Playground equipment: postdigital design and the mechanics of history, urban space and play

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Abstract

This article examines children's playgrounds as technological, spatial and historical phenomena, juxtaposing their origins in the industrial era of the late nineteenth to early twentieth centuries with Lightbug, a recent project to develop digitally-augmented playground equipment. Questions of space, movement, mechanics, imagination, play and technical and historical specificity will be explored and it will be suggested that attention to the industrial and machinic character of playground technology can highlight contemporary attitudes to, and possibilities for, children's outdoor play in the postdigital era. It asks questions about the introduction of digital technology and media forms into long-established physical play, about the physicality and technical nature of embodied play and about the relationships between play, play environments and imagination highlighted in times of technological change.

Keywords: playgrounds, parks, urban space, children's geographies, postdigital design, digital design, play technology

Children’s playgrounds are spatial, historical and technological phenomena. The industrial cities of the mid-to late-nineteenth century were marked by new temporal and spatial divisions between work and leisure, made concrete in the conversion of common and waste ground into parks for the rapidly growing urban population. A key impetus to the construction of parks – and subsequently to the playgrounds established within parks - was a desire to constrain and tame children’s outdoor play. As technical and disciplinary structures, playgrounds enclosed play, but also shaped it. The infrastructure of children's playgrounds mechanised earlier environments of play; the playful capacities of trees, slopes and banks, undergrowth and bodies of water were simulated by climbing frames, slides, sand pits, paddling pools and swings, in a new scaffolding of the bodily techniques and vertiginous pleasures of physical play. This ludic infrastructure was industrial in form and material as well as function: cast iron, sheet steel, bolts, rivets, axles, bearings and chains. It persists today, often little changed from Edwardian times. What place does or should it have in a postindustrial period of rapid technological change, not least in a children's play culture characterised by the intangible technics of streamed digital media, networked communication and videogame worlds? Through the juxtaposition of an Edwardian park playground in inner city Bristol, south-west England, with a research project imagining a postdigital future playground, I will explore issues of movement, imagination, play and technical and historical specificity. I will suggest that attention to the industrial and machinic character of playground technology can highlight contemporary attitudes to, and possibilities for, playgrounds in the postdigital era. To this end I will take as a case study the design and testing of an experimental digitally-

augmented playground swing. The LightBug project integrated interactive lights, movement-sensing, and programmable game mechanics into the industrial era swing. It asked questions about the introduction of digital technology and media forms into long-established physical play, about the physicality and technical nature of embodied play - the bodily techniques required by or instantiated by particular mechanical apparatus, and about the relationships between play, play environments and imagination highlighted in times of technological change.

There are five playgrounds in my local park. They include a metal-framed and fenced basketball court close to one of the bordering roads, during the day mainly populated by groups of young men shooting hoops or playing 5-a-side football, in the evening by clusters of younger kids, teenaged boys and girls, often with phones and bluetooth speakers adding to the aural ambience. Nearby is a ‘half-court’, a small square of tarmac with a metal grille wall that supports a basketball hoop, attended by a steel booth-like structure designed to attract older children and teenagers, at dusk as the younger children and their parents depart. It provides a little shelter for social interaction but without allowing too much privacy. At the top of the hill a small fenced play area for infants and toddlers, funded in part by the middle-class parents that now populate the nearby streets and patronize the adjacent café, set in a hip classic Citroën van. A short metal slide runs safely down the side of a low mound covered in artificial grass, a low extended structure of metal and plastic rails and tubes and a large heavy swing with a netted hoop seat. Carry on over the top of the hill and nestled between a steep slope and the railway line that marks the northern edge of the park is a long

narrow play area, the oldest serving play area in the park: a timeworn collection of a small steel slide about a metre and a half tall, a set of swings for babies and toddlers with rubber cage seats, and a taller frame supporting three swings for older and larger bodies. They are set in an expanse of crumbling tarmac with patches of the now ubiquitous minced rubber-tyre surface to mitigate trips and falls[1].

Fragments of the longer material and cultural history of the park can still be glimpsed in the original Victorian iron railings – removed to supply arms production in World War One and now just rough metal stubs set into the low surrounding walls, and in the name itself - Victoria Park - one of many such in the UK. Evidence of the park's earlier structures of play and leisure can only be found now in photographs and accounts published by local historians - an Edwardian lido, a bandstand. The park itself was established as the result of rate-paying industrial workers of south Bristol campaigning for a green space for leisure, a place to meet away from their tightly-packed terraced houses and cramped backyards. They petitioned the city council in 1871 with a 'Cry of the Poor' for a 'People's Park', a 'breathing place' amidst the cramped housing and dirty workshops of Bedminster. The park was eventually opened in 1891 (Drummond n.d., Young 1989). As across the UK at the time, waste ground and common land was territorialised by stone walls and iron railings, tamed and landscaped, lawns and flower beds laid down, rules and bye-laws imposed (fig.1).

