consider private investment necessary to support the development of grassroots sports for increasing physical activity, particularly for the growing number of casual sports participants.

3.3.8 NBA Sports Videogames

Pickup basketball players are part of a global community of practice (McLaughlin, 2008; Wenger, 1998) created by the broadcast images of NBA games (McLaughlin, 2008) and reinforced by NBA sports videogames. NBA games are broadcast in 215 countries and the broadcast of the 2017–18 NBA season attracted more than 1 billion unique viewers (Murray, 2019). The most famous basketball videogame series, NBA 2K published by 2K Sports, is sold in over 122 countries. Total sales of NBA 2K videogames have reached 80 million units since 1999, and over 10 million copies of NBA 2K18 (Visual Concepts, 2017) were sold in the United States in 2017, making it the second most popular videogame in the United States that year (Taylor, 2018).

NBA-branded basketball videogames are significantly meaningful to members of the global basketball community. Videogame theorists Fares Kayali and Steven Conway argue that sports videogames are a part of fan culture (Kayali, 2013) and an authentic extension of sports culture (Conway, 2010). Sociologists Garry Crawford and Victoria Gosling argue that sports videogames can be an important part of a sports fan’s everyday life, and can contribute to a player’s narrative identity and social interactions (Crawford & Gosling, 2009). Game theorist Ian Bogost suggests sports videogames are just another way of partaking in a sport (Bogost, 2013).

While NBA basketball videogames, such as the NBA 2K and the EA Sports’ NBA Live series, realistically replicate the conventions and mechanics of NBA basketball as closely as possible; other popular NBA basketball videogames, such as NBA Street (NuFX, 2001), Freestyle 2 (JC Entertainment, 2015) and NBA 2K Playgrounds 2 (Saber Interactive, 2018) appropriate the social, cultural and spatial practices of pickup basketball. Figures 22, 23 and 24 show screenshots from each of these videogames. As popular culture researcher David J. Leonard observed more
than a decade ago, these ‘street’ basketball videogames forgo realism to exaggerate basketball player moves, and capitalise “on the popularity of urban life and the fetishization of hip-hop” (Leonard, 2006, p. 432). The appropriation of pickup basketball culture in videogames expanded in 2013, when NBA 2K videogames incorporated a pickup basketball world called MyPark for online console gaming; shown in Figure 25.
The multiplicity of ways in which basketball videogames create meaning for the global basketball community are too numerous to address here. What is essential for my research project is appreciating the ways in which NBA videogames continue to expand the blending of real and virtual basketball worlds. NBA 2K videogames, in particular, continue to broaden how NBA videogames interact with the physical world. In 2016, 2K Sports joined with quantified-self platform providers Fitbit, to provide videogame players with a mechanism to unlock bonuses in *NBA 2K17* (Visual Concepts, 2016) with data generated by real-world physical activity (Cowan, 2016). More recently, 2K Sports linked the NikeConnect platform with the *NBA 2K18* (Visual Concepts, 2017) videogame; using a smartphone to scan the NikeConnect tag on an NBA jersey unlocks bonuses within the game.

The *NBA Baller Beats* (Majesco Entertainment, 2012) exergame also provides a very literal example of how NBA videogames can interact with the physical world. *NBA Baller Beats* requires physical exertion to play the game; it asks players to rapidly bounce a 22Oz (0.62Kg) basketball to music in a typical videogame console playspace such as a living room, a potentially risky activity for causing damage. As Bobby Brady famously said after breaking his mother Carol’s favourite vase, “she always says, don’t play ball in the house” (Schwartz & Mayberry, 1970). More seriously, *NBA Baller Beats* is like most exergames that noted videogame theorist Ian Bogost argues are less than sympathetically adapted to the social, cultural and practical characteristics of typical homes (Bogost, 2005). Figure 26 shows an *NBA Baller Beats* promotional image.
Understanding how important NBA videogames are to the global basketball community, and how they mix the real and the virtual worlds of basketball, bolstered my motivation to blend NBA videogames with real pickup basketball played in public playspaces. In Section 3.4, I describe how my vision-driven research that intended to explore the qualities of an NBA videogame prompted the generative interpretation of my 2K-Reality idea.

3.3.9 NBA 2K Videogame Commentary

NBA 2K videogames implement the dual remediation of NBA television broadcasts and NBA basketball. NBA 2K videogames “deliberately try to blur the line between videogames and sports broadcasts” (Kayali, 2013, p. 214), and attempt “to blur the lines between the ballpark and the virtual stadium, the athlete and the virtual athlete” (Leonard, 2006, p. 427). Influential new media theorists Jay David Bolter and Richard Grusin define remediation as “the representation of one medium in another medium” (Bolter & Grusin, 1999, p. 45) brought about by acts of repurposing. Like all remediation, NBA 2K videogames’ operate “under the current cultural assumptions about immediacy and hypermediacy” (Bolter & Grusin, 1999, p. 21). The immediacy of NBA 2K videogames, the aim of eliminating a player’s awareness of mediation while playing the game, draws upon expectations derived from watching NBA television broadcasts to deliver an immersive interactive experience. NBA 2K videogames enact hypermediacy by appropriating and remixing well-known cultural forms and materiality associated with the practice of basketball. Working together, the immediacy and hypermediacy of NBA 2K videogames create an authentic NBA-themed experience. As sports videogame scholar Andrew Baerg comments in his textual analysis of the NBA 2K12 basketball videogame, sound “plays a major role in generating hypermediacy in 2K12” (Baerg, 2012, p. 373); moreover, sports media researcher and writer Abe Stein notes that “commentary and sports personalities have been at the heart of the convergence of televised sports and videogames since the very beginning” (Stein, 2013, p. 124).

Therefore, remediating the substantial role sports commentary plays in creating a sense of “immersion, agency and excitement” (Rhodes, Coupland & Cruickshank, 2010, p. 111) in television broadcasts and videogames, may have the potential to generate an authentic, meaningful and enjoyable immersive experience in pickup basketball playspaces for both players and spectators. Furthermore, as Andy Miah contends in his book Sport 2.0, in which he examines the convergence of sports and digital cultures, “sports commentary is among the most important examples of how greater immersion for spectators is created … [and] the common ground between the technological and cultural aspects of augmenting sports spectating is language” (Miah, 2017, p. 110, emphasis in original).

3.3.10 Computer-augmented Basketball Environments

In recent years digital technology has been utilised to create temporary computer-augmented basketball environments that expand upon the traditions of NBA location-based amusements and videogames. Most notably, the AKQA digital agency has used developments in screen technology to create an immersive basketball training facility and a pickup basketball experiential marketing simulator.
In 2014 and 2015, AKQA created an LED basketball court for Nike Rise—a reality television show contest in China. The interactive LED court displayed motion graphics to guide players through training drills and play scenarios (AKQA, n.d.a). Figure 27 shows Nike Rise 2.0 contestants following motion graphics during training drill.

In 2015, Nike again implemented the LED basketball court system as part of a temporary city-wide multi-sport urban intervention Nike called Welcome to the City of Zoom. The first competitive games to be played on the LED basketball court prompted the obvious question from journalists covering the event—what was it like to play on the LED court? Isaiah Briscoe, a highly rated high school point guard, revealed that it was hard to focus while playing because the court was continually flickering. But at the same time; it was fun to play on, and a crazy experience too hard to explain (Smith, 2015). Figure 28 shows teams competing at the Zoom City Arena.

AKQA’s LED basketball court system demonstrates how digital screen technology can augment basketball deliberate practice and competition; in 2015, the agency also designed an experiential marketing computer-augmented environment for basketball deliberate play.

‘The Last Shot’ is described as “a fully immersive and interactive LED half court” (AKQA, n.d.b, para. 4). Visitors to the 2015 NBA All-Star Weekend in New York City were invited to “take one of MJ’s high-pressure, championship-winning buzzer beaters” (AKQA, n.d.b, para. 3), in a simulation of three great moments in Michael Jordan’s career. Participants stepped into MJ’s shoes and
stepped back in time (AKQA, n.d.b) to mimic Michael Jordan in front of virtual era-specific crowds. Figure 29 shows players immersed in ‘The Last Shot’ Michael Jordan simulator.

Figure 29. The Last Shot Michael Jordan simulator.

Shooting hoops in a computer-augmented basketball environment, in front of a virtual crowd, has also been visualised in film. In 2016, the movie Passengers (Maher, Marmur, Moritz, & Tydum, 2016) included a ‘design fiction’ in which the lonely protagonist shoots hoops in the presence of an acoustic virtual crowd and motion graphics cheerleaders, much to his delight. Figure 30 shows the character Jim Preston celebrating a winning shooting hoops score in the movie Passengers.

Figure 30. Screenshot from the movie Passengers (19:19). ©2016 Village Roadshow Pictures

These examples demonstrate how other designers have interpreted the desires and ambitions held by members of the basketball community to produce new experiences in computer-augmented basketball environments. Furthermore, each installation exhibits different characteristics relevant to my design criteria. For example, AKQA’s LED basketball court system does not directly challenge the logic of the sport, nor does the design fiction in Passengers. The spatial, temporal and practical elements crucial to the sport remain unchanged; although, AKQA’s LED lights do appear to affect players’ vision and playing in darkened environments is not ideal. More importantly, both ‘The Last Shot’ and the design fiction in Passengers demonstrate reinterpretations of NBA mimicry and make-believe. And all three examples suggest that augmenting existing basketball playspaces may present an opportunity for creating innovative computer-augmented pickup basketball experiences.
In this section, I have discussed some of the notable pickup basketball sociocultural factors that emerged from my explorative interpretation—a design process implicit to the vision-driven research quadrant of Norman and Verganti’s DRQ framework. These factors helped inform my understanding of the design situation my research project addressed, and the judgment I employed to design the 2K-Reality prototypes. My initial exploration of NBA videogames propelled my research project into a generative interpretive design phase, that being bricolage.

3.4 2K-REALITY BRICOLAGE

In this section, I describe and discuss my bricolage design process. This generative interpretation process determined the design of my research project artefact. As illustrated in Figure 31, bricolage is the second quadrant of the DRQ framework I applied to my research project.

![THE DESIGN RESEARCH QUADRANGLE](image)

*Figure 31. The Design Research Quadrangle: Bricolage.*


On Monday, 14 July 2014, I visited my musician friend David Rule (1969–2019) to take advantage of his Xbox 360 (Microsoft, 2005) videogame console, so I could analyse the NBA 2K12 videogame as part of my vision-driven research. After Dave agreed to play a game with me, I adjusted the audio sliders to silence the videogame background music. Eliminating videogame music is not unusual for videogame players. As videogame sound design researcher Sander Huiberts identified in his doctoral thesis, roughly 40% of videogame players listen to other music during gameplay at least once a month (Huiberts, 2010).

As shown in Figure 32, NBA 2K12 provides control over the qualities of ‘TV Broadcast Audio Presentation’ during gameplay. NBA 2K12 has audio sliders to control the volume of six in-game audio channels: Commentary Vol, PA Vol (Public Announcements), Sound Effects Vol, Crowd Vol, Player Chatter Vol, and 2K Beats In-Game Music Vol. Following our gameplay session, I tinkered with the audio sliders to isolate and analyse the composition of each audio channel.
Purely coincidentally, during my audio analysis, Dave drew my attention to a new digital audio sampler he’d recently acquired. My introduction to the Native Instruments Maschine Mikro MK2 Compact Groove Production Studio (Native Instruments, n.d.), shown in Figure 33, prompted my application of bricolage—the breakthrough event in my practical design process.

3.4.1 Generating the 2K-Reality Idea

I associated the acoustic agency the NBA videogame affords players with the acoustic agency the portable Maschine Mikro MK2 sampler affords DJs—how manipulating the videogame controller generates commentary and crowd sounds in the NBA 2K12 videogame with audio samples, and how DJs performing live in public spaces activate the sampler interface to produce music with audio samples.

This conceptual association inspired my 2K-Reality idea—using the sampler for the live performance of amplified NBA 2K12 commentary and crowd sounds coupled with pickup basketball, to expand NBA mimicry and make-believe practices.
3.4.2 Testing the 2K-Reality Idea

The technology I had at hand allowed me to ‘hack’ the NBA 2K12 videogame to test my 2K-Reality idea. The Xbox 360 audio I/O (in/out) provided me with a simple method for appropriating the videogame sounds. I used RCA leads to connect the Xbox 360 to a Yamaha Audiogram 3.0 (Yamaha Music, n.d.) audio interface, which was linked to my Apple MacBook Air (Apple Inc., n.d.) with a USB cable. The Soundtrack Pro audio software installed on my MacBook Air allowed me to monitor, record and edit the NBA 2K12 videogame audio feed. Figure 34 shows the hacking system I used to produce the 2K-Reality audio content and test my bricolage idea.

Testing my bricolage idea took less than two hours. After I recorded a continuous stream of NBA 2K12 commentary audio, I edited the single audio file into discreet commentary elements that represented the most common basketball action and event sequence: passing, shooting and scoring or missing a basket. I subsequently recorded and edited NBA 2K12 crowd sound effects into two discreet samples: crowd noise and crowds cheering. Next, having learnt the basics of Maschine 2—the Maschine Mikro MK2 MacOS software, I imported the audio samples and assigned them to different colour-coded buttons for testing. My tests immediately confirmed the potential of the 2K-Reality idea. The engaging sonic agency experience simulated the NBA 2K12 videogame sound design.

My bricolage tests determined the audio constraints and effects needed to afford the performance of a more realistic simulation. I implemented a ‘choke’ constraint to prevent the simultaneous activation of commentary samples with different buttons—so the commentator could not speak over himself, and a ‘one-shot’ constraint to stop the commentary samples from looping. I used a ‘sustain’ effect to prevent the crowd sounds from ending abruptly, then
assigned a four-layer ‘polyphonic’ effect to the crowd sounds. This effect allowed one button to reactivate and overlay the same sound—repeatedly tapping the crowd sound button increased the loudness of the crowd.

I then produced some break beats to simulate the use of music in NBA arenas and the NBA 2K videogames. Break beats are short loop-able music sequences, which according to Grandmaster Flash capture the best part of a song (Rose, 1994). I assigned a break beat to a button set with a ‘loop’ effect; so that when holding down the button, the break beat would play endlessly. Figure 35 shows NBA 2K12 audio samples in a Maschine 2 project file, running on an Apple MacBook Air.

![Machine 2 Project File](image)

*Figure 35. Example 2K-Reality rapid prototype Maschine 2 project file.*

My implementation and testing of the audio constraints and effects signalled the end of my bricolage design process. Playing with my 2K-Reality bricolage artefact produced a more realistic simulation of the NBA 2K12 videogame sound design.

### 3.4.3 Evaluating the 2K-Reality Idea

I judged my 2K-Reality idea worth testing because the design concept I envisioned appeared to conform to my practitioner framework—the compliant sports augmentation design criteria that guided my design intent towards playful design sports technology that preserves the practice of pickup basketball by respecting, protecting, and cultivating norms and values.

The 2K-Reality idea complied with my spatial, temporal and practical design criteria. Augmenting pickup basketball with sounds would not threaten the internal logic of the sport. Although introducing commentary and crowd sounds into the practice of pickup basketball would modify the spatial qualities of a playspace, the sounds would not change the playspace physically or require players to alter their spatial play patterns. Nor would the sounds demand the visual attention of players. The sounds would be synchronous with gameplay; they would not interrupt the temporal norms of pickup basketball. And, 2K-Reality was not a personal sports technology device.
The 2K-Reality idea fulfilled my social design criterion by directly involving a spectator in the production of a shared acoustic experience. I envisioned a creative and fun activity that might stimulate physical activity and social interactions.

The 2K-Reality idea adhered to my technology and access design criteria and suggested a strategy that could possibly address my funding design criterion. I perceived 2K-Reality as benign technology—it does not use sensors to collect data; a human distributes data in the form of sound. I pictured 2K-Reality as a piece of public infrastructure, freely accessible to any spectator willing to perform as a basketball DJ. I anticipated that the pickup basketball community of practice would recognise the commentary sounds and connect them to the NBA 2K videogames; thus, the 2K Sports brand. A thought that raised the notion of sonic branding as a strategy for funding a real-world application of the 2K-Reality idea.

Having established that my 2K-Reality idea could satisfy aspects of my design criteria, I was prompted to apply my additional and ongoing vision-driven research, which I documented in the previous Section 3.3. I needed to determine if 2K-Reality was an original design, and to find out if analysing other NBA-themed products and experiences, or acquiring theoretical knowledge, could assist my development of the 2K-Reality idea. I needed to understand 2K-Reality; identify what 2K-Reality was related to, and learn how to describe 2K-Reality.

3.4.4 Examining the 2K-Reality Idea

As noted in Section 2.5.2, Nelson and Stolterman assert that the generative interpretation of ‘possible meanings’ is always related to the meanings disclosed by explorative interpretation (Nelson & Stolterman, 2012). My bricolage process reflects this assertion. My generation of the 2K-Reality idea emerged from my explorative interpretation—my intent to analyse the NBA 2K12 videogame as part of my vision-driven research.

A coincidental contingent event that brought two different technologies into close proximity prompted my conceptual blending. I associated different types of physical interactions with technology that produce meaningful sounds, and I fused embodied performance styles—DJs and basketball players. I envisioned a possible future related to present realities; I pictured DJs performing iconic videogame sounds to articulate, amplify and enhance existing pickup basketball NBA mimicry and make-believe practices.

I had conceptually linked two socially embodied practices of pretending to be an NBA champion—the embodied NBA mimicry and make-believe performed by pickup basketball players with the mediated NBA mimicry and make-believe performed by videogame players. A connection also made by Sicart who, as noted in the epigraph of my dissertation, explains that “playing sports casually, and playing sports videogames, are about performing the impossibilities of professional sports, letting us dream the possibilities of being our heroes” (Sicart, 2013, p. 32).

Blending these two make-believe practices is the essence of my 2K-Reality idea. 2K-Reality mixes embodied and mediated NBA mimicry and make-believe. I appropriate ‘pretending to play in the NBA’ as a make-believe frame or ‘principle of generation’ to design a make-believe prop.
My 2K-Reality idea reflects Bateman’s assertion that principles of generation are “assumptions to be exploited” (Bateman, 2011, p. 148) for designing props that support make-believe. My idea to augment the existing NBA make-believe practices present in pickup basketball with NBA videogame sounds is intended to operate in a way that accords to Turner’s observation that “if make-believe opens the door to other worlds, then the sense of mediated presence keeps it open” (Turner, 2016, p.147).

### 3.4.5 Classifying the 2K-Reality Idea

To test my 2K-Reality idea, I fused the NBA 2K12 videogame with the Maschine Mikro MK2 digital audio sampler. The 2K-Reality bricolage artefact I created appeared to be a hybrid medium that exists between known types of media, NBA-themed media in particular.

According to Gaver et al., ludic designs “fit between familiar genres” (Gaver et al., 2004, p. 887). Gaver and colleagues’ first ludic design assumption “was that ludic designs should sit between several product genres without clearly belonging to any” (Gaver et al., 2004, p. 888). Figure 36 illustrates this characterisation of ludic design.

![Figure 36. Ludic design.](image)


Following this description, I classified the 2K-Reality bricolage artefact as a ludic design—an interactive and playful sports technology media product, situated in a space between sports media and entertainment genres. As shown in Figure 37, I adapt Gaver et al.’s model to illustrate 2K-Reality as a basketball ludic design, that lies in-between the basketball media genres I identified in Section 3.3.
The 2K-Reality ludic design blends aspects of the basketball media and entertainment genres illustrated in Figure 36, as well as blending aspects of the product genres shown in Figure 37, without clearly belonging to any of the genres.

2K-Reality recontextualises NBA videogame and NBA TV broadcast entertainment by appropriating broadcast-style commentary and crowd sounds for remediation in pickup basketball playspaces.

2K-Reality is a public art installation that simulates the cultural practice of augmenting basketball playspaces with sound; that is discussed in Section 3.3.4. 2K-Reality invites spectators to perform like basketball DJs, MCs and sportscasters by playing an amplified digital musical instrument.

2K-Reality creates an immersive computer-augmented environment that amplifies the physical expressions of pickup basketball players and celebrates impressive play and successful shots, similar to a basketball location-based amusement.

As well as being situated between media genres, 2K-Reality reflects other characteristics Gaver et al. ascribe to ludic designs. 2K-Reality is non-utilitarian and presents the familiar in an unexpected context: it’s open and ambiguous and offers exploration possibilities, it aims to promote pleasure and social engagement (Gaver et al., 2004). Furthermore, by utilising the Maschine Mikro MK2 digital audio sampler, my 2K-Reality idea employs a design strategy that Sengers and Gaver argue can be used to support interpretative appropriation (Sengers & Gaver, 2006). Sengers and Gaver describe a ‘blank canvas’ as a device that clearly communicates what it does and how to use it, but leaves its purpose, meaning and usefulness open for users to decide (Sengers & Gaver, 2006). The Maschine Mikro MK2 digital sampler provided me with a ready-made ‘blank canvas’ designed explicitly for appropriation by performers.

In this section, I have described and discussed my bricolage design process; the creative process that determined my research project artefact—2K-Reality. This process propelled my research project into a design-driven research phase, which I explain in the next section. And, as
mentioned above, it also prompted my additional and ongoing vision-driven research, which I documented in the previous section, Section 3.3.

### 3.5 2K-REALITY DESIGN-DRIVEN RESEARCH: RAPID PROTOTYPE

As discussed in Section 2.5.3, design-driven research correlates with compositional interpretation and assembly for ‘making meaning’. Designers aim to connect found meanings and possible meanings to produce a unified system—a product or experience that creates a new meaning for people (Nelson & Stolterman, 2012). As illustrated in Figure 38, design-driven research is the third quadrant of the DRQ framework that I applied to my research project.

As noted in Section 3.4.2, testing my 2K-Reality idea involved an explicit act of hacking. In this section, I discuss the compositional interpretation or ‘hacking’ design process I used to assemble the 2K-Reality rapid prototype; a make-believe prop I judged could afford the performance of realistic NBA-themed soundscapes meaningful to pickup basketball players and spectators. Figure 39 illustrates my design process, which I discuss below and describe in some detail in Appendix B.

![The Design Research Quadrangle](image)

Figure 38. The Design Research Quadrangle: Design-driven research.
My 2K-Reality interpretive hacking design process was guided by my practitioner framework and Walton’s Reality Principle. I sought to augment pickup basketball with acoustic NBA make-believe and preserve existing social practices and the spatiotemporal norms of the sport.

As noted in Section 3.4.4, I appropriated the ‘pretending to play in the NBA’ make-believe principle of generation to design a make-believe prop. As discussed in Section 2.3.2, Walton uses the term Reality Principle to describe principles of generation that closely reflect the real world. Accordingly, we can conclude that ‘pretending to play in the NBA’ clearly acts upon a Reality Principle. Pickup basketball players and NBA 2K videogame players experience fictional worlds that intentionally simulate real-world NBA scenarios.

Therefore, to be meaningful, the 2K-Reality make-believe prop needed to afford the performance of realistic NBA-themed soundscapes that simulate the sound design of NBA 2K12 and NBA TV broadcasts.

As shown above in Figure 39, and described in Appendix B, I designed my 2K-Reality rapid prototype by implementing the following six steps: i) content identification, ii) NBA 2K12 audio recording, iii) NBA 2K12 commentary analysis and break beats production, iv) NBA 2K12 audio sample selection, v) graphic user interface design, and vi) content authoring.

Figure 40, shows the physical result of my design process: the Maschine Mikro MK2: 2K-Reality rapid prototype.
At the end of my design process, the 2K-Reality rapid prototype comprised the modified Maschine Mikro MK2 physical interface and twenty Maschine 2 software project files, each of which each managed five alternative sample groups. Each sample group contained sixteen audio samples that corresponded to the sixteen-button interface; the same three crowd sound effect samples, one of twenty break beats samples, and different combinations of sixty-one commentary samples. The rapid prototype utilised five sound constraints and effects—‘choke’ and ‘one-shot’ constraints; and ‘sustain’, ‘polyphonic’ and ‘loop’ effects, all of which I describe in Appendix B.

3.5.1 Identifying the 2K-Reality Form

My 2K-Reality interpretive hacking design process produced a ludic design make-believe prop that takes the form of Sonic Videogame Art. I employed videogame art appropriation techniques in conjunction with sonic interaction design.

As Mitchell and Clarke state, “in all videogame art, something is appropriated: the graphics, the gameplay, the conventions of the interface, etc.” (Mitchell & Clarke, 2003, p. 346). Appropriating audio-visual elements from videogames is a widely used artistic strategy and probably the most definitive feature of videogame art (Mitchell & Clarke, 2003; Stockburger, 2007). Appropriating commentary samples from the NBA 2K12 videogame is the critical hacking strategy I employed to design a 2K-Reality rapid prototype that exploits the ‘pretending to play in the NBA’ Reality Principle. The explicit intertextual reference to NBA 2K videogames and NBA television broadcasts is the crucial factor in creating an authentic and meaningful NBA make-believe experience for the pickup basketball community of practice.

2K-Reality is a sonic videogame art form that implements the four overlapping categories of videogame artworks identified by Mitchell and Clarke, which I cited in Section 2.3.1: i) remixing, ii) reference, iii) reaction and iv) reworking (Mitchell & Clarke, 2003).

i) Remixed videogame art appropriates elements from a videogame and discards the game itself (Mitchell & Clarke, 2003). 2K-Reality is remixed videogame art; I discarded its appropriation source—appropriated and deconstructed NBA 2K12 videogame sounds are reconstructed in a different context using a different medium.
ii) Videogame art reference works retain videogame gameplay, but throw away everything else; the still recognisable gameplay is filled with new audio-visual content to convey new meaning (Mitchell & Clarke, 2003). 2K-Reality achieves a reference videogame art status by retaining gameplay differently to other works in this category. 2K-Reality maintains gameplay by directly referencing the game of basketball. While playing 2K-Reality does not replicate the act of playing the NBA 2K12 videogame, 2K-Reality soundscapes accurately reproduce the acoustic qualities and narrative patterns heard when playing NBA 2K12.

iii) Mitchell and Clarke use the term ‘reaction’ to define artistic interventions in game worlds (Mitchell & Clarke, 2003). The 2K-Reality videogame art affords the performance of soundscapes that intervene in a pickup basketball game world.

iv) According to Mitchell and Clarke, videogame art in the reworking category “tend[s] to fall into four distinct categories: patches, skins, maps, and mods” (Mitchell & Clarke, 2003, p. 343). I cannot strictly categorise 2K-Reality as a reworking, according to Mitchell and Clarke’s descriptions. However, in *Games AS Art: The Aesthetics of Play*, Pearce defines a videogame ‘patch’ as “a plug-in that sits on top of another game” (Pearce, 2006, p. 76) to subvert mainstream videogame culture. If this is the case, perhaps 2K-Reality may best be described as a videogame infrastructure ‘patch’—a ‘plug-in’ used to overlay real pickup basketball games with NBA 2K videogame sounds. Furthermore, like the many forms of videogame art that tend to involve acts of subversion (Stockburger, 2007; Pearce, 2006; Mitchell & Clarke, 2003), 2K-Reality also subverts mainstream videogame culture. The 2K-Reality sonic videogame art form inverts the established practice of commodifying pickup basketball culture in commercial videogames, described in Section 3.3.8.

Moreover, 2K-Reality exhibits reworking characteristics by producing similar results to videogame art that employs the reworking technique. For instance; machinima artworks involve live-performance to create linear videogame-based cinematic experiences. Similarly, 2K-Reality requires live-performance to produce a linear videogame-based acoustic experience. Both machinima and 2K-Reality produce recognisable videogame narratives for audiences that expand the scope of the original game—a simple attribute of reworking (Mitchell & Clarke, 2003).

As I noted in Section 2.3.1, SID (Sonic Interaction Design) concerns exploring how sound can convey information and meaning with aesthetic and emotional qualities in interactive contexts (Rocchesso, 2011). I also cited SID theorist Daniel Hug who recommends sound designers employ similar appropriation strategies to those used for creating videogame art (Hug, 2010b); and argues that narrativity and performativity informed by film and videogame sound design is fundamental to SID (Hug, 2013; Hug, 2010a).

My interpretive hacking design process focused carefully on creating a videogame-based sonic performance device that could produce an immersive acoustic experience for pickup basketball players; made meaningful by simulating the narrative sound design of NBA 2K12 and NBA TV broadcasts.
Apart from producing break beat audio files, my SID was limited to adapting the Maschine Mikro MK2 user interface. Within the constraints of the 4-by-4 layout of the buttons; I sought to make the interface as easy as possible to operate, and have it make sense to the pickup basketball community. As detailed in Appendix B, I arranged the layout of the commentary interface buttons to follow the temporal patterns of pickup basketball play; I separated the buttons I anticipated would be used frequently, and I attempted to afford logical two-handed multi-touch interface interactions. To finish, I colour-coded the interface buttons and added labels.

By appropriating acoustic elements from the NBA 2K12 videogame and break beats from contemporary music, my 2K-Reality make-believe prop automatically acquires the potential immersive capabilities of sound. Sound surrounds us—we hear all around without having to focus, we can’t shut sounds out automatically, we are “not equipped with earlids” (McLuhan, Fiore & Agel, 1967, p.111). Accordingly, digital media theorist Frances Dyson calls sound the “immersive medium par excellence” (Dyson, 2009, p .4).

NBA 2K12 commentary sounds provide an ability to convey information and meaning with narratives. As noted in Section 3.3.9, sports commentary plays a substantial role in creating a sense of immersion in sports television broadcasts and videogames, and sports spectating (Rhodes et al., 2010; Miah, 2017). And as interactive sound designer Mats Liljedahl points out, “when you want to convey a clear and unambiguous message, the human voice is a natural choice” (Liljedahl, 2011, p. 31).

NBA 2K12 crowd sounds contribute the potential to create a sense of virtual co-presence—“the feeling of being together in a shared space” (Wagner et al., 2009, p. 251). Which, as ‘presence’ researchers Wagner et al. argue, is a significant feature of mixed reality experiences because it constructs “shared spaces by presenting matching virtual and real stimuli to multiple users” (Wagner et al., 2009, p. 251).

Break beats music introduces a range of potential cognitive effects, emotional qualities and physical responses. As sports psychologists Costas Karageorghis and David-Lee Priest point out, available evidence shows that “music captures attention, raises spirits, triggers a range of emotions, alters or regulates mood, evokes memories, increases work output, heightens arousal, induces states of higher functioning, reduces inhibitions and encourages rhythmic movement” (Karageorghis & Priest, 2012, p. 45). Karageorghis and Priest argue that each of these purposes has applications in sport. Furthermore, an earlier landmark review of the effects of music in exercise and sport concluded that “appropriately selected music can enhance enjoyment levels and adherence to physical activity” (Karageorghis & Terry, 1997, p. 54).

The interpretive ‘hacking’ design process, or compositional interpretation and assembly process I have discussed produced the 2K-Reality rapid prototype. This design process propelled 2K-Reality from bricolage to a sonic videogame art form, ready for testing in urban pickup basketball playspaces. In the next section, I discuss the design implications derived from testing and evaluating the usability of the 2K-Reality rapid prototype design.
3.6 2K-REALITY HUMAN-CENTRED DESIGN RESEARCH

As described in Section 2.5.4, HCD research involves the testing of prototypes to ensure design solutions are usable and understandable. In this section, I will briefly discuss the first aspect of my urban probe HCD research—the fourth quadrant of the DRQ framework I applied to my research project, as illustrated in Figure 41. I outline my interpretive evaluation of 2K-Reality rapid prototype usability, the aspects that informed my iterative design and development of the 2K-Reality exhibition prototype, a process I describe in the next Section 3.7.

In Chapter 4, I address the second component of my HCD research. I summarise each of my urban probes and discuss my participant-observer evaluation of the 2K-Reality audience experience, and the interpretative appropriation of the 2K-Reality exhibition prototype.

![THE DESIGN RESEARCH QUADRANGLE](image)

*Figure 41. The Design Research Quadrangle: Human-centred design research. Adapted from Norman, D. A., & Verganti, R. (2014). Incremental and radical innovation: Design research vs. technology and meaning change. Design Issues, 30(1), p. 91.*

3.6.1 Rapid Prototype Installation System

The 2K-Reality rapid prototype installation system, illustrated in Figure 42 and described in Table 4, produced loud clear sound but was cumbersome to transport, install and operate in public space. The rapid prototype installation system I used in Taipei was even more cumbersome due to a speaker configuration that required an amplifier.
Figure 4.2 2K-Reality rapid prototype installation system (Melbourne). Legend: 1. Maschine Micro MK2 Sampler, 2. Apple MacBook Air, 3. Yamaha Audigram 3, 4. 2 x Behringer B300 Powered Loudspeakers.