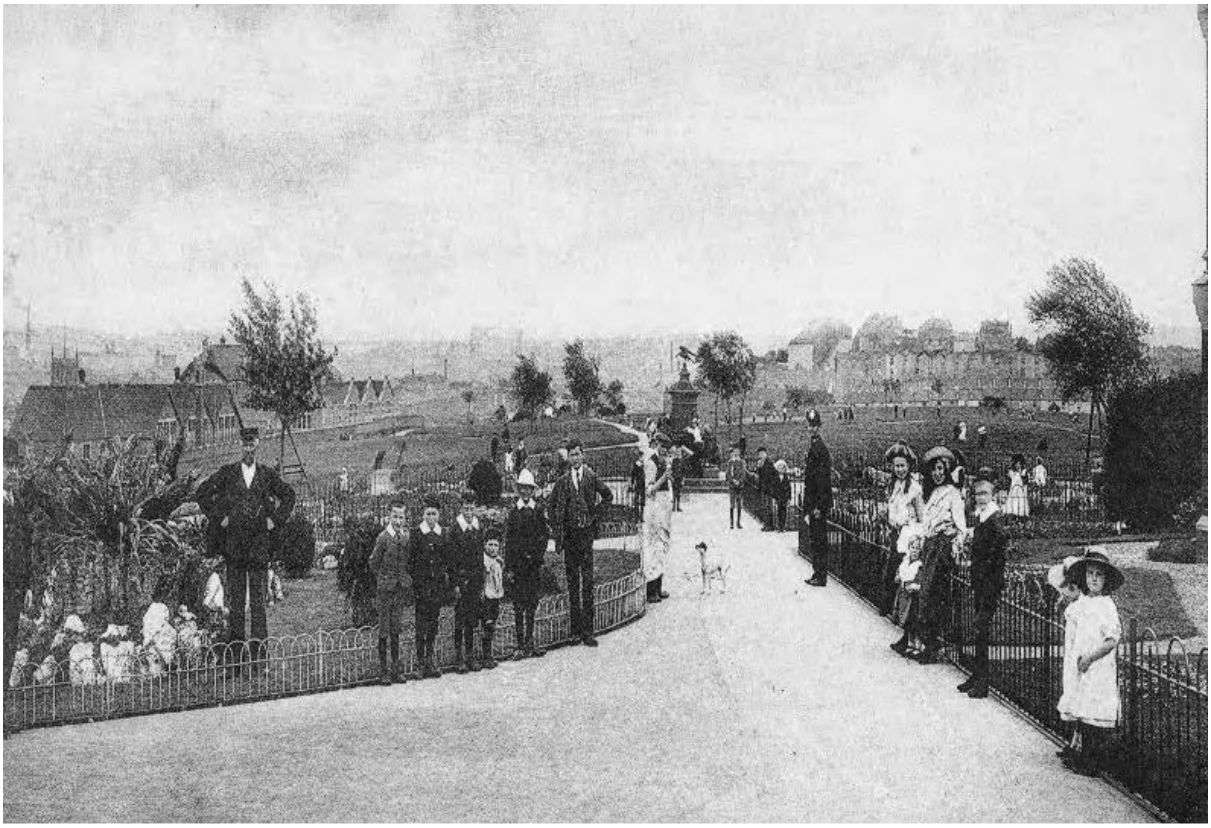

Fig. 1 Victoria Park, Bedminster, Bristol, c.1905 (out of ©).

The historical literature on public parks in Britain has very little to say about children's playgrounds specifically[2], though the provision of sport and exercise facilities and zones for adults are detailed, including pitches for quoits and football, tennis courts and bowling greens (Jordan 1994: 86). Some equipment now regarded as children's apparatus appears at first to have been installed for adult play, including climbing poles and seesaws (Clark 1973: 36). I have been unable to find any record or photograph of specialised playgrounds or apparatus in Victoria Park itself, though at least one other park in the south-west of England had recognisable swings and seesaws by 1905 (fig.2). The focus of this article is the playground in Britain, but similar developments were taking place in Europe, the US, and Australasia[3]. Brian Sutton-Smith notes that playground equipment at this time was often sport-oriented,

with ‘gym’ structures including ladders and parallel bars as well as swings. These structures and the exercise they were designed for were, he notes, a response to perceived demands of the emerging cultures of organised sport along with the military anxieties of new or newly competitive nation-states (Sutton-Smith 1981, 177-8). New social forces of privatisation and domestication resonated with these health and military concerns, Victorian morality and fascination with childhood, and the influence of idealist educationalists such as Rousseau and Froebel (Sutton-Smith 1981, 151-2).

Fig 2. Daisy Bank Park, Stroud, south-west England, postcard franked 1905 (out of ©).

One approach to theorising the playground as a historical and cultural space amidst current urban, media and social transformation would be to address this process in

particular: the demarcation of a space of regulated leisure as separate from working and domestic urban space by walls and railings, and the formal, aesthetic and ergonomic territorialisation of the newly enclosed space. From this perspective the park's external and internal boundaries are key - materially and politically in terms of its establishment *as* a park, and socially as a space with distinct rules and specialised roles (gardeners, wardens, park-keepers, etc.). The Victorian park was one instance of the broader forces of urban development and discipline that Michel Foucault describes in *Discipline and Punish*: the subjugation of liminal and common space, with all the opportunities it had offered for unregulated meeting and exchange (Foucault 1979). As with all the inter-linked phenomena Foucault discusses (hospitals, prisons, schools, boulevards) these newly disciplined spaces were as *productive* as they were repressive – in the parks, of healthy leisure in the polluted city, of new forms of sociality and play. The impetus behind the campaigns for their establishment, and the motivations of philanthropists who donated funds and land, was at once one of promoting health and well-being through fresh air and exercise, and of providing alternatives to public drunkenness (Clark 1973, Young 1989).

For working class children though it appears that the park radically changed and constrained their lives, at least in the brief moments of play available to them outside work and education. As cities expanded rapidly in the late nineteenth century, surrounding fields, woods and rivers were swallowed up and only streets and urban waste grounds were available. Children's outdoor play at this time is largely undocumented and we can only guess at its specificities and extent from hints in contemporaneous literature or extrapolate from more recent documents such as the

work on play in post-War bombsites (Highmore 2013) or the descriptions of street and playground play in the work of Iona and Peter Opie (Opie 1993, Opie and Opie 2013). One of the main impetuses for the establishment of Victoria Park was to address concerns about children's uncontrolled occupation of the wasteground and common spaces from which it would be shaped. In particular the 'ratepayers' wanted park wardens to police the children's behaviour (Drummond n.d.). In the 1840s the newspaper editor Joseph Leach described the children of Bedminster in near Biblical terms:

> I never saw such living swarms before in my life. They buzzed about like flies, alighted on every projection, crept up every eminence, filled the air with their voices and the face of nature with their forms and seemed in numerical extent and facility of annoyance to be only surpassed by the Egyptian locusts (in Drummond n.d.)

Here then is a microcosmic echo of Foucault's analysis of Haussman's Paris: at once productive of formal aesthetics of space and lines of sight and genteel pleasures of bourgeois and respectable working-class people (fig. 1); and disciplinary in its organisation of space for surveillance and the formal and informal policing of disruptive behaviour[4]. Against Leach's pestilential vision we can place the Bedminster ratepayers' original appeal for a place where family men could "feel the grass under our feet, or sit with our wives on a summer's eve and watch our children play" (Drummond n.d.).

The trade-off between the safety and proximity of the formal park and the openness and adventure of play in woods and waste ground seems today to be a poor deal for generations of children. Before dedicated areas for children's play were established in the early parks, children were presumably expected to accompany their parents on sedate walks between the flower beds, obeying the signs to keep off the grass – or transgress and face the warden or park-keeper. This disciplinary figure entered children's media culture in the UK in comics such as *The Beano* as a mythic antagonist always appearing to police ball games, tree climbing, and swimming.[5] Children did not necessarily accept these new restrictions and surveillance, and resisted spatial boundaries and adult supervision:

> Although playgrounds increased, children did not wholeheartedly embrace this socialization of play […] Children struggled to hold on to their former freedom to play where they pleased (Lauwaert 2009, 38).

Gutman and de Coninck-Smith note that such resistance to the new disciplinary regimes of education and spatial play was evident throughout the late nineteenth century and beyond, as 'boys and girls wrestled with each other, their parents, and civic authorities as they laid claim to streets as their public territory well into the twentieth century (Gutman and de Coninck-Smith 2008, 4)[6].