Table 4.  
2K-Reality Rapid Prototype Installation System

<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>2K-REALITY RAPID PROTOTYPE INSTALLATION SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAMPLER USER INTERFACE</td>
<td>Maschine Mikro MK2 Sampler</td>
</tr>
<tr>
<td>GRAPHIC USER INTERFACE</td>
<td>16 Illuminated Buttons, Colour-coded &amp; Labelled</td>
</tr>
<tr>
<td>CPU HARDWARE</td>
<td>Apple MacBook Air</td>
</tr>
<tr>
<td>AUDIO INTERFACE</td>
<td>Yamaha Audigram 3</td>
</tr>
<tr>
<td>SOFTWARE PROGRAM</td>
<td>MacOS Maschine 2</td>
</tr>
<tr>
<td>NBA 2K12 COMMENTARY</td>
<td>61 Samples</td>
</tr>
<tr>
<td>NBA 2K12 CROWD SOUNDS</td>
<td>3 Samples</td>
</tr>
<tr>
<td>BREAK BEATS MUSIC</td>
<td>20 Samples</td>
</tr>
<tr>
<td>CONTENT RANDOMISATION</td>
<td>Manual Switching 20 Maschine 2 Project Files</td>
</tr>
<tr>
<td></td>
<td>20 x 5 Interface Sample Groups</td>
</tr>
<tr>
<td>TRAJECTORY CONTROLS</td>
<td>N/A</td>
</tr>
<tr>
<td>PA SYSTEM</td>
<td>2 x Behringer B300 Powered 300w Loudspeakers</td>
</tr>
</tbody>
</table>

3.6.2 Rapid Prototype Usability

Each of my rapid prototype urban probe studies, described in Sections 4.2 to 4.4, exposed the practical and usability deficiencies of the 2K-Reality rapid prototype installation system. The studies underscored the anticipated need to design a more approachable and straightforward technology configuration; this would include hardware and software capable of incorporating a
greater variety of commentary and break beat samples, and provide more control over trajectory-specific commentary.

Most importantly, however, the urban probes I conducted determined that the rapid prototype graphic user interface design and audio programming was sufficiently usable and understandable for performing credible and meaningful NBA-themed soundscapes.

As shown in Figure 43, people operating the 2K-Reality rapid prototype needed to place the Maschine Mikro MK2 sampler on their knees, and position the MacBook Air within reach to alternate sound samples by swapping sample groups and changing software project files—the Maschine 2 software that controls the sampler prohibits randomising audio samples automatically. The method for alternating samples was barely tolerable, especially since the MacBook Air screen was often affected by glare. The majority of urban probe participants who operated prototype required the assistance of a second operator to change the sample groups, so that alternative commentary and break beats samples could be activated. Furthermore, the unfamiliarity of the Maschine Mikro MK2 sampler interface appeared to intimidate some potential users of the 2K-Reality rapid prototype.

![Figure 43. 2K-Reality rapid prototype operation in Taipei.](image)

As noted in Section 3.5, the 2K-Reality rapid prototype utilised three crowd sound effect samples, twenty break beats samples and sixty-one commentary samples. This limited number of audio samples produced monotonous soundscapes. As documented in Sections 4.2 to 4.4, multiple urban probe participants—who provided feedback by writing comments, answering questionnaires or participating in video interviews—highlighted the need for more commentary samples and more break beat music samples. For example, two different interviewees made the following comments: “it needs to have more variety” and “I think it needs more kinds of music”.

While conducting my participant-observer research, a design issue concerning appropriate meaning emerged at different times during each of my rapid prototype studies. Occasionally a 2K-Reality operator would activate a contextually inappropriate commentary sample by pressing an interface button that accurately reflected the basketball action they observed and interpreted. This design issue only concerned the activation of the team-based-play sample buttons: ‘General Play’, ‘Offence’ and ‘Defence’. For example, an operator pressing the ‘Offence’ button could unintentionally activate a commentary sample such as “nice pass”, which is irrelevant to
participants in a 1-on-1 pickup basketball trajectory—the offensive player has no teammates to pass to.

As discussed in Section 3.3.9, remediation operates through immediacy and hypermediacy, eliminating the awareness of mediation, and the appropriation and remixing of media that meets cultural expectations effectively (Bolter & Grusin, 1999). When encountered, the practical and usability deficiencies of the 2K-Reality rapid prototype installation system diminished the NBA videogame remediation experience for participants. The difficulties people faced using 2K-Reality reduced immediacy; players and spectators became more aware of mediation. The monotonous soundscapes and production of inappropriate meanings interrupted hypermediacy; the pickup basketball community’s cultural assumptions, established by NBA videogames and NBA TV broadcasts, were not met. Therefore, the diminished remediation represented a breakdown in the ‘pretending to play in the NBA’ make-believe 2K-Reality is designed to expand. This, in turn, reduced the potential for all participants to enjoy the immersive NBA-themed experience.

3.7 2K-REALITY DESIGN-DRIVEN RESEARCH: EXHIBITION PROTOTYPE

In this section, I outline the design and development of my 2K-Reality exhibition prototype, my second compositional interpretation and assembly process, informed by the urban probe HCD research I conducted using the 2K-Reality rapid prototype. As illustrated in Figure 44, I reapply the design-driven research quadrant of the DRQ framework. A more detailed description of this design-driven research phase is provided in Appendix C.

![Figure 44. The Design Research Quadrangle: Design-driven research 2.](image)


My second interpretive assembly process focused on improving the practicality and usability of the 2K-Reality prototype. I aimed to better facilitate ‘interpretative appropriation’ and enhance 2K-Reality’s remediation of the NBA 2K videogame; to sustain the ‘pretending to play in the NBA’ make-believe Reality Principle.
On Wednesday, 1 April 2015, I was informed that 2K-Reality was selected for public exhibition at the disruption-themed 21st International Symposium on Electronic Art—ISEA2015 to be hosted by Simon Fraser University in Vancouver, Canada. Preparing a 2K-Reality installation system that I could exhibit for multiple days at ISEA2015 framed the design of my second 2K-Reality prototype; the exhibition prototype—a more sophisticated, understandable, usable and practical system.

As I reported in the previous Section 3.6, my rapid prototype urban probe studies indicated that my 2K-Reality design would benefit from implementing iterative design improvements. My participant-observer research HCD research confirmed the need to design a second 2K-Reality prototype that would: i) present a less intimidating more approachable sampler interface, ii) employ a less complex technology configuration, iii) utilise software capable of managing a greater variety of commentary and break beat audio samples, automatically alternate audio samples and provide operators with more control over trajectory-specific commentary sounds.

For reasons I detail in Appendix C, my design-driven research determined that pairing an Apple iPad 2 (Apple Inc., 2011) with an Alesis IO Dock (Alesis, n.d.) could help address my iterative design objectives. The iPad 2 would accommodate a large number of audio samples, and present potential 2K-Reality operators with a familiar physical interface for operating a digital audio sampler. The IO Dock provided a high-quality audio interface for the iPad 2 and could supply the iPad 2 with continuous power. The iPad 2-IO Dock sampler interface configuration would also be far less complicated to install than the rapid prototype. The setup integrated three functions: a physical interface, an audio interface and a CPU (central processing unit). Figure 45 illustrates how an Apple iPad or iPad 2 pairs with an Alesis IO Dock.

After I determined the iPad 2-IO Dock sampler interface configuration, I began designing an installation system that would present people a more convenient way to use 2K-Reality sampler interface. I collaborated with Edward Lin (林寬祐), Ron Lo (羅峥榮) and James Hung (洪嘉懋) to design the 2K-Reality exhibition prototype kiosk, shown in Figure 46. Our design process, described in some detail in Appendix C, involved physically hacking off-the-shelf components to produce the kiosk plinth, and printing a 3D polymer protective case for the iPad 2-IO Dock sampler interface. Figure 47 shows a detail of the sampler interface casing.

![Figure 45. Apple iPad and Alesis IO Dock.](https://http2.mlstatic.com/consola-alesis-io-dock-mezclador-audio-D_NQ_NP_852065-MCO31555647400_072019-F.webp)
While I worked on the exhibition prototype kiosk, I designed and developed the 2K-Reality iOS App in collaboration with an independent iOS software engineer, Vincent Huang (黃一葦). We retained the successful design characteristics of the 2K-Reality rapid prototype and implemented solutions to the deficiencies my HCD research revealed. We had four design and development objectives: i) to simulate the 2K-Reality rapid prototype physical interface and replicate the GUI, ii) emulate the audio constraints and effects applied to the rapid prototype sounds, iii) automatically alternate audio samples, and iv) design and implement a GUI for controlling trajectory-specific commentary sounds, and selecting preferred break beats music. In Appendix C, I describe the 11-step design process that we used to develop the 2K-Reality iOS App.

The 2K-Reality iOS App comprises 138 commentary samples, twenty-four break beat samples, and three crowd sound samples. The App applies a random-shuffle function to the twelve commentary buttons and the ‘Beats’ button; this switches samples five seconds after a button is activated. The App includes a slide-in, expandable and scrollable menu that provides users with
additional control over the ‘General Play’, ‘Offence’ and ‘Defence’ commentary buttons, and the ‘Beats’ button. Users can switch off the random-shuffle function, and select specific commentary or break beats samples from a list.

Figure 48 shows the primary GUI for the 2K-Reality iOS App. Figures 49 and 50 show the slide-in, expandable and scrollable menu. Table 5 identifies the audio constraints and effects applied to each button, and the audio samples actuated by each button. Table 6 below provides a comparison of 2K-Reality prototype components to illustrate the improvements delivered by my exhibition prototype design-driven research. Figure 51 presents a visual comparison of the samplers interfaces used for each 2K-Reality prototype.

![Figure 48. 2K-Reality iOS App primary GUI.](image1)

![Figure 49. Slide-in and expandable menu GUI.](image2)

General Play, Offence, Defence, Beats and Credits
Figure 50. Expanded and scrollable General Play menu GUI.
Table 5.
2K-Reality iOS App Audio Programming and Audio Samples

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<tbody>
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<td><strong>SHOOTS</strong></td>
<td><strong>MISSES</strong></td>
<td><strong>HITS</strong></td>
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<tr>
<td>6 COMMENTARY SAMPLES</td>
<td>11 COMMENTARY SAMPLES</td>
<td>13 COMMENTARY SAMPLES</td>
<td>18 COMMENTARY SAMPLES</td>
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<tr>
<td>CHOKED-ONE SHOT</td>
<td>CHOKED-ONE SHOT</td>
<td>CHOKED-ONE SHOT</td>
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<tr>
<td>5 SECOND RANDOM-SHUFFLE</td>
<td>5 SECOND RANDOM-SHUFFLE</td>
<td>5 SECOND RANDOM-SHUFFLE</td>
<td>5 SECOND RANDOM-SHUFFLE</td>
</tr>
</tbody>
</table>

- and no mistakes on the layup • and the layup falls • and the layup is good • and the layup is up and in • drops in the layup for two • lays it up and banks it in
- fires it up • floats one • heaves it up • and that one misses • can’t get it to go • cannot hit • no good • no good on that one • no luck • shot is no good • shot is off • that one is off • that one misses • the shot no good • the shot will not go • and that’s not gonna go
- and it’s in • and it’s on target • and that one’s good • and yes sir that one drops • basket good • basket is good • count that one • count the shot • gets it to go • gets the bucket • good • got it • hits it • it falls • it’ll count • that one goes count it • that’s good • that’s in there

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<th>S3</th>
<th>M3</th>
<th>H3</th>
</tr>
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<tbody>
<tr>
<td><strong>SHOOTS AGAIN</strong></td>
<td><strong>SHOOTS 3</strong></td>
<td><strong>MISSES 3</strong></td>
<td><strong>HITS 3</strong></td>
</tr>
<tr>
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<td>22 COMMENTARY SAMPLES</td>
<td>4 COMMENTARY SAMPLES</td>
<td>8 COMMENTARY SAMPLES</td>
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<td>CHOKED-ONE SHOT</td>
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<td>5 SECOND RANDOM-SHUFFLE</td>
<td>5 SECOND RANDOM-SHUFFLE</td>
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</table>

- again • another shot • goes back up • second shot opportunity • they shot again • tries again • with the second effort
- from deep three point range • beyond the arc • fires from deep • fires the three • for the three • for three • from deep • from downtown • from outside the arc • from the arc • launches a three • lots it go with a three • puts up a three • puts up the prayer • shoots the three • takes a three • takes the three • the three is launched • the trey • three pointer • tries a three
- and a miss there on the triple • misses the deep three point attempt • no good on the triple • offline with his three
- banga home the trifecta • cans it from downtown • drains it from beyond the arc • drills it from outside • enormous three pointer • it falls • it’s good from long range • nails it

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<th>GP</th>
<th>O</th>
<th>D</th>
<th>X!</th>
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<tbody>
<tr>
<td><strong>GENERAL PLAY</strong></td>
<td><strong>OFFENCE</strong></td>
<td><strong>DEFENCE</strong></td>
<td><strong>EXCLAMATION</strong></td>
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<td>CHOKED-ONE SHOT</td>
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<tr>
<td>5 SECOND RANDOM-SHUFFLE AND SELECTABLE</td>
<td>5 SECOND RANDOM-SHUFFLE AND SELECTABLE</td>
<td>5 SECOND RANDOM-SHUFFLE AND SELECTABLE</td>
<td>5 SECOND RANDOM-SHUFFLE</td>
</tr>
</tbody>
</table>

- can they get it? • dee up • don’t let up • gotta love the execution out there • it’s a thing of beauty • just making it look easy out there the way they’re running • nice move • oh no you hate to see that • still looking to get on the scoreboard • that’s not productive basketball • that’s not winning basketball • the fans are enjoying this show • they need this • they’re scoring and shooting with a lot of confidence • tighten it up out there • hit for tat, neck and neck
- finds the open look • all sorts of time • changes up • dishes it • easy shot • great offensive performance they’re puttin’ on • I like the way they got the ball inside there • just an unbelievable display of offence here today • lots of room • moving the ball well • open look • some nice passing • picked out the pass nicely • puts the move on • that offence just keeps clicking • the offensive rebound • they’re just out running their opponent here • they can take their time on this possession • they’re moving the ball • they’re working it around
- and they’ll turn it over • ball’s knocked loose • deflected • good defence got in the way • it’s stolen • tipped • it’s tipped • knocks it lose • stripped it away • swiped away
- oh ho /yeah • oh ho ho ho, that was nasty • oh ho ho ho that should be absolutely illegal • wo ho ho, yes

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<thead>
<tr>
<th>B</th>
<th>C</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BEATS</strong></td>
<td><strong>CROWD BOOS</strong></td>
<td><strong>CROWD CHEERS</strong></td>
</tr>
<tr>
<td>24 BREAK BEAT SAMPLES</td>
<td>1 CROWD SAMPLE POLYPHONIC AND SUSTAINED</td>
<td>1 CROWD SAMPLE POLYPHONIC AND SUSTAINED</td>
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</tbody>
</table>

- Amii Stewart: Knock on Wood • Beadie Boys: Shake Your Rump • Blondie: Rapture • Brian Eno: Glitch • Cypress Hill: When the Shit Goes Down • David Bowie: Sorrow • Devo: Working in a Coal Mine • DJ Shadow: You Can’t Go Home Again • Donna Summer: I Feel Love • Gary Numan: We Are Glass • George Benson: Gimme the Night • Grace Jones: Pull Up To The Bumper • Greyboy: Genevieve • Happy Mondays: Loose Flips • Isaac Hayes: Shaft • James Brown: Funky Drummer • Jurassic 5: The Game • MC 900ft Jesus: Buried At Sea • Norma Jean: Sorcerer • Peaches: Fuck The Pain Away • PM Dawn: You Got Me Floatin’ • Santigold: Get It Up • The Police: Walking on the Moon • Unkle: Shin
Table 6.
2K-Reality Prototype Component Comparison

<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>2K-REALITY INSTALLATION SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RAPID PROTOTYPE</td>
</tr>
<tr>
<td>SAMPLER USER INTERFACE</td>
<td>Maschine Mikro MK2 Sampler</td>
</tr>
<tr>
<td>GRAPHIC USER INTERFACE</td>
<td>16 Illuminated Buttons, Colour-coded &amp; Labelled</td>
</tr>
<tr>
<td>CPU HARDWARE</td>
<td>Apple MacBook Air</td>
</tr>
<tr>
<td>AUDIO INTERFACE</td>
<td>Yamaha Audiogram 3</td>
</tr>
<tr>
<td>SOFTWARE PROGRAM</td>
<td>MacOS Maschine 2</td>
</tr>
<tr>
<td>NBA 2K12 COMMENTARY</td>
<td>61 Samples</td>
</tr>
<tr>
<td>NBA 2K12 CROWD SOUNDS</td>
<td>3 Samples</td>
</tr>
<tr>
<td>BREAK BEATS MUSIC</td>
<td>20 Samples</td>
</tr>
<tr>
<td>CONTENT RANDOMISATION</td>
<td>Manual Switching 20 Maschine 2 Project Files 20 x 5 Interface Sample Groups</td>
</tr>
<tr>
<td>TRAJECTORY CONTROLS</td>
<td>N/A</td>
</tr>
</tbody>
</table>

2K-REALITY - SAMPLER USER INTERFACES

<table>
<thead>
<tr>
<th>RAPID PROTOTYPE</th>
<th>EXHIBITION PROTOTYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maschine Mikro MK2 Sampler</td>
<td>Apple iPad 2</td>
</tr>
</tbody>
</table>

*Figure 51. 2K-Reality rapid prototype and exhibition prototype sampler interfaces.*
3.8 DESIGN CONCLUSIONS

In this chapter, I described and discussed my interpretive design process to answer my first research question: How can the Design Research Quadrangle framework be applied to design a sports technology innovation for pickup basketball?

I began my research project by developing a practitioner framework that articulated my personal design hypothesis—compliant sports augmentation. This process established my starting point for conducting vision-driven research and reflects Verganti’s viewpoint that the innovation of meaning begins by envisioning a personal hypothesis based on reflection and self-criticism (Verganti, 2017). Employing this approach was invaluable to my research project. As noted in Section 3.2.2, Nelson and Stolterman, and likewise Lawson, argue that first intentions are crucial to a design process; they can influence the entire process and are detectable in the outcome (Nelson & Stolterman, 2012; Lawson, 1980/2005). I found this to be the case in my research project. My compliant sports augmentation design criteria guided my vision-driven research and framed my design interpretations, and remain detectable in my 2K-Reality design. I urge designers to review Verganti’s *Overcrowded: Designing Meaningful Products in a World Awash with Ideas* (Verganti, 2017) before they consider utilising the DRQ framework.

My vision-driven research, or exploration to interpret new meanings, revealed the ubiquity of NBA mimicry and make-believe in the cultural practice of pickup basketball. Although I found NBA make-believe to be a compelling design opportunity, I did not know if, or how I might exploit this significant practice, until a coincidental event prompted my application of bricolage, the critical moment in my design research process.

As noted in Section 2.5.2, Norman and Verganti state that the results from tinkering, or bricolage, are “completely accidental” (Norman & Verganti, 2014, p. 93). I tend to disagree. I suggest a designer conducting vision-driven research can promote the possibility of bricolage by following Löwgren and Stolterman’s recommendation to analyse a repertoire of example artefacts relevant to a design situation (Löwgren & Stolterman, 2004). A designer, like a bricoleur, can choose an inventory of objects to tinker with, such as technology products. Interactions with these objects are events from which bricolage can create a structure in the form of an artefact (Louridas, 1999). A designer’s choice of objects and environments will influence the type of interaction events that may prompt the creation of structures—or design artefacts. The generation of my 2K-Reality idea was not ‘completely accidental’; intentional vision-driven research conducted in a conducive playspace provoked the coincidence that generated my 2K-Reality idea. As Louridas explains, “Bricolage is … at the mercy of contingencies, either external, in the form of influences, constraints, and adversities of the external world, or internal, in the form of the creator’s idiosyncrasy” (Louridas, 1999, p. 520).

My first application of design-driven research was principally an extension of my bricolage process. I continued my initial act of hacking to transform the 2K-Reality idea into a meaningful prototype I could test in situ. I attempted to create a system that would expand the ‘pretending to play in the NBA’ make-believe Reality Principle. To achieve this, the 2K-Reality rapid prototype
would have to afford the performance of NBA soundscapes that realistically simulated NBA
videogame and NBA TV broadcast sound design.

As Louridas also explains; the final result of bricolage “is never an ideal fit to the requirements of
the project” (Louridas, 1999, p. 519). By conducting urban probe HCD research as a participant-
observer, I was able to evaluate the deficiencies in the 2K-Reality rapid prototype that diminished
the ‘pretending to play in the NBA’ make-believe Reality Principle that 2K-Reality was designed
to exploit and expand. The 2K-Reality rapid prototype created an experience that was “not real
enough”, as one questionnaire respondent put it.

My HCD research findings indicated that 2K-Reality needed a less intimidating and more
approachable sampler interface and a simplified technology configuration. Also, software capable
of managing a greater variety of audio samples, that could automatically alternate audio samples,
and provide controls for trajectory-specific commentary sounds. I applied a second design-driven
research process to address my HCD research findings and then conducted additional urban
probe HCD research. My second 2K-Reality prototype afforded the performance of soundscapes
that simulated the sound design of NBA videogames and NBA TV broadcasts more realistically.

To conclude, Norman and Verganti suggest that connecting the research approaches in the DRQ
framework often produces a particular pattern, whereby vision-driven research leads to design-
driven research, which leads to HCD research (Norman & Verganti, 2014). I agree this pattern
is likely; however, I suggest that applying the DRQ framework is not a linear nor straightforward
process. From my experience, it’s likely to involve multiple steps that require a designer to reapply
the different approaches. Furthermore, I argue that designers should consider applying vision-
driven research throughout a design process that utilises the DRQ framework; an envisioned
new meaning may be enhanced by continuously seeking knowledge by means of explorative
interpretation. My continued explorative interpretation of pickup basketball sociocultural factors
helped me to understand the connections 2K-Reality urban probe participants made with other
NBA entertainment experiences; and therefore, the potential meanings they ascribed to the
2K-Reality experience.

In this chapter, I have described and discussed how I designed the two 2K-Reality prototypes
by applying Norman and Verganti’s four types of interpretive design research. In the following
chapter, I expand upon my HCD research process by reporting the urban probe studies I
conducted to evaluate how people used 2K-Reality and how audiences responded to the
2K-Reality experience.
Chapter 4: Evaluating 2K-Reality

Research Question Two
What can we learn from evaluating the 2K-Reality in context?

4.1 INTRODUCTION

In Section 3.6, I outlined my evaluation of 2K-Reality rapid prototype usability, the first component of my HCD research. In this chapter, I will address the second aspect of my HCD research—the fourth quadrant of the DRQ I applied to my research project. I describe and discuss the urban probe fieldwork I conducted to answer my second research question: What can we learn from evaluating the 2K-Reality in context?

I begin in Section 4.4.1 by outlining my approach to urban probe HCD research. I then introduce the context for each 2K-Reality urban probe and define the nomenclature I use to describe participants. I also indicate the scale and duration of each study.

In Sections 4.2 to 4.4, I will summarise the three urban probes I conducted using the 2K-Reality rapid prototype and the feedback data I collected. In Section 4.5, I summarise the fourth urban probe I conducted using the 2K-Reality exhibition prototype, which facilitated my evaluation and interpretive analysis of how people used 2K-Reality to perform different styles of soundscapes, which I discuss in Section 4.6.

In Section 4.7, I will evaluate the audience response to 2K-Reality by reflecting upon my collective observations of all four urban probes. I conclude in Section 4.8 by summarising my urban probe findings.

Figure 52 represents my implementation of a third component of the model of practitioner research—evaluating the use of 2K-Reality and the audience experience.
4.1.1 2K-Reality Urban Probes

As discussed in Section 2.5.4, the urban probe HCD research method draws upon "probology" (Gaver et al., 2004). Urban probes are deployed to understand the impact of novel artefacts designed to intervene in urban life. Through observation and experimentation, urban probe researchers attempt to elicit reactions and prompt discussions about a research artefact (Paulos & Jenkins, 2005). As Gaver et al. advise, researchers conducting probes are empathetic interpreters who value uncertainty, play and exploration, and the subjective interpretations of participants (Gaver et al., 2004). Furthermore, HCI theorists Boehner et al. note that probes are conducted...
not to collect facts, but to support interpretive analysis and inspire design (Boehner, Vertesi, Sengers & Dourish, 2007).

Accordingly, my approach to conducting urban probes is aligned with ethnomethodology and reflects the techniques employed by HCI scholar Stuart Reeves, who specialises in studying social interactions with technology in public settings. My concern was interpreting the ways in which members of local pickup basketball communities responded to 2K-Reality, while not being “concerned with applying a formal method to the analysis of data in order to generate ‘findings’ and situate those findings within a theoretical framework in order to explain them” (Reeves, 2011, p. 31). I conducted participant-observer research as a competent member of the community I studied—an important characteristic for an ethnomethodologist seeking to understand interventions (Denzin, 1969). I noted observable and reportable forms of interaction with the 2K-Reality sampler interface, and the reactions audiences had to the soundscapes.

I deployed four 2K-Reality urban probes in three cities in different countries: Melbourne, Australia; Taipei, Taiwan; and Vancouver, Canada—each presented distinctly different social and environmental contexts. My first probe ran for four days at the RMIT University A’Beckett Urban Square basketball courts in Melbourne. I conducted the second and third probes in Taipei, Taiwan; for two days at the Shih-Chien University Gym, and on a single night beneath the Xinsheng Elevated Road in central Taipei. The fourth urban probe operated for four days as a public art exhibit at ISEA2015 in Vancouver, Canada.

Because 2K-Reality couples soundscape performers with basketball performers, it is confusing to apply existing frameworks to describe 2K-Reality urban probe participants. However, the nomenclature I use is appropriated from the Framework for Designing Interfaces in Public Settings created by Reeves (2011). I use the term ‘participant’ to describe all people immersed in the 2K-Reality soundscapes. I call the participant who performs soundscapes by interacting with the 2K-Reality interface an ‘orchestrator’. My use of the term ‘orchestrator’ is adopted from Reeves and implies the ‘arranging or scoring music’ definition of orchestrating. I use the term ‘audience’ to refer to all participants bar the orchestrator; that is, pickup basketball players, spectators and bystanders—who, initially, unwittingly hear the soundscapes.

Tracking the number of audience members during each of the urban probes was difficult. The open nature of the public spaces and my intense focus on observing participants and pickup basketball games—whereby players swap teams and sometimes change clothing, prevented me from tallying the number of audience members accurately. The orchestrators counted in the studies, including me, performed soundscapes for approximately fifteen minutes or more.

Table 7 summarises the four 2K-Reality urban probes by indicating the location, prototype system and approximate scale of each study.
Table 7.
The 2K-Reality Urban Probes

<table>
<thead>
<tr>
<th>URBAN PROBE</th>
<th>Study 1</th>
<th>Study 2</th>
<th>Study 3</th>
<th>Study 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>COUNTRY</td>
<td>Australia</td>
<td>Taiwan</td>
<td>Taiwan</td>
<td>Canada</td>
</tr>
<tr>
<td>CITY</td>
<td>Melbourne</td>
<td>Taipei</td>
<td>Taipei</td>
<td>Vancouver</td>
</tr>
<tr>
<td>LOCATION</td>
<td>RMIT UNIVERSITY A’BECKETT URBAN SQUARE</td>
<td>SHIH CHIEN UNIVERSITY GYM</td>
<td>XINSHENG ELEVATED ROAD</td>
<td>ISEA2015 SFU WOODWARD’S ATRIUM</td>
</tr>
<tr>
<td>2K-REALITY SYSTEM</td>
<td>Rapid Prototype</td>
<td>Rapid Prototype</td>
<td>Rapid Prototype</td>
<td>Exhibition Prototype</td>
</tr>
<tr>
<td>INSTALLATION DAYS</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>APPROXIMATE HOURS OF OPERATION</td>
<td>22 Hours</td>
<td>10 Hours</td>
<td>6 Hours</td>
<td>22 Hours</td>
</tr>
<tr>
<td>APPROXIMATE NUMBER OF PLAYERS</td>
<td>80</td>
<td>35</td>
<td>35</td>
<td>80</td>
</tr>
<tr>
<td>NUMBER OF ORCHESTRATORS</td>
<td>5</td>
<td>8</td>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>APPROXIMATE NUMBER OF SPECTATORS</td>
<td>80</td>
<td>20</td>
<td>30</td>
<td>120</td>
</tr>
<tr>
<td>APPROXIMATE NUMBER OF BYSTANDERS</td>
<td>200</td>
<td>20</td>
<td>20</td>
<td>350</td>
</tr>
</tbody>
</table>

4.2 URBAN PROBE STUDY 1: RMIT UNIVERSITY A’BECKETT URBAN SQUARE

A fortunate coincidence determined the location for my first urban probe. Construction of the RMIT University A’Beckett Urban Square basketball courts concluded only weeks before scheduling my first urban probe. Participants in the study—approximately eighty players and eighty spectators, included RMIT University students from a range of cultural backgrounds and other pickup basketball players from Melbourne. The standard of pickup basketball suggested that most of the players played the game regularly. Figure 53 shows the RMIT University A’Beckett Urban Square urban probe location.

![Figure 53. RMIT University A’Beckett Urban Square.](image-url)
I performed the dual role of orchestrator and participant-observer researcher for most of the time on each of the four days. I performed soundscape orchestrations for a variety of pickup basketball trajectories; 5-on-5, 4-on-4 … 1-on-1, and players shooting hoops. Figure 54 shows a video frame of a 4-on-4 pickup basketball game. Figure 55 shows a video-frame of a 1-on-1 pickup basketball game.

**Figure 54.** 4-on-4 at RMIT University A’Beckett Urban Square

**Figure 55.** 1-on-1 at RMIT University A’Beckett Urban Square.

Only four independent orchestrators performed soundscapes with the 2K-Reality rapid prototype during the first urban probe. Figure 56 shows an independent orchestrator in action.

**Figure 56.** Independent orchestrator at RMIT A’Beckett Urban Square.
4.2.1 Urban Probe Study 1: Written Comments

Urban probe participants wrote thirteen unprompted comments in a comments book I prepared for anonymous unstructured feedback. Participants remarked upon the enhanced atmosphere of the playspace, the NBA make-believe experience, and the effects of the virtual co-present arena crowd. For example;

“Feedback 10/10 I feel privilige [sic] of witnessing this experience, good to get everyone involved.”

“Overall I think it adds to the atmosphere off [sic] the game. Thanks alot [sic].”

“I think that this is a fantastic idea that really gets people involved with the sport. Our favourite was how we felt like we were playing in the NBA or 2K. Fantastic work! A lot of effort was put into this and we really appreciate it greatly. Thank you! Hugo, Robbie and Luka.”

“It’s super awesome! It feels like I was seen by thousands and thousands of people, there was pressure, but it was really great!” (translated from Mandarin).

Other remarks indicated that 2K-Reality soundscapes motivated participants.

“Makes you want to play harder.”

“Awesome idea! It makes players play with even more passionate [sic].”

Some comments described the enjoyment and amusement generated by 2K-Reality.

“Duddeegee Literally the sickest shit right now! Defs [sic] need this all the time at the courts.”

“Great idea! Very funny and adds a good atmosphere to the court. I’d hire this for a birthday party. Good fun!!!”

One participant noted the need for more music samples.

“Had fun. Machine goes good. Just needs more beats. But first 10 minutes is fun.”

*Figure 57* shows a sample of comments from the comments book.
4.2.2 Urban Probe Study 1: Summary

Reflecting on my role as an orchestrator, observing 2K-Reality participants and collecting feedback produced the first evidence that 2K-Reality can create new meanings for pickup basketball players and spectators.

Urban probe participants appeared to create new relationships of understanding—players and spectators recognised the NBA-theme and connected the experience to the NBA 2K videogame. Conversations with participants and written comments acknowledged 2K-Reality’s ability to enhance the atmosphere of the playspace, and create a socially inclusive and enjoyable make-believe experience. Participants also reported some cognitive and emotional effects; feeling motivated and feeling under pressure.
As described in Section 3.6, my observations and evaluation of the 2K-Reality rapid prototype installation system revealed practical and usability deficiencies. In short, orchestrations of credible and meaningful NBA-themed soundscapes indicated that the rapid prototype’s GUI and audio programming was usable. However, the first rapid prototype study reinforced the need for a simplified hardware configuration and more sophisticated software; and indicated that hearing many more commentary and break beat samples would help sustain the quality of the experience.

4.3 URBAN PROBE STUDY 2: SHIH CHIEN UNIVERSITY GYM

I located my second and third studies in Taipei. My decision was influenced by personal and professional relationships and the popularity of pickup basketball in Taipei. The Shih Chien University Department of Industrial Design supported the Taipei urban probes financially, and six student volunteer research assistants from the department helped conduct the studies. I paid each research assistant above-award wages for forty hours’ work.