My concern in this article is with playground equipment in particular - as technology and its part in these shifting spatiotemporal dynamics of children's play. I argue that architecture, landscaping, urban zoning, and the machinery of playground apparatus are all technical in the same sense that digital media and online play spaces are understood as technical. All are designed to facilitate, shape or channel the possibilities for play and often to close off or deny particular parameters of time and space in play. That is to say that whilst the spaces of children's play have changed significantly over the past few centuries - and those changes can be explained in broad terms in relation to historical and economic periodisation (industrialisation and urbanisation, mobile privatization (Williams 1974) and the rise of the middle class and consumer culture – including for children (Bak 2020), the informational and virtualised era of postindustrial capitalism) - they are in no way a shift from a pre-technological to a technological environment and culture in children's play. Climbing a tree has its distinct technics and bodily techniques, and a rope swing is nothing if not a ludic machine.

So, for the purposes of this article, two main spatial and machinic dynamics are pertinent. First, the historical and cultural dynamics of playground establishment and construction itself in the late Victorian and Edwardian era (in the UK at least): the conversion of waste ground and common land into formal parks with severe limitations on children's freedom of movement and play. This can be symbolised by boundaries: the new iron railing-topped stone walls around the new park and the low wire tracery around rose beds and lawns, box and privet hedges and tended grass that

demarcated activity within it. Second, the dynamic of children's play equipment within their newly designated zones of play. When the playgrounds did appear in the UK, generally in the early years of the twentieth century, they offered a mechanised analogue of the play environments and behaviours the parks had replaced. Slides, swings, climbing frames and roundabouts offered a regulated and intensified simulation of the vertiginous pleasures of rope swings, tree climbing, mud slides, and so on. An *extensive* space of play that was effectively borderless with natural features and zones that might afford manifold play potential (a tree can be climbed, inhabited, imagined as a pirate ship, etc.) rendered *intensive*, localised in space, play itself focused and scaffolded in cast iron, bearings, rivets and chains. This raises a question for the study and design of playspaces today: if the industrial technologies of cast iron and steel and the Victorian engineering of urban space have profoundly shaped outdoor play throughout the twentieth century, to what extent are - or could - digital technologies effect an analogous shaping of postindustrial play?

To approach a critical study of the historical periodisation of children's physical play culture one needs to look more to the study of technology, architecture and ergonomic design than the more familiar attention to media culture (Kline 1993, Cross 1997). Children's *material* culture is under-researched and underplayed in the formation of modernity and modern subjectivity (Gutman and de Coninck-Smith 2008 and Brandow-Faller 2018 are notable exceptions) yet design, technologies and progressive ideas about play and education have both shaped and been shaped by modern design (Giddings 2020). We can track cultural shifts and preoccupations in the shapes and

colours of play equipment - colourful plastic, painted wood and decorative elements transform the iron frames of climbing frames at the end of the twentieth century. The anticipation and configuration of playful behaviours of this architectonic design have changed more slowly and less significantly however. The engineering of swings has been tweaked to facilitate slightly different kinaesthetic experiences for instance, roundabouts have either been modified to address concerns about safety and maintenance or simply been removed, and contemporary slides tend to of a modest height or constructed down steep slopes to remove the dangers of children falling from their steps and sides. Climbing frames have changed the most in appearance, again partly to reduce the risks of falling and partly because their form and function suggests more sculptural latitude.

These changes aside however, the proprioceptive and vertiginous pleasures of swinging and sliding persist, and children in playgrounds today are still largely climbing on, swinging through, and sliding down industrial forms and engineering. This kinaesthetic activity is not an eloquent or easily translatable language, but it does speak of a lived relationship with the mechanics of modernity that is at once absolutely tightly rivetted to industrial forms in material terms, but free-floating in the imaginary. The stories, characters and scenarios - or just ambient chat, songs and jokes - may not appear to relate at all to the mining, smelting, forging and manufacturing of the steel infrastructure, but they are not arbitrary, no mere dreams. Rather they are generative of a diffuse and dispersed imaginary: embodied movement, scale, latitude in relation to the equipment itself, temporalities, repetitions (and rebellions) set to the

rhythms of school life, meal-times, bedtimes that regulate children's lives in the late modern era. How then might playground equipment be rethought and redesigned, adjusted or augmented for a postdigital era? Is its mechanical simplicity and ergonomic scaffolding of proprioceptive play essentially perfected now, separate from the industrial age in which it was forged and the mediated and virtualised play of the twenty-first century?

It was getting dark and the damp air was now a steady drizzle as the chill of a December evening intensified. None of this was noticed by the children in our playtest however as they swung to and fro, excitedly calling out to each other and to the adults in attendance. The darkness only added to their excitement as the strips of LED lights we had cable-tied to the park swings apparatus glowed brightly, lines of vivid colour, alternating green, blue, purple, red as we pressed buttons on the remote control in response the flying children's instructions. The cast iron frame and steel chains were almost invisible now, all that could be seen were the strips of floating light catching flailing feet and excited faces in lurid split-second images (fig. 3, fig. 4). The children's excited shouts tangled up imaginative play, competitive boasts, and design ideas:

- The ultimate level should be where it changes colours!

(Adult: If anyone's feeling cold and wet, we could head back)

- I like cold and wet, cold and wet is good

- Oh yes, I levelled up! I'm on the highest level!

- I'm higher than you!

- Oh white… maybe white should be the lowest level. Because the other colours are more exciting…

- Rainbow should be the highest… the flashing one should be the highest

(Lots of overlapping statements and suggestions about colours)

- And multi-coloured should be higher than Alfie's head!

Fig 3. Interactive LED strips, Brandon Hill Park, Bristol (© the author Dec 2014).

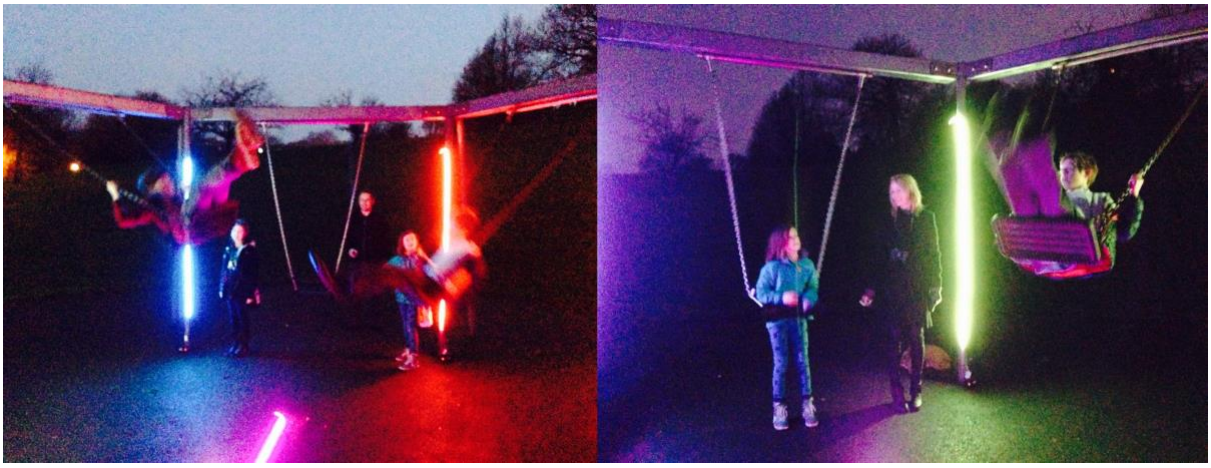

Fig. 4 Playtesting light/swing play, Brandon Hill Park, Bristol (© the author Dec 2014).