Our research team conducted the second 2K-Reality urban probe for two days in the Shih Chien University Gym, shown in Figure 58. Approximately forty players and thirty spectators—male and female students with different levels of playing ability—participated in the study, and seven independent orchestrators performed soundscapes. Figure 59 shows an independent orchestrator operating the 2K-Reality rapid prototype in the evening on the second day. We captured the installation sessions on video, this time from multiple angles. We also attempted to gather feedback in a different form—a questionnaire.

Figure 58. Shih Chien University gym.

Figure 59. Independent orchestrator at the Shih Chien University gym.
### 4.3.1 Urban Probe Study 2: Questionnaire

Participants returned forty-three questionnaires. Analysing the responses using any formal analysis was deemed unlikely to uncover anything meaningful—due to the uniformity of the student sample, the many incomplete answers, and the difficulty deciphering and translating some of the replies. However, understandable questionnaire responses generally reflected the sentiments noted in the comments book during the first urban probe in Melbourne.

Five questionnaire respondents noted connecting their experience to playing in the NBA or playing a videogame. Six described the experience as ‘cool’ or ‘fantastic’, and ten as ‘fun’ or ‘funny’. Seven described the atmosphere as ‘enhanced’ or ‘great’; two participants reported feeling cognitive and emotional effects; one felt stressed yet excited; the other inspired but tense.

All respondents answered the question: What was your first impression of the sound installation? Responses on a Likert-type scale returned the following results: eight neutral, twenty-five positive, and ten very positive. No negative or strongly negative impressions were recorded.

Most respondents agreed that the experience was entertaining and enjoyable. However, one respondent commented that the soundscapes were ‘not real enough’, and another suggested the installation needed ‘more samples’.

### 4.3.2 Urban Probe Study 2: Summary

My observations of participants and the feedback I collected from the second urban probe study merely reinforced my evaluation of the potential for the 2K-Reality idea. The study indicated that pickup basketball communities from significantly different cultures can interpret the 2K-Reality experience similarly. Participants reported that 2K-Reality could enhance the enjoyment of playing and watching pickup basketball; they also made the same suggestions to improve the 2K-Reality rapid prototype as participants in my first urban probe in Melbourne.

### 4.4 Urban Probe Study 3: Xinsheng Elevated Road

Our research team conducted the third 2K-Reality urban probe in central Taipei beneath the Xinsheng Elevated Road; a popular pickup basketball playspace famous for hosting visiting NBA players. All participants in the study—approximately fifty dedicated pickup basketball players and forty spectators belonged to the local pickup basketball community.

Intense 5-on-5 pickup basketball games were played continuously during the six-hour installation. Once again, I performed the dual role of orchestrator and participant-observer, and two of my research assistants orchestrated soundscapes for approximately twenty minutes each during the six-hour installation. Figure 60 shows the urban probe environment beneath the Xinsheng Elevated Road. Figure 61 shows one of my research assistants, Ron Lo (羅峥榮), performing the role of 2K-Reality orchestrator.
To prepare for the urban probe, we produced a set of eleven new commentary samples to answer a localisation question: Would pickup basketball players and spectators in Taiwan prefer Mandarin commentary? My research assistants helped to arrange a recording session with a local voice actor. First, the actor viewed a sample of NBA games on YouTube that contained professional Taiwanese commentary. The actor transcribed commentary phrases learnt from the videos to a list of commentary samples needed to populate the 2K-Reality interface. The actor then performed to a selection of YouTube reference videos of NBA basketball games. After selecting takes and editing the eleven commentary samples, I assigned each one to a corresponding commentary button to create a complete interface sample group. I retained existing samples for the ‘Exclamation’, ‘Beats’ and three crowd sound buttons. Figure 62 shows the Mandarin commentary recording session, and Table 8 lists the Mandarin commentary samples.
Table 8.
Mandarin Commentary Audio Samples

<table>
<thead>
<tr>
<th>MANADARIN COMMENTARY AUDIO SAMPLES</th>
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<tbody>
<tr>
<td><strong>COMMENTARY BUTTONS</strong></td>
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<tr>
<td>L</td>
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4.4.1 Urban Probe Study 3: Semi-structured Video Interviews

My research assistants made a significant contribution to my research project and helped collect valuable feedback data. They conducted nine semi-structured video interviews with twelve participants in Mandarin. We translated interviewee responses into English, which I then converted into subtitles in video post-production.

Recorded at night in cold and windy weather, surrounded by traffic, the nine interviews required a significant logistical effort. Lighting, filming and recording the interview audio required teamwork to achieve a meaningful result—the six students performed brilliantly. Their self-motivation and personal initiative, thoughtful and considerate manner, and ability to work together in an unfamiliar context under challenging conditions, far exceeded my expectations. It was a pleasure working with them.

Figure 63 shows the 2K-Reality research team outside the Xinsheng Elevated Road basketball courts, next to a 2K-Reality recruitment poster.
Figure 63. 2K-Reality rapid prototype research team.

From left to right: Ron Lo (羅峥榮), Alex Ren (任懋君), Nessie Zheng (鄭雅琦), me—Tim Ryan (劉恩廷), Edward Lin (林寬祐), Kent Yang (楊郁謙) and James Hung (洪嘉懋).

The twelve urban probe participants who consented to video interviews comprised ten males and two females. Seven males and one female experienced 2K-Reality as both players and spectators. One female (interviewee #3) and three males (interviewees #4, #5 and #8) experienced 2K-Reality as spectators only. Figure 64 shows screen captures from each of the semi-structured video interviews.

Figure 64. Semi-structured video interview screen captures.

i) NBA-theme and NBA Make-believe
When asked an open question about their impressions of 2K-Reality, all interviewees mentioned a sense of being immersed in an NBA-themed environment—participants made associations with playing NBA 2K videogames, watching NBA television broadcasts, attending NBA games and playing NBA-themed amusements. For example:

“I feel like I’m playing NBA 2K game series on Xbox”—Interviewee #2

“Like playing on an NBA court … the commentary of your movement is like a broadcast”—Interviewee #4

“I think what you’re doing is trying to create an atmosphere like playing at an NBA court. Pretty good, you’re almost achieving that”—Interviewee #3

“It’s just like a basketball shooting arcade machine … it makes you shoot the ball more rhythmically”—Interviewee #7

Some interviewees described the immersive effect as a make-believe experience. For example:

“It feels like playing in the real NBA; it feels like I’m a big basketball star”—Interviewee #10

“Even though the sound effects do not really come from the crowd, it makes you feel that it’s real”—Interviewee #5

ii) Playspace Atmosphere
When asked about the atmosphere 2K-Reality created, interviewees consistently highlighted the effect of the crowd sounds. Both players and spectators indicated that the crowd sounds enhanced the atmosphere for playing and watching pickup basketball. For example:

“I very much like the cheering sounds, it makes me feel great”—Interviewee #2

“I think the cheer of the crowd is great”—Interviewee #4

“I thought there was a game on tonight; then we realised it was an experiment”—Interviewee #8

iii) Cognitive and Emotional Effects
Asked how the soundscapes affected them personally, players mentioned cognitive and emotional effects. Interviewees described feelings of happiness and excitement but also identified a sense of pressure that made some nervous and motivated others. For example:
“I think it makes me happier while playing”—Interviewee #11

“It makes us really excited”—Interviewee #7

“I feel more excited and passionate when playing” … “But feel more stressful”—Interviewees #10 then #9 (interviewed together)

“The sound effects not only encourage players to play better, but also puts pressure on them”—Interviewee #5

Asked to recall if the soundscapes directly affected how they played, some interviewees recalled changes in acoustic awareness. For example:

“Sometimes when we really concentrate, we won’t hear that sound. We can hear it when we stand still”—Interviewee #7

“When I didn’t know what I’m gonna do on the court, there’s a sound like make a 3 point shot”—Interviewee #2

iv) Suggestions
When asked if they had any suggestions for improving 2K-Reality, the interviewees consistently identified the need for more audio samples. For example:

“It needs to have more variety”—Interviewee #1

“I think it needs more kinds of music”—Interviewee #3

Some interviewees suggested that 2K-Reality may be suitable for organised basketball games. For example:

“I think this device is really suitable for competitions”—Interviewee #8

“Maybe it can be used during a competition like the inter-department cup at school”—Interviewee #1

One interviewee articulated a suggestion sometimes overheard in conversations by my research assistants. He expressed interest in a smartphone App that would afford a personal interface for controlling 2K-Reality.

“If you have an App I would like to try it”—Interviewee #7

v) General Impressions
When asked if the 2K-Reality experience was worthwhile, all of the interviewees expressed approval. For example:

“I think it’s fantastic”—Interviewee #5

“If every place had this installation it could be nice”—Interviewee #3
“I think if every court had this device it would be really good. It might attract more people to come and play”—Interviewee #7

vi) Mandarin Language Version

When asked about their impressions of the Mandarin language version, all bar one of the interviewees expressed a preference for the English language NBA 2K version. However, some participants declared an interested in a Mandarin language version voiced by a well-known professional commentator. Interviewee #4 described the major flaw in the study, and interviewee #12 represented the consensus viewpoint.

“It might be because the Chinese version is not that good”—Interviewee #4

“The Chinese version is; weird. Because it's the NBA, English is more suitable”—Interviewee #12

4.4.2 Urban Probe Study 3: Transcribed Comments

Nessie Zheng (鄭雅琦), one of my research assistants, approached participants to collect comments about the 2K-Reality experience; she asked people if they'd like to comment and noted what people said without asking any further questions. Nessie transcribed twenty comments in Mandarin, and with assistance, later translated them into English. The comments replicated and reinforced the opinions expressed in the semi-structured video interviews. Two comments were particularly informative; they reiterated that the soundscapes do not appear to affect some players. For example:

沒聽到(球員)
“Can’t hear it as a player”

這個裝置不會影響我打球。
“The installation does not affect me when playing”

All twenty transcribed and translated comments are attached in Appendix E.

4.4.3 Urban Probe Study 3: Summary

The third urban probe study once again reinforced the potential of the 2K-Reality idea. The video interviews and transcribed comments echoed the findings from the first two urban probes and reiterated that 2K-Reality can create new meanings for pickup basketball players and spectators.

The semi-structured video interviews and transcribed comments provided documentary evidence that urban probe participants can recognise the NBA-theme, and connect 2K-Reality with the NBA 2K videogame and other NBA amusements. Interviewees acknowledged the enhanced playspace atmosphere and reported enjoying the experience. Participants once again reported some cognitive and emotional effects: feeling motivated and feeling under pressure.
Interviewees articulated an important aspect of the 2K-Reality experience for the first time; that being, the changes in acoustic awareness when playing. This is a topic I discuss in Section 4.7.1.

Testing the Mandarin language version of 2K-Reality also provided valuable feedback. The experiment prompted the majority of interviewees to articulate how the NBA 2K commentary lends credibility to the 2K-Reality experience.

The urban probe also highlighted the immeasurable benefits of working with a research group to study an interactive technology artefact operating within a public setting.

## 4.5 URBAN PROBE STUDY 4: ISEA2015 WOODWARD’S ATRIUM

Part of the curated ISEA2015 public art exhibition, the fourth 2K-Reality urban probe, was deployed in the Simon Fraser University (SFU) Woodward’s Atrium in central Vancouver, which proved to be an ideal playspace for conducting a 2K-Reality urban probe. The architecture of the space provided an excellent acoustic environment and SFU provided a high-quality sound PA sound system that included a sub-woofer. Although the installation was initially scheduled to operate for two days, I accepted an invitation from the ISEA2015 organisers to extend my exhibition to four days.

The urban probe timescale and environment and the improved 2K-Reality prototype produced a higher number and greater variety of participant observations to interpret and evaluate. The enclosed basketball playspace was home to a regular pickup basketball community, and atrium retail outlets drew the general public into the playspace surroundings. As shown in Table 7 in Section 4.1.1, the study involved a larger audience and 23 independent orchestrators.

Figure 65 shows the 2K-Reality exhibition prototype system installed at the ISEA2015 urban probe. Figure 66 shows me orchestrating 2K-Reality soundscapes for members of the local pickup basketball community. Figure 67 shows 2K-Reality urban probe audience members—pickup basketball players, a turn-taking player/spectator and spectating bystanders. Figure 68 shows a player interacting with me as the 2K-Reality orchestrator. And Figure 69 shows a bypassing wedding party choosing to participate in 2K-Reality.
Figure 65. 2K-Reality exhibition prototype technology components. Legend: 1. Alesis IO Dock and Apple iPad 2, 2. Yamaha MGP12X mixer, 3. 2 x Yamaha MSR400 powered loudspeakers, 4. Yamaha MSR800W subwoofer.

Figure 66. Me as participant-observer researcher and orchestrator.

Figure 67. 2K-Reality audience—players, spectators and bystanders.
To ensure that a critical mass of pickup basketball players would attend the venue at specific times, my wife Liu Pei-Chung helped me post an online request for volunteer basketball players on a Taiwanese bulletin board website (attached in Appendix L). Four Taiwanese students studying engineering at the University of British Columbia (UBC) in Vancouver volunteered to participate for a few hours on two separate days. The actual participation of three of the volunteers was particularly helpful because it encouraged other people to play with them during otherwise quite times. In appreciation for their participation, the student volunteers were provided with a pass to attend the ISEA2015 exhibition and were taken out to dinner at a swish restaurant days after the event. Figure 70 shows me with the three Taiwanese student basketball players from UBC.

*Figure 68. Player interacting with me as the 2K-Reality orchestrator.*

*Figure 69. 2K-Reality wedding group participants.*

*Figure 70. UBC student basketball players.*

Left to right: Shin-Hann Yang, me—Tim Ryan, Yodan Karyanto and Jian-Yuan Lin.
4.5.1 Urban Probe Study 4: Summary

The ISEA2015 urban probe replicated, complemented and expanded upon the findings derived from the rapid prototype urban probes conducted in Melbourne and Taipei. The qualities of the playspace ensured a greater diversity of potential participants, and the 2K-Reality exhibition prototype improved my participant-observer approach in three ways. First, I was able to perform more sophisticated soundscapes that produced more distinctly observable participant responses. Second, the exhibition prototype appealed to numerous independent orchestrators that facilitated my evaluation of 2K-Reality’s interpretative appropriation. Third, the independent orchestrators allowed me to observe audience members from a different perspective—as a player and spectator, I was able to hear comments and see expressions I was unable to when orchestrating soundscapes. Figure 71 shows me playing basketball as a participant-observer while an independent orchestrator operates 2K-Reality.

![Figure 71. Me as a participant-observer researcher and pickup basketball player.](image)

In the following section, I present my evaluation of the soundscape orchestrations performed during the ISEA2015 urban probe—the most significant contribution the fourth and final study made to my research project.

4.6 2K-REALITY SOUNDSCAPE ORCHESTRATION

4.6.1 Exhibition Prototype: System Evaluation

The 2K-Reality exhibition prototype and installation system, described in Section 3.7, significantly improved the 2K-Reality experience for urban probe participants.

The 2K-Reality kiosk and the ubiquitous nature of the iPad touchscreen interface proved to redress the impracticality of the sampler-based rapid prototype described in Section 3.6.2. The 2K-Reality iOS App programming was responsive and reliable, and the GUI was easy to understand and use—it generally took independent orchestrators approximately ten minutes to learn. After which, the layout of the interface proved to be sufficiently intuitive for orchestrators to look away from the interface intermittently to concentrate on observing and interpreting pickup basketball gameplay and social interactions. Additionally, most independent orchestrators mastered the use of the scrollable slide-in and expandable menu for selecting trajectory specific commentary.
samples and preferred break beats. As a result, the 2K-Reality exhibition prototype afforded the performance of more sophisticated, credible and meaningful NBA-themed soundscapes.

As a reminder, Figures 72, 73 and 74 once again show the three interface configurations presented to users of the 2K-Reality exhibition prototype, with which they performed interpretive soundscapes.

Figure 72. 2K-Reality iOS App primary GUI.

Figure 73. Slide-in and expandable menu.
4.6.2 Exhibition Prototype: Soundscape Orchestration

Sengers and Gaver (2006) suggest that designers evaluating ludic systems should consider investigating how many different interpretations a system generates and why. In other words, observe and identify forms of interpretative appropriation—how users of a playful system construct their own meanings.

My observations and evaluation of 2K-Reality independent orchestrators and the types of soundscapes they performed acknowledges the substantial role I played as a participant-observer researcher. My role as an orchestrator influenced independent orchestrators, and therefore, impacted my observations. Many independent orchestrators watched my interactions with the interface before attempting to operate 2K-Reality; others requested an introductory explanation of the interface. I can’t determine the extent my influence on independent orchestrators, but the behaviour patterns I observed suggest that mimicry played a significant role during many an orchestrator’s attempts to master the interface.

Figure 75 shows a sample of the independent orchestrators I observed during the ISEA2015 urban probe—both adults and children.
During the 2K-Reality urban probes, orchestrators performed interpretive soundscapes coupled with pickup basketball games. Reflecting on my own orchestrating, and observing twenty-three independent orchestrators using the 2K-Reality exhibition prototype enabled me to identify and interpret seven categories of performative soundscapes orchestration. The seven categories of orchestration I describe below are: i) simultaneous, ii) paradoxical, iii) directive, iv) rhythmic, v) multi-user, vi) mastering, and vii) exploratory. The first four categories are distinctly performative; the last three are functional sub-categories.

Each category appeared to generate distinct yet reasonably consistent responses from players and spectators in the form of physical gestures, vocal responses, facial and emotional expressions, and social interactions; reactions that contributed to orchestrator performativity and sonic agency feedback loops between audience members and orchestrators. Each orchestration category
reflects the apparent focus and intent of the orchestrators. It should be noted that orchestrators shifted between performative orchestration categories readily and swiftly.

i) Simultaneous Orchestration describes synchronised interpretive soundscapes that articulate and celebrate the players’ performances, in a style that simulates the sound of NBA television broadcasts and NBA videogames. The soundscapes accurately describe events and conform to the expectations of the pickup basketball community. A typical simultaneous orchestration consists of synchronised commentary samples that accurately described a shooting action and the shot result, followed by cheering crowds sounds if the shot was successful. Incidentally, ‘simultaneous’ is a term I have adopted, via Crawford and Gosling (2009), from French literary theorist Gérard Genette, who regards sports commentary as a perfect live expression of the “simultaneous (narrative in the present contemporaneous with the action)” (Genette, 1980, p. 217).

Simultaneous orchestrations were the prevalent style of soundscape performance throughout the urban probe, and they exhibited an orchestrators’ ability to understand and amplify basketball aesthetics with commentary and crowd sounds. Sports philosopher Stephen Mumford describes four aesthetic categories in sport, each of which 2K-Reality urban probe orchestrators represented in soundscape performances: i) bodily motion, form and grace; ii) higher-level, abstract forms; iii) drama; and iv) innovation and genius (Mumford, 2014).

Orchestrators used the discreet commentary samples to accurately describe elements of ‘bodily motion, form and grace’ that emerged from their understanding and interpretation of basketball action. However, the most meaningful soundscape interpretations of motion, form and grace were expressed with crowd sounds, to represent what Elcombe calls ‘that moments’ (Elcombe, 2012)—that shot, that steal, that block; the stand out aesthetic moments in pickup basketball games.

Orchestrators also interpreted ‘higher-level, abstract forms’ of pickup basketball aesthetics by using ‘General Play’ and ‘Offence’ commentary samples to describe patterns of play and tactics. Samples such as “gotta love the execution out there” and “great offensive performance they’re puttin’ on” illustrated an orchestrators’ ability to identify aspects of aesthetic team play.

Soundscape representations of ‘drama’ occurred during 2K-Reality urban probes, usually when an orchestrator was interpreting action that included players they knew. In these cases, soundscape meanings were more personal and reflected a historical understanding of player relationships, relative abilities and particular skills. For example, an orchestrator performing soundscapes for his older brother, a professional basketball player on vacation from playing in the Philippines, persistently activated the ‘oh no, you hate to see that’ commentary sample when his brother was performing dunks. Teasing his older brother by denigrating this rarely seen pickup basketball move, considered the most spectacular in basketball, attracted observable glares from his brother and smiles and laughter among spectators and bystanders. Figure 76 shows the brothers discussing the 2K-Reality interface after the ‘drama’ described.
Although instances of ‘innovation and genius’ are not usually associated with grassroots sports participants, orchestrators used crowd cheering sounds to highlight relatively extraordinary moments in gameplay. For example, unintentional or risky actions that produced a positive outcome, such as a successful shot while falling, a blind pass, or an accidental interception.

ii) Paradoxical Orchestration characterises synchronised interpretive soundscape performances that are incompatible with observed gameplay or contradict cultural norms. For example, the intentional denigration of an impressive play event, such as a successful three-point shot coupled with a synchronised commentary sample such as ‘oh no you hate to see that’, followed with booing crowd sounds. In this situation, the apparent paradox appeared to be coherent to the interpretive community yet contradictory to their expectations.

Paradoxical orchestrations appeared to generate feedback loops most consistently. Reactions from the audience, directed at the orchestrator, often influenced an orchestrators’ activation of subsequent commentary and crowd sounds.

iii) Directive Orchestration distinguishes an orchestrator’s attempt to direct player movements and influence play with commentary samples, somewhat akin to a coach on the sidelines calling out instructions to players. Urban probe observations revealed the ‘Shoots 3’ samples to be the most deliberate and frequently used direction, followed by ‘Offence’ samples that instructed players to pass the ball to teammates. The prevalence of directing three-point shots suggested a desire held by an orchestrator to witness a risky, spectacular and suspenseful shot as a spectator. Player responsiveness to the ‘Shoots 3’ instruction appeared to be due to an increased level of sensory awareness of soundscapes when further from the hoop and not under pressure from opposition players.
Directive orchestrations provide another example of orchestrators interpreting ‘higher-level, abstract forms’ of pickup basketball aesthetics. Their attempts to direct play action with commentary instructions exhibited an understanding of offensive opportunities.

iv) *Rhythmic Orchestration* describes expressive hip hop-like musical soundscape performances that occur when orchestrators deliberately use 2K-Reality as a digital musical instrument. While most orchestrators utilised the looping function to play break beats for a chosen length of time, some orchestrators mastered the use of the ‘one-shot’ programming functionality to manipulate break beats rhythmically. Although performed relatively infrequently, these DJ-style soundscapes entertained players and spectators and sometimes generated dance-like actions among players and spectators alike.

v) *Multi-user Orchestration* is a functional sub-category that refers to soundscape performances orchestrated by multiple people operating the 2K-Reality interface at the same time. A cooperative technique observed on occasions involved two orchestrators, one of whom activated the commentary sample buttons while the other operated the crowd sounds and beats sample buttons.

vi) *Mastering Orchestration* is the second functional sub-category that describes the laboured soundscapes performed by new orchestrators attempting to master the operation of the 2K-Reality interface.

vii) *Exploratory Orchestration* is the third functional sub-category, which I use to describe an experimental form of random toying with the 2K-Reality interface that generates a chaotic cacophony of noise. This form orchestration was most evident when children, mostly under the age of ten, were in a group competing for access. Although exploring the 2K-Reality interface appeared to engender fun for the orchestrator, the soundscapes became moderately annoying for some players and spectators.

**4.6.4 Exhibition Prototype: Observations of Orchestrators**

The majority of 2K-Reality orchestrators displayed facial expressions and physical gestures that expressed enjoyment, and audience feedback loops appeared to enhance their enjoyment.

2K-Reality orchestrators experienced the effect of what cinematic theorist and composer Michel Chion terms ‘ergo-audition’—“hearing oneself doing something” (Hug, 2010b, p. 402). Their enjoyment seemed to emerge from what sonic interaction designer Daniel Hug calls the ‘differential of power’ (Hug, 2010b); by merely touching a small button, an orchestrator filled the entire playspace with sound. Hug argues that this effect can lead to a sense of power and a positive manifestation of sonic agency that Chion describes as ‘plaisir de l’ergo-audition’—the joy of hearing-oneself (as cited in Hug, 2010b).

Players and spectators often acknowledged an orchestrators’ soundscape performance, which in turn influenced the orchestrator. An orchestrator’s relationship to players and spectators occupying the playspace appeared to significantly affect their performativity and interactions with
audience members. This observation corresponds with Franinović and Salter observations of public sonic interaction design works. They note that participants who engage with works that afford playing with public behaviour “may feel observed and judged as their actions, emotions, and thoughts become tangible” (Franinović & Salter, 2013, p. 56). Orchestrators performing 2K-Reality soundscapes for players and spectators who were known to them appeared to be least affected by self-consciousness, which in turn raised their orchestration confidence. Their familiarity with the audience typically generated more diverse styles of performance and more complex meanings, which increased the level of enjoyment of the experience for all participants.

4.7 2K-REALITY AUDIENCE RESPONSES

During the 2K-Reality urban probes I sought to identify the effects the soundscapes had on participants. I concentrated on noting verbal and non-verbal reactions and social interactions that took the form of physical gestures, vocal responses, facial expressions and conversations. It is important to note that apart from conversations, I did not attempt to evaluate the meaning of these exchanges. As cognitive psychologists, Richard Jackson Harris and Fred W. Sanborn point out, “emotions themselves are internal states and must be inferred from behaviour” (Harris & Sanborn, 2013, p. 167); and interpreting emotions is tricky because obvious inferences are sometimes incorrect (Harris & Sanborn, 2013).

Being deeply engaged with the 2K-Reality urban probe in the dual role of orchestrator and participant-observer was advantageous for interpreting my observations. The intense concentration needed to observe and translate pickup basketball gameplay into soundscapes focused my attention on the influence my performances had on players and spectators. As an orchestrator, I was often the subject of responsive physical gestures and vocal expressions.

4.7.1 Audience Reactions: Soundscapes

My observations of urban probe participants indicate that 2K-Reality soundscapes can increase the frequency and intensity of the types of expressive behaviour and social interactions that already exist in pickup basketball playspaces. Typical pickup basketball player behaviour such as physical gestures and vocal expressions associated with success, excellence and achievement; error, chance, disappointment and embarrassment, and responses to taunting, etc. were intermittently affected by 2K-Reality soundscapes coupled to basketball gameplay. Players’ celebratory arm raising, fist-pumping, clapping, head shaking, shoulder shrugging and finger gestures, frequently appeared to be prompted by soundscapes. Physical gestures also included facial expressions; although it was difficult to ascertain the level of influence the soundscapes had on these expressions, it was evident that 2K-Reality produced smiles, looks of surprise and confusion, and idiosyncratic facial expressions. 2K-Reality soundscapes also prompted vocal responses from players in various spoken forms. Players interacted with orchestrators by making comments, requests and suggestions; asking questions and stating rhetorical questions; and some players mimicked the 2K-Reality commentary samples.
The reactions mentioned above suggest that 2K-Reality soundscapes also produce a sense of ergo-audition for players, as their actions usually influenced the sounds activated by an orchestrator. Furthermore, players responding to scoring a basket and hearing cheering crowd sounds indicated the potential for plaisir de l’ergo-audition among players. Media theorist Marshall McLuhan provides a possible explanation, in that; “men at once become fascinated by any extension of themselves in any material other than themselves” (McLuhan, 1964/1994, p. 41).

By generating the joy of hearing-oneself among players, 2K-Reality implements a technique that Hug suggests is a “powerful means of creating compelling experiences” (Hug, 2010b, p. 402), both positive and negative. As reported in Section 4.4.1, some urban probe interviewees confirmed this suggestion. Some recalled feelings of arousal due to the crowd sounds, such as happiness and motivation; others described feeling nervous and under pressure.

Importantly, as noted in Section 4.4, participant interviews and transcribed comments revealed that players experience fluctuations in their sensory awareness of 2K-Reality—concentrating on playing reduced their ability to hear the soundscapes. When players are absorbed in the game, and their awareness becomes merged with their actions, they appear to experience what psychologists Susan Jackson and Mihaly Csikszentmihalyi define as the second dimension of ‘flow’—the enjoyable experience of mind and body working together effortlessly. According to Jackson and Csikszentmihalyi, when players experience flow, they may be prevented from hearing anything (Jackson & Csikszentmihalyi, 1999). However, the state of flow in pickup basketball is often fleeting. Player awareness of 2K-Reality soundscapes appeared to be intermittent and governed by contingent spatial and temporal conditions encountered during gameplay. For example, as mentioned by interviewee #2, players sometimes heard directive commentary and responded in ways that reflected the meaning of the language. Players, therefore, demonstrated the ability to interpret the message conveyed by the commentary sounds—what Chion defines as semantic listening (Chion, 1994).

The spectators that made the most observable and reportable responses to the 2K-Reality soundscapes appeared to have a personal interest in watching the pickup basketball games. These invested spectators were either turn-taking players waiting to play or play again or people with a personal connection to players, such as friends, girlfriends or family members. Spectators also frequently requested orchestration demonstrations and asked for specific information about how to operate the 2K-Reality interface.

Each of the urban probes attracted the attention of bystanders. The acoustic disruption that 2K-Reality created in pickup basketball playspaces expanded the spatial presence of pickup basketball beyond its conventional boundaries. This disruption and expansion, most evident during the ISEA2015 urban probe, intrigued numerous bystanders, many of whom carefully observed an orchestrator. Some, in turn, became orchestrators and thereby became an active participant in an activity they might typically ignore.

The ISEA2015 urban probe also provided the best opportunity to enter into conversations with a diverse range of participants. Many participants complimented 2K-Reality, communicated
an understanding of the playspace enhancement concept, and recognised prospects for generalisation into other grassroots sports contexts.

4.7.2 Audience Reactions: NBA 2K Commentary Sounds

The majority of participants across all urban probes recognised that 2K-Reality had appropriated commentary sounds from an NBA 2K videogame. The 2K-Reality commentary sounds, voiced by Kevin Harlan, are synonymous with the NBA 2K videogame series dating back to NBA 2K6 (Visual Concepts, 2005) in 2005. This recognition of familiar NBA-themed sounds in a significantly different context appeared to resonate with the pickup basketball community immediately. The enjoyment of the 2K-Reality experience seems to reflect Marshall McLuhan’s media theory observation that “[an] experience translated into a new medium literally bestows a delightful playback of earlier awareness” (McLuhan, 1964/1994, p. 211). Furthermore, I maintain that the resonance 2K-Reality created with NBA 2K commentary sounds made each pickup basketball community receptive to the intervention and encouraged participation. A claim I suggest is supported by the localisation experiment I conducted in Taipei. Although a well-known commentator did not voice the Mandarin commentary used in the study, participants showed a distinct preference for the NBA 2K commentary, and interviewees expressed the need for commentary that has a meaningful attachment to the NBA.

The random-shuffle function applied to commentary samples suggested that the element of surprise increased the potential for enjoying the 2K-Reality experience. As well as prompting verbal and non-verbal reactions, some players repeated specific basketball moves to explore the palette of alternative commentary sounds coupled to those moves. The team-play that inspired the orchestration of ‘General Play’ and ‘Offence’ commentary samples also indicated the potential for a surprise to create a shared sense of enjoyment among players; and in particular, spectators.

4.7.3 Audience Reactions: NBA 2K Crowd Sounds

The 2K-Reality crowd sounds significantly enhanced the atmosphere of pickup basketball playspaces. My urban probe observations and the participant feedback I collected suggests that the crowd sounds are a distinctly important feature of the 2K-Reality experience for both players and spectators. The co-presence of the make-believe NBA-arena crowd was almost continuous during each of the urban probes. Orchestrators manipulated the generic ‘Crowd’ sound to maintain and vary the intensity of the make-believe crowd and activated the ‘Crowd Cheers’ and ‘Crowd Boos’ sounds in response to specific events in the playspace.

The ‘Crowd Cheers’ sound elicited the most consistent reactions from players; for example, upon scoring and hearing orchestrated cheers, players often made celebratory gestures towards the make-believe NBA-arena crowd and the orchestrator. The ‘Crowd Boos’ sample was regularly used paradoxically by orchestrators to contradict impressive play; the unexpected failure of the make-believe crowd to fulfil audience expectations often prompted observable reactions. Aggrieved players made their feelings known; their physical gestures, vocal responses or facial expressions that communicated surprise or disappointment, often caused laughter, smiling,
pointing, and other idiosyncratic reactions from players and spectators. Younger orchestrators, in particular, appeared to delight in teasing players with traditionally inappropriate booing.

4.7.4 Audience Reactions: Break Beat Music

Like music during NBA games, mentioned in Section 3.3.4, 2K-Reality break beat music complemented crowd sounds to enhance the playspace atmosphere. Break beats music was most evident during play transitions and breaks in play when players were warming up and organising teams for the next game.

I observed that break beat music frequently induces physical responses from players and spectators in the form of dancing and other rhythmic gestures, such as clapping in time with the beat. The break beats compelled some participants to vocalise their recognition of the break beat source; some made break beats requests to orchestrators, some expressed disappointment that particular music was not available and suggested music for future inclusion.