The London-based Danish artist Tine Bech was conducting an early test in a project to explore the possibilities of pervasive media for 'traditional' playground equipment, and specifically to bring the mechanical technology of outdoor play into the digital age; not through touch screens and game controllers, but through interactivity, game mechanics and light. The aim was to test whether these forms and activities, familiar to children today through digital game play, can enhance and extend imaginative and physical engagement with play on and around playground equipment. Tine's art and research explores the playful possibilities of interactive art, using light and sensors rather than screens and buttons (Bech 2014). The children were our 'young coaches',[7] a team of 7 - 12 year-olds who had been partners in the design process from the start, contributing to the selection and commissioning process, then consulting on and testing the resulting projects. Our group encouraged and shaped the playground idea into a focus on swings, and they tested and fed back on the swing's iterations on its journey from drawings to full prototype[8].

My initial interest in this project was theoretical, almost sceptical. In my research on play and technology, and videogame and toy cultures in particular, I have been suspicious of, on the one hand, attempts to repurpose videogame modes and pleasures to other more 'meaningful' or educational activities, and on the other, widespread assumptions that attaching screens, buttons and 'interactivity' to existing practices and environments inevitably improves children's engagement and captures their interest. So, my initial, friendly and genuinely open question on joining the project as an academic researcher was 'why *does* playground equipment need augmenting with digital technology?'

I am using the word technology in the broadest terms here. From the code and LEDs of an experimental interactive swing and the mechanics of 'traditional' swings to the architecture and zoning of the playground itself as a 'machine for playing' (to misquote Le Corbusier), the disciplining of children's lives, movement and games by broader trends of urban planning, education and media, to the moving human body itself as technical (Mauss 1960). This article's title is a nod to Martin Heidegger's *equipment* as technology in this broadest sense of an instrumentalised environment: tools, machines and systems 'to-hand'. Heidegger illustrates this concept with an image of a skilled craftsman in his workshop, a space and set of tools so familiar it can be navigated and used without the need for conscious thought. This blurring of mind and body, technologies and expertise, suggests a rich comparison with the child's 'work' of play and the phenomenology of play with apparatus from toys to

balls, slides to climbing frames, videogames to smart phones. However, whereas Heidegger's paradigmatic example of the craftsman/hammer emphasises the dextrous and expert hand, playground equipment demands the movement of the whole body. Hands grasp the swing chains, but the initiation and maintenance of the swinging action is whole-body, coordinated and rhythmic, working with gravity and momentum: a corporeal and sensorimotor achievement. Heidegger's 'equipment' also brings a critical attention not limited to any particular localised tool use, but rather to tools, technicities, and systems that are always part of larger networks and systems. From the child on the swing to foundries and factories of steel framed apparatus, contractors and maintenance teams, out to more diverse and historical technics of council planning departments, and the zoning and circumscribing of parks themselves. Our experimental swing project itself was equipped from a tangle of technics, systems and contingencies, from Danish distributed computing systems to public research funding, from ad hoc assemblages of climbing ropes and carabiners to children's media-fuelled imaginations and bodily rhythms and pleasures.

The children's enthusiastic and sustained engagement with the test in the park offered early encouragement: that making colourful and responsive innovations to the swing might actually make a qualitative change in children's imaginative and physical play with this Victorian apparatus. The modes of play that manifested during the test spun off from the familiar swinging activity, as the added spectacle and atmosphere provided by the light strips stimulated social play and collective suggestions from and between the swinging children as they shouted out what colour they wanted their

strips to change to, and spontaneously generated game mechanic ideas - demanding a particular colour when the swing reached a particular height for example. It demonstrated that an interactive, illluminated play structure could be an exciting augmentation, prompting new and sustained modes of play, both imaginative and kinaesthetic.

The test raised a number of issues that stayed with us throughout the project. First, the visual spectacle of lines and light and the more complicated shapes and movement of playing bodies through them gave this test and subsequent tests a distinct visual and environmental character - both for the swinger moving through the light-frame, and for spectators and their cameras. The combination of industrial and preindustrial play and electronic lines of light gave the project a science fiction edge, in action reminiscent of *Tron* or other SF visions of light and speed (fig 5). As Tine constructed actual prototypes the apparatus often took on a steampunk or cyberpunk feel, with LEDs lashed to chains, digital components wired to the steel frame (fig 4). Second, and more problematically, the test demonstrated clearly the limitations of LED light in daylight. After dark the lights were thrilling, during the dim late afternoon less so, and in full sunlight they were barely noticeable.

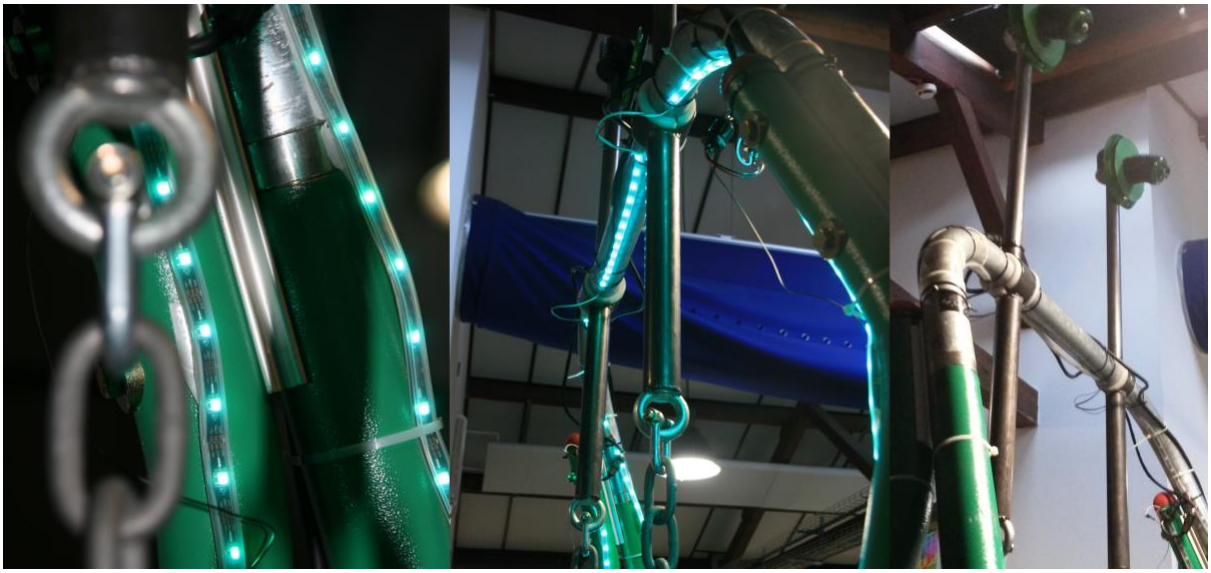

Fig 5. First prototype of Lightbug, installed at the Pervasive Media Studio, Watershed, Bristol (© the author Feb 2015).