Just as the randomisation of commentary sounds created a sense of surprise for 2K-Reality participants, the randomisation of different break beats also surprised some participants; this appeared to contribute to the enjoyment of the 2K-Reality experience.

Although the 2K-Reality exhibition prototype utilised only four more break beats than the rapid prototype, the random-shuffle function ensured that audiences heard a greater variety of music during the ISEA2015 urban probe.

4.8 EVALUATION CONCLUSIONS

In this chapter, I have attempted to answer my second research question: What can we learn from evaluating the 2K-Reality in context?

Conducting 2K-Reality urban probes as a participant-researcher delivered findings in three ways: i) as discussed in Section 3.6.2, 2K-Reality rapid prototype urban probes produced results that informed the iterative design and development of the 2K-Reality exhibition prototype; ii) evaluating the 2K-Reality exhibition prototype urban probe enabled me to identify the different ways people appropriate 2K-Reality to perform soundscapes, which I described in Section 4.6; and iii) all four urban probes delivered findings that help reveal how audiences can respond to 2K-Reality, which I described in Section 4.7.

4.8.1 Urban Probe Research Findings

By synthesising my interpretive evaluation of 2K-Reality urban probes, I arrive at the following primary finding:

That by remediating NBA 2K12 videogame sounds, 2K-Reality appears to enhance the enjoyment of playing and watching pickup basketball by inducing NBA-themed plaisir de l’ergo-audition—the joy of hearing oneself in the NBA. Comments made by participants, such as Interviewee #10 who stated “it feels like playing in the real NBA; it feels like I’m a big basketball
star”, illustrate how NBA-themed soundscapes can activate the ‘pretending to play in the NBA’ make-believe Reality Principle that 2K-Reality was designed to expand.

My interpretive evaluation of 2K-Reality urban probes also suggest the following findings.

I observed pickup basketball spectators appropriating 2K-Reality as I intended; they orchestrated NBA-themed soundscapes that interpreted and amplified the aesthetics of pickup basketball. Furthermore, 2K-Reality orchestrators appeared to enjoy creating NBA-themed plaisir de l’ergo-audition, for audiences and themselves. Orchestrators demonstrated four performative and three functional forms of interpretative appropriation. But most often performed soundscapes that simulated the sound of NBA television broadcasts and NBA videogames.

My observations and the urban probe feedback I collected indicate that pickup basketball players and spectators interpret the 2K-Reality experience as I intended. Participants in three different cultures recognised the NBA-theme and connected 2K-Reality with NBA 2K videogames and other NBA entertainment experiences. Comments such as "it’s like playing in the NBA"; "I feel like I’m playing NBA 2K game series on Xbox"; “commentary of your movement is like a broadcast”, and “it’s just like a basketball shooting arcade machine”, suggest that 2K-Reality has meaning to the pickup basketball community of practice. As Nelson and Stolterman explain, “a design has meaning when we can see how it is connected to other things that we value” (Nelson & Stolterman, 2012, p. 194). Furthermore, by connecting 2K-Reality to a range of different NBA-themed mediated experiences, participants identified a 2K-Reality ludic design characteristic. They recognised similarities to other NBA media genres while acknowledging that 2K-Reality is clearly different.

Urban probe participants reported that 2K-Reality commentary and crowd sounds can motivate players, but can also induce pressure and stress. Participants made comments such as: “makes you want to play harder”, “the sound effects not only encourage players to play better, but also puts pressure on them”, “it makes us nervous when people watch us like we are real NBA players”, and “it feels like I was seen by thousands and thousands of people, there was pressure, but it was really great!”.  

Urban probe participants repeatedly mentioned how the 2K-Reality crowd sounds and break beats can enhance the atmosphere of pickup basketball playspaces. Multiple questionnaire responses described the atmosphere as ‘enhanced’ or ‘great’, and participants made comments such as: “very funny and adds a good atmosphere to the court”, “I think the cheer of the crowd is great”, and “even though the sound effects do not really come from the crowd, it makes you feel that it’s real”. Accordingly, enhancing the atmosphere of the playspaces appeared to amplify the expressive behaviour of participants and prompt social interactions. Furthermore, participants’ repeated recommendations to include more break beat music samples in 2K-Reality suggests that music makes a vital contribution to enhancing the atmosphere.

When pickup basketball players experience ‘flow’, by concentrating on playing the game, their sensory awareness of 2K-Reality soundscapes appears to diminish. Interviewee #7 clearly
described the changes in sensory perception that players can experience: “sometimes when we really concentrate, we won’t hear that sound. We can hear it when we stand still”.

The ISEA2015 urban probe indicated that 2K-Reality may have the potential to engage bystanders and encourage intergenerational play. On three occasions during the ISEA2015 urban probe, parents orchestrated soundscapes for their children when shooting hoops, and then swapped roles. Figure 77 shows a mother joining her son to engage in intergenerational play.

Figure 77. 2K-Reality intergenerational play.

In this chapter, I have recounted my evaluation of 2K-Reality by describing and discussing what I learnt from my urban probe HCD research. In the next chapter, I apply theory from prior discussions to explain how we may interpret and understand 2K-Reality as a make-believe prop.
Chapter 5: Interpreting 2K-Reality

Research Question Three
How may we interpret and understand 2K-Reality?

5.1 INTRODUCTION

In this chapter, I address my third research question: How may we interpret and understand 2K-Reality? To answer this question, I adopt an approach consistent with Edmonds and Candy’s model of practitioner research—I apply theory relevant to my design practice to examine and critique my 2K-Reality design and the 2K-Reality audience experience.

In Sections 3.4 and 3.5, I described 2K-Reality as a ludic design which takes the form of sonic videogame art. In this chapter, I will discuss how 2K-Reality functions as a make-believe prop that employs Deterding’s four design dimensions of make-believe: theming; scripting, ruling and framing; role-playing; and storification (Deterding, 2016). As noted in Section 2.3.2, Deterding argues that game studies has produced little research on make-believe, and suggests the four design dimensions of make-believe can help researchers identify the ‘active ingredients’ in playful design make-believe experiences. By using the design dimensions of make-believe to interpret the design and implementation of 2K-Reality, I endeavour to make a case study contribution to the game studies discourse centred on make-believe.

In Section 5.1.1, I will introduce my interpretation of 2K-Reality as a make-believe prop. I recall the relevant aspects of Kendall Walton’s make-believe theory of representation that I referred to in previous chapters. I will then proceed to identify how the 2K-Reality make-believe prop employs Deterding’s four design dimensions of make-believe.

In Section 5.2, I will discuss make-believe theming; how 2K-Reality creates a new NBA-themed space with appropriated NBA 2K12 videogame sounds.

In Section 5.3, I will examine make-believe scripting, ruling and framing; how 2K-Reality presents orchestrators with a set of instructions that affords explorative possibilities for performing meaningful NBA-themed soundscapes.

In Section 5.4, I will address make-believe role-playing. I describe how 2K-Reality invites orchestrators to adopt a make-believe role and perform through make-believe avatars.

In Section 5.5, I will explore make-believe storification. I use the play-centric perspective for understanding game-based narratives proposed by Celia Pearce, to analyse how 2K-Reality orchestrators use commentary sounds to construct narratives.

In Section 5.6, I will discuss how the 2K-Reality unifies the four design dimensions of make-believe into an amplified reality medium that creates an intermedia basketball experience.
Figure 78 represents my implementation of a fourth component of the model of practitioner research—applying theory to interpret and understand the 2K-Reality design and experience.

**Figure 78. Model of practitioner research: 2K-Reality trajectory component 4.**


### 5.1.1 2K-Reality Make-believe Prop

2K-Reality is a digital technology prop designed to create a game of make-believe in pickup basketball playspaces.

As discussed in Section 3.3.1, I conducted vision-driven research to explore and interpret pickup basketball sociocultural factors. My explorative interpretation revealed the significant
practice of NBA athlete mimicry and make-believe in grassroots basketball. In Section 3.4, I described how my 2K-Reality idea appropriates ‘pretending to play in the NBA’ as a make-believe ‘principle of generation”—the term Walton uses to describe the context for individual, or agreed and shared imagination.

In Section 3.5, I indicated that pretending to play in the NBA in grassroots basketball and NBA videogames is a principle of generation that clearly acts upon a Reality Principle—the term Walton uses to describe make-believe experiences that closely reflect the real world. ‘Pretending to play in the NBA’ occurs in constructed and mediated fictional worlds that simulate the real-world NBA scenarios.

When we interpret the 2K-Reality design as a digital technology make-believe prop, we can identify three make-believe prop components: i) an interactive prop, ii) an acoustic prop, and iii) reflexive props.

i) The 2K-Reality sampler interface is an interactive prop designed to encourage prop-oriented make-believe. 2K-Reality invites a spectator to adopt an alternative fictional belief: to pretend they are playing the role of an NBA-arena DJ, an NBA commentator and an NBA crowd.

ii) Role-playing spectators use the 2K-Reality interactive prop to produce an acoustic prop; the NBA-themed soundscapes that immerse pickup basketball players and spectators, and mimic the real-world sounds of NBA 2K videogames, NBA TV broadcasts and NBA arenas. The soundscapes create a physical yet invisible prop, designed to encourage prop-oriented make-believe and content-oriented make-believe, whereby players can pretend they’re ‘playing in the NBA’, or imagine being their favourite NBA player in a specific NBA game.

iii) Players and spectators immersed in the 2K-Reality acoustic prop, who choose to engage in make-believe, become props themselves and contribute to the creation of a shared fictional NBA world. Walton describes participants in make-believe worlds as reflexive props (Walton, 1990). As reflexive props, 2K-Reality audiences can engage in prop-oriented make-believe and content-oriented make-believe. For example, players and spectators can pretend to interact with the imaginary NBA-arena crowd, or participate in the construction of shared imaginary NBA scenarios within the fictional NBA world created by the 2K-Reality acoustic prop.

When interpreted as a make-believe prop, 2K-Reality exhibits what may be a distinguishing design characteristic. According to Walton and Bateman, the fictional truths created by a make-believe prop are generally not about the participants (Walton, 1990; Bateman, 2011), whereas the fictional truths generated by the 2K-Reality make-believe prop are about the participants. Although the 2K-Reality interactive prop is not about participants, the 2K-Reality acoustic prop typically articulates and amplifies the aesthetics of pickup basketball—the actions and events performed by pickup basketball players. As discussed in Section 4.6.3, 2K-Reality orchestrators most often performed ‘simultaneous orchestrations’ to produce soundscapes that simulate the sound of NBA television broadcasts and NBA videogames.
Furthermore, Bateman suggests that "one significant problem with the Reality Principle is that it is wed to the appreciator’s understanding of the world, and is thus divorced from the intentions of the artist" (Bateman, 2011, pp. 146–147); for 2K-Reality, this is not the case. As indicated in sections 3.4 and 3.5, I specifically designed 2K-Reality to exploit the pre-existing Reality Principle exhibited by pickup basketball players—‘pretending to play in the NBA’; a ubiquitous pickup basketball fantasy.

5.2 MAKE-BELIEVE THEMING

Deterding identifies the design of themed spaces as possibly the most prominent implementation of make-believe theming; for example, physical spaces such as theme parks and themed restaurants (Deterding, 2016). Sports stadiums and arenas are another notable example of themed spaces according to sports sociologist Kevin Dixon (2016); and, by logical extension, cultural sociologist Garry Crawford encourages us to regard realistic sports simulation videogames as virtual themed spaces (Crawford, 2015).

2K-Reality blends physical and virtual theming strategies. 2K-Reality immerses real basketball playspaces in highly recognisable NBA-themed sounds appropriated from a virtual NBA playspace. By remediating broadcast-style commentary sounds from NBA 2K12, 2K-Reality also appropriates the significant role they play in generating NBA 2K12 hypermediacy (Baerg, 2012), which I discussed in Section 3.3.9.

The 2K-Reality make-believe acoustic prop creates a specific type of NBA-themed space. 2K-Reality creates a branded space with NBA 2K sonic branding, which connects real and virtual grassroots basketball experiences. Theming pickup basketball playspaces with NBA 2K sounds reflects the extensive practice of theming, and the associated concept of branding, in the broader world of sports. Examples include the theming and branding of Olympic Games host cities; the naming rights of sports stadiums and arenas; the ‘brandscaping’ of retail sports stores (Riewoldt, 2002); and the NBA branding that permeates many forms of entertainment, amusements, computer-augmented environments, etc., discussed in Section 3.3.

By introducing the NBA 2K sonic brand into pickup basketball playspaces, 2K-Reality creates a new form of branding touchpoint. 2K-Reality soundscapes mix the three elements of sonic branding, voice, ambience and music to affect players and spectators cognitively, emotionally and physiologically. This, according to sonic branding scholar Sonja Kastner, and sonic advertising pioneer Daniel Jackson, has the potential to powerfully impact the perception and evaluation of brands (Kastner, 2013; Jackson, 2003). Furthermore, Jakob Lusensky, the author of Sounds Like Branding, argues that sonic branding can create stronger and more memorable brand impressions than visual branding (Lusensky, 2010).

As illustrated in Sections 4.2.1 and 4.3.1, urban probe participants recognised the 2K-Reality NBA-theme and NBA 2K sonic branding and acknowledged the make-believe Reality Principle that 2K-Reality cultivates. Some participants associated their 2K-Reality experience with ‘playing on an NBA court’, others with ‘playing NBA 2K’; some associated it both: “we felt like we were
playing in the NBA or 2K™. Furthermore, the NBA-theme and NBA 2K sonic branding seemed to encourage participation in the 2K-Reality urban probes. An observation that appears to reflect Walton’s theory, that the Reality Principle affords “richer and more natural participation in … games of make-believe” (Walton, 1990, p.160), and Deterding’s summation that familiar theming has the desirable effect of relaxing playful design users (Deterding, 2016).

Following philosopher Michel Foucault, the NBA-themed acoustic space created by 2K-Reality reflects the characteristics of a heterotopia. 2K-Reality soundscapes speak of other NBA places by reflecting the familiar acoustic qualities of NBA videogames, NBA TV Broadcasts and NBA arenas. Therefore, the immersive soundscape experience implements an occasion of Foucault’s third heterotopian principle by “juxtaposing in a single real place several spaces, several sites that are in themselves incompatible” (Foucault & Miskowiec, 1986, p. 25). Furthermore, 2K-Reality urban probes appeared to create audience effects that reflect the description Peter Johnson, a leading authority on Foucault’s heterotopia principles, provides for experiencing such spaces: “Heterotopias draw us out of ourselves in peculiar ways; they display and inaugurate a difference and challenge the space in which we may feel at home” (Johnson, 2006, p. 84).

For example, multiple 2K-Reality urban probe participants provided feedback that described feeling nervous, stressed or under pressure. Some reported the 2K-Reality crowd sounds as the source of these feelings—“it feels like I was seen by thousands and thousands of people, there was pressure, but it was really great!”. Others suggested that soundscapes drawing the attention of real spectators caused these feelings—“it makes us nervous when people watch us like we are real NBA players”.

5.3 MAKE-BELIEVE SCRIPTING, RULING AND FRAMING

Deterding argues that ‘scripting, ruling and framing’ has the potential to engage playful design users in acts of open-ended make-believe co-creation (Deterding, 2016); an activity we can associate with Gaver’s ludic design interpretative appropriation concept (Gaver, 2008) and with the musicality Fluxus idea (Friedman, 1998).

The 2K-Reality interactive make-believe prop presents people with a set of instructions that represent scripting, ruling and framing. The GUI displays an open-ended script—colour coding, naming and labelling communicate instructions in a spatial layout designed to correlate with the temporality of pickup basketball actions and events. The App programming establishes the rules—real-time acoustic feedback reveals how the sounds can be activated and manipulated, and how they behave. The cultural practice of pickup basketball provides the frame.

Figure 79 once again shows the primary 2K-Reality GUI—the script. Table 9 shows the 2K-Reality rules—the constraints and effects applied to the audio samples actuated by orchestrators who interpret the pickup basketball frame.
### Figure 79. 2K-Reality Primary GUI script.

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<td><strong>MISSES</strong></td>
<td><strong>HITS</strong></td>
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<td>11 COMMENTARY SAMPLES CHOKED-ONE SHOT 5 SECOND RANDOM-SHUFFLE</td>
<td>13 COMMENTARY SAMPLES CHOKED-ONE SHOT 5 SECOND RANDOM-SHUFFLE</td>
<td>18 COMMENTARY SAMPLES CHOKED-ONE SHOT 5 SECOND RANDOM-SHUFFLE</td>
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<td><strong>SHOOTS 3</strong></td>
<td><strong>MISSES 3</strong></td>
<td><strong>HITS 3</strong></td>
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<tr>
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<td>22 COMMENTARY SAMPLES CHOKED-ONE SHOT 5 SECOND RANDOM-SHUFFLE</td>
<td>4 COMMENTARY SAMPLES CHOKED-ONE SHOT 5 SECOND RANDOM-SHUFFLE</td>
<td>8 COMMENTARY SAMPLES CHOKED-ONE SHOT 5 SECOND RANDOM-SHUFFLE</td>
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<td><strong>OFFENCE</strong></td>
<td><strong>DEFENCE</strong></td>
<td><strong>EXCLAMATION</strong></td>
</tr>
<tr>
<td>15 COMMENTARY SAMPLES CHOKED-ONE SHOT 5 SECOND RANDOM-SHUFFLE SELECTABLE</td>
<td>20 COMMENTARY SAMPLES CHOKED-ONE SHOT 5 SECOND RANDOM-SHUFFLE SELECTABLE</td>
<td>10 COMMENTARY SAMPLES CHOKED-ONE SHOT 5 SECOND RANDOM-SHUFFLE SELECTABLE</td>
<td>4 COMMENTARY SAMPLES ONE SHOT 5 SECOND RANDOM-SHUFFLE</td>
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<td><strong>BEATS</strong></td>
<td><strong>CROWD BOOS</strong></td>
<td><strong>CROWD</strong></td>
<td><strong>CROWD CHEERS</strong></td>
</tr>
<tr>
<td>24 BREAK BEAT SAMPLES LOOPING-ONE SHOT AND SUSTAINED SELECTABLE</td>
<td>1 CROWD SAMPLE POLYPHONIC AND SUSTAINED</td>
<td>1 CROWD SAMPLE POLYPHONIC AND SUSTAINED</td>
<td>1 CROWD SAMPLE POLYPHONIC AND SUSTAINED</td>
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Table 9.

2K-Reality iOS App Rules
Deterding notes that “contemporary make-believe scripting, ruling, and framing is chiefly artistic” (Deterding, 2016, p. 114), and reflects analogue precursors such as works produced by Fluxus artists (Deterding, 2016). Accordingly, the ‘musicality’ and ‘chance’ Fluxus ideas, help explain how the 2K-Reality make-believe prop employs scripting and ruling for the pickup basketball frame.

Many Fluxus works adopted the innovation of ‘event scores’, sometimes known instructions (Friedman, Smith & Sawchyn, 2002) to create works with musicality—“works which can be realised by artists other than the creator” (Friedman, 1998, p. 250). As noted in Section 2.3.1, Celia Pearce argues that in the context of digital videogame art, a Fluxus ‘score’ equates to software ‘code’. And that like Fluxus scores, code “does not ‘exist,’ except in a conceptual sense, until played” (Pearce, 2006, p. 73).

The 2K-Reality interactive make-believe prop uses a digital score, or script and rules, to afford musicality. As shown in Figure 75, in Section 4.6.2, any member of the pickup basketball community of practice can use the 2K-Reality score in my absence. They can appropriate 2K-Reality to perform soundscapes that immerse audiences in their interpretive realisations of NBA-themed make-believe.

Affording musicality for creating make-believe reflects Deterring’s observation: that contemporary make-believe playful designs typically need to account for “a great amount of openness, emergence, ambiguity, and multiplicity of meanings and actions” (Deterding, 2016, p. 118). As ‘this capacity still proves elusive for computers’ (Deterding, 2016, p. 118), contemporary make-believe playful designs typically include a “human in the loop” (Deterding, 2016, p. 118).

2K-Reality requires a ‘human in the loop’ to play with a score that includes a computational implementation of the Fluxus ‘chance’ idea. This combination accounts for openness, emergence, ambiguity, and the multiplicity of pickup basketball trajectories, actions and meanings. First, as noted in Section 4.6, 2K-Reality orchestrators performed soundscapes that interpreted contingent basketball aesthetics in real-time. Second, 2K-Reality exhibition prototype orchestrators worked together with the iOS App programming rules to create soundscapes that incorporated chance operations, which, again as noted in Section 2.3.1, Pearce argues is a strategy for creating indeterminate experiences that videogame art and Fluxus share.

Ken Friedman highlights two forms of chance used by Fluxus artists: evolutionary chance and random chance (Friedman, 1998). The 2K-Reality score employs both types to create what Fluxus artist George Brecht called ‘compound chance events’ (Brecht, 1966). 2K-Reality’s GUI (the script) affords evolutionary human chance operations—orchestrators interact with 2K-Reality according to how they interpret the randomness of pickup basketball gameplay (the frame). The 2K-Reality iOS App programming code (the rules) produces random chance operations—the five-second-delay random-shuffle function automatically changes commentary and break beats. Together, they create compound chance events that determine the content of the soundscapes. While different styles of soundscape orchestration can influence the balance of evolutionary chance and random chance, the number of compound chance events that can be created with 2K-Reality is indeterminate.
Although we cannot accurately anticipate the permutations and combinations of compound chance events, Table 10 illustrates two permutation examples of human chance operations, along with the number of possible algorithmic random chance operations, and the maximum number of compound chance events the combinations can produce. Each permutation would typically occur within much longer sequences.

Table 10. Example Compound Chance Events

<table>
<thead>
<tr>
<th>EXAMPLE COMPOUND CHANCE EVENT</th>
<th>3960 MAXIMUM COMBINATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OFFENCE</strong></td>
<td></td>
</tr>
<tr>
<td>20 RANDOM-SHUFFLE</td>
<td>20 RANDOM-SHUFFLE</td>
</tr>
<tr>
<td><strong>SHOOTS</strong></td>
<td>11 RANDOM-SHUFFLE</td>
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<tr>
<td>18 RANDOM-SHUFFLE</td>
<td>18 RANDOM-SHUFFLE</td>
</tr>
<tr>
<td><strong>HITS</strong></td>
<td>1 POLYPHONIC</td>
</tr>
<tr>
<td><strong>CROWD CHEERS</strong></td>
<td></td>
</tr>
<tr>
<td>1 POLYPHONIC</td>
<td></td>
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</tbody>
</table>

**EXAMPLE NARRATIVE**
- moving the ball well
- fires it up
- and yes sir that one drops
- crowd cheers

<table>
<thead>
<tr>
<th>EXAMPLE COMPOUND CHANCE EVENT</th>
<th>1320 MAXIMUM COMBINATIONS</th>
</tr>
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<tbody>
<tr>
<td><strong>GENERAL PLAY</strong></td>
<td></td>
</tr>
<tr>
<td>15 RANDOM-SHUFFLE</td>
<td>15 RANDOM-SHUFFLE</td>
</tr>
<tr>
<td><strong>SHOOTS 3</strong></td>
<td>22 RANDOM-SHUFFLE</td>
</tr>
<tr>
<td>4 RANDOM-SHUFFLE</td>
<td>4 RANDOM-SHUFFLE</td>
</tr>
<tr>
<td><strong>MISSES 3</strong></td>
<td>10 RANDOM-SHUFFLE</td>
</tr>
<tr>
<td><strong>DEFENCE</strong></td>
<td>10 RANDOM-SHUFFLE</td>
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**EXAMPLE NARRATIVE**
- they need this
- from outside the arc
- no good on the triple
- and they’ll turn it over

5.4 MAKE-BELIEVE ROLE-PLAYING

Deterding notes that role-playing in the context of human–computer interactions generally occurs in two ways: users adopting make-believe roles, and users interacting with a system through a make-believe avatar (Deterding, 2016). The 2K-Reality interactive make-believe prop affords users both of these aspects of role-playing. 2K-Reality orchestrators can pretend to be an NBA-arena DJ to enhance the atmosphere of the playspace with contemporary music break beats—a role that reflects the NBA-arena sound design techniques (Beckham, 2013). 2K-Reality orchestrators can also act through two acoustic NBA avatars—the NBA 2K12 sports commentator Kevin Harlan and an NBA-arena crowd.

2K-Reality's single ‘Beats’ button provided an easy way for orchestrators to emulate the role of an NBA-arena DJ. Orchestrators activating and manipulating break beats contributed significantly to enhancing the playspace atmosphere, particularly during breaks in basketball gameplay. This use of break beats reflected how music is used in NBA-arenas. As McLeod observes, the ubiquitous presence of music during stoppages play has become vital to experiencing live sports events (McLeod, 2011). As well as simulating the use of music in NBA arenas, orchestrators playing break beats connected with the culture of hip hop. As mentioned in Section 4.6.3, some
orchestrators embraced the opportunity to be a basketball DJ by learning to appropriate the App rules to create rhythmic hip-hop inspired musical soundscapes.

Although 2K-Reality orchestrators cannot select or design a personal avatar to act through, they can in effect act through voice and sound effects avatars. First, orchestrators can pretend to be a sportscaster—they can act through Kevin Harlan, who voices the play-by-play commentary samples. Second, orchestrators can pretend to represent a group of spectators—they can act through the NBA-arena-style crowd sound effects.

My 2K-Reality urban probe observations revealed that orchestrators typically acted through the voice of Kevin Harlan as a make-believe NBA sports commentator to synchronise the annunciation of basketball moves and actions in a manner consistent with NBA television broadcasts and NBA videogames; other times they didn’t. Sometimes orchestrators changed Kevin Harlan’s role into a coach that attempted to influence the game from the sideline. In Section 4.6.3, I described this performative style of orchestration as ‘directive orchestration’.

Citing Sherry Turkle (1995), Deterding notes that role-playing can provide an alibi to explore behaviours they otherwise wouldn’t (Deterding, 2016), a behaviour that 2K-Reality orchestrators occasionally demonstrated during the urban probes. Sometimes 2K-Reality orchestrators selected specific commentary sounds to activate disrespectful comments they may not have otherwise articulated to the whole playspace themselves. An example I observed, also noted in Section 4.6.3, occurred when orchestrators performed the ‘paradoxical orchestration’ of the ‘oh no you hate to see that’ commentary sample in response to impressive play events.

2K-Reality orchestrators adopted a vastly different make-believe avatar when acting through the crowd sound effects. During urban probes, the NBA-arena crowd sounds filled the playspace almost continuously and set the tone of the atmosphere. Playing the role of a make-believe NBA-arena crowd was the most straightforward orchestrating function to execute. And the sounds consistently affected audience responses and social interactions between audience members. Manipulating the make-believe crowd sounds appeared to be an excellent example of Hug’s ‘differential of power’ effect, which I mentioned in Section 4.6.4—orchestrators appeared to experience a sense of power by creating a big sound with a small button (Hug, 2010b).

While 2K-Reality orchestrators primarily engaged in prop-oriented make-believe role-playing, pickup basketball players also enacted prop-oriented make-believe role-playing. For example, as mentioned in Section 4.7.2, I observed some players repeating specific moves to influence the ‘simultaneous orchestration’ of soundscapes, thereby encouraging the orchestrator to activate the alternative commentary sounds used to describe that move. For example, the ‘Shoots 3’ button can activate twenty-two alternative descriptions of a three-point-shot. Also, as mentioned in Section 4.7.3, players often displayed moments of role-playing by making gestures towards the make-believe NBA-arena crowd. I also encountered one ISEA2015 urban probe participant who indicated he may have been engaging in content-oriented make-believe role-playing. He asked for booing crowd sounds to be continuously activated while he practised free throws—as if playing in an opposing team’s NBA-arena.
5.5 MAKE-BELIEVE STORIFICATION

Deterding uses the term ‘storification’ to describe a design aspect of make-believe that can “complete, enrich, and reinforce the fictional world conveyed by theming” (Deterding, 2016, p. 112). 2K-Reality implements storification through NBA 2K12 commentary samples—orchestrators construct NBA-themed acoustic narratives to depict the aesthetics of pickup basketball.

Celia Pearce provides a play-centric perspective for understanding different game-based narratives that help identify how 2K-Reality commentary-based storification is constructed and experienced. Pearce has identified six narrative ‘operators’ that can coexist in games: i) the experiential, ii) the performative, iii) the augmentary, iv) the descriptive, v) the metastory and vi) the story system (Pearce, 2004). Coincidentally, Pearce uses the game of basketball to explain the six narrative operators, but only identifies the existence of four. Applying Pearce’s play-centric perspective for understanding game-based narratives illustrates how the 2K-Reality make-believe prop utilises storification extensively to maintain and enrich the NBA-theme and support the ‘pretending to play in the NBA’ Reality Principle.

i) Experiential narratives are those experienced by game players; they emerge from playing a game (Pearce, 2004). Pickup basketball players create experiential narratives that are dependent on the contingent spatial, temporal and social interactions inherent to team-based basketball gameplay. Experiential narratives typically influence the construction of 2K-Reality NBA-themed acoustic narratives.

ii) Performative narratives are third-person interpretations of narratives that emerge from a game (Pearce, 2004). 2K-Reality orchestrators typically use their sonic agency to express their observation of narratives created by pickup basketball games. As noted in Section 4.6.3, urban probe participants performed ‘simultaneous orchestrations’ to accurately describe basketball aesthetics with NBA 2K12 commentary sounds, in a style that simulates the sound of NBA videogames and NBA TV broadcasts.

iii) Augmentary narratives provide spectators with layers of information (Pearce, 2004). All 2K-Reality soundscapes are augmentary narratives—orchestrators interpret experiential narratives to articulate performative narratives with a layer of acoustic information amplified throughout the playspace. Incidentally, the narrative agency 2K-Reality affords to orchestrators may be unusual. Digital media theorist Janet Murray notes that “we do not usually expect to experience agency within a narrative environment” (Murray, 2017, p. 159).

iv) Descriptive narratives are experiential and performative narratives retold to third parties by players and spectators (Pearce, 2004). 2K-Reality urban probe participants created descriptive narratives when they related their experiences to others. For example, some participants mimicked and discussed their favourite commentary samples that facilitated the sense of ‘plaisir de l’ergo-audition’—the joy of hearing-oneself (as cited in Hug, 2010b). Descriptive narratives also emerged when orchestrators discussed their performative techniques with other participants. In a more abstract sense, the discussions my research project has stimulated, including this dissertation, can also be considered examples of 2K-Reality descriptive narratives.
When Pearce states that basketball "includes neither a metastory nor a story system", I argue she is mistaken. Furthermore, I claim that the playful design characteristics of 2K-Reality rely upon metastories and a story system to create meaningful NBA-themed make-believe experiences.

v) Pearce characterises a metastory as a "specific narrative ‘overlay’ that creates a context or framework for the game conflict" (Pearce, 2004, p. 145). As noted in Section 2.2.2, McLaughlin describes pickup basketball as "a living culture that responds to the local circumstances and personal histories of its players" (McLaughlin, 2008, p. 2). The social, temporal and spatial qualities of any basketball playspace provide a narrative overlay that creates a specific context and framework for each game—a metastory. Pickup basketball players regularly play at local courts where their basketball identity is familiar to the community of practice. Team selection rituals, reputations, relationships, physicalities, abilities, favourite moves, preferred positions, team-play orientation, previous victories, losses and conflicts etc., can all contribute to a framework for game ‘conflict’, on and off the court. As sociologist and pickup basketball doctoral researcher Kenneth Sean Chaplin notes, players "use preexisting relationships to inform the ways they make routine sense, meaning, and decisions about others, specifically, where and how they play, and whom they typically play with and against" (Chaplin, 2015, p. 218). Chaplin also notes that contention can routinely occur in pickup basketball "because of the players' divergent ideological approaches, social attitudes, and distinct cultural practices" (Chaplin, 2015, p. 18).

Metastories not only create different contexts and frameworks for pickup basketball, they can influence the construction of 2K-Reality acoustic narratives. As discussed in Section 4.6.4, the context established by an orchestrator’s relationship to players and spectators appeared to influence their orchestration styles and the narratives they constructed.

vi) When Pearce suggests that basketball does not have a “story system or kit of generic narrative parts that allows the player to create their own narrative content” (Pearce, 2004, p. 145), I argue that she is incorrect. Basketball has a universal story system comprised of generic moves and actions—the language of basketball (Mochalski, 2014). Players mimic, learn and embody the language of basketball; and recognise the play-by-play commentary terminology used to depict them. Accordingly, 2K-Reality’s score individuates commentary samples, or generic narrative parts, to afford orchestrators the ability to construct contingent acoustic narratives. The basketball story system is the basis of the 2K-Reality make-believe prop design.