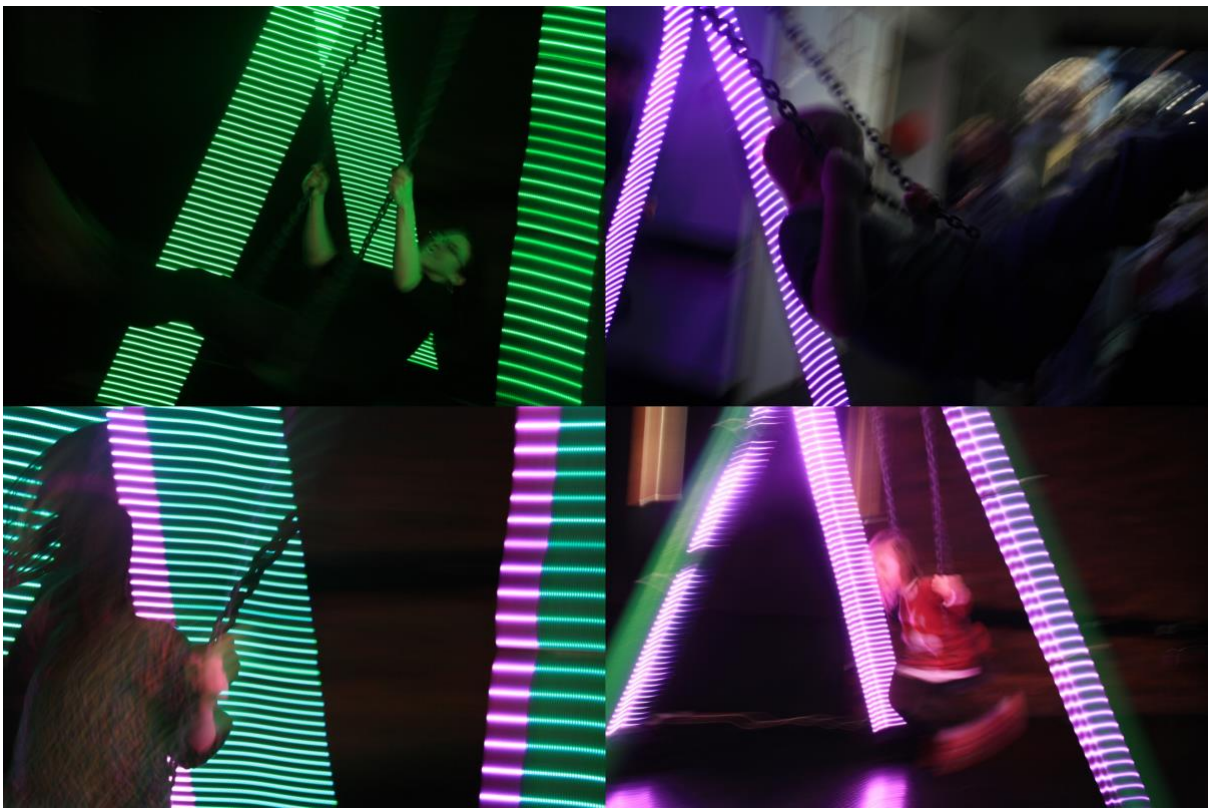

Fig. 6. Lightbug in motion at the Pervasive Media Studio, Watershed, Bristol (© the author Feb 2015)

Third, and most promisingly, the test demonstrated emphatically that interaction in the form of responsive light was appealling to children, that it might keep them playing on the play equipment for longer, and that older children, children who saw themselves as perhaps a little too old now for swings, were more than happy to play, enthusiastically and imaginatively.

Along with considerations of light levels, a number of other material and environmental questions were raised. What infrastructural investment would be needed - power supply, maintenance, health and safety, vandal-proofing - if this were installed in a public park? What kinds of play might manifest if augmented swings were to become familiar and unexceptional? What game mechanics might be coded in, and what new games might develop spontaneously? If this early test hinted at some answers to these questions, it strongly suggested the methodological and conceptual trajectory of the research. The contrast between the play on the swings and the initial stages of work with the young coaches was marked, and telling. We had worked with the children at the Pervasive Media Studio some weeks earlier. With no actual apparatus to play on we discussed the project with them, asked them about their attitudes to and play in park playgrounds. They ‘always’ go on the swings when they go to the park, they reported, and they use the play equipment, but ‘not how it’s supposed to be used’ as Addy put it, ‘it’s been around for such a long time that you want to make it do something different’. Caitlin recounted her favourite game with and around a slide, the details of which were lost in the enthusiasm of the telling, but

involved ‘everyone running around, up the ladder and down the slide’. We asked them to imagine a new technologically augmented swing. What, we asked them to speculate on and draw, might it look like and be able to do? Their talk and drawings demonstrated a very particular imaginative mode: they conjured up a swing frame encrusted with digital media functionality and leisure-oriented accessories: lights and audio speakers, drinks holders and sockets to plug in iPods and phones, something like an outdoor analogue of an ideally-equipped bedroom.[9]. Swinging itself was barely mentioned.

For the project itself as a play or game design process the difference between this drawn imaginary of children’s media lives and the emergent action and interaction of the park playtest demonstrated the value of early testing with moving bodies as well as imagining minds. This has philosophical as well as methodological ramifications. As Christopher Harker notes, in his theorisation of the spatial and temporal dimensions of children’s play, different modes of play, or ‘playing performances’, demand varying relationships of the affective and the cognitive. In kinaesthetic play such as that evident in the winter swing test, ‘it is the affective register that becomes heightened. Playing is not thoughtless as such, but rather in many instances prioritizes non-cognitive (physical and emotional) processes’ (Harker 2005: 56). The salience of his assertion that ‘the materiality of bodies in mobile play exceeds representation’ was evident in the different responses of these playful bodies when asked to sedately (and cognitively) imagine an advanced interactive swing as against the sensual corporeality - proprioceptive, visual, social - of actual swinging in the LED apparatus. Ferrer et al

make a similar argument as they reflect on the relationship between imagining and embodied action in their design and testing of a digitally interactive slide structure. They note that 'imagining combines an awareness of relationships between bodies with a certain inadequacy or incompleteness in knowledge.' A discussion of ideas between two designers during the production and testing of their slide illustrates this, they were

> …imagining user bodily actions through their own body actions and based on other interaction experiences [through gestural movements they were] imagining the user's engagement at the same time as their body actions and transitions were put in relation to code, machines, software tools, and other devices (Ferrer et al 2016, 124).