2K-Reality combines all six of the play-centric narrative operators identified by Pearce concurrently. 2K-Reality storification make-believe emerges from the interplay between each of the narrative operators. Within the metastories established by the social context of a pickup basketball playspace, orchestrators interpret the experiential narratives that emerge from pickup basketball gameplay as performative narratives. Which they subsequently convert into acoustic augmentary narratives using the basketball story system and the 2K-Reality score. Descriptive narratives emerge from participants retelling aspects of their experience. The interplay between narrative operators establishes feedback loops that can influence the specific nature of the NBA-themed make-believe experience.
5.6 MAKE-BELIEVE UNIFICATION

According to Deterding, playful designs that integrate the four design dimensions of make-believe can produce the most compelling and sophisticated make-believe experiences. Deterding suggests that such unified make-believe designs are often difficult to categorise or distinguish among the new forms of digital games that augment everyday life, generally referred to as pervasive games (Deterding, 2016; Montola, Stenros & Waern, 2009).

In Sections 5.2 to 5.5, I have illustrated how people interact with 2K-Reality as a make-believe prop that employs each of Deterding’s four design dimensions of make-believe: i) theming—NBA 2K12 sonic branding; ii) scripting, ruling and framing—an interactive score designed for a pickup basketball frame; iii) role-playing—pretending to be an NBA-arena DJ; and iv) storification—pickup basketball narratives articulated by NBA 2K12 commentary sounds.

In this section, I distinguish 2K-Reality as a unified make-believe design—an amplified reality computer-augmented environment.

5.6.1 2K-Reality Amplified Reality

One urban probe participant in Taipei associated the 2K-Reality experience with augmented reality and his interpretation seems to correlate with the concept of amplified reality. Interviewee #5 stated that:

“It’s a kind of augmented reality. Normal AR [augmented reality] tech is through a camera lens to put some virtual things in your reality scene. But it’s always in the first person; other people can’t see it. This, on the contrary, allows all the audience to feel the AR effects with sound AR, not only the players themselves.”

As discussed in Section 2.3.3, amplified reality is a complementary augmented reality concept that describes computational tools embedded into the physical world that enhance public expressions for shared experiences (Falk et al., 1999). Accordingly, 2K-Reality may be interpreted as an amplified reality medium, described generically as a location-based computer used to produce amplified sounds that enhance playful public expressions and create a shared experience.

Consequently, the 2K-Reality unified make-believe design may be interpreted as an amplified reality medium. Explicitly described as role-playing DJs using a digital score to perform NBA-themed acoustic narratives that expand and share ‘pretending to play in the NBA’ make-believe in basketball playspaces.

Although I interpret 2K-Reality as a compliant implementation of the amplified reality concept, it is necessary to note that 2K-Reality does not entirely adhere to the notion that Falk et al. discuss. 2K-Reality does not satisfy the description that “amplified reality is about how the perceived might control how information is made available” (Falk et al., 1999, p. 275). In other words,
In Falk et al.’s vision for amplified reality, the enhanced expressions of objects or people in the world are controlled by those objects or people. In the 2K-Reality version of amplified reality, a spectator acoustically enhances the expressions of basketball players. The players do not control the commentary or crowd sounds that represent their performative expressions.

In Section 3.4, I classified the 2K-Reality bricolage artefact as a ludic design. In Section 3.5, I identified the 2K-Reality rapid prototype as a form of sonic videogame art. In this chapter, I have illustrated how 2K-Reality employs the four design dimensions of make-believe in a combination that generates an amplified reality medium. The experience the 2K-Reality amplified reality medium produces may best be interpreted as an intermedia heterotopia. As I reported in Section 4.8, experiencing 2K-Reality appears to induce NBA-themed plaisir de l’ergo-audition— the joy of hearing oneself in the NBA, by simulating the sound design of NBA videogames and NBA TV broadcasts.

As noted in Section 2.5.2, Dick Higgins’ introduced the term ‘intermedia’ to describe new media hybrids that draw upon and fuse existing media (Friedman, 1998; Higgins, 2001). As Fluxus scholar Hannah Higgins notes, unlike mixed-media or multimedia, which combine existing media categories, “intermedia actively probes the spaces between the different media” (Higgins, 2002, p. 91). The intermedia concept reflects the characterisation of ludic designs as products that fit between familiar genres. Whereas I classified the 2K-Reality bricolage artefact as a ludic design, based on my urban probe findings, I interpret performing soundscapes and being immersed in the 2K-Reality soundscapes as an intermedia experience. As Friedman argues, the categorical ambiguity intermedia works create by linking different forms of media, “require us to consider them in terms of human effects” (Friedman, 2007, p. 10).

Table 11 attempts to illustrate how the 2K-Reality amplified reality medium creates an intermedia basketball heterotopia with NBA-themed soundscapes by indicating how 2K-Reality occupies a space in-between existing basketball categories, agents, interfaces, interactions, means of sound production, players and playspaces.

Table 11.
*2K-Reality Amplified Reality and Intermedia Basketball Heterotopia*

<table>
<thead>
<tr>
<th>MEDIA PLATFORM</th>
<th>NBA VIDEOGAME</th>
<th>2K-REALITY</th>
<th>NBA ARENA</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRIMARY AGENT</td>
<td>Players</td>
<td>Orchestrators</td>
<td>Organisers</td>
</tr>
<tr>
<td>INTERFACE</td>
<td>Controller</td>
<td>Sampler</td>
<td>Social</td>
</tr>
<tr>
<td>INTERACTION</td>
<td>Manipulation</td>
<td>Actuation</td>
<td>Activation</td>
</tr>
<tr>
<td>REACTION SYSTEM</td>
<td>Videogame</td>
<td>iOS App</td>
<td>Multi-media Event</td>
</tr>
<tr>
<td>PRODUCTION</td>
<td>Generative</td>
<td>Performative</td>
<td>Collective</td>
</tr>
<tr>
<td>ACTORS</td>
<td>NBA Basketball Avatars</td>
<td>Pickup Basketball Players</td>
<td>NBA Basketball Players</td>
</tr>
<tr>
<td>PLAYSPACE</td>
<td>Virtual Elite</td>
<td>Real Grassroots</td>
<td>Real Elite</td>
</tr>
<tr>
<td>IMMERSION</td>
<td>SIMULATION</td>
<td>AMPLIFIED REALITY</td>
<td>REALITY</td>
</tr>
</tbody>
</table>
As noted in Section 2.3.3, using sounds to amplify and share the physical expressions of athletes has a long history in sports broadcasting. The 2K-Reality amplified reality medium represents an extension of this tradition. 2K-Reality orchestrators create a shared make-believe experience by augmenting the aesthetics of pickup basketball like the radio broadcasters who performed sound effects to enhance the appreciation of cricket; and the TV sound designers and foley artists who enhance sports broadcasts with pre-recorded sounds.

The 2K-Reality intermedia basketball heterotopia also extends the use of digital make-believe props to expand the repertoire of NBA experiences for the basketball community of practice. Whereas as NBA 2K videogames act as a make-believe prop for ‘pretending to play in the NBA’ in a virtual playspace; 2K-Reality acts as a make-believe prop for ‘pretending to play in the NBA’ in a real playspace.

In this chapter, I have explored how 2K-Reality functions as a make-believe prop that unifies Deterding’s four design dimensions of make-believe. In the next chapter, I conclude my dissertation by discussing the two primary outcomes of my research project. I will also outline the limitations of my project, suggest future research directions and discuss broader applications of my 2K-Reality playful design idea.
Chapter 6: Conclusions

6.1 CONCLUSION

To conclude my dissertation, I will reflect on my research project by discussing the two primary outcomes my research project produced: i) the 2K-Reality sports technology meaning-driven innovation, and ii) the Compliant Sports Augmentation Framework. I will also outline my research project limitations, suggest future research directions and discuss broader applications of my 2K-Reality playful design idea.

My research project emerged from my design practice and responds to the design question: How can I design a videogame-based sports technology innovation for pickup basketball that is compliant with the social practice and the spatiotemporal norms of the sport?

6.1.1 Playful Sports Technology

Literature relevant to my design question indicates that basketball researchers and sports technology designers have paid little attention to fun—the primary motivation for playing pickup basketball. Digital sports technology designed for grassroots basketball and other sports primarily focuses on evaluation and measurement, which can devalue fun and enjoyment and the affective benefits of physical activity (Henderson et al., 1999). My research suggests that Côté’s deliberate play theory (Côté, 1999) can potentially underpin an alternative approach to designing digital sports technology for casual grassroots sports such as pickup basketball.

The perspectives advanced by the playful design research community, which includes Gaver, Sicart and Deterding, and the precursor art practices of Fluxus, indicate that a playful design approach may be ideally applicable for enhancing the enjoyment of casual grassroots sports with videogame art. Deliberate play activities and playful design both focus on processes, not outcomes; and prioritise autonomy, experimentation and expression (Côté et al., 2007; Gaver, 2008; Sicart, 2015). Furthermore, theorists such as Pearce explicitly link Fluxus game art practices with contemporary videogame art appropriation strategies; and design techniques that can promote participation, creativity and playfulness (Pearce, 2006).

6.1.2 Meaning-driven Sports Technology Innovation

Design and innovation literature relevant to my design practice indicates that meaning-driven innovation may be different from the current methods used to design sports technology. Norman and Verganti argue that “meaning-driven radical innovation [is] an example of social determinism” (Norman & Verganti, 2014, p. 81); therefore, it presents an alternative to the technological determinism that appears to dominate the design of current grassroots sports technology innovations.

Applying a meaning-driven innovation method with a playful design approach may deliver sports technology designs that respond to recommendations made by researchers in the fields of sports entrepreneurship (Ratten, 2018); sports management, physical recreation and public
health; (Australian Government Independent Sport Panel, 2009; Henderson et al., 1999; Kahn & Norman, 2012; MacCallum et al., 2012); and game studies (Olson, 2015; Sicart, 2015). That is—sports technology designed for casual grassroots sports that can attract investment, promote fun and social interaction, and support the virtues inherent to playful sports practices; as opposed to organised competitive sports.

### 6.2 2K-REALITY MEANING-DRIVEN INNOVATION

Norman and Verganti describe meaning-driven innovations as radical products that have three characteristics: i) they emerge from interpreting sociocultural patterns, ii) they signify a radical change in meaning, and iii) they utilise an incremental or non-existent change in technology (Norman & Verganti, 2014).

According to this definition, I argue that 2K-Reality fulfils the meaning-driven innovation criteria. However, I temper my claim by acknowledging that 2K-Reality is only an innovation proposal; in other words, an invention. Norman and Verganti concur with innovation studies literature that generally considers the adoption, practical implementation, or consumption of a product a condition of innovation (Norman & Verganti, 2014; Cruickshank, 2010; Fagerberg, 2004). Furthermore, 2K-Reality remains a speculative meaning-driven innovation proposal. Based on my urban probe findings, 2K-Reality achieves a meaning-driven innovation status within limits, which I describe in Section 6.4.2.

i) Sociocultural Patterns

2K-Reality emerged from the socially embodied practice of NBA make-believe, which is common to both pickup basketball and NBA videogames, the two forms of basketball play the 2K-Reality idea blends.

2K-Reality was designed to expand NBA make-believe practices by exploiting the ‘pretending to play in the NBA’ make-believe Reality Principle—the mimicry and make-believe assumptions established by NBA videogames and TV broadcasts.

ii) Radical Change in Meaning

In Chapter 4, I present evidence that suggests 2K-Reality has meaning, changes meaning and produces meaning.

2K-Reality has meaning to pickup basketball players and spectators; urban probe participants in three different countries connected 2K-Reality with NBA 2K videogames and other NBA entertainment experiences.

2K-Reality significantly changes meaning for the pickup basketball spectator(s) performing soundscapes. During the urban probes, 2K-Reality orchestrators actively participated in pickup basketball games by augmenting a playspace with NBA-themed soundscapes. The remediated and recontextualised NBA 2K videogame sounds created a new basketball heterotopia in pickup basketball playspaces.
2K-Reality soundscapes generated meaning within the new basketball heterotopia. As reported in Section 4.6, 2K-Reality orchestrators produced meanings for players and spectators occupying the playspace. Simultaneous orchestrations amplified the aesthetics of pickup basketball, and paradoxical orchestrations contradicted cultural norms. Directive orchestrations attempted to instruct player movements and influence play, and rhythmic orchestrations mimicked hip-hop DJ performances. Each of these performative styles of soundscape orchestration created feedback loops that also influenced the meanings that emerged in a playspace.

In sum, the evidence from my urban probe HCD research suggests these meanings combine to produce a radical change in meaning. 2K-Reality creates NBA-themed plaisir de l’ergo-audition—the joy of hearing oneself playing in the NBA.

iii) Incremental Change in Technology

The 2K-Reality exhibition prototype employs two incremental changes in technology. First, the 2K-Reality installation system is a public access variation of existing technology configurations used in commercial basketball playspaces such as NBA-arenas and FIFA 3X3 event courts, shown in Figure 18 in Section 3.3.4 and Figure 19 in Section 3.3.6. Second, the custom-designed 2K-Reality iOS App mimics the aspects of the Machine Mikro MK2 digital audio sampler and is a specialised variation of other Apps.

6.2.1 Applying the Design Research Quadrangle Framework

In Chapter 3, I present how I designed the 2K-Reality meaning-driven innovation by applying the DRQ (Design Research Quadrangle) framework.

As suggested in Section 2.5, the DRQ is useful as a rich high-level theoretical framework that combines different design approaches, acknowledges the complexity of design, and withholds from prescribing design actions. As a result of my research project, I maintain that the DRQ framework can link practice-based design research to innovation. However, I suggest that utilising the DRQ framework requires designers to supplement the framework with design theory developed by other theorists, and to repeatedly apply different interpretive design approaches during a design process.

Figures 80 illustrates how I addressed my design question and responded to my first research question: How can the Design Research Quadrangle framework be applied to design a sports technology innovation for pickup basketball? The figure shows the trajectory of my 2K-Reality interpretive design process—from my practitioner framework to the 2K-Reality sports technology meaning-driven innovation.
1. I developed a practitioner framework to articulate a personal design hypothesis and establish my design criteria. Implementing this step aligned my application of the DRQ framework with Edmonds and Candy’s model of practitioner research. Verganti argues that the innovation of meaning begins by envisioning a personal hypothesis (Verganti, 2017), and Edmonds and Candy describe the practitioner framework as an untested design hypothesis (Edmonds & Candy, 2010). My practitioner framework and design criteria defined my playful design approach.

2. I began my practical design process by applying vision-driven research, which I continued to conduct throughout my research project. My explorative interpretation process revealed the presence and exploitation of NBA make-believe and basketball playspace acoustic augmentation.

3. My vision-driven research provoked a coincidence that led to bricolage—the act of generative interpretation that produced my idea to expand ‘the pretending to play in the NBA’ make-believe Reality Principle. I used my design criteria to evaluate and examine my idea for 2K-Reality; and by applying playful design theory, I classified the 2K-Reality bricolage artefact as a ludic design.

4. Bricolage precipitated my design-driven research process, a compositional interpretation and assembly process that involved hacking the NBA 2K12 videogame to develop a meaningful 2K-Reality rapid prototype for testing in situ. My practitioner framework guided my design judgements, and by reflecting on my design process and applying theory, I identified 2K-Reality as a form of sonic videogame art.

5. I conducted participant-observer urban probe HCD research to evaluate the 2K-Reality rapid prototype and the experience it produced. My interpretive evaluation of three urban probes delivered HCD research findings that indicated practicality, and usability improvements were...
needed to enhance and sustain ‘the pretending to play in the NBA’ make-believe Reality Principle. 2K-Reality was designed to expand.

6. I reapplied design-driven research to assemble a second 2K-Reality prototype based on my HCD research findings. I designed the 2K-Reality exhibition prototype to afford the performance of NBA-themed soundscapes that more realistically simulated the sound design of NBA videogames and NBA TV broadcasts.

7. The final stage of my practical design research process involved conducting a fourth urban probe HCD research study to evaluate the efficacy of the 2K-Reality exhibition prototype. The study produced findings that indicate my second design-driven research process successfully afforded the performance of more realistic NBA-themed soundscapes.

6.2.2 The Design Dimensions of 2K-Reality

As shown in Table 12, by applying design theory to my interpretive design process and urban probe evaluations, I have generated seven design dimensions that specify how the 2K-Reality sports technology meaning-driven innovation may be interpreted and understood. I argue that this combination of design dimensions, which produces a playful and social make-believe sports experience with videogame sounds, represents an original and novel approach to the design of sports technology for grassroots sports.

Table 12.
2K-Reality Design Dimensions

<table>
<thead>
<tr>
<th>2K-REALITY DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIMENSIONS</td>
</tr>
<tr>
<td>1 APPROACH</td>
</tr>
<tr>
<td>2 ARTEFACT</td>
</tr>
<tr>
<td>3 FORM</td>
</tr>
<tr>
<td>4 INTERACTION</td>
</tr>
<tr>
<td>5 MEDIUM</td>
</tr>
<tr>
<td>6 EXPERIENCE</td>
</tr>
<tr>
<td>7 OUTCOME</td>
</tr>
</tbody>
</table>

2K-Reality is situated within the field of playful design. The 2K-Reality sports technology design augments existing pickup basketball activities with new digital elements to afford a playful experience.

2K-Reality may be classified as a ludic design. The 2K-Reality sports technology artefact blends aspects of known product genres without clearly belonging to any and affords the production of meaning.
2K-Reality is identifiable as a form of sonic videogame art. The 2K-Reality sports technology installation acts as a sports videogame infrastructure ‘patch’—a ‘plug-in’ used to overlay real pickup basketball games with NBA 2K videogame sounds.

In Chapter 5, I discuss how 2K-Reality functions as make-believe prop to expand and enhance the ‘pretending to play in the NBA’ Reality Principle. 2K-Reality applies and unifies four design dimensions of make-believe: theming; scripting, ruling, and framing; role-playing; and storification (Deterding, 2016). 2K-Reality combines appropriated NBA-theming with a pickup basketball interactive score, operated by a role-playing spectator who acts as an NBA-arena DJ to interpret and produce narrative meaning, using a mix of broadcast-style commentary, arena-style crowd sounds and music break beats.

I conclude that this combination of make-believe design dimensions creates a reality computer-augmented environment that may be interpreted and understood as an amplified reality medium, which produces an intermedia basketball experience—a eudaimonic sports technology outcome.

6.2.3 Eudaimonic Sports Technology

Like McGonigal and Deterding and others, Sicart encourages designers to explore the augmentation of existing practices from a eudaimonic perspective informed by Aristotelian philosophy and positive psychology (Deterding, 2015). Sicart connects ludic design with ‘designing for eudaimonia’—the good life—and suggests adopting this perspective to design sports technology (Sicart, 2015). Using the Nike+ gamification platform for running as an example, Sicart argues that such systems “are superficial understandings of both the good life and the activity of play” (Sicart, 2015, p. 237), an assessment with which I concur. Like Sicart, who questioned whether measuring the performance of running encourages “the embodied pleasures of the sport” (Sicart, 2015, p. 230), I challenged the value of quantified-self applications designed for pickup basketball, a stance that initiated the development of my practitioner framework, discussed in Section 3.2.2.

To design for eudaimonia, Sicart urges designers to create playful designs that help develop skills and virtues, autonomy, appropriation and expression—by first identifying the aspects of an activity that make up the good life. I argue that Côté’s deliberate play theory, introduced in Section 2.2.4, identifies the elements that constitute a good life in the activity of pickup basketball; and therefore, the theory can support a eudaimonic playful design approach to grassroots sports.

I created 2K-Reality by seeking to augment the characteristics of deliberate play. The elements that lead to fun and immediate gratification for pickup basketball players. My approach appears to reflect that described by Sicart as, “a process of reflection focusing on interpreting the key elements that lead to virtuosity and autonomy through the lens of expressive, appropriative play” (Sicart, 2015, p. 237).

By respecting and cultivating the existing norms and values of pickup basketball, 2K-Reality exhibits eudaemonic sports technology characteristics. 2K-Reality celebrates the skills and virtues of pickup basketball players and those of a soundscape orchestrator. 2K-Reality affords
appropriation for interpretive and performative expression. And all 2K-Reality participants remain autonomous.

Put otherwise, the 2K-Reality playful design invites people to play with and through a system to augment ludus with paidia—the famous play classifications conceived by sociologist Roger Caillois (2001). 2K-Reality, a playful activity without rules (paidia) augments negotiated rule-based and goal-oriented pickup basketball play (ludus). Thus, the sonic agency and creativity that 2K-Reality affords become part of the practice of pickup basketball, which is consistent with Sicart’s idea of designing sports technology for eudaimonia (Sicart, 2015).

6.2.4 2K-Reality Meaning-driven Innovation Social Context

My 2K-Reality meaning-driven innovation attempts to offer an example of how private sector funding might potentially sustain sports technology designed to encourage participation in casual grassroots sports, and therefore increase physical activity. By appropriating sounds from a commercial sports videogame to design a sonic videogame art installation for a casual grassroots sport, I provide an example of a creative, enjoyable and socially inclusive public experience that may have the potential to attract private investment.

As discussed in Section 2.2.6, physical inactivity is a global pandemic (Kohl 3rd et al., 2012) and sport is an essential yet underutilised catalyst for increasing physical activity (WHO, 2018). Factors that contribute to the underutilisation of grassroots sports as a catalyst for physical activity are well-known. The inadequate provision of community-based sports and recreation facilities, the inequity of public and private sports funding, and the ineffective management of the trend towards casual sports participation are primary obstacles.

The WHO’s Global Action Plan on Physical Activity 2018–2030 (WHO, 2018) reflects other international reports that view inadequate recreation facilities as a significant barrier to increasing physical activity. Edwards and Tsouros, authors of a European WHO physical activity planning guide, argue that local governments have a crucial role to play in designing new community-based recreation spaces that rectify the reduction in outdoor areas provided for children and adolescents. They also highlight that current investments in facilities for competitive sports are a likely reason for young people to abandon playing sports (Edwards & Tsouros, 2006). Furthermore, multidisciplinary researchers that contribute to the Cities for Everyone research project in Sydney Australia highlight that pickup sports like basketball are under threat from “increasingly cash-strapped local councils” (Wise, Parry, Aquino, Neal & Velayutham, 2018, para. 18) and the competition for space in urban environments.

In 2018, Julia Gillard, a former Prime Minister of Australia, used The Prime Ministers Sporting Oration to call for all levels of government, the private sector and philanthropists to increase investment in grassroots sport (GOoffice, 2018). Gillard’s call reflects the 2016 European Commission High Level Group on Grassroots Sport report, which recommends that member-states encourage private sector contributions to grassroots sport ahead of elite sports and redirect public funding from elite sports to grassroots sports (Andreeva et al., 2016).
International sports management reports argue that organisations and clubs have not adjusted to sports participation trends that respond to lifestyle changes and youth preferences. For example, The Future of Sport in Australia report identified that “many sporting organisations have not embraced more recreational forms of their sports” (Australian Government Independent Sport Panel, 2009, p. 144) and have failed to capitalise upon commercial opportunities. And the Move It: Increasing Young People’s Participation in Sport report argues that public policy and investment in England, which prioritises traditional competitive team sports, is at odds with preferences of young people (Kahn & Norman, 2012).

By example, my 2K-Reality meaning-driven innovation proposal seeks to contribute a strategy for addressing these obstacles to casual sports participation; and, in turn, help encourage an increase in personal physical activity.

As mentioned in Section 5.2, 2K-Reality creates a new sonic branding touchpoint that may have the potential to generate strong and memorable brand impressions, and impact the perception of brands (Kastner, 2013; Lusensky, 2010; Jackson, 2003). Introducing sports videogame sonic branding into casual grassroots sports playspaces may be attractive to sports videogame publishers such as 2K Sports and EA Sports and other sports-oriented organisations. 2K Sports and EA Sports already occupy some grassroots sports playspaces, Figure 81 shows an example. Furthermore, incorporating advertising endorsements in the sports videogame sonic branding of playspaces would maintain the make-believe principles of generation inherent to grassroots sport, as the technique would emulate TV broadcasts.

The value of sonic branding could potentially make a contribution to the improvement, enhancement and maintenance of playspaces, and therefore may be a strategy that can help redress the inadequacy of community-based sports and recreation facilities. This approach would reflect the long-implemented strategy established by JCDecaux, the world's largest outdoor advertising corporation. Since 1964, JCDecaux has maintained public infrastructure such as street-furniture and bus stops in return for advertising space (JCDecaux, n.d.). Furthermore, if 2K-Reality could be shown to increase physical activity, sponsors of installations could possibly qualify for ‘corporate social responsibility’ tax breaks.
6.3 THE COMPLIANT SPORTS AUGMENTATION FRAMEWORK

According to Edmonds and Candy, doctoral candidates may use the model of practitioner research to transform a practitioner framework into shared outcomes, such as case studies, creative strategies, design criteria and more rigorous frameworks (Edmonds & Candy, 2010; Candy & Edmonds, 2018).

In this section, I present the Compliant Sports Augmentation Framework (CSAF). The CSAF formalises a rigorous version of my practitioner framework by synthesising the practice, theory and evaluation elements of my research project; and presents the design implications that emerged from my research project as a design framework.

Figure 82 represents my implementation of a fifth component of the model of practitioner research—my development of the CSAF sports technology design framework for grassroots sports.

Furthermore, the figure illustrates how I utilised the meaning-driven innovation method within Edmonds and Candy’s model of practitioner research to conduct a practice-based design and innovation research project. This approach may be useful to other designers, as both frameworks can accommodate different trajectories for design research that investigates the creation and evaluation of interactive technology innovations.
The CSAF may contribute to digital sports technology design for grassroots sports. The framework aims to encourage the design of grassroots sports technology for deliberate play, rather than deliberate practice. The CSAF presents perspectives designers can utilise to consider an alternative approach to the technological determinism of self-quantification.

The structure and development of the CSAF is influenced by the deliberate play theory proposed by sports psychologist Jean Côté (1999), the ‘thick theory of athletic performance’ articulated by sports philosopher Sigmund Loland (2002), the notion of designing for eudaimonia in sports.
raised by play scholar Miguel Sicart (2015), and the strategies recommended by international public health and sports management reports for encouraging participation in grassroots sport.

It is necessary to state that I do not argue that adopting an approach that utilises the CSAF will produce superior sports technology innovations for grassroots sports. I suggest that reflecting upon each dimension of the framework may assist designers in developing meaningful grassroots sports technology design concepts different from prevailing designs. I also acknowledge that technology designed to augment a sports activity will introduce a degree of change by definition; augmenting a sport implies adding something to modify the experience. I do not suggest that a compliant sports augmentation needs to ‘maximise’ all the criteria in the framework. However, I do argue that sports technology designs that implement a higher degree of ‘maximise’ criteria in more dimensions will produce a more compliant sports augmentation for casual grassroots sports.

Table 13 summarises the CSAF. Each of the twelve dimensions is an interrelated operator, and the criteria represent ends of a continuum. The aspects I suggest should be minimised, reflect the characteristics of current sports technology designs that prioritise evaluation and measurement, and intervene in spatiotemporal norms.

Table 13. The Compliant Sports Augmentation Framework
Internal Logic

The spatial, temporal and practical dimensions of the CSAF concern the internal logic of sports. As noted in Section 3.3.2, the rules that establish dynamic relationships between structural and functional elements and players determine the internal logic of a sport. The CSAF advocates for maintaining the internal logic of grassroots sports by adopting Loland’s ‘thick theory of athletic performance’ ethical stance, which Loland associates with amateur sports ideologies (Loland, 2002).

1. Spatial

The spatial dimension encourages the design of sports technology that consolidates and enhances existing playspace structures—the flexible grassroots playspaces such as playgrounds and parks, streets and driveways, backyards and beaches etc. The CSAF discourages sports technology that may affect spatial play patterns by intervening within the boundaries of play.

2. Temporal

The CSAF promotes sports technology designs that avoid interrupting the temporality of play patterns. The temporal dimension prioritises integrating sports technology with the rhythms of a sport; designs that synchronise with play-action, play transitions and play breaks.

3. Practical

The practical dimension concerns sports equipment; the physical tools used by participants. The CSAF favours enhancing existing equipment in preference to adding new elements or introducing changes to equipment that contravene accepted norms. Accordingly, the practical dimension concerns access and equity.

Norms and Values

The social and cultural dimensions of the CSAF involve fostering social interaction—a primary motivation for participating in sport and physical activity (Allender et al., 2006).

4. Social

The CSAF discourages sports technology designs that rely on personal devices, such as smartphones. The social dimension encourages designing sports technology that creates inclusive social experiences, which promote, expand and support in-person social interactions, including intergenerational play.

5. Cultural

The cultural dimension urges designers to identify, utilise, incorporate, modify, appropriate etc. the practices integral to the broader culture of a sport. The CSAF advocates for sports technology designs that sports communities can connect to other things they value. As opposed to appropriating extraneous design tropes from other sports.

Eudaimonia

The attitude, goal, gratification, content and interaction dimensions of the CSAF specifically promote sports technology designed for deliberate play. They intentionally differentiate the characteristics of sports technology designed for deliberate practice from the design attributes
required to support Sicart’s notion of ‘designing for eudaimonia’. They also reflect Loland’s ‘thick theory of athletic performance’ by encouraging designers to respect, protect and cultivate the existing norms and values inherent to a grassroots sport (Loland, 2002).

6. Attitude
   The attitude dimension calls for sports technology designs that focus on processes, not outcomes. This dimension encourages designers to design for eudaimonia by supporting the autonomy of sports participants. Particularly deliberate play participants and the variations of sports they organise, and the rules they negotiate for play.

7. Goal
   The goal dimension encourages the design of sports technology that celebrates the aesthetics of grassroots sports and creates memorable experiences, as opposed to evaluating and comparing aspects of performance or monitoring achievements. Accordingly, the goal dimension focuses on enhancing the fun and joy inherent to deliberate play activities.

8. Gratification
   The gratification dimension concerns the feedback sports technology provides to players and spectators and relates to the temporal dimension. The CSAF promotes designing technology that delivers immediate and unified feedback rather than delayed and isolated feedback.

9. Content
   The CSAF prioritises sports technology designs that produce media content to amplify, mix and share subjective expressions, rather than capture, individuate and personalise objective impressions.

10. Interaction
    The interaction dimension discourages using sports technology for surveillance—the use of sensors to capture, store and distribute personal data. The CSAF encourages benign interactive technology that affords agency through appropriation.

Public Health
The access and funding dimensions concern availability and provision. They introduce aspects of public health by acknowledging policy recommendations for encouraging participation in grassroots sports and increasing physical activity.

11. Access
    The CSAF promotes the design of sports technology that can be shared and universally accessed. The access dimension advocates for the design of public infrastructure sports technology, in contrast to personal devices that restrict access.

12. Funding
    The funding dimension urges designers to consider economic models that can subsidise the implementation and maintenance of sports technology that encourages participation and physical activity in community-based public settings. The CSAF promotes sports technology designs that minimise personal expenditure.
6.4 RESEARCH PROJECT LIMITATIONS

6.4.1 Urban Probe Research Impediments

Deploying each of the 2K-Reality urban probes in uncontrolled basketball playspaces was a challenging exercise. My experience concurs with Reeves, who recognises "the significant problems that are posed by studying technology in-action within public settings" (Reeves, 2011, p. 29). I faced logistical and practical issues, location access issues, environmental challenges, language barriers and data gathering difficulties.

Installing, maintaining, operating and observing the installation, while also monitoring the security and safety of the technology, severely limited the type and quality of data I collected. Studying the 2K-Reality intervention as a participant-observer was very informative; however, effectively documenting the experience for later analysis proved difficult. Although I made multiple efforts to gather data using different approaches, limited resources significantly constrained my ability to collect documentary feedback.

Organising a team of research assistants to help collect data was extremely beneficial, and I would recommend that other doctoral researchers do the same if conducting studies in public settings.

Table 14 summarises my urban probe evaluation approaches, which I discussed in Sections 4.2 to 4.5, and indicates their relative contribution to my interpretive evaluation of 2K-Reality.

Table 14.
2K-Reality Urban Probe Evaluation Approaches

<table>
<thead>
<tr>
<th>URBAN PROBE</th>
<th>Study 1</th>
<th>Study 2</th>
<th>Study 3</th>
<th>Study 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCATION</td>
<td>RMIT UNIVERSITY A’BECKETT URBAN SQUARE</td>
<td>SHIH CHIEN UNIVERSITY GYM</td>
<td>XINSHENG ELEVATED ROAD</td>
<td>ISEA2015 SFU WOODWARD’S ATRIUM</td>
</tr>
<tr>
<td>2K-REALITY SYSTEM</td>
<td>Rapid Prototype</td>
<td>Rapid Prototype</td>
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Conducting research as participant-observer was most informative. However, I found it particularly challenging to observe the three types of participant groups concurrently (players, spectators and bystanders, and orchestrators). The different participants—with diverse motivations, playing abilities and relationships—made it, like Fluxus works, “impossible to devise a system able to account for the vast range of meanings” (Higgins, 2002, p. 59). Furthermore, fun and make-believe are both internal cognitive processes; therefore, interpreting my observations relied on behavioural inferences. As Kendall Walton notes with regards to sports, “it will not always be obvious whether and to what extent a competitor or spectator engages in make-believe” (Walton, 2015, p. 82).