The value of embodied and technical play in itself as a research method and imaginative resource became clear. With only pens, paper, talk, and more or less sedentary bodies, the children's speculative designs for the future play equipment could only anticipate technological accretion. Whereas once swinging, their imaginations were distributed through their bodies and the physics of the equipment itself[10]. Conversely, the madness of the swing test had its own cognitive method: amidst the flailing and shouting, ideas for game mechanics were ejected: systems of quantification and reward, computer game conventions of levels and bosses - all tied to the concrete technical features of light-emitting diodes and sensors that were being tested, and lived, in real time.

For the conceptualisation of play with mechanical equipment the design and testing process opened up new insights into the character of, and possibilities for, kinaesthetic games. In mechanical terms, what kinds of movement do swings facilitate, and how can these dimensions and dynamics of movement be sense or captured and fed back in a game mechanic? Tine and I spent some time remembering our own childhood swing play and testing different types of contemporary swing (fig. 6). More conceptually, I wondered, what kinds of space were the children, swings and lights operating in? Or, more accurately, what kinds of space and spatial dynamics were they bringing into being?[11] Tine's early ideas for connected playground equipment aimed to open up these possible dynamics (fig. 7).

Fig. 7. The ludomechanics of swings (© the author Nov 2014)

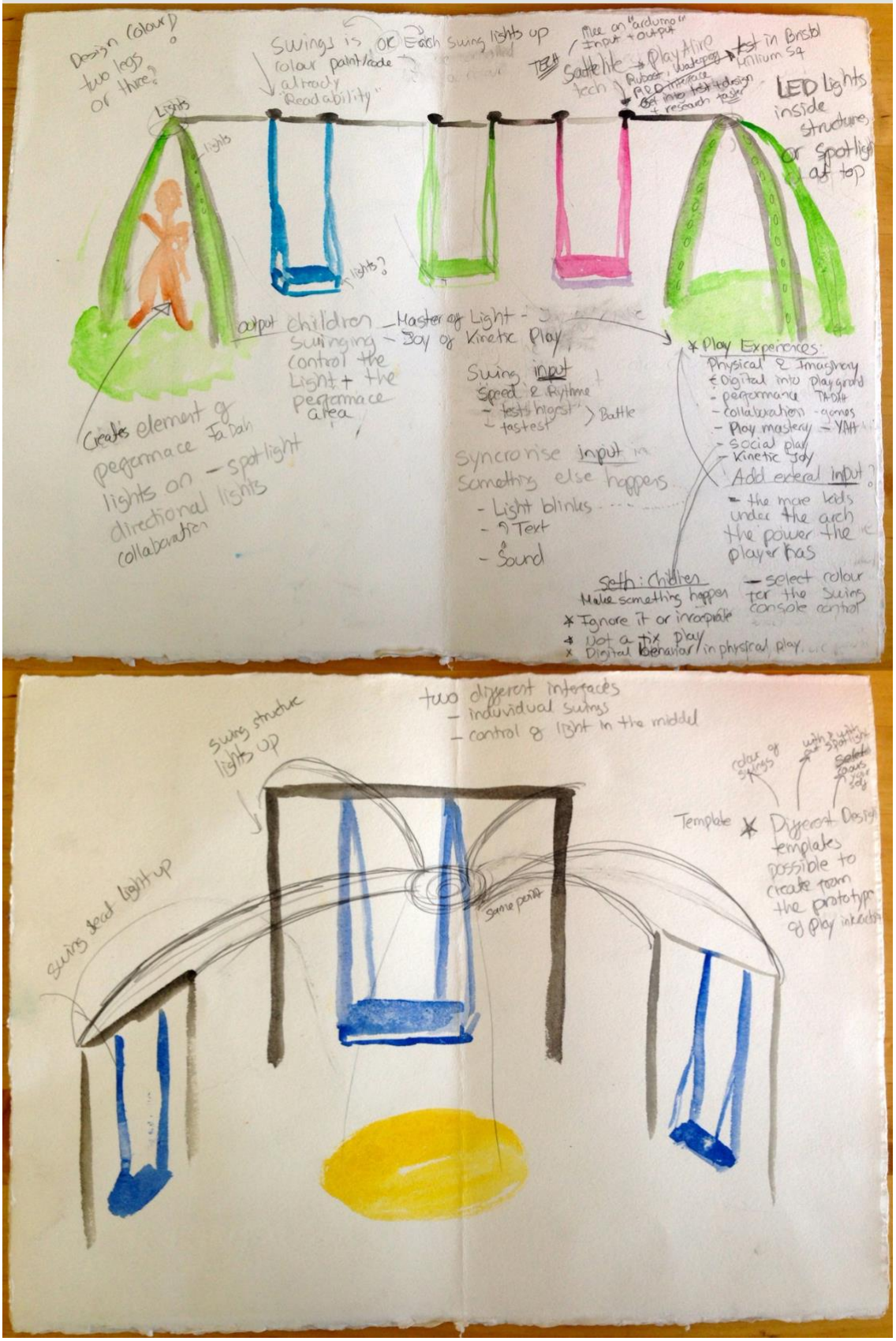

Fig. 8. Early sketch ideas for interactive playground equipment (© Tine Bech 2014).

At first glance swing play would seem to be of a different order of kinaesthesia and space: the rigid apparatus is set in concrete, the swing's movement through it constrained to a one-dimensional arc, to and fro. Leaving aside for now the wider loops of play around and through swings (the role of pusher as well as swinger, lying or standing on the swing, jumping off, dodging the swing or climbing the frame, and so on) swing play is an intriguing challenge for the description and conceptualisation of space and movement, and the relationships between technologies, bodies, and imagination. A swing is a simple machine: an extended line or set of lines, usually but not always flexible (rope, chains), usually with some kind of attachment at the bottom end of the line to facilitate the support of the body or grip of the hands (a seat, a strong stick, even just a knot in the rope), and at the other end attached to a support from which the line or lines can pivot, a tree branch or manufactured frame (fig. 8).