I also faced the same predicament Deterding identifies as a problem for research studying make-believe playful designs. 2K-Reality soundscapes introduced multiple interventions at once, making it hard to draw definitive conclusions about what sound elements affected make-believe on different participants at different times (Deterding, 2016).

Whereas Reeves, for example, finds video data useful for analysing research in public settings (Reeves, 2011), my multiple attempts to use video technology to gather data for analysis proved somewhat useless. Even with three cameras and the assistance of a team, I found video recording to be a time-consuming and ineffective data-gathering approach. Documenting my installations with audio-visual technology was not useful for my interpretive analysis. The practical constraints of capturing the dynamic movements of pickup basketball players on a half-court made analysing details within the wide-angle video frame meaningless. My attempt to use a strategically placed digital audio recorder also proved ineffective. Recordings were affected by environmental conditions, which severely limited interpreting captured participant vocal expressions.

My attempt to use a questionnaire to circumvent a language barrier at the Shih-Chien University Gym was useful. However, the quality of responses in the forty-three questionnaires barely justified the significant effort required to implement the data-gathering approach. A loss of meaning in translation, from English to Mandarin and back again, may have contributed to the quality of feedback. But it was more likely due to the quality and length of my questionnaire. Which, upon reflection, was far too broad and ambitious for proper contemplation in basketball playspaces. The questionnaire is attached in Appendix D.

Collectively, my conversations with numerous participants proved to be valuable for my evaluation of the urban probes. However, the unpredictable and fragmentary nature of participant encounters and the multiple demands on my attention prevented me from recording conversations in any detail.

### 6.4.2 Urban Probe Time-scale

My evaluation of 2K-Reality is subject to an extremely critical issue: sustaining interest in 2K-Reality beyond its initial attraction as a temporary installation. The short-term urban probes, the longest of which was four days, fail to address the likelihood that the novelty of 2K-Reality and the enjoyment of the experience will significantly diminish over time. Pickup basketball is principally
a local activity; McLaughlin describes the cultural practice as intensely local (McLaughlin, 2008). Players exposed to 2K-Reality for long periods are likely to tire of repetitive sounds. As Deterding notes, the attraction of theme and narrative in playful designs is novelty (Deterding, 2016).

However, the development of the 2K-Reality exhibition prototype demonstrated that the novelty of the experience can be extended by up-scaling the number of appropriated samples and incorporating chance operations. Any future development of the 2K-Reality idea needs to address the issue further, to ensure the spontaneity and surprise. As Deterding also notes, complexity, or producing new content, is a typical strategy for expanding the scope of a revisited experience (Deterding, 2016).

### 6.4.3 Measuring Physical Activity

2K-Reality is designed to increase the time players engage in physical activity by enhancing the enjoyment of playing. The cumulative effect of playing pickup basketball for longer may have personal health benefits. As studies have shown, even small increases in the amount of time spent engaging in regular physical activity has the potential to markedly improve an individual's health (Arem et al., 2015; Moore et al., 2012).

Measuring whether 2K-Reality urban probe participants played pickup basketball for longer than usual was practically impossible. However, some ISEA2015 urban probe participants returned to the play space with colleagues or family, which suggests 2K-Reality may have encouraged some players to spend additional time on-court. Furthermore, as noted in Section 4.8.1 and shown in Figure 77, some parents felt compelled to play basketball with their children when they initially appeared unprepared to do so. These occurrences illustrated an increase in physical activity among some participants and fulfilled one of my underlying design ambitions: to encourage intergenerational physical play.

## 6.5 Future Research Directions

### 6.5.1 2K-Reality Design Research Directions

My research project indicates that further design research could improve people’s interpretative appropriation of 2K-Reality, and therefore support the performance of more sophisticated soundscapes that enhance the ‘pretending to play in the NBA’ Reality Principle.

Numerous elements of the 2K-Reality design can be enhanced, modified and experimented with to potentially improve, sustain and diversify the 2K-Reality experience. Furthermore, an ultimate realisation of the 2K-Reality design would need to incorporate the physical properties of permanent infrastructure.

Future 2K-Reality design research can investigate a custom hardware interface that affords simple yet more sophisticated orchestration techniques. For example, a custom-designed physical interface could afford more expressive soundscape orchestrations. Larger physical buttons that incorporate haptic feedback and pressure sensors, and proximity sensors that respond to gestures, would provide orchestrators with more control and require less visual attention.
Software developments might explore accommodating personalised audio samples, content sharing and library switching, and online preloading and membership logins to encourage creative audio preproduction away from the court. Semantic listening software, like SoundHound and Shazam, could be employed to screen and negate the inclusion of offensive commentary samples.

Sound design experiments might examine alternative videogame appropriation sources, including those I eliminated from consideration early in my research project. For example, the exaggerated humorous commentary sounds synonymous with the NBA Jam (EA Sports, 2010) videogame. Conducting experiments in different cultures with professional videogame commentary in languages other than English would also be an aspect worth investigating.

Exploring the impact of a non-compliant or disruptive version that empowers an orchestrator with the judgemental sounds of officialdom could also produce intriguing results.

Although primarily designed for public playspaces, conducting 2K-Reality HCD research in controlled environments, such as local sports facilities, could potentially generate higher quality research data. For example, probes in controlled basketball playspaces could facilitate scheduled research sessions with different cohorts and utilise more sophisticated contemporary technology. A system that includes a more advanced 2K-Reality iOS App that records physical interactions for automatic playback, linked to cameras equipped with optical tracking and artificial intelligence, may help collect and analyse performance and response data. The HomeCourt platform noted in Section 2.2.5 is an example of artificial intelligence camera technology that could be adapted for research.

However, I remain sceptical that technology is the best approach to collecting data that can reveal insights into aspects of fun and games of make-believe. I suggest future 2K-Reality-oriented or similar research may benefit from utilising a play questionnaire such as the Playful Experiences Questionnaire (PLEXQ) (Boberg, Karapanos, Holopainen & Lucero, 2015), developed by Boberg et al. to measure facets of playfulness. Responses to a PLEXQ might reveal different aspects of playful experiences that cannot be observed.

### 6.5.2 Grassroots Sports Future Research Directions

My research project suggests future research that investigates make-believe and deliberate play may have a beneficial role in promoting participation in grassroots sport.

2K-Reality is designed to enhance the social practice of ‘pretending to play in the NBA’, and my research demonstrates that NBA make-believe can be augmented and potentially enhanced with videogame sounds. As previously noted, Deterding argues that make-believe remains an aspect of play neglected by game studies research (Deterding, 2016). And, as I suggested in Section 2.6, make-believe also appears to be absent from grassroots sports research. Yet, as noted in Section 3.3.1, mimicry and make-believe is readily apparent in pickup basketball and exploited by advertising (Antolihao, 2015; Elcombe, 2007; Morris, 2002; Andrews, 1998). Furthermore, make-believe in sports is a multibillion-dollar industry. Fantasy Sports online games,
whereby people manage “imaginary or virtual teams of real players of a professional sport” (Orbis Research, 2019, para. 1), had a global market size of US$13.9 billion dollars in 2018, and is predicted to grow to US$33.2 billion dollars in 2025 (Orbis Research, 2019). This mismatch appears to suggest that make-believe in grassroots sports practices is worthy of future research.

The majority of participants in my research project were adults—pickup basketball players engaged in deliberate play; an intrinsically motivated, peer-regulated activity organised to maximise enjoyment and provide immediate gratification. However, it appears that adult deliberate play has not been a subject of research. Furthermore, some characteristics of pickup basketball, both documented in published research and observed by me during my research, appear not to fit within the current definition of deliberate play. For example, showing off—the performative showcasing of skills to spectators—is not identified as a characteristic of deliberate play activities. Accordingly, adult deliberate play may be a worthwhile focus of future games and play research that could support sports technology designs and encourage physical activity. Furthermore, as mentioned in Section 2.2.5, casual or non-organised grassroots sport has higher and increasing participation rates than organised sport (Ratten, 2018; Deelen et al., 2018; Hajkowicz et al., 2013).

### 6.5.3 Broader Applications

The 2K-Reality sports technology design can be adapted to other grassroots sports. Other ‘realistic’ sports videogames contain audio content meaningful to their respective grassroots sports communities of practice.

Adapting the current 2K-Reality design can be addressed by analysing the spatial and sociocultural practices associated with other sports, and by modifying the content and interface design accordingly. Adaptations would create similar amplified reality environments that could playfully enhance grassroots sports aesthetics with elite sports make-believe.

Three other internationally popular sports immediately present opportunities—football, baseball and cricket—each of which, like basketball, I have played competitively and socially. However, organised versions of baseball, indoor cricket and indoor football present the most compelling grassroots sports situations for adaptations that modify and expand the 2K-Reality concept.

For example, like pickup basketball, the turn-taking characteristics of both baseball and indoor cricket, and the practical organisation of their playspaces, provide potential orchestrators and captive audiences for soundscapes. Unlike pickup basketball, baseball culture suggests that utilising colour-commentary to replicate the practice of trash talking or sledging, as Australians call it, would be credible. Baseball’s spatial configuration also invites consideration of two interfaces, one for each team on different sides of the diamond; duelling orchestrators could create composite soundscapes.

The organisation of indoor cricket suggests a radically different adaptation—providing an interface to game officials. Augmenting the role of umpires would be an intriguing phenomenon to explore. In effect, indoor cricket umpires already provide commentary by merely keeping
score and managing the game—a somewhat tiresome task at times, which may be made more enjoyable with a 2K-Reality-like system, without distorting the meaning of their official involvement in a game.

The sheer popularity of football and the practical organisation of indoor football presents an adaptation opportunity—one that my research project has already explored by conducting a co-design research project with students from Denmark, called Urban FIFA (Strandby, Szatkowski, Petersen, Storebjerg, Dindler & Ryan, 2016).

6.5.4 Urban FIFA

The development of Urban FIFA replicated the 2K-Reality design-driven research process. Urban FIFA appropriates iconic commentary and crowd sounds from the EA Sports FIFA 15 (EA Sports, 2014) football videogame, and the App design reflects the play patterns and the formal temporal structure of indoor 3-on-3 football.

The design-case paper, Urban FIFA: Augmenting Social Sports with Video Game Elements, is attached to this dissertation in Appendix I. Figure 83 shows a participant-observer researcher orchestrating Urban FIFA soundscapes at the Fodboldfabrikken (Football Factory) indoor football facility in Aarhus Denmark.

Although carried out in a very different context, the findings of the Urban FIFA research project correlate with my interpretation and evaluation of the 2K-Reality urban probes. Urban FIFA orchestrators developed similar soundscape performance styles. Football players exhibited mimicry and make-believe behaviour and responded cognitively, emotionally and physically. The enjoyment of playing 3-on-3 football appeared to be enhanced, and researchers observed an increase in social interaction (Strandby et al., 2016).

In the report, Move It: Increasing Young People's Participation in Sport, authors Lauren Kahn and Will Norman argued for better use of digital platforms to encourage active participation in grassroots sport. And supported their argument by stating that “EA Sports’ FIFA is one of the most popular games in the country among young boys, yet does little to encourage active participation in football” (Kahn & Norman, 2012, p15). Urban FIFA appears to indicate that leveraging the
FIFA videogame to augment elite football mimicry and make-believe among grassroots football players, may have the potential to encourage active participation.

### 6.6 BLENDING SPORTS VIDEOGAMES WITH REAL GRASSROOTS SPORT

My research project suggests that 2K-Reality contributes a response to Cheryl Olson, who questioned how might commercial videogames be used to support real-world sports and encourage physical activity (Olson, 2015).

2K-Reality blends a commercially available sports videogame with a real grassroots sports to augment the primary motivation for participation—fun and joy. 2K-Reality amplifies the mimicry and make-believe inherent to grassroots sports deliberate play; to provide participants with an opportunity to perform on the ‘big stage’—a universal and motivating sports fantasy.

As the renowned game design and play facilitator Bernard DeKoven said:

“Fun is a powerful force. Even the promise of fun is enough to make us want to play” (DeKoven, 2015, p. 298).


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APPENDIX A 2K-REALITY ORCHESTRATION DEMONSTRATION VIDEO LINKS

Quickly produced 2K-Reality orchestration demonstration video. Simultaneous, Paradoxical, Directive, Rhythmic and Rhythmic Toying

Please use the following link to view the demonstration video:
http://mayswell.com/2kreality-demonstration-video

Alternative video links:

Vimeo
https://vimeo.com/358252069
Password: 2KRattachment

YouTube
https://youtu.be/4ITBcLeknU0
In this appendix, I describe each step of the interpretive ‘hacking’ design process I used to assemble the 2K-Reality rapid prototype — my first practical application of the design-driven research quadrant of Norman and Verganti’s DRQ framework, which I discussed in Section 3.5. Figure B1 reiterates an illustration of my design process, which I describe below.

**Stage 1: Content Identification**

Although I was confident that *NBA 2K12* would be the appropriation source for 2K-Reality commentary sounds, I evaluated the sound design in two other popular NBA-themed videogames, *NBA Live 10* (EA Sports, 2009) and *NBA Jam* (EA Sports, 2010). I eliminated *NBA Live 10* as an appropriation source because of its age and market status, and similarity to *NBA 2K12*, which had a broader audience appeal than *NBA Live 10* (Kayali, 2015). *NBA Jam*, which introduced vocal expressions such as “Is it the shoes!?”, “He’s heating up”, and “BOOMSHAKALAKA” into the lexicon of basketball culture, I deemed to be inappropriate; due to its overly exuberant commentary style, its 2-on-2 player format, and focus on dunking (see Stage 3 below).

**Stage 2: NBA 2K12 Audio Recording**

I used multiple techniques to generate and record as many different play-by-play commentary phrases as possible: playing with different teams, modifying player capabilities, and performing various styles of play. Setting the videogame to control both teams proved most productive. It allowed me to list and note the time of useful expressions and commentary variations. This technique was particularly successful in generating commentary that had been difficult to generate by playing the game myself. For example, maximising the three point shooting capabilities for all players on each team produced a range of commentary variations for that single action.
I made no additional crowd sound recordings for the 2K-Reality rapid prototype. My analysis of NBA 2K12 crowd sounds in different arenas revealed minimal changes to crowd sounds. I also discovered that crowd chants were indistinguishable and barely noticeable.

Stage 3: NBA 2K12 Commentary Analysis and Break Beats Production

Before editing the audio content for 2K-Reality, I analysed the NBA 2K12 commentary through the lens of my practitioner framework, which eliminated many NBA 2K12 commentary phrases from the inclusion in 2K-Reality. For example, comparing pickup basketball games with the NBA games simulated by NBA 2K12 identified differences in the internal logic of the games — the treatment of time, the recording of scores, and the enforcement of rules. The time it takes to play a game of pickup basketball is determined by the score, whereas time structures NBA 2K videogames. Pickup basketball players count the number of baskets, not the number of points scored. Players negotiate and enforce the rules of pickup basketball, whereas simulated referees officiate NBA 2K videogames. To ensure 2K-Reality maintained the norms of pickup basketball, I discounted including any NBA 2K12 commentary referring to time, accumulated points and officiating. Furthermore, dunks or slam dunks — the most spectacular and celebrated scoring move in basketball — cannot be performed by the vast majority of pickup basketball players. Therefore, I omitted commentary describing dunks from inclusion in 2K-Reality.

My analysis of NBA 2K12 commentary also revealed the significant use of ‘colour-commentary’ — factual information, anecdotes, and background knowledge about NBA players and teams — that complements the ‘play-by-play’ commentary that describes basketball action and events. I precluded colour-commentary from 2K-Reality because it would be contextually irrelevant to pickup basketball players. Accordingly, I needed to incorporate sounds that could fill temporal breaks in the play-by-play commentary.

NBA television broadcasts reveal the role of NBA-arena DJs during NBA games. Break beats are commonly performed by DJs to enhance the atmosphere in the arena and manipulate the emotions of spectators, particularly during pauses and breaks in play. As mentioned in Section 3.3.4, music is also used to augment pickup basketball play spaces. I decided that the break beats music I produced for my bricolage tests could be used to fill the pauses in 2K-Reality play-by-play commentary, and complement crowd sounds. I employed my music connoisseurship (Nelson & Stolterman, 2012; Eisner, 1985) to select and edit break beats from a range of contemporary music tracks that I considered may appeal to a broad audience and might compel physical responses like dancing. For example, The Game by Jurassic 5, Backstage Girl by DJ Shadow, I Feel Love by Donna Summer, Walking on the Moon by the Police, Glitch by Brian Eno, and Shake Your Rump by the Beastie Boys.

Stage 4: NBA 2K12 Audio Sample Selection

My practitioner framework and Walton’s make-believe Reality Principle guided my selection of 2K-Reality audio samples. I sought to maintain the internal logic of pickup basketball gameplay trajectories, and create a system that afforded the performance of NBA commentary narratives that
realistically simulated NBA television broadcasts and the NBA 2K videogame series. Furthermore, the sixteen-button Maschine Mikro MK2 sampler interface constrained my selections.

Because scoring is the primary goal in pickup basketball, I began by allocating three interface buttons to commentary that describes the typical shots performed by pickup basketball players — layups, two-point shots, and three-point shots. To ensure a realistic simulation that meets the expectations of the basketball community of practice, each of these shots required scoring or missing commentary to describe a result. However, one commentary phrase sufficiently describes a successful layup because play-by-play basketball commentary links the close-to-the-basket style of shot with scoring; while missing a layup is the same as missing a two-point shot. Offensive and defence rebounding — retaining or gaining possession of the ball after a missed shot, is a critical play-event in any form of basketball. Predicting which player or team gains possession from a rebound is difficult to do, so I did not consider rebounding commentary to be a priority. However, my analysis of NBA 2K12 commentary prompted me to add a ‘shoots again’ button to the interface to suggest an offensive rebound; which in pickup basketball allows play to continue, whereas defensive rebounds require the ball to be moved away from the hoop, beyond the three-point arc. Figure B2 illustrates the logic I used to allocated eight of the sixteen sampler interface buttons to commentary that describes shot taking sequences typical in pickup basketball.

![Figure B2. Eight commentary buttons for shot taking sequences.](image)

The act of scoring a basket and my bricolage tests informed my allocation of the next three interface buttons — crowds cheering, generic crowd noise, and beak beats, raising the total number of interface button allocations to eleven out of sixteen.

My elimination of NBA 2K12 commentary that referred to officiating prompted my consideration of how 2K-Reality might respond to pickup basketball fouls, an import element of gameplay. Watching NBA television broadcasts provided me a clear answer. Parochial NBA basketball crowds often boo flagrant fouls. I decided that a crowd booing button would afford 2K-Reality users with an extremely flexible sound that could express disapproval of foul play, arguments and other disreputable acts; or be used to taunt players. Conversely, to ensure that 2K-Reality could articulate and amplify impressive pickup basketball gameplay, I appropriated
commentary that exclaimed celebrations of remarkable events in *NBA 2K12*, such as dunks and blocks. I selected four samples to accentuate impressive play and complement the atmospheric effect of cheering crowds.

With three interface buttons remaining for representing actions other than shot taking, I chose to allocate one interface button to commentary that describes individual and team-play offensive moves. And assign another interface button to commentary that describes defensive acts that produce turn-overs — the interventions that force the offensive team to lose control of the ball. I allocated the final interface button to commentary that describes neither offensive nor defensive actions, but overall team gameplay, such as “that’s not productive basketball, that’s not winning basketball”.

**Stage 5: Sampler Graphic User Interface Design**

Upon finalising the sample groups for each of the sixteen sampler interface buttons, I turned my attention towards designing the 2K-Reality graphic user interface (GUI) — a seven-step process that assigned the commentary, crowds sounds and break beats music sample groups to buttons within the 4-by-4 layout of the Maschine Mikro MK2 sampler — that included naming and labelling, and colour-coding each button of the interface.

**Step 1:** On paper, I began arranging the eight commentary buttons that describe shot taking sequences. I arranged ‘Shoots’, ‘Misses’, and ‘Hits’ (scores) from left to right; so operators observing and interpreting pickup basketball gameplay could follow the temporal pattern of shooting sequences across the rows of the interface. I then replicated this arrangement for ‘Shoots 3’, ‘Misses 3’, and ‘Hits 3’. Figure B3 illustrates my first set of GUI design decisions.

![Figure B3. Step 1 GUI illustration.](image)

**Step 2:** As scoring marks the end of a play sequence, I positioned the ‘Hits’ and ‘Hits 3’ buttons on the far right of the interface. Because a layup is a two-point shot, I placed the ‘Layup’ button next to the ‘Shoots’ button, leaving a button next to ‘Shoots 3’ for ‘Shoots Again’. Figure B4 illustrates my second set of GUI design decisions.

![Figure B4. Step 2 GUI illustration.](image)
Step 3: I reserved the bottom row for the break beats and crowd sounds — the buttons I anticipated would be used most frequently. Figure B5 highlights the bottom row of the interface in blue to indicate the buttons reserved for break beats music and crowd sounds.

![Figure B5](image)

Step 4: I assigned the ‘Layup’, ‘Shoots’, ‘Misses’ and ‘Hits’ set of buttons to the top row of the sampler interface, and placed the ‘Shoots Again’, ‘Shoots 3’, ‘Misses 3’ and ‘Hits 3’ set of buttons below. Reason being, layups and two-point shots are the most frequent acts of scoring in pickup basketball. By separating the most frequently used scoring buttons from the crowd sounds and break beats, I intended to afford two-handed multi-touch interface operations. As shown in Figure B6, these steps resolved the positions for all shooting related buttons.

![Figure B6](image)

L - Layup; S - Shoots; M - Misses; H - Hits
Sa - Shoots Again; S3 - Shoots 3; M3 - Misses 3; H3 - Hits 3

Step 5: Having determined three of the rows of the interface, I considered the columns of the interface to help situate the remaining sample buttons. I positioned the ‘Exclamation’ button in the far right column with the ‘Hits’ and ‘Hits 3’ and ‘Crowd Cheers’ button to accommodate simultaneous multi-touch activation. I positioned the ‘Defence’ button below the ‘Misses’ and
‘Misses 3’ buttons because of the conceptual relationship; that being, commentary that indicates an unsuccessful offensive play sequence. I similarly aligned the ‘Offence’ button with the ‘Shoots’ and ‘Shoots 3’ buttons because of the offensive play conceptual relationship. These decisions forced the final commentary button ‘General Play’ into place. Figure B7 shows the addition of the third row of buttons and the ‘Crowd Cheers’ button.

![Figure B7](image)

*Figure B7. Addition of third row of sample buttons and the crowd cheers button.*

GP - General Play; O - Offence; D - Defence; X! - Exclamation Cc - Crowd Cheers

**Step 6:** Positioning the ‘Crowd Cheers’ button on the right-hand side of the interface determined the placement of the generic ‘Crowd’ and ‘Crowd Boos’ buttons. I positioned the generic of neutral ‘Crowd’ sound button in-between the negative ‘Crowd Boos’ button and the positive ‘Crowd Cheers’ button. This arrangement conveniently positioned the unique ‘Beats’ music button in a prominent and distinct position in the bottom left-hand corner. Figure B8 shows the addition of the final three buttons and the finalised interface button arrangement.

![Figure B8](image)

*Figure B8. Completed interface button arrangement.*

B - Beats; Cb - Crowd Boos; C - Crowd

**Step 7:** The logic and associations used to arrange the interface buttons informed the colour-coding of the interface. I chose green to colour-code successful shots — ‘Layup’, ‘Hits’ and ‘Hits 3’. I chose orange to colour-code unsuccessful offensive play sequences — ‘Misses’, ‘Misses 3’
and ‘Defence’ — to provide a visual contrast to green. I then colour-coded ‘Shoots’, ‘Shoots 3’ and ‘Shoots Again’ blue, also to provide a visual contrast. I assigned turquoise to the crowd sound buttons merely to distinguish them. I selected red to isolate the ‘Beats’ button and reflect its anticipated use during stoppages in play. I then selected yellow for the ‘Exclamation’ button in an attempt to distinguish it from other forms of commentary. I used purple and lilac for ‘General Play’ and the ‘Offence’ buttons respectively, as they were the remaining colours of the spectrum with sufficient visual contrast, and to represent their similar functional context. Determining the button names, and the labels to be pasted onto each button, finalised the 2K-Reality rapid prototype GUI. Figure B9 shows the Maschine Mikro MK2 colour-coded and labelled interface buttons for the 2K-Reality rapid prototype.

![Figure B9. 2K-Reality rapid prototype Maschine Mikro MK2 GUI.](image)

**Stage 6: Content Authoring**

Having completed the GUI design, I proceeded to populate a Maschine 2 project file with audio samples and apply the ‘choke’ and ‘one-shot’ constraints, and the ‘sustain’, ‘polyphonic’ and ‘loop’ effects I determined during my bricolage tests. I also tested the Maschine Mikro MK2 pressure sensitive button function to see if the buttons could activate alternative commentary samples. However, the feature proved to be unreliable. Furthermore, the software prevented the time-based switching of samples. These limitations necessitated my creation of multiple interface sample groups in a Maschine 2 project file, which required manual switching to afford variations in commentary and break beats.

When finalised, my content authoring process had generated twenty Maschine 2 software project files, each of which each managed five alternative sample groups. Each sample group contained sixteen audio samples that corresponded to the sixteen-button interface; the same three crowd sound effect samples, one of twenty break beats samples, and different combinations of sixty-one commentary samples.

My compositional interpretation and assembly process, or the interpretive ‘hacking’ design process that I have described, produced the 2K-Reality rapid prototype. This design process propelled 2K-Reality from bricolage to a sonic videogame art form, ready for testing in pickup basketball playspaces.
APPENDIX C 2K-REALITY EXHIBITION PROTOTYPE DESIGN PROCESS

In this appendix, I describe in some detail my design and development of the 2K-Reality exhibition prototype — my second compositional interpretation and assembly process I discussed in Section 3.7. This design process was informed by the urban probe HCD research I conducted using the 2K-Reality rapid prototype, which I outlined in Section 3.6.

Exhibition Prototype Sampler Interface

In 2015, Apple iPad tablets provided an accessible touchscreen interface technology; with a proven capability for running Apps that replicated the functionality of stand-alone digital audio production equipment. For example; in 2015 Propellerhead produced the ReBirth App for iPad that recreated the Roland TB-303 bass synth, TR-808 and 809 drum machines. The fact that I owned an iPad 2 (Apple Inc., 2011) prioritised its consideration as a hardware platform for the second 2K-Reality prototype. I subsequently evaluated iOS Apps that could replicate the functionality of the Maschine Mikro MK2 sampler. I started by testing the iOS App version of the Maschine 2 MacOS software, but I quickly deemed it unsuitable; the iOS App retained little of the MacOS software functionality. I also previewed other iOS drum machine Apps, such as Beatmaker 2 and iMPC Pro but decided that the App interfaces were too convoluted for public use; the Apps would have presented users with irrelevant and disabled options.

Before committing to developing a custom-designed 2K-Reality App, I needed to address the practical need for high-quality audio output and continuous power. Using the iPad 2’s 3.5-mm stereo headphone minijack interface for outputting audio to a high-quality PA sound system would be messy and produce less than optimum sound quality, and operating a public installation for multiple hours each day would require continuous power. Online product research revealed that Alesis, a company renown for manufacturing analogue and digital audio equipment, produced an iPad audio interface that met my requirements—the Alesis IO Dock (Alesis, n.d.). Fortuitously, a second-hand Alesis IO Dock, compatible with my iPad2, was listed for sale in a nearby location. Pairing the iPad2 with the Alesis IO Dock solved the core hardware requirements for an understandable, practical and usable exhibition prototype. Figure C1 once again illustrates how an Apple iPad or iPad 2 pairs with an Alesis IO Dock.

![Figure C1. Apple iPad and Alesis IO Dock.](https://http2.mlstatic.com/consola-alesis-io-dock-mezclador-audio-D_NQ_NP_852065-MCO31555647400_072019-F.webp)
Exhibition Prototype Kiosk

Conducting research in Taipei presented opportunities for designing and developing the second 2K-Reality prototype, unavailable to me in Melbourne. My Taipei urban probes and 2K-Reality’s selection for ISEA2015 initiated my collaboration with an independent iOS software engineer, Vincent Huang (黃一葦). The ISEA2015 installation requirements also prompted my design of a 2K-Reality kiosk in collaboration with three research assistants—Edward Lin (林寬祐), Ron Lo (羅峥榮), and James Hung (洪嘉懋).

While developing the 2K-Reality iOS App discussed below; Edward, Ron, James and I considered the design of two kiosk elements — the kiosk plinth, and a protective case for the sampler interface. A primary constraint framing the design of the kiosk was portability, more specifically, international airline baggage allowances. The limitations prompted an exploration of collapsible stand design precedents that could support the weight of the sampler interface unit and endure unrelenting physical interactions. We evaluated the size, weight, strength and cost of possible options; including off-the-shelf, hackable, and custom-manufactured—concertina, telescopic and screw-based mechanisms. We decided to purchase a cheap concertina magazine stand from Taobao, the Chinese version of eBay, and modify or hack it using a unique Taipei resource — the Xingcheng Street in central Taipei, the only remaining “Blacksmith Street” from the Japanese Colonial Era (Taipei Fine Arts Museum, 2013), home to numerous metalwork shops that provide a range of services in one location. Three workshops helped modify the height of the concertina magazine stand and prepare mountings for the sampler interface casing. I also purchased hook turnbuckles and structural supports to strengthen the rigidity of the stand and reduce horizontal movement. Figure C2 once again shows the exhibition prototype kiosk.

![Figure C2. 2K-Reality exhibition prototype kiosk.](image-url)
Following a design discussion about a protective case for the sampler interface, Ron and James used Rhino 3D modelling software to produce a 3D printed polymer casing for the iPad 2-IO Dock sampler interface configuration. A translation issue caused the local 3D print shop to print the casing using white polymer rather than black. After painting the casing, we attached the mountings, constructed the entire kiosk, and tested it. Figure C3 once again shows a detail of the sampler interface casing.

The final kiosk design met the essential requirements for my exhibition at ISEA2015, and I was able to transport the kiosk internationally myself; the encased sampler interface as hand luggage and the collapsible kiosk plinth in checked-in-baggage.

![Figure C3. 3D printed sampler interface casing.](image)

### 2K-Reality iOS App Development

It took 11 steps for me to design and develop the 2K-Reality iOS App in collaboration with independent iOS software engineer Vincent Huang (黃一葦); a process I discussed in Section 3.7.2.

Vincent used the Apple Xcode integrated App development environment and CoreAudio Framework to develop the 2K-Reality iOS App.

**Step 1:** Using Photoshop, I produced graphics files to replicate the 2K-Reality rapid prototype GUI, then I supplied the layered Photoshop files to Vincent.

**Step 2:** Vincent imported the GUI graphics files into Apple Xcode and programmed the button depression ‘animations’.

**Step 3:** I supplied Vincent with 165 uncompressed audio samples—138 commentary samples appropriated from *NBA 2K12*, twenty-four break beat music samples, and three *NBA 2K12* crowd sound samples.

**Step 4:** Vincent imported the audio samples and populated the 2K-Reality iOS App GUI.

**Step 5:** Vincent programmed the audio constraints and effects for each button, by replicating those applied in the Maschine 2 software that controlled the 2K-Reality rapid prototype.
**Step 6:** Vincent programmed a random-shuffle function that switches samples 5 seconds after a button is activated; then assigned the function to the 12 commentary buttons and the ‘Beats’ button. The random-shuffle function ensured that 2K-Reality audiences would hear far more commentary and break beats samples.

**Step 7:** We discussed, designed and developed a conventional looking interface option to afford maintaining meaning for different pickup basketball trajectories. Our slide-in, expandable and scrollable menu provides users with additional control over the ‘General Play’, ‘Offence’ and ‘Defence’ commentary buttons, and the ‘Beats’ button. Users can switch off the random-shuffle function, and select specific commentary or break beats samples from a list.

**Step 8:** Again using Photoshop, I produced the graphics files for the slide-in, expandable and scrollable menu; then supplied them to Vincent.

**Step 9:** Vincent programmed the slide-in, expandable and scrollable menu.

**Step 10:** Vincent supplied me with the 2K-Reality iOS App for testing.

**Step 11:** I tested the 2K-Reality iOS App and found no errors.

The following figures and table once again show the outcome of this process; the 2K-Reality iOS App GUI, the constraints and effects audio programming, and audio samples. Figure C4 shows the primary GUI for the 2K-Reality iOS App. Figures C5 and C6 show the slide-in, expandable and scrollable menu. Table C1 below provides a comparison of 2K-Reality prototype components to illustrate the improvements delivered by my exhibition prototype design-driven research. Figure C7 presents a visual comparison of the samplers interfaces used for each 2K-Reality prototype. Table C2 identifies the audio constraints and effects applied to each button, and the audio samples actuated by each button.

![Figure C4. 2K-Reality iOS App primary GUI.](image-url)
Figure C5. Slide-in and expandable menu GUI.

Figure C6. Expanded and scrollable General Play menu GUI.
Table C1.
2K-Reality Prototype Component Comparison

<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>2K-REALITY INSTALLATION SYSTEMS</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RAPID PROTOTYPE</td>
<td>EXHIBITION PROTOTYPE</td>
<td></td>
</tr>
<tr>
<td>SAMPLER USER INTERFACE</td>
<td>Maschine Mikro MK2 Sampler</td>
<td>Apple iPad 2</td>
<td></td>
</tr>
<tr>
<td>GRAPHIC USER INTERFACE</td>
<td>16 Illuminated Buttons, Colour-coded &amp; Labelled</td>
<td>16 Colour-coded &amp; Labelled Buttons with a Slide-in Expandable &amp; Scrollable Menu</td>
<td></td>
</tr>
<tr>
<td>CPU HARDWARE</td>
<td>Apple MacBook Air</td>
<td>Apple iPad 2</td>
<td></td>
</tr>
<tr>
<td>AUDIO INTERFACE</td>
<td>Yamaha Audiogram 3</td>
<td>Alesis IO Dock</td>
<td></td>
</tr>
<tr>
<td>SOFTWARE PROGRAM</td>
<td>MacOS Maschine 2</td>
<td>2K-Reality iOS App</td>
<td></td>
</tr>
<tr>
<td>NBA 2K12 COMMENTARY</td>
<td>61 Samples</td>
<td>138 Samples</td>
<td></td>
</tr>
<tr>
<td>NBA 2K12 CROWD SOUNDS</td>
<td>3 Samples</td>
<td>3 Samples</td>
<td></td>
</tr>
<tr>
<td>BREAK BEATS MUSIC</td>
<td>20 Samples</td>
<td>24 Samples</td>
<td></td>
</tr>
<tr>
<td>CONTENT RANDOMISATION</td>
<td>Manual Switching 20 Maschine 2 Project Files 20 x 5 Interface Sample Groups</td>
<td>Automated Random-Shuffle with 5 Second Delay</td>
<td></td>
</tr>
<tr>
<td>TRAJECTORY CONTROLS</td>
<td>N/A</td>
<td>Sample Specification Menu (General Play, Offence, Defence, and Beats)</td>
<td></td>
</tr>
</tbody>
</table>

Figure C7. 2K-Reality rapid prototype and exhibition prototype sampler interfaces.
Table C2.
2K-Reality iOS App Audio Programming and Audio Samples

<table>
<thead>
<tr>
<th>L</th>
<th>S</th>
<th>M</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Layup</strong></td>
<td><strong>Shoots</strong></td>
<td><strong>Misses</strong></td>
<td><strong>Hits</strong></td>
</tr>
<tr>
<td>6 Commentary Samples</td>
<td>11 Commentary Samples</td>
<td>13 Commentary Samples</td>
<td>18 Commentary Samples</td>
</tr>
<tr>
<td>Choked-One Shot</td>
<td>Choked-One Shot</td>
<td>Choked-One Shot</td>
<td>Choked-One Shot</td>
</tr>
<tr>
<td>and no mistakes on the layup and the</td>
<td>fires it up floats one heaves it up</td>
<td>and that one misses can't get it to go cannot hit</td>
<td>and it's in and it's on target and that</td>
</tr>
<tr>
<td>layup falls and the layup is good and the</td>
<td>launches it on the way puts it up releases</td>
<td>no hit no good no good on that one</td>
<td>one's good and yes sir that one drops</td>
</tr>
<tr>
<td>layup is up and in drops in the layup for</td>
<td>shoots it up straight up unloads</td>
<td>no luck shot is no good shot is off</td>
<td>basket good basket is good count that</td>
</tr>
<tr>
<td>two lays it up and banks it in</td>
<td></td>
<td>that one is off that one misses the shot</td>
<td>one count the shot gets it to go gets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no good the shot will not go and that's</td>
<td>the bucket good got it hits it it falls</td>
</tr>
<tr>
<td></td>
<td></td>
<td>not gonna go</td>
<td>it'll count that one goes count it that's</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>good that's in there</td>
</tr>
<tr>
<td><strong>Shoots Again</strong></td>
<td><strong>Shoots 3</strong></td>
<td><strong>Misses 3</strong></td>
<td><strong>Hits 3</strong></td>
</tr>
<tr>
<td>7 Commentary Samples</td>
<td>22 Commentary Samples</td>
<td>4 Commentary Samples</td>
<td>8 Commentary Samples</td>
</tr>
<tr>
<td>Choked-One Shot</td>
<td>Choked-One Shot</td>
<td>Choked-One Shot</td>
<td>Choked-One Shot</td>
</tr>
<tr>
<td>again another shot goes back up</td>
<td>from deep three point range beyond the</td>
<td>and a miss there on the triple misses the</td>
<td>bangs home the trifecta cans it from</td>
</tr>
<tr>
<td>second shot opportunity they shoot again</td>
<td>arc fires from deep fires the three for the</td>
<td>deep three point attempt no good on the</td>
<td>downtown drains it from beyond the arc</td>
</tr>
<tr>
<td>tries again with the second effort</td>
<td>three for three from deep from downtown</td>
<td>triple offline with his three</td>
<td>drills it from outside enormous three</td>
</tr>
<tr>
<td></td>
<td>from outside the arc from the arc launches</td>
<td></td>
<td>pointer it falls it's good from long range</td>
</tr>
<tr>
<td></td>
<td>a three lots it go with a three puts up a three puts up the</td>
<td></td>
<td>nails it</td>
</tr>
<tr>
<td></td>
<td>puts the move on that</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>open look</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>all sorts of time changes up dishes it easy shot great</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>offensive performance they're puttin' on I like</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>the way they got the ball inside there</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>just an unbelievable display of offence here</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>today lots of room moving the ball well open look some</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>nice passing picked out the pass nicely puts the move on that</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>offence just keeps clicking the offensive</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>rebound they're just outrunning their opponent here they can</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>take their time on this possession they're moving the ball</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>they're working it around</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General Play</strong></td>
<td><strong>Offence</strong></td>
<td><strong>Defence</strong></td>
<td><strong>Exclamation</strong></td>
</tr>
<tr>
<td>15 Commentary Samples</td>
<td>20 Commentary Samples</td>
<td>10 Commentary Samples</td>
<td>4 Commentary Samples</td>
</tr>
<tr>
<td>Choked-One Shot and Selectable</td>
<td>Choked-One Shot and Selectable</td>
<td>Choked-One Shot and Selectable</td>
<td>Choked-One Shot and Selectable</td>
</tr>
<tr>
<td>can they get it? dee up don't let up</td>
<td>finds the open look all sorts of time changes up</td>
<td>and they'll turn it over ball's knocked loose</td>
<td>oh ho yeah oh ho ho woo that was</td>
</tr>
<tr>
<td>gotta love the execution out there it's a</td>
<td>dishes it easy shot great offensive performance</td>
<td>deflected good defence got in the way</td>
<td>nasty oh ho ho ho that should be absolutely</td>
</tr>
<tr>
<td>thing of beauty just making it look easy out there the way they're running nice move</td>
<td>they're puttin' on I like the way they got the ball inside there</td>
<td>it's stolen tipped it's tipped knocks it</td>
<td>illegal wo ho ho yes</td>
</tr>
<tr>
<td>oh no you hate to see that still looking to</td>
<td>just an unbelievable display of offence here today lots of room</td>
<td>lose stripped it away swiped away</td>
<td></td>
</tr>
<tr>
<td>get on the scoreboard</td>
<td>moving the ball well open look some nice passing picked</td>
<td></td>
<td></td>
</tr>
<tr>
<td>that's not winning basketball the fans are</td>
<td>out the pass nicely puts the move on that</td>
<td></td>
<td></td>
</tr>
<tr>
<td>enjoying this show they need this they're scoring and shooting with a lot of confidence tighten it up out there bit for</td>
<td>offence just keeps clicking the offensive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tat neck and neck of confidence tighten it up out there bit for</td>
<td>rebound they're just outrunning their opponent here they can</td>
<td></td>
<td></td>
</tr>
<tr>
<td>that's not winning basketball they need</td>
<td>take their time on this possession they're moving the ball</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>they're working it around</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Beats</strong></td>
<td><strong>Crowd Boos</strong></td>
<td><strong>Crowd</strong></td>
<td><strong>Crowd Cheers</strong></td>
</tr>
<tr>
<td>24 BreakBeats Samples</td>
<td>1 Crowd Sample</td>
<td>1 Crowd Sample</td>
<td>1 Crowd Sample</td>
</tr>
<tr>
<td>Looping-One Shot and Sustained</td>
<td>Polyphonic and Sustained</td>
<td>Polyphonic and Sustained</td>
<td>Polyphonic and Sustained</td>
</tr>
<tr>
<td>and Selectable</td>
<td>and Selectable</td>
<td>and Selectable</td>
<td>and Selectable</td>
</tr>
</tbody>
</table>
| • Amii Stewart: Knock on Wood • Beastie Boys: Shake Your Rump • Blondie: Rapture • Brian Eno: Glitch • Cypress Hill: When the Shit Goes Down • David Bowie: Sorrow • Devo: Working in a Coal Mine • DJ Shadow: You Can't Go Home Again • Donna Summer: I Feel Love • Gary Numan: We Are Glass • George Benson: Gimme the Night • Grace Jones: Pull Up To The Bumper • Greyboy: Genevieve • Happy Mondays: Loose Fit • Isaac Hayes: Shaft • James Brown: Funky Drummer • Jurassic 5: The Game • MC 900Ft Jesus: Buried At Sea • Norma Jean: Sorcerer in a Coal Mine • DJ Shadow: You Can't Go Home Again • Donna Summer: I Feel Love • Gary Numan: We Are Glass • George Benson: Gimme the Night • Grace Jones: Pull Up To The Bumper • Amii Stewart: Knock on Wood • Beastie Boys: Shake Your Rump • Blondie: Rapture • Brian Eno: Glitch • Cypress Hill: When the Shit Goes Down • David Bowie: Sorrow • Devo: Working in a Coal Mine • DJ Shadow: You Can't Go Home Again • Donna Summer: I Feel Love • Gary Numan: We Are Glass • George Benson: Gimme the Night • Grace Jones: Pull Up To The Bumper • Greyboy: Genevieve • Happy Mondays: Loose Fit • Isaac Hayes: Shaft • James Brown: Funky Drummer • Jurassic 5: The Game • MC 900Ft Jesus: Buried At Sea • Norma Jean: Sorcerer • Peaches: Fuck The Pain Away • PM Dawn: You Got Me Floatin' • Santigold: Get It Up • The Police: Walking on the Moon • Unkle: Shin •
Research Project Title
2K-Reality: A Spectator Orchestrated Sonic Installation for Pick-up Basketball.

主要研究者
Tim Ryan

參與此案的人有哪些? 研究此專案的理由為?

研究問題
完成這項問卷將會幫助研究者得到以下答案:
實況和群體動態模擬音效(crowd-fx sonic)裝置應用在街頭籃球場上是否能讓球員和觀眾有愉快的體驗?

請注意, 這份問卷沒有正確答案, 也不會強迫你一定要完成這份問卷
2K-實境 問卷 2K-Reality Questionnaire

關於你 - 基本資料 About You - Demographic
性別: 男 女 Gender: Female Male
年齡範圍 Age Range: □ <18 □ 18-21 □ 22-25 □ 26-29 □ 30-33 □ 33+

問題 Occupation:

籃球 Basketball
1. 你打籃球的頻率為? How often do you play Basketball?
□ 每周一次 □ 一星期兩次 □ 一星期三次 □ 一星期三次以上
Once a week □ Twice a week □ 3 times a week □ More than 3 times a week

2. 你打籃球最常用的方式? What kind of Basketball do you play most often?
□ 一對一 □ 二對二 □ 三對三 □ 四對四 □ 五對五
1-on-1 □ 2-on-2 □ 3-on-3 □ 4-on-4 □ 5-on-5

3. 你會在一個球隊中打組織性的籃球? Do you play organised basketball for a team?
□ 是 □ 沒有
Yes □ No

4. 你打籃球打多久了? How long have you played basketball for?
□ 少於一年 □ 一年以上 □ 兩年以上 □ 五年以上 □ 十年以上
< 1 year □ 1 year + □ 2 years + □ 5 years + □ 10 years +

5. 你曾經獨自投籃或練球嗎? Do you ever play basketball/shoot hoops alone?
□ 沒有 □ 有. 如果有, 你如何自己玩?
No □ Yes □ If yes, how do you play alone?

6. 你有在其他場地打過籃球嗎? Do you play Basketball at other locations?
□ 沒有 □ 有. 如果有, 請寫下是哪些場地
No □ Yes □ If yes, please name them.

7. 你最常在哪一個時段打球? When do you play most often play Basketball?
□ 清晨 □ 早上 □ 下午 □ 傍晚 □ 晚上
Early Morning □ Morning □ Afternoon □ Late Afternoon □ Night

日期____ 時間____ 問卷編號____
Date __________ Time __________ Questionnaire Number ____________
8. Why do you play Basketball at this court?

9. Do you play Basketball video games?
   - No
   - Yes
   - If yes, please name them.

10. Are you a fan of the NBA?
    - No
    - Yes

11. Do you support a team in the NBA or any other professional basketball team?
    - No
    - Yes
    - If yes, please name them.

12. Do you watch professional Basketball games on television or online?
    - No
    - Yes

13. Do you have any favourite basketball players?
    - No
    - Yes
    - If yes, please name them.

14. How did you experience the 2K-Reality sound installation?
    - As a Player
    - As a Spectator
    - As an Operator

15. What was your first impression of the sound installation?
    - Strongly Negative
    - Negative
    - Neutral
    - Positive
    - Very Positive
16. 可以請你描述一下對2K-實境 音效裝置的印象嗎？
Can you describe your impression of the 2K-Reality soundscape installation?

17. 2K-實境 音效裝置對觀眾來說有趣嗎？
Was the 2K-Reality sound installation entertaining as a spectator?
☐ 不有趣  ☐ 有趣
No     Yes

18. 2K-實境 音效裝置對球員來說有趣嗎？
Was the 2K-Reality sound installation enjoyable as a player?
☐ 不有趣  ☐ 有趣
No     Yes

19. 2K-實境 音效裝置會影響你打球嗎？
Did the 2K-Reality sound installation affect how you played?
☐ 不會  ☐ 會。如果會，能告訴我們它的影響如何嗎？
No     Yes     If yes, can you tell us how?

20. 2K-實境 音效裝置會影響打球的樂趣嗎？
Did the 2K-Reality sound installation affect the enjoyment of playing?
☐ 不會  ☐ 會。如果會，能告訴我們它的影響如何嗎？
No     Yes     If yes, can you tell us how?

21. 你會對2K-實境 音效裝置做出身體反應嗎？
Do you recall responding to the sonic installation physically?
☐ 不會  ☐ 會。如果會，能告訴我們你如何反應嗎？
No     Yes     If yes, can you tell us how?

22. 你會對2K-實境 音效裝置做出口語上的反應嗎？
Do you recall responding to the sonic installation verbally?
☐ 不會  ☐ 會。如果會，能告訴我們你如何反應嗎？
No     Yes     If yes, can you tell us how?
23. 2K-實境 音效裝置會增加看球賽或打球的樂趣嗎？
Did the 2K-Reality sound installation add to the enjoyment of watching games or playing?
☐ 不會  ☐ 會
No  Yes

24. 2K-實境 音效裝置有任何會使你覺得困擾的地方嗎？
Did any of the elements of the 2K-Reality sound installation annoy you?
☐ 不會  ☐ 會. 如果會. 能告訴我們它如何使你覺得困擾嗎？
No  Yes  If yes, can you tell us how?

25. 你有在球場裡或球場外, 或是線上討論過2K-實境 音效裝置嗎？
Did you discuss the 2K-Reality sound installation at or away from the courts, or on-line?
☐ 沒有  ☐ 有
No  Yes

26. 你有任何方法來分享2K-實境 音效裝置的新消息嗎？
Did you share ‘news’ of the 2K-Reality sound installation in any way?
☐ 沒有  ☐ 有. 如果有. 能告訴我們你如何分享嗎？
No  Yes  If yes, can you tell us how?

27. 你有使用? Did you use?
☐ Line  ☐ Facebook  ☐ Twitter QQ

28. 你有操作過音效裝置嗎? Did you operate the sonic installation?
☐ 沒有  ☐ 有
No  Yes

29. 你有和其他人一起操作過音效裝置嗎？
Did you operate the sonic installation with another person?
☐ 沒有  ☐ 有
No  Yes
1. 感覺像是在玩電腦遊戲，滿好玩的，增添一種看球的樂趣。
It feels like playing computer game. Makes us have fun to watch the ball game.

2. 感覺會讓場上更有緊張感，且投進的歡呼比較開心，但音效控制看似不簡單。
The sound from the device makes the atmosphere tighter in court, and the cheers for score make us happier. But it seems not easy to control the device.

3. 就很酷、很好笑，有參與感。
Very cool! Very funny! It feels like we all participate in it.

4. 場上有認識球員沒投進的時候，配了音效很好玩。臨場感，覺得英文會更像籃球遊戲，更有感覺。
It's funny to hear the sound if the player we know didn't get the shoot. We are virtually transported, and the English version is more like video game.

5. 沒聽到(球員)
Can't hear it as a player.

6. 打球會比較開心，有特效會比較開心。像在看比賽。常常會有比較好，歡呼聲很棒。音效像球評，不會影響打球。
Much fun when playing with the sound. Just like watching the game. The more often the sounds occur, more happier we are. It won't disturb the players, if the sounds like the form broadcasters.

7. 有趣，進球有成就感，很像真的在打比賽。會緊張，像比賽有人在看。對於觀眾會比較想看這邊的比賽。室內籃球場會比較適合。
Fun, because it's like playing in the NBA, we have a sense of accomplishment after a score. It makes us nervous when people watch us like we are real NBA players. The sounds make audience more interested to watch game in this court, but it would be more appropriate to set the device in indoor courts.

8. 對觀眾來說很新奇，會被吸引，像籃球機的音效。
The sound is just like a basketball arcade machine, and very fresh for audience to attract them.

9. 打球的時候不大會聽到，覺得英文版比較好，中文得有點俗。
Not easy to hear the sound, and I like the English version more, the Chinese version is a little cheesy.

10. 觀眾比較有感覺。
The audience can feel the sound more than the players.
11. People as audience can feel the sound more than as players. When playing on the court, can't feel the sound. Because I don't understand English, so I feel Chinese version more than English version.

12. It's like playing in 2K game. It feels familiar and I am virtually transported. But don't hear the Chinese version.

13. Lively atmosphere, it makes us feel the atmosphere more. (as audience)

14. It's OK to set the installation in public courts. The most impressing thing is shooting sound. It makes me feel more when playing. I'm the fan of LBJ.

15. It's OK to set the installation in public courts. I think so so so to this device. The installation does not influence me when playing.

16. Not appropriate to be in the form of a device, and maybe APP is better.

17. Xinsheng Park is more appropriate! It makes us have more much interaction between audience and players! It's an interesting device, and maybe it can allow people to record their own voice to make more interaction.

18. It's like pick-up basketball, and makes us have rhythm sensation.

19. I like the Chinese version more because I can't understand English. We would not pay too much attention to the sound when playing, but have a little rhythm sensation to play with the sound. Can't hear the background music, but can feel there seem to be many people here.

20. It makes audience focus on the game which the sound is played for, and makes players are more virtually transported.

2K-Reality: An Acoustic Sports Entertainment Augmentation for Pickup Basketball Play Spaces

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ABSTRACT
In this paper we describe 2K-Reality; an acoustic sports entertainment augmentation designed to enhance the enjoyment of playing and watching the cultural practice of pickup basketball. 2K-Reality is an interactive digital artefact for pickup basketball play spaces that recontextualizes sounds appropriated from a National Basketball Association (NBA) videogame to create interactive sonic experiences for players and spectators. We discuss how the design blends NBA videogames and real basketball play spaces using broadcast-style commentary, stadium-style crowd sounds effects and contemporary music break beats activated by spectators interacting with a touchscreen interface connected to a public address (PA) system. Using an ethnomusicographic approach, we analyse the different ways spectators orchestrate the different sounds, and the subsequent effects 2K-Reality soundscapes had on social interactions and the experiences of playing and watching pickup basketball. We conclude from our study that 2K-Reality is a demonstration of a compliant sports augmentation, a term we use to describe a digital enhancement of playing and watching grassroots sports without modifying existing spatial, temporal and cultural practices or the standards codified by a sport’s governing body.

CCS CONCEPTS
• Human-centered computing → Mixed/augmented reality
• Applied computing → Sound and music computing

KEYWORDS
Sports Augmentation; Amplified Reality; Grassroots Sport; Pickup Basketball; Sports Videogames; Urban Play Spaces

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1 BACKGROUND AND MOTIVATION
2K-Reality is an interactive digital artefact and a prototype public infrastructure installation for pickup basketball play spaces that recontextualizes sounds appropriated from the NBA 2K12 [41] videogame to create a novel sense of immersion, agency and atmosphere for pickup basketball players and spectators. It blends sports videogames and real play spaces by immersing pickup basketball players and spectators in NBA-style soundscapes. Broadcast-style commentary, stadium-style crowd sounds effects and contemporary music break beats amplify the everyday performative expressions, narrative identities and social interactions inherent to the interpretive community of pickup basketball.

The aims of the 2K-Reality design research project correlate with the calls to address global concerns that technology linked to reduced physical activity and increased sedentary leisure activities has a significant social and economic cost that is intergenerational and unsustainable [28].

1.1 Grassroots Sports
2K-Reality addresses these concerns by demonstrating how technology can help encourage physical activity by enhancing the enjoyment of physical activity and social interactions in grassroots sports play spaces. An approach which is consistent with the objectives of Designed to Move: A Physical Activity Action Agenda; a report funded by Nike, and supported by over 50 independent health organisations, that outlines a ‘framework for action’ to encourage increased physical activity. Specifically, the call to embrace technology to create digital innovations for play spaces that children find fun and can compete with popular sedentary activities [28]. Moreover, 2K-Reality aims to encourage increased physical activity amongst teens and adults and encourage intergenerational play, a subject that receives scant attention in the Designed to Move Report [31]. We are interested in similar questions to those asked by leading mental health and media researcher Cheryl Olson; is there any evidence that videogames can support real-world sports? And how might
we use commercially available sports videogames to influence the variables necessary to encourage physical activity [21].

1.2 Pickup Basketball

Basketball is a significant and powerful cultural practice with a huge global community. Pickup basketball is the term used to describe the grassroots impromptu version of the sport played without the institutional constraints imposed by organised basketball.

2K-Reality seeks to augment pickup basketball to make it more plausible and interesting by directly addressing the qualities identified by Côté et al. as being inherent to deliberate play. Côté’s concept of deliberate play, which pickup basketball exemplifies [6], emphasizes the significance of fun, immediate gratification and pretending in recreational sport [5,7]. 2K-Reality compounds the fun of pickup basketball with appropriated NBA sounds that enhance immediate gratification and create an NBA fantasy.

1.3 Sports Videogame Sound

Our research considers how convergent technologies are blurring video gaming with sports [8]. With 2K-Reality we aim to encourage participation in actual sports activities in real play spaces using videogame sound as a catalyst to inspire participation, creativity and appreciation from spectators [21]. The immersive acoustic performances created with 2K-Reality explicitly reference the most popular basketball videogame series by appropriating iconic sound from NBA 2K12 to amplify pickup basketball action in urban play spaces.

By reconstructing NBA 2K12 videogame sounds, 2K-Reality employs an element of subversion. It represents a reversal of sports videogames’ appropriation and simulation of pickup basketball practices in videogames such as Freestyle 2 [18], NBA Street [10] and more recently NBA 2K17 [42]. 2K-Reality also brings attention to a significant gap in NBA entertainment. NBA entertainment currently caters for fans in stadiums, television and on-line video viewing audiences, and sports simulation videogame players, but provides no entertainment for basketball fans during their everyday lives when actively participating in the sport of basketball.

Our approach provides an alternative to mainstream sports-based Fargaming, which augments sports videogames with the minuscule of skill-based physical exertion performed indoors using technologies like Microsoft Kinect, PlayStation Move, and Nintendo Wii [21].

2 THE 2K-REALITY PROTOTYPE ARTEFACT

The 2K-Reality artefact takes the form of a digital music instrument (DMI) with a graphic user interface (GUI) similar to a digital audio sampler keypad. A touchscreen kiosk, a custom designed iOS App running on an iPad2, hosted by an Alesis iO Dock [1] housed in a 3D printed case fastened to a collapsible stand, is connected to a public address (PA) system installed in public or quasi-public basketball play spaces (Fig. 1). The installation can be experienced in three ways: i) as a performer playing basketball, ii) as a spectator observing and listening, or iii) as an interactive soundscape orchestrator operating the 2K-Reality interface.

Figure 1: The 2K-Reality physical artefact - custom designed portable kiosk comprising of a collapsible stand with mounted 3D printed case housing an Alesis iO Dock hosting an iPad2 (connected to a PA System not shown).

2.1 The 2K-Reality Interface

The ontology of the 2K-Reality interface draws on the language of basketball [27], a well-established body of knowledge expressed in physical form by the individual moves and actions performed by basketball players in particular positions on-court, and identified, enunciated and shared by broadcast commentators and spectators. The layout, colour coding, naming and labelling of buttons reflect the recognisable structures, elements and practices inherent to pickup basketball play (Fig. 2).

Figure 2: 2K-Reality iOS App Graphic User Interface
Row 1 - Layup: Shoots: Misses: Hits
Row 2 - Shots Again: Shoots 3: Misses 3: Hits 3
Row 3 - General Play: Offensive: Defensive: Exclamation
Row 4 - Beats: Crowd Boos: Crowd: Crowd Cheers
The layout of buttons is the primary representation of meaning contained in the interface; their relative positions and horizontal groupings reflect the language of basketball. The left to right arrangement of the commentary buttons correlate with the temporal patterns of pickup basketball play elements. For example, activating a ‘shooting the ball’ commentary sample would typically be followed by activating a ‘miss’ or ‘hit’ commentary sample. Their vertical arrangement reflects the frequency of occurrence and groupings promote two-handed usability and multi-touch interactions. The buttons for the most common actions are positioned along the top row with maximum separation from the frequently used atmospheric sound buttons placed along the bottom row. Commentary buttons for what can loosely be termed team-based actions are grouped together to assist interface navigation and action interpretation.

2.2 The 2K-Reality iOS App Programming

All commentary buttons, and the Beats music button, operate using a 5-second delay random-shuffle feature to ensure content variation and avoid monotony. Commentary samples, except for Exclamations, are constrained (choked) so the commentator’s voice cannot speak over itself. Crowd sound intensity is enhanced with polyphonic layering activated by repetitive button tapping. Break beat samples loop seamlessly when the Beats button is pressed continuously.

The General Play, Offence and Defence commentary buttons, and the Beats music button, can be manipulated to enable specific samples listed in a scrollable slide-in menu. This feature allows the user to re-activate the random-shuffle feature and select trajectory and scenario-specific samples for different forms of pickup basketball play, e.g., 3-on-3 or 1-on-1. Selecting specific beats samples accommodates personal music preferences.

2.3 Commentary Sounds

2K-Reality appropriates 138 discreet broadcast-style play-by-play commentary samples from the NBA 2K12 videogame that are voiced by Kevin Harlan and complemented by some comments by Clark Kellogg. Kevin Harlan’s voice is synonymous with the NBA 2K videogames series; his commentary features in twelve NBA 2K videogames dating back 2003. His association with the NBA, established by television broadcasts and expanded worldwide by the NBA 2K videogames, created an unambiguous association with the NBA for the majority of pickup basketball players experiencing 2K-Reality soundscapes. Kevin Harlan’s voice is familiar among the basketball community of practice and recognition of his voice attaches the 2K Sports and NBA brands to the soundscapes. His voice signifies a convergence of NBA entertainment in 2K-Reality.

2.4 Crowd Sounds

2K-Reality implements three different ambient sound effects to augment the atmosphere of pickup basketball play spaces. Stadium-style crowd hubbub, crowds cheering and crowds booing. These crowd sounds introduce a large virtually co-present crowd of spectators to the play space.

2.5 Break Beats Music

The 2K-Reality ‘Beats’ button activates one of twenty-four available music break beat samples; short loop-able digital music files that, according to Grandmaster Flash, capture the best part of a song [34]. 2K-Reality break beats replicate both ubiquitous use of music in sports entertainment media and the ubiquitous and vital stadium practice of playing incidental ‘pep’ music during NBA games [25]; and therefore, contribute to the authenticity and credibility of the 2K-Reality fantasy NBA experience. The break beats also signify the close cultural connection the practice of basketball has with the culture of hip-hop [3].

Like many hip-hop tracks, the 2K-Reality breaks beats draw from a range of music genres and eras, including hip-hop itself. Four examples of which are: James Brown’s classic and widely sampled Funky Drummer break played by Clyde Stubblefield [1]; a sample from Walking on the Moon by The Police [19]; a sample from Gilcich’s Brian Enzo [11], and a sample from The Game by Justus [20]. None of the 2K-Reality break beats includes vocals so they can complement, and not compete with, the commentary vocals.

3 URBAN PROBES

2K-Reality artefacts have been deployed four times in three different countries - Australia, Taiwan and Canada; each of which presented distinctly different social, spatial, temporal and environmental contexts. These multiple deployments of 2K-Reality into urban basketball play spaces, what Pauls and Jenkins would call ‘urban probes’ [30], were used to conduct digital ethnography research from a participant-observer perspective, as shown in Fig. 3.

Figure 3: 2K-Reality Urban Probe in Vancouver Canada

The Australian deployment was conducted during daylight hours, over four days for a total of 22 hours, in a university administered public basketball play space in the centre of Melbourne. The pickup basketball community primarily
consisted of international university students from Asia and local residents.

Two separate locations were used for deployments in Taiwan. Eleven hours over two days were spent in a semi-enclosed university gym where students play pickup basketball during the daytime. One night, for five hours, 2K-Reality was installed in a popular public basketball play space in the centre of Taipei. It's local pickup basketball community primarily consists of high-quality players.

The deployment in Vancouver Canada was conducted in conjunction with a digital arts event over four days for a total of 22 hours. 2K-Reality was exhibited in an enclosed quasi-public commercial atrium with a permanent basketball court. Occupants of the space included the local pickup basketball community, retail shoppers and visitors to the art event.

Tracking the amount of people who participated in the urban probes was difficult due to the nature of the public spaces and the culture of pickup basketball, whereby players swap teams and even change clothing. Table 1 indicates the approximate audience sizes in each city where the urban probes were deployed.

### Table 1: 2K-Reality Urban Probe Participants

<table>
<thead>
<tr>
<th>Location</th>
<th>Melbourne</th>
<th>Taipei</th>
<th>Vancouver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Players</td>
<td>80</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>Orchestators</td>
<td>5</td>
<td>11</td>
<td>24</td>
</tr>
<tr>
<td>Spectators</td>
<td>80</td>
<td>56</td>
<td>120</td>
</tr>
<tr>
<td>Bystanders</td>
<td>200</td>
<td>96</td>
<td>350</td>
</tr>
</tbody>
</table>

Play space observations, what we learnt through exposure to and involvement with the everyday practices of pickup basketball [36], employed an explicitly interpretive ethnometodological approach. We did not attempt to make factual judgements [35]. Our focus was on identifying the observable and reportable forms of performative soundscape orchestrations, and the subsequent effects 2K-Reality sounds had on pickup basketball player behaviour and play space social interactions. Significant events and actions performed by participants were photographed and tagged with notes taken during and shortly after the urban probes using a smartphone. Our reflexivity produced ways of knowing about members of pickup basketball communities, their experiences and their environments [32] and contributed to our interpretation and understanding of the effects of 2K-Reality soundscapes orchestrations.

In Taipei, our observations were supported by nine semi-structured video interviews with twelve participants and twenty-two participant questionnaires that were conducted with the help of six local research assistants.

In the following section, we will present our main insights from the analysis.

### 3.1 Soundscape Orchestration

Participants operating the 2K-Reality DM1 mixed sounds to amplify pickup basketball play and stimulate social interactions they perceived and interpreted. Put simply they performed as pickup basketball MCs and DJs. The act of orchestrating soundscape performances with 2K-Reality created a powerful sense of aural participation for participants; they immediately heard the result of their interactions with the 2K-Reality artwork and sensed physical, verbal and emotional audience responses to their sonic agency.