Fig. 9. Swing apparatus, Victoria Park, Bristol (© the author Nov 2014)

So, a single swing offers very little in the way of varied input: pendular motion with no opportunity for punctual input other than the moments of starting and stopping - and even these are imprecise zones of phase change not the responsive immediacy of the button presses that drive most computer game play. Two or more chains or ropes more or less constrain the swinging movement to one dimension, whereas a single line

opens up a two-dimensional space of movement (fig. 6). The degree of flexibility in the lines determines any latitude for departure from the mechanical metastability of the one-dimensional arc. Large fairground swings with rigid metal lines offer no flexibility or latitude, common park swings on chains allow a number of other dimensions of movement (and hence possibilities for play): rotating the swing on the horizontal plane so that the chains twist around one another, building up kinetic energy to be released in a vertiginous spin, side-to-side movement - often in combat with a neighbouring swing (fig. 6). But even 'normal' swinging requires the learning of a complex bodily and mechanical technique: a coordinated and rhythmic set of movements, swinging the legs forward whilst leaning back, sometimes using the hands to bend the line of the supporting chains to add impetus. Once the to-and-fro momentum has been established it can be sustained or added impetus. Standing on the swing facilitates a greater acceleration of motion as the legs can be bent and straightened to thrust the seat forward and the whole weight of the body thrown back and forward through the chains. The relatively recent wide hoop swings, now found in parks and public spaces, are engineered to minimise the range and speed of swinging to a relatively short and slow arc. They impel a more sedate movement and hence a more contemplative attitude to play, or perhaps the very edges of play: a gentle distracted rhythm, suggesting gentle conversation and a relaxed gaze up into the trees and sky.

Each of these modes of movement-space no doubt suggest or seed their own broad channels of imaginative play. Some, closely bound to the movement itself - high

swinging suggesting flight for instance - with others the gentle pendulum motion generating lines of thought not connected to the apparatus itself… daydreams, idle conversation. For the research project we were less immediately concerned with *play* in general and more with *games* as a distinct, structured mode of play. This was in the first instance as much a question about the engineering of movement as it was about game design: in what ways could the simple engagement with a swing be registered as an input to be processed and responded to by an augmented swing apparatus? And what kinds of output, initiatory or responsive, could a swing generate that could be recognised and in turn responded to in a sensitive enough way to satisfy the player and with enough variety or latitude for the construction of a satisfactory game mechanic?[12]

As the core interactive system for the swing, Tine chose the Danish company PlayAlive's 'satellite' system. Designed to be embedded in outdoor play equipment it is robust, vandal-proof and versatile, offers a button press (or kick) mode of interaction. It doesn't have a screen as such, but has a petal-like arrangement of coloured LEDs under its thick, translucent surface which support a simple form of animation and visual feedback. Once embedded in play equipment it appears as a convex plastic disc. We had visited an installation of the system in a Copenhagen public park: the circular surfaces animated to suggest birds' wings flapping in flight across the famous Copenhagen rooftops, here abstracted and miniaturised as low structures to climb over and through (fig. 9). The satellites drew potential players into their orbit through synthetic birdsong as well as the blue or red animated wings. This

facility immediately opened up the possibility of enriching the speculative system's feedback to players through sound as well as light.

Fig 10. PlayAlive's satellites installed in 'Rooftops' apparatus in Copenhagen (© the author Nov 2014)

Two other features of the satellite device subsequently shaped the project direction most significantly however. First, its ability to be linked in a series or network with other satellites and programmed as a distributed mesh of responsive elements, a spatialised system. Second, each contains an accelerometer so that attached to moving equipment they can measure the extent and speed of motion, supporting games and play requiring the sensing and processing of mechanical movement. After some discussion and testing with PlayAlive, Tine settled on an arrangement of the satellites as mounted above the swing frame, on rigid extensions of the chains (fig. 10). As the seat and chains traced their arc under and through the frame, the buttons above rocked back and forth, their motion digitised and processed as input to a laptop running PlayAlive's software.

Playtesting and public presentations of the first iteration of Lightbug - as the swing was now called, its satellites on stalks reminiscent of insect compound eyes and antennae - demonstrated a definite appeal (fig. 10).

Fig. 11. Testing the prototype Lightbug, (© the author Feb 2015)

The prototype featured a simple challenge / reward game: the child (or their 'assistant') would choose a colour by hitting a satellite at the foot of the swing. This satellite was programmed to cycle through its colours: white, purple, blue, orange, etc. Thumping the satellite when a particular colour was displayed would select that colour for the game. The accelerometers mounted on the top of the swing apparatus, connected to the moving chains supporting the swing seat, converted the swinging motion into responsive light. The light crept up each leg of the swing's frame, dropping back a little if the swinging slowed, but with a regular enough motion the LED strips would light up the legs of the swing, meeting at the top, and rewarding this achievement with a fanfare of fun sounds and the flashing colour of the whole apparatus. This simple game proved very popular, with a queue of children and adults waiting to try or retry it all day. Some people immediately picked up on the game mechanic and played with concentration, quickly rewarded with the flashing lights and sounds. Others, smaller children and adults of a more contemplative bent, were happy to toy with the apparatus's response in a more exploratory way: starting, stopping, swinging slowly to see the lights rise and fall, setting pulsing rhythms rather than linear progression to the climactic win-state[13].

The choice of satellites and the mechanical design their accelerometers necessitated meant a rigid enforcement of the swing's dimensions of movement. The pivots on the crossbar, and the steel tubes were needed to remove any flexibility or latitude in the chains' movement to control and maximise the transmission of the swing's motion to the satellites' accelerometers. Thus, side-to-side movement was removed, as was play

by twisting the seat and chains. Any possible interactive response or game mechanic then could only work with this single dimension of space, leading necessarily to the only other variable available to us: time. Speed, rhythm, the punctuality of starting and stopping were the only factors that the accelerometers could register as player-generated input. As noted above, we always anticipated that any future development of the project could include networked input across the playground: a distributed interface with input from satellites as accelerometers (on a roundabout for instance) and as buttons (at the top of a climbing frame perhaps). We imagined this as an installation in a public park playground, gently glowing or flashing structures luring would-be players into intense, programmed games or more contemplative or distracted play, less rule-driven, more a relaxed and exploratory testing of the equipment's responsive range and parameters in sound and light.[14] However, it should be noted that experimental projects such as Lightbug struggle against this longer history of play technology. Environmental, economic and infrastructural challenges to novel and technologically complex apparatus led discussions of Lightbug's possible futures towards visitor attractions, fairgrounds and shopping centres, and specific installations for festivals. For now at least, the mechanics and economics of the interactive playground tend towards a more privatised form of playspace.