#### 3.1.1 Performative Orchestration

From our study we identified seven categories of 2K-Reality orchestration.

- **Simultaneous Orchestration** is a term we coined to describe synchronised interpretive soundscape performances that amplify, encourage and celebrate the players' performances in a manner consistent with NBA TV broadcasts and NBA videogames. Simultaneous orchestration soundscapes accurately describe events and conform with the expectations of the pickup basketball interpretive community. This category of orchestration was the prevalent style of soundscape performance throughout the urban probes. A typical simultaneous orchestration consisted of a commentary sample that accurately described a shooting action and the shot result, followed by cheering crowd sounds if the shot scored a basket.

- **Parallelical Orchestration** is a term we coined to describe synchronised interpretive soundscape performances that are incompatible with perceived play action and social interactions, or contradict cultural norms. For example, the intentional denigration of an impressive play action, like sinking a three-point shot with a synchronised commentary sample such as 'oh no you hate to see that', followed with booing crowd sounds. In this situation the apparent paradox was coherent to the interpretive community but contrary or contradictory to their expectations.

- **Directive Orchestration** is a term we coined to describe an orchestrator's attempt to direct player movements and influence play with commentary samples, somewhat akin to a coach on the sidelines calling out instructions to players on-court. Urban probe observations revealed the 'Shoots 3' samples to be the most frequently and explicitly used direction, followed by 'Offence' samples that instructed players to pass the ball to teammates. The prevalence of directing three-point shots suggested a desire held by an orchestrator to witness a risky, spectacular and suspenseful shot as a spectator. The responsiveness of players to the 'Shoots 3' instructions appeared to be due to an increased level of auditory awareness of soundscapes when further from the hoop and under less pressure from opposition players.
Rhythmic Orchestration is the term we use to describe expressive music-like or tap-like soundscape performances that occur when orchestrators explicitly use 2K-Reality as a musical instrument. Although infrequent during urban probes, these soundscape entertained players and spectators and sometimes generated dance-like actions among players and spectators alike.

The performance of rhythmic orchestrations was radically different to the preceding styles of orchestration and suggested that orchestrators may have been intrinsically motivated [35]. Acquiring the level of skill needed to play the 2K-Reality artefact expanded as a musical instrument required interest, self-motivation and time; coordinating selected beat beats with synchronised commentary sounds, or crowd sounds or both, to create musical soundscape required dexterity and timing. Alternatively, the orchestrators may have been seeking an extrinsically rewarding experience [35]; the performance of rhythmic orchestrations shifted the audience's attention specifically towards the orchestrator and elevated their presence above the basketball play.

One urban probe orchestrator managed to create interesting and amusing refrains that one might consider ‘mixed’ original music works that appeared to serve the orchestrator's self-gratification.

3.1.2 Functional Orchestration Sub-categories Multi-user Orchestration is the term we use to refer to the soundscape performances orchestrated by multiple people operating the 2K-Reality interface at the same time. A cooperative technique that was observed on multiple occasions involved two orchestrators, one of whom operated the commentary sample buttons while the other operated the crowd sounds and beats sample buttons.

Mastering Orchestration is the term we use to refer to the laboured soundscapes performed by new users attempting to master operation of the 2K-Reality interface while concurrently perceiving and interpreting play action and social interactions.

During the urban probes new orchestrators often chose to observe preceding orchestrators and subsequently began by mimicking the orchestration techniques they observed. The 2K-Reality interface generally took orchestrators approximately 10 minutes to master, after which the layout of the sampler interface proved to be intuitive enough for orchestrators to look way from the artefact intermittently to concentrate on perceiving and interpreting pickup basketball play and social interactions. Additionally, most orchestrators mastered the use of the scrollable slide-in and expandable menus that provides trajectory specific commentary samples and breaks beats.

Exploratory Orchestration is the term we use to refer to the exploratory form of random playing with the GUI that generates a chaotic cacophony of noise. This form orchestration was most evident when children, mostly under the age of ten, were in a group competing for access to the interface. Although playing around with the 2K-Reality interface appeared to engender fun, the soundscape became moderately annoying for some players and spectators.

3.2 Response to Soundscape
When asked an open question about their impressions of 2K-Reality, all interviewees mentioned a sense of being immersed in an NBA themed environment. Interviewees made associations with playing NBA videogames, watching NBA television broadcasts, attending NBA games and playing NBA amusements. For example: Interviewee #2 said "I feel like I'm playing the NBA 2K game series on Xbox". Interviewee #4 suggested that "the commentary of your movement is like a broadcast"; Interviewee #3 observed that "I think what you're doing is trying to create an atmosphere like playing at an NBA court"; and Interviewee #7 recalled that "it's just like a basketball shooting arcade machine."

Coupled with responses making associations with existing forms of NBA entertainment, some interviewees made comments that described a make-believe experience. For example: Interviewee #6 stated that "it feels like playing in the real NBA; it feels like I'm a big basketball star"; and Interviewee #9 recalled that "even though the sound effects do not really come from the crowd, it makes you feel that its real."

When asked how the soundscape affected them personally, urban probe interviewees reported feelings of arousal, such as happiness and motivation, but also reported feeling nervous and under pressure. For example: Interviewee #11 commented that "I think it makes me happier while playing"; Interviewee #7 said "it makes us really excited"; Interviewee #5 suggested that "the sound effects not only encourage players to play better, but also puts pressure on them"; and Interviewee #1 mentioned that he felt "nervous because everyone is watching the game."

3.2.1 Reaction to Commentary Sounds. The acoustic quality of Kevin Hart's voice conveys clear, unambiguous messages to the 2K-Reality audience [23]. From our study we found that performative orchestrations of commentary samples were mostly used to construct simultaneous narratives [8] that clearly articulated and amplified the spatial, temporal and dynamic interactions enacted by pickup basketball players and spectators [16].

The simultaneous narratives created with commentary samples we consider to be spatial stories. They privilege the aesthetics of on-court spatial exploration and impressive basketball play events [16, 24]. Over time, the short spatial stories of pickup basketball action and social interaction became a cohesive narrative for the play space as a whole [2].

We discovered that when players hear commentary samples coupled with their basketball play they can experience what Chion describes as "plaisir de l'ego-audition", the "joy of hearing oneself" [13]. Their consistent physical and verbal responses seemed to confirm that the archetypical experience of ego-audition was able to be generated by the sound of commentary sounds that described their actions.

The random shuffle function applied to 2K-Reality commentary samples suggested that the element of surprise increased the potential for players to experience the joy of hearing themselves [14]. The variation of commentary samples encouraged some players to explore the palette of alternative commentary sounds assigned to an action by repeating moves.
which reinforced the apparent experience of ergo-audition [15].

The actions of teams that inspired the orchestration of 'General Play' and 'Offence' commentary samples also indicated the potential for a shared sense of co-acting ergo-audition. And lastly, the acoustic amplification that shared players' ergo-audition with spectators appeared to increase the joy of hearing oneself [15].

3.2.2 Reactions to Crowd Sounds. Urban probe observations indicated that the crowd sounds were a distinctly meaningful feature of the 2K-Reality augmentation for all participants; perhaps the most meaningful for players whose awareness with them was more pronounced. The acoustic presence of the virtual spectators contributed significantly to the atmosphere of pickup basketball play spaces augmented by 2K-Reality. The generic 'Crowd' hubbub sound effects sample could be heard almost continuously during the urban probes; orchestration used the sound's polyphonic effects to maintain and vary the intensity of a make-believe NBA game ambience.

The 'Crowd Cheers' sample appeared to have most consistent ergo-audition effects on pickup basketball players. Players experiencing 2K-Reality often responded physically and verbally to the cheering crowd sounds when the sample was activated to acknowledge them scoring a basket. Such reactions indicated that the mere presence of virtual spectators had an effect on them.

The 'Crowd Boos' sample was most often used paradoxically by orchestration. An element of surprise was evident in the expressions of amusement or confusion when a player's expectations were not met by the orchestrator. These manifestations of surprise stimulated the most obvious social interactions between players and spectators and the orchestrator, especially among people known to each other. Players seemed to feel somewhat aggrieved by not having their expectations met, or by receiving what they thought was inappropriately orchestrated ergo-audition, and made their feelings known.

3.2.3 Reactions to Break from Music. Like the music used during NBA games, 2K-Reality break beats music complements crowd sounds to enhance the play space atmosphere. The presence of music compelled some participants to dance and perform rhythmic movements. The break beats also compelled the vocalization of appropriation source recognition, requests for specific loops to be played, expressions of disappointment that specific music was not available and suggestions of music for future inclusion.

3.2.4 Response to Sonic Branding. We found that the NBA 2K sonic branding of pickup basketball play spaces was critical to the credibility of the 2K-Reality immersive experience and represents a new form of branding touchpoint with the potential to impact the perception and evaluation of the 2K Sports brand. Urban probe participants routinely revealed a collective recognition that 2K-Reality had appropriated sounds from an NBA 2K videogame. The simultaneous recognition of the familiar and understanding of the difference indicated a resonance with the pickup basketball community in the play space; and as the leading videogame art theorist Mitchell and Clarke suggest, this resonance was likely heightened by the fact 2K-Reality was as obviously an unauthorised appropriation [36].

The importance of appropriating the commentary sounds from an NBA 2K videogame was highlighted by a localisation experiment conducted in Taipai. A Mandarin language version of 2K-Reality was produced and tested during one urban probe; it revealed a distinct preference among participants for the NBA 2K commentary as the Mandarin language version lacked a meaningful attachment to the NBA.

3.2.5 Soundscapes Immersion. By coupling perceivable interpretations of physical pickup basketball practice with soundscapes, participants reported that 2K-Reality provided a sense of immersion for pickup basketball players and spectators. Although pickup basketball players were continually immersed in 2K-Reality soundscapes players reported that their focus on playing basketball effected their awareness of the 2K-Reality soundscapes. Interviews and discussions with players who participated in the 2K-Reality urban probes revealed that when they were absorbed in play their awareness of the soundscapes disappeared. But when, for example, the intensity of play was relieved by baskets being scored, players reported being aware of the cheering crowd sounds. And when not under pressure from the opposition, usually far from the hoop, players sometimes demonstrated their awareness of the soundscapes by following instructions announced by commentary sounds. These patterns of awareness seem to reflect Jackson and Cukierzmihalsky's reports on the effects of flow in sports effecting hearing [17].

Spectators immersed in 2K-Reality soundscapes experience a make-believe NBA basketball atmosphere that introduced a new way of informing them about the spatial and temporal qualities of pickup basketball play and the social interactions occurring in the play space [16].

4. COMPLIANT SPORTS AUGMENTATION

Like NBA sports videogames, 2K-Reality obfuscates the divide between virtual and real basketball [22]. It utilizes human perception to actuate a form of augmented reality, defined by authors Falk, Redden and Björk, as Amplified Reality [12]. 2K-Reality adds virtual attributes to the shared experience of pickup basketball and makes them available to everybody present in the play space.

We suggest that the 2K-Reality amplified reality design conforms to a compliant augmentation specification. 2K-Reality uses sound to create an experience that can enhance the enjoyment of playing and watching pickup basketball without altering existing spatial, temporal and cultural practices or the specifications and regulations codified by the International Basketball Federation (FIBA), basketball's governing body. It demonstrates how sound can be used as a benign sports entertainment augmentation that contests the dominant forms of emerging sports augmentations manifest as self-quantification devices. No personal technology is required to experience the 2K-Reality augmentation, it does not require players to adorn technology, it does not collect personal data or interrupt existing patterns of play. It is an immersive augmentation that retains a Wittgensteinian 'family resemblance' with the numerous
physical devices used by spectators to celebrate and amplify professional sporting performances and stimulates the acoustic techniques used to enhance live NBA games in stadiums.

We also suggest that the compliant augmentation technique 2K-Reality employs to enhance pickup basketball can be applied to other grassroots sports. This idea has been tested by the installation and observation a football version of 2K-Reality called Urban FIFA [40].

The interpretation of the effects 2K-Reality has on playing pickup basketball reported in this paper is further supported by the research conducted by the Unknown Designer Research Group (UDRG) during the installation of Urban FIFA. Although carried out in a very different context - a controlled indoor football environment, many of the observations of football players participating in the Urban FIFA research project correlate with the observations of pickup basketball players involved in 2K-Reality urban probes. Orchestrators developed similar soundscape performance styles and players responded physically and emotionally to the soundscapes.

The UDRG summarized that the Urban FIFA soundscapes contributed to a "rise of new social interactions between the players on the field and between players and the orchestrator". They concluded that blending videogame culture with social sport can encourage reactions, change the experience of playing 3-on-3 football, and enhance and increase social interaction [40].

5 DISCUSSION & FUTURE APPLICATIONS

Our study of 2K-Reality urban probes provided insights into the blending of videogame sounds with real sports play spaces in urban environments. However, our study was significantly influenced by complex logistical problems that led to mixed-reality designer researcher Reeves suggests is inevitable when studying technology in-situ within public settings [33]. In particular, the ability to conduct interviews during most urban probes was limited by insufficient resources to maximize the quality of our studies. This limitation was highlighted in Taipei, when useful feedback was effectively recorded with the support of six research assistants. Our study was also limited by the temporary nature of the urban probes. Although temporary urban probes appeared to encourage participation and enhance the enjoyment of pickup basketball, we believe that studying a secure long-term installation is required to fully reveal the insights that the 2K-Reality’s sports entertainment augmentation can generate.

Through our study of 2K-Reality, and the study of Urban FIFA, we suggest that the compliant augmentation approach can be adopted to enhance more grassroots sports. Baseball and Cricket are two examples we consider to be interesting and appropriate. The design for each of which would require attention to their significantly different cultural traditions. For example, the spatial, temporal and cultural practices of baseball suggest a need for two physical interfaces, one for each batting team. Baseball traditions also suggest that commentary sounds would need to device ‘trash talk’, a common practice among grassroots baseball players and spectators. Cricket’s grassroots playing traditions suggest that blending the rules of umpire and orchestrator may be appropriate; commentary samples would therefore include the articulation of rules and instructions.

6 CONCLUSION

Our study has shown that 2K-Reality may enhance the experience of playing and watching pickup basketball by creating an amplified reality experience in urban play spaces. A mix of orchestrated simultaneous narratives [8] articulated by a virtual reincarnation of Kevin Hart as the voice of NBA 2K videogames; the generation of an NBA atmosphere with a virtual co-present NBA crowd; and the DJ mixing of stimulating contemporary break beats music, immerses pickup basketball players and spectators in an acoustic make-believe world. A world usually occupied by representations of the NBA athletes pickup basketball players aspire to emulate. The immersive effect provides an opportunity for amateur basketball players to perform on the big stage, a universal and motivating sports fantasy [9, 37].

We conclude that the 2K-Reality compliant augmentation demonstrates how appropriating iconic sounds from commercially available sports videogames can support real-world sports activity, and has the potential to influence the variables necessary to encourage deliberate play physical activity.

Viewed in an historical context, we consider the 2K-Reality acoustic sports entertainment augmentation to be an innovative extension of sports sound design that augments sports with commentary, crowd sound effects and music to enhance sport as an everyday media entertainment experience. A tradition that has evolved across mediums and play spaces with advances in technology; since the innovation of ‘synthetic’ cricket broadcasts on radio in 1910, when commentators in local studies, aided by foley sound effects, described the play as if they were present at the ground [38].

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Conceived, designed and produced in Australia; 2K-Reality appropriates audio samples from the NBA 2K12 video game and a variety of music recordings in accordance with the Australian Copyright Exceptions to Copyright Act: Section 46, Clause 103, Research or Study; and Section 72, Reproduction and Related Uses - reproduction of part of an artistic work in later artistic work. These acts reflect the Fair Use exception in section 107 of the US Copyright Act and fair usage copyright conventions specified by most countries.

ACKNOWLEDGMENTS

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REFERENCES


APPENDIX G  AUDIO MOSTLY 2017: WEBSITE AWARDS NOTICE


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conferred to

Tim Ryan and Jonathan Duckworth

for the paper entitled

2K Reality: An acoustic sports entertainment
Augmentation for Pickup Basketball Play Spaces.

George Fazekas, Conference Chair
APPENDIX I  URBAN FIFA NORDICHI 2016 CO-AUTHORED PAPER


URBAN FIFA: Augmenting Social Sports with Video Game Elements

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Abstract

We present the design and evaluation of Urban FIFA, which explores the idea of bringing elements from FIFA video game into a physical setting and how this affects the game experience. The design was realised by taking three core elements from FIFA15™: the game setup, the scoreboard and the soundscapes, and applying these in a physical indoor football arena. Our evaluation focuses on how the installation altered the structural, social- and performative aspects of the experience, and suggests that implementing simple digital elements can significantly transform the experience of social sports. Moreover, our study suggests several future design opportunities and warrants further research on the effects of augmenting social sports with content and techniques appropriated from video games.

Author Keywords

Augmented reality; videogames; social sports; pervasive games.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.
Introduction and motivation

While many video games are based on a physical counterpart, the act of bringing elements from video games into the physical world is arguably less frequent. Examples that demonstrate the potential of such elements include Pac-Man [3] where elements from Pacman were used to create an urban game environment and 2K Reality [15] where the acoustic soundscape of NBA 2K was used to create a more engaging experience, when playing a standard pickup basketball game.

In this design case, we further explore the concept of bringing elements from a video game into a physical sport setting. In particular, we do so to understand how the performative- and social aspects of the experience may be transformed and promote new forms of sports engagement. Our design case, Urban FIFA, combines elements from the world of FIFA with the world of indoor football.

The Urban FIFA Design is intended to be implemented at an urban environment such as a street football field. However, due to bad weather in Denmark and the pursuit of controlled test settings, we chose to conduct the research at an indoor football field. The local indoor football arena, which we designed for is an indoor AstroTurf field measuring 20x10 meters, fully enclosed by walls and net. In this paper, we refer to a football game played indoor on an AstroTurf field. When we use the term street football, we refer to an informal football game played at an outdoors urban setting on a concrete turf.

The FIFA video games [4] and indoor football both have regular football as their ancestor, but result in different types of experiences for the users in terms of structural-, social- and performative engagement. The video game utilizes the rules of football to make an interactive digital representation of football. In a similar way, street football has adapted the rules of regular football to the urban environment, creating a particular genre of the game. The Urban FIFA design case explores the effects of bringing elements from the virtual world into the physical world, and highlights how this augmentation alters the game experience.

The Urban FIFA installation

The installation uses three core elements from the videogame FIFA 15: The game setup process (Figure 1a), the scoreboard (Figure 1b) and the soundscape mediated through the Urban FIFA soundboard (Figure 1c). These elements were chosen through a deconstruction process of FIFA 15 in which we analysed the different elements of the game and how each element contributes to the video game experience. Furthermore, the chosen elements were identified as being essential to the overall enjoyment of the video game while being technically possible to implement in a physical play space.

The first element that the users interact with is the game setup interface (Figure 1a). Participants choose teams using a console controller: a device used with games or entertainment systems to provide input to a video game, typically to control an object or character in the game. In our installation, we used an Xbox 360 controller (Figure 2). However, the design is in no way limited to or thought for a specific entertainment system. The GUI of this element resembles the interface of FIFA15 to encourage an association to the virtual game world.

The second element is a custom-made scoreboard (Figure 1b), which structures the game in the same way as FIFA with live updated score and accelerated time. Accelerated time being 90 minutes shown on the scoreboard, is 10 minutes of actual game time.

The third element is a soundboard, based on the 2K Reality App [15] developed for pick-up basketball. The process of creating the Urban FIFA iPad app started with a discussion on the similarities and differences between pick-up basketball and street football, as well as the production process required to replicate the 2K Reality app. Both 2K Reality and the Urban FIFA soundboard explore the opportunity to augment social sports by introducing elements of virtual sports entertainment into real-world sports' play spaces. They achieve this by augmenting the play space atmosphere with orchestrated broadcast-style commentary and stadium-style crowd sound effects. The Urban FIFA soundboard adds the original soundscape from FIFA 15, including the commentary track of Martin Tyler and Alan Smith [5]. The soundboard is made of recordings of FIFA 15 commentary samples that have been edited and grouped into common actions performed by football players (Figure 3). Each button contains 5-15 different and randomised samples. The soundboard has two different GUIs: The actions interface (Figure 3) for live commentary and crowd sounds, and the events interface (Figure 4) for structuring the match (e.g. match specific commentary introductions, whistle blows and music loops). Additionally, the soundboard creates a new role, that of an orchestrator (Figure 1c). The orchestrator's role is to apply the FIFA 15 soundscape live to the game through the iPad app. This enables the orchestrator to establish the atmosphere and structure of FIFA 15. Thereby completing the Urban FIFA framing, around the game of indoor football.
Related work

The notion of blending elements from a digital game with the physical world has been well known and explored by multiple researchers, primarily under the term of gamification. Fizek et al. defines gamification as applying aspects of a game into an everyday activity [6]. While having similarities with gamification, Urban FIFA differs, as it is not designed to 'gamify' an everyday activity but to augment an existing game. The genre of 'pervasive games' has explored various ways in which games and physical space can be blended [2]. Most recently, Pokémon Go™ has demonstrated how such concepts can create appealing game concepts, but the genre of pervasive games has a relatively long research tradition and has also featured in the NordICHI literature [12].

Related to sports in particular, it may be argued that Urban FIFA reflects a more general mediatization [11] and convergence between sports and video games where digital elements are folded with the physical world and the spectator and performer experience has become increasingly augmented by digital media. This tendency is pervasive throughout the world of sports as our frameworks for understanding and appreciating sports are intertwined with various media (see [10] and [8] for discussion). In terms of the technological developments, American football and basketball have arguably led the development using advanced statistics, overlays and on-court projections [14], but also various manager games within football and cycling reflect this convergence. Often the focus is on the perspective of the spectator, but from a mediatization perspective, new media also affects the social and performative aspects of the participants. From this perspective, the urban FIFA case may be regarded as a very direct inquiry into the effects that new technologies can have on sports and games.

Evaluation

We approached this case study as research-through-design [13]. In the design-process and production of the installation, we conducted 12 observations and seven semi-structured interviews [16] at the designspace. We conducted observations and interviews with random players at the design space to better understand the activity for which we were designing. Furthermore, we interviewed the owner of the local football arena [7], who contributed with key insights into the game.

For the evaluation of the Urban FIFA, we conducted nine semi-structured group interviews with two-five participants of approximately one hour each. Five interviews before the participants experienced Urban FIFA and four afterwards. Our interviews were conducted as semi-structured interviews during a day long workshop at the local indoor football arena. The interview questions revolved around three major themes: their prior familiarity with the videogame FIFA and street football, their experience with Urban FIFA and its elements and Urban FIFA's effect on social interaction.

During our evaluation, we observed four different situations where a group of people had booked the football pitch for an hour. Each situation had different groups of participants, which varied in age, gender, social constellations and athletic skills. Furthermore, we observed matches both with and without Urban FIFA operating, in order to get coherent split testing of the effects of the design. Observations were kept in logs, pictures, audio-recordings and videos. Afterwards, observations and interviews were translated, transcribed and analysed.

Findings

Our findings have been organized into three separate sections: structured play, social aspects and performative aspects. This has been done in order to highlight the different traits of the results and their implications.

Structured play

The understanding of play as a concept is crucial when structuring an informal activity. Play is a free activity where the participants stands outside of the forms of everyday life, engaging in play and being absorbed utterly and completely [9]. While the outcome of playing is unknown, a game is structured to have an end at some point, which consequently typically results in a winner and a loser. Within the field between play and game, where the setting of Urban FIFA is designed, our goal was to enhance the structure of football while still preserving the playfulness of informal indoor football. Furthermore, we introduced new elements for participants to play with and enjoy the game.

The structured play in Urban FIFA starts with the game setup element, which allowed the players to 'set up' their match by choosing two teams to compete. This added more structure to the play, while also enhancing the competitive aspect of wanting to succeed with your team, as seen by the response from participants: "Before we went at it [cf. Playing with the installation active], we didn’t even know who won. It added a sense of tension. It ignited that winning mentality". Participants immersed themselves further into the
game, as the structure facilitated a higher degree of competition.

Urban FIFA’s impact on the match's structured play was evident in that players intuitively waited for the whistle before initiating the game. Furthermore, the players switched sides at half-time without being prompted to do so. The latter is atypical behaviour in street football. This suggests that the design makes the players form an association to the game structure of FIFA. This was also explicitly mentioned by participants in the interviews following the game: “We just had to follow the rules from FIFA.”

Figure 5: Participants playing Urban FIFA

An important element in creating structured play, was implementing the scoreboard with a game timer. This resulted in a change of tactics on the field, due to the pressure of time and score. Players began to play defensively when they were behind in score, while playing more offensively if they were leading. With the score close and time running out, the losing team would attempt to push for the win, as explained by one of our participants: “There was a kind of psychological game at play. Okay, we are down by two. We know we have to score three to be in front.” The difference between play and game becomes apparent when Urban FIFA is active. The appearance of tactics shows a movement from play towards game. The structural elements have shown impactful in regards to the experience of Urban FIFA and has altered the experience from play towards game, thereby defining the experience as structured play.

Social aspects

During the evaluation of Urban FIFA, we observed a rise of new social interactions between the players on the field and between players and the orchestrator. These encounters arose in situations where the orchestrator had the role of maintaining and supporting the co-experience [1]. This was achieved by orchestrating a soundscape through commentaries, crowd noise, music and whistle-blows.

After participants had chosen teams, it was the orchestrator’s responsibility to provide the appropriate commentary introduction for the match. It was also the orchestrator’s responsibility to “blow the whistle” to start and end the game. While the Urban FIFA installation was operating, we observed that the players awaited the orchestrator’s use of the whistle before they started the game. The participants’ previous knowledge of the rules and norms in both FIFA and football could be an explanation for this. This could be substantiated since the sense of structure was not evident in our control games.

Certain commentaries played by the orchestrator led to clear reactions and responses by the players. Some commentaries prompted a more obvious reaction from the players compared to others, these being reactions to the ‘Shoots’, ‘Goals’, ‘Saves’ and ‘Dummies’ commentary-groups and the ‘Crowd’ sounds (Figure 3). When the orchestrator played the ‘Shoots’ sounds it was evident that some players reacted by immediately shooting. The ‘Goals’ sounds resulted in players celebrating their goals in a more performative way. The ‘Saves’ sounds had the goalkeepers appreciating their role of the game more, as their contribution to the match became highlighted. Furthermore, the ‘Dummies’ sounds highlighted the specific players’ individual skill when outplaying an opponent. The different ‘Crowd’ sounds had the effect of enabling the players to celebrate their goals and drop social barriers. This is evident in a participant’s description of the experience (“I noticed that the two teams playing before us were very quiet. There was almost not a word. This was not noticeable when the crowd-cheering and commentary-track was added. It also helped loosen everyone up, since no one previously knew each other.”).

Figure 6: The orchestrator using the scoreboard

One of the designers and a couple of participants held the role of the orchestrator in our evaluation. However, participants seemed to struggle with upholding the soundscape as the learning curve of the scoreboard’s GUI was steep and the pace of the game was fast. Nevertheless, as they began to master the application, new encounters arose quickly. Examples of this were participant’s cheering their goals and dummies being tried repeatedly in order to provoke specific teammates or opponents. The orchestrator had an observable impact on the encounters and the social constellation in play.

In terms of social aspects, it was clear how Urban FIFA promoted playful interaction between the orchestrator and the players. Furthermore, the orchestrator had the ability to encourage reactions, change the experience of the game and loosen social barriers.

Performative aspects

The performative aspects of the installation, highlights how Urban FIFA resulted in a change in participant behaviour. Specifically we saw a marked shift, in the manner of which players expressed cheers and elation.

All the participants in our workshop played indoor football, both with and without the Urban FIFA installation activated. The change in behaviour is most pronounced in the role of the goalkeeper. Traditionally in indoor football, this position is viewed as boring, often regarded as being the least attractive position. This was also the case, when asking our participants (“Yeah, normally it’s a pretty boring part to play... usually the goal scorers get the credit”). However, due to the orchestrators use of the scoreboard, simulating crowd cheers for a great save, or the commentary track uttering “What a great save”, this changed the attractiveness of a traditionally mundane role. Players
now described the role of goalkeeping as fun and exciting ("I thought it was a bit more exciting to be the goalkeeper, new, especially when you hear [a great save] from the commentator").

Figure 7: Participants celebrating a goal.

Additionally, performative aspects appeared in how the participants changed their way of celebrating goals. Without the design activated, the goals were celebrated by modest claps, a quick high five or a "good job". This aspect however transformed when participants played with the Urban FIFA design. The effects of the soundboard and the scoreboard, contributed to the players own sense of performing. They began to mimic their football idols, whenever they scored. Some made small huddles with hugs after a goal, some dragged their i-shirt over their head whilst running wild, others choose to copy their favourite football player's signature goal celebration, such as Cristiano Ronaldo's broad powerful stance, or Lionel Messi's sacred index fingers pointing towards the sky.

In essence, the Urban FIFA installation alters the way players perform their actions during a match. It suggests a more playful nature of interacting with each other, and a much higher degree of performative actions. It enhances the performance of the participants, and opens up for more social interaction.

Discussion

Urban FIFA was an effort to gain insight into the effects of augmenting social sports with content and techniques appropriated from video games. In the following, we will discuss the limitations and possibilities of the design and the general perspective of augmenting any social sport with elements appropriated from a corresponding videogame.

The Urban FIFA concept is a step towards better understanding and designing interaction and augmentation in social sports games. Our findings suggest that adding videogame elements to social sports has a game-changing impact: it not only provides a change in atmosphere but significantly changes the way people play the game. In our design case, this augmentation was seen to have an effect on how the structure of the game was changed, how participants interacted and how participants became performers. These findings were based simply on appropriating three elements from FIFA15 and implementing them at a local indoor football arena. Our research shows how digital elements can create new game experiences or alter existing ones. This raises the question; which other elements could be implemented and with what results? Furthermore, what would happen if this concept was replicated with other social sports and videogame elements?

The results suggest that there are numerous possibilities for future research. Specifically, an exploration of the effects of adding another digital element to an installation could create basis for further analysis in the effects of augmenting social sports activities. One approach could be adding a replay function to an amateur football match, and see what effects this has on the game experience.

Generally, the concept of adding videogame elements to a corresponding physical world setting, can be implemented through a variety of other social sports. Mario Kart elements could, for example be added to a GoKart environment or Counter Strike elements could be added to a paintball facility.

A potential value of applying the ideas presented in this design case is to further the understanding of videogames, and their possibilities of improving social activities in the real world. Every real-life social sports and digital game has a divergence that can be explored to better understand, what makes videogames enjoyable, and possible to implement in the real world.

Conclusion

This paper had the purpose of exploring the results, of appropriating elements from videogames, into their corresponding social sport game. We examined this by extracting three core elements from the videogame FIFA15, and applied these to a setting where participants played indoor football. The findings presented in this paper shows that by appropriating simple core elements of a videogame it is possible to alter the game experience of a corresponding social sport. Our specific design case promoted structural, social and performative reactions by the participants.

The potential of this design-case is to replicate the process with various sports and corresponding videogame elements to get a greater understanding of videogames, and their possibilities of augmenting social sport activities in the real world.

Acknowledgements

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References


Exhibition Catalogue Entry

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Webpage: 2K-Reality Scheduled Performance Notice

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PLAY B.BALL TO THE SOUND OF THE NBA
AN RMIT UNIVERSITY EXERTION GAMES LAB RESEARCH PROJECT SUPPORTED BY SCID

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我們會從台灣過去參加，而他的作品2K-Reality有個很重要的部份需要經由打籃球的人來呈現，大會的相關訊息如連結（http://sched.co/3mT）

如果情況允許，希望能徵得人員來一場3對3的籃球比賽，地點時間如下：

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時間 - 1-2pm（希望能在12:30前集合好我們做個簡單的說明）
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很樂意幫大家準備一些場邊解渴飲料，有任何問題也歡迎發問，不過因為我們沒去過溫哥華，比較一時沒有頭緒的部份還請大家多擔待跟指教。

謝謝大家！
APPENDIX M  SONAR+D 2017 MARKETLAB: WEBPAGE AND ORCHESTRATORS

RMIT University CiArt (Creative interventions, Arts and Rehabilitative Technology Lab) Webpage: Disruptive Critters, Wildly Oscillating Molecules of Unanticipated Momentum, and 2K-Reality.


2K-Reality Simulation Orchestrators

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PLAY B-BALL TO THE SOUND OF THE NBA
BROADCAST COMMENTARY + STADIUM CROWD SOUNDS + DJ BREAK BEATS

2K REALITY
AN ACOUSTIC SPORTS ENTERTAINMENT AUGMENTATION FOR PICKUP BASKETBALL PLAY SPACES