Conclusion: playground equipment from the Victorian to the postdigital

The structures and spaces of playground equipment are at once documents of the shifting historical attitudes to and investment in children and outdoor play, and the

actual machinery of these attitudes and investment. A public park today is a palimpsest of 150 years of municipal, philanthropic and community investment (and neglect), and of engineering of distraction, exercise, imagination, sociality and pleasure from the height of the Industrial Revolution to the postindustrial and postdigital era. The apparatus available to children in park playgrounds has, in general, changed very little. Swings and slides persist, roundabouts and seesaws have dwindled. Late twentieth and early twenty-first century additions (e.g. half-courts, skate parks) are built very much on the same schema: specialised space, discipline and safety, steel and concrete to resist the elements and vandalism, and to optimize the economics of maintenance. Play apparatus is still nearly always equipped and powered only by the playing bodies themselves, gravity, centrifugal forces and individual or intersubjective imaginative impetus.

That the numbers of unattended children now playing on this equipment are modest is similarly significant. The lack of technical innovation *and* the relatively lower use of the playground speak of a lack of public investment in children's outdoor play and the continuation of the broad processes of mobile privatization. If the postdigital playground is developing anywhere, it is in the home, in and around videogames and social media[15]. Like nearly all other public and school playgrounds Victoria Park is postdigital only at the level of imaginative dynamics brought to bear by the children from their popular digital and networked cultures at home (Burn 2013), or - now - with the ubiquitous presence of mobile phones (Nansen 2020).

In acknowledging the trends towards domestication and virtualisation of spatial play I do not want to either overstate this shift (plenty of children still play in parks) nor to reinforce prevalent notions of a rigid distinction between play with digital media and outdoor active and imaginative play. As Bjørn Nansen argues, the latter is contrasted with digital devices, '[h]ere, outdoor play often enters public discourse as a way of getting children away from the screen (Nansen 2020, 61)[16]. Moreover, I would note that the contemporary valorisation of outdoor play often echoes the 'improving' motivations and ideologies of the first playgrounds, but now updated with new concerns about solitariness, obesity, inappropriate media, online risks, and so on. Unlike other experiments and research into interactive playgrounds (e.g. Poppe et al 2014) the Lightbug project was interested in play for its own sake, as an end in itself, not in regulating and surveilling children's behaviour or promoting health, child cognitive or motor development or social activity for their own sake. We wanted to resist that opposition, to see the flow of embodied and imaginative play across the virtual and actual, whilst keen to experiment with alternatives to screens, keyboards and controllers (Bech 2014), to facilitate different kinds of cognitive and sensorimotor engagement and response. We were interested from the start by what the children might bring to the equipment, what emergent physical or imaginative games and modes of play they might build around the structure, the interaction and the simple game mechanics. On the one hand then, we were not interested in disciplining or shaping play any more than necessary, whilst on the other attempting to imagine postdigital play as building on and working with well-established, natural even,

mechanics of space, infrastructure and bodies and the new possibilities of augmented proprioception, sensing, computer feedback and game mechanics.

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[1] Since the first draft of this article was written in 2020, all the swings and slides have been removed from this playground, leaving only the tarmac and rubber surface.

[2] For instance, Clark 1973, Jordan 1994, Young 1989.

[3] Swings began to appear in school playgrounds in the US by the late 1840s (Brett et al 1993, 17), and New York passed legislation to establish small parks with playground equipment in the 1880s (Brett et al 1993, 20).

[4] This chimes with contemporaneous playground construction initiatives across the UK, the US, Europe and New Zealand (Brett et al 1993, Frost 2012, Lauwaert 2009, Nansen 2020, Sutton-Smith 1981) and their common goals to channel children's movement into physically and morally healthy play.

[5] I am familiar with the comic and antagonist figure of the 'parkie' in comics such as The Beano in my childhood in the late 1970s, but don't remember encountering actual park-keepers themselves.

[6] Children's battles for playful access to unregulated urban space have not been completely lost, see for instance Carroll et al 2019

[7] The children were recruited as a part of Play Sandbox, a REACT round of which our interactive playground was one project to imagine and realise innovative technologies for children's play. REACT Hub was funded by the UK Arts and Humanities Research Council to initiate collaborations between arts and humanities researchers and creative companies. "These collaborations champion knowledge exchange and cultural experimentation and the development of innovative digital technologies in the creative economy" (REACT website). Led by the University of the West of England (UWE), and based in the Pervasive Media Studio and the Watershed in Bristol, it was a collaboration between UWE and the universities of Bath, Bristol, Cardiff and Exeter. Play Sandbox itself was a rapid R&D programme that established and supported collaborations to develop revolutionary new playful products and services for children.

[8] We were not the first to experiment with interactive playground equipment triggering light and sound, or drawing on digital game mechanics. See for example, Ferrer et al 2016, Grønbæk et al 2012, Poppe et al 2014.

[9] See Giddings 2019 for another example of this difference between speculative and hands-on modes of imagination with children's involvement in design for play.

[10] The difference was marked and significant, but the similarities should be borne in mind too: both are 'playing performances' and as such are embodied and sensual, cognitive and imaginative. When young children draw, their bodies and voices are mobilised and the drawing itself is dramatised and animated, it emerges as it is drawn - the finished picture is just a trace of the real durational imaginative process.

[11] I have written elsewhere on what I've called the centripetal dynamics of play with physical environments such as playgrounds - by this I mean that the salient spaces of movement, action and interaction in physical, mobile and imaginative play are not defined by boundaries (of the park, or playground) but by an intensity of behaviour seemingly attracted to particular points - a piece of play equipment or structure for instance (Giddings 2014, 117-136).

[12] For instance from the early days of the project we discussed the idea of synchronised swinging, two linked swings with their swingers attempting to coordinate their movements. Actual testing of this idea with park swings quickly demonstrated that the physics and mechanics of swings render this practically impossible.

[13] They also reminded us of the material problems: the prototype swing was tested in indoors with controllable ambient light, accessible power sources, and with researchers and helpers on hand to introduce and explain, fix and tweak, and to keep an eye on safety issues.

[14] Physical, environmental, economic and social factors impinged though. Again the competition between LED light and sunlight, the need for an electricity supply and much more regular and expert maintenance than the robust and mechanically simple chains and cast iron of the Victorian equipment. Much longer durations of situated testing would be needed to explore this, but I suspect that much of the testers' excitement and engagement was the product of the novelty of the interactive swing and that the more sustained games and play we speculated about would be needed to maintain interest and engagement in long-term, mundane use.

[15] But, as Bjørn Nansen points out, public playgrounds are becoming postdigital through the presence of smart phones, games and locative apps in the hands and pockets of parents and older children (Nansen 2020).

[16] Children themselves make no such distinction between virtual and actual playspaces, and young children's imaginative worlds loop through virtual and actual spaces of the videogame, the home, and outdoor spaces such as backyards and school playgrounds (Dixon and Weber 2011, Giddings 2014, Nansen 2020). And videogames themselves are playgrounds in themselves, engineered spaces with dedicated apparatus and social capacities (Lammes 2008).