

Crip Design for Collaborative Musical Interfaces: Iterative Development of Bot Party, a Touch-Based Sonic Game

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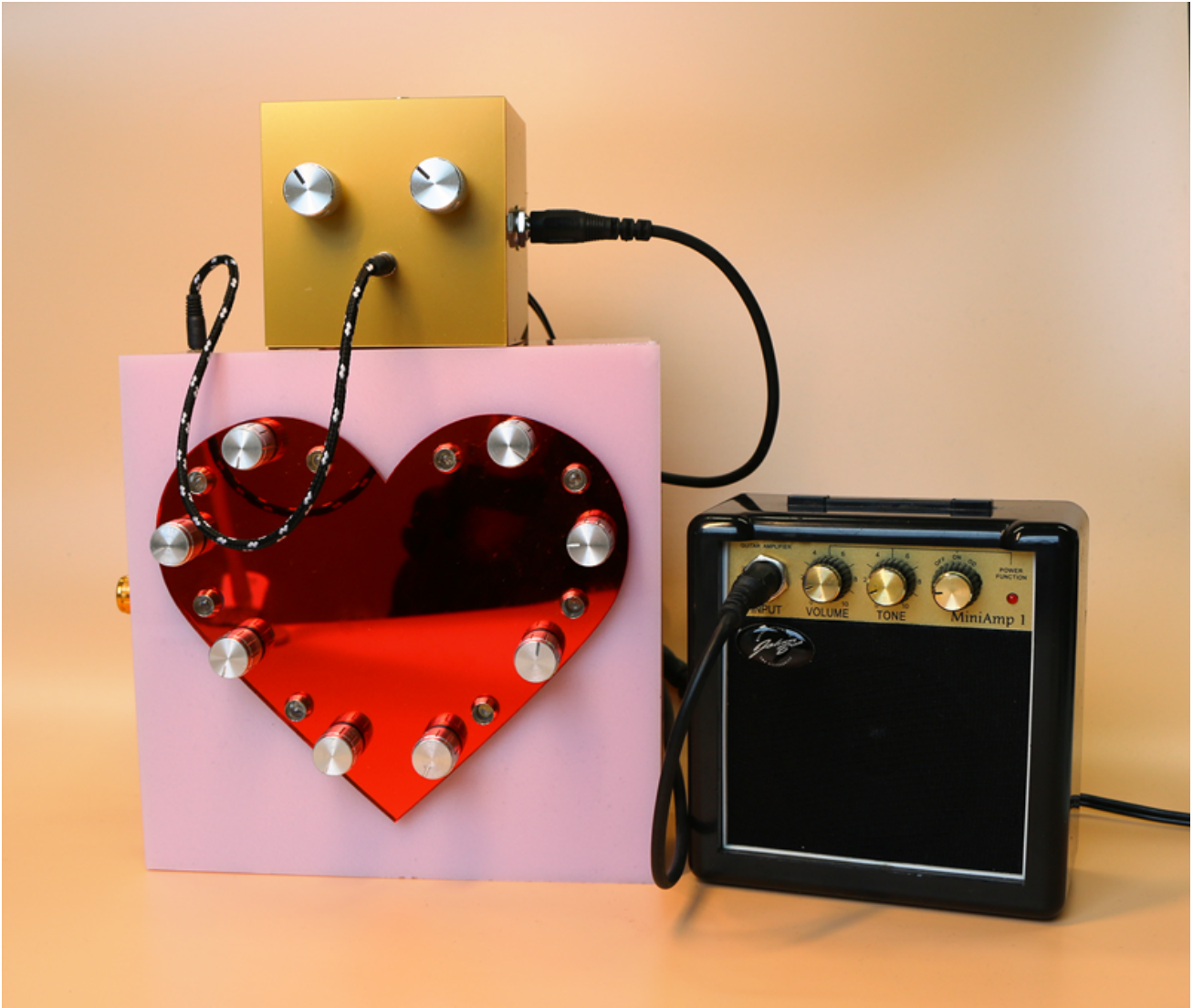


Figure 1: Version One of *Bot Party* (*Baby Bot*): a DIY 555 synthesis unit and an 8-step sequencer connected via control voltage.

Abstract

This paper presents the iterative design of *Bot Party*, a collaborative touch-based sonic game and alt.ctrl musical interface that uses capacitive sweeping for inter-player touch detection



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and IMU-driven motion control as its two interlocking interaction modes. Developed over seven years through practice-led research grounded in crip design epistemology, the project explores how disability-led approaches to interface design produce novel forms of embodied musical interaction. The system consists of three handheld controllers, each with a distinct musical voice controlled by IMU-driven movement, that generate an evolving collaborative soundscape driven by touch mechanics. Beginning as two separate units (a DIY analogue step sequencer and a custom 555 sound synthesis unit designed for group play), the project

evolved through four major iterations exhibited at fifteen public venues. The central contribution I develop here is conceptual: crip knowledge production is not an accommodation of an existing design paradigm, but a generative source for new ones. The practice-based themes of embodied joy, care, distributed choreography, sociality, transgression, and the body-as-instrument are presented as supporting evidence for this claim. This research suggests that crip epistemology can serve as a generative framework for expanding the possibility space of musical interface design.

Keywords

crip design, accessible musical interfaces, embodied interaction, touch, haptics, music games, collaborative music, tangible interface

1 Introduction

The design of new interfaces often embeds normative assumptions about the bodies that will use them. Standard controllers, including MIDI keyboards, presuppose a normative range of physical capability, an assumption rarely interrogated within the design process itself [8]. Commercial embodied musical games such as *Dance Dance Revolution* and *Guitar Hero* represent some of the most widely experienced musical game interfaces ever created, yet they further embed these assumptions: demanding precise timing, rapid physical response, and individual mastery of prescribed patterns [9, 18, 37]. What novel interfaces and sonic interactions emerge when the designer's body cannot meet these demands, not as a limitation to be accommodated but as a generative starting point for exploring what happens when colonial capitalism's metrics of profitability and scale give way to bespoke interfaces and artful engagements with design?

This paper presents *Bot Party*, a collaborative touch-based sonic game and alt.ctrl interface developed through crip design methodology over seven years and four prototype iterations. The system operates through two interlocking interaction modes: IMU-driven movement controls a distinct musical instrument in each of three handheld controllers, nicknamed bots, while capacitive sweeping detects physical contact between players. The IMUs give players sonic agency through gesture; the touch mechanic creates the social connections that the play loop rewards. Each controller has a distinct voice (percussion, melody, or harmonic drone) and the three bots together create a triadic sonic ensemble that can only be fully realised through embodied collaboration.

The project originated as *Baby Bot*, two separate units (a step sequencer and a sound unit connected via control voltage) designed for group play with knobs as the primary control interface. Through three further iterations, cables and traditional knobs were replaced with physical touches between players. The question driving the design was whether physical sound exploration could be distributed among a group of participants to promote emotional engagement. This question arose from the designer's lived experience as a disabled creator. Living with chronic pain in a body that cannot sit stationary for long periods or use conventional controllers, they were motivated to explore alternative form factors. Rather than adapting existing interfaces, they pursued a ground-up approach rooted in crip epistemology, a form of knowledge that emerges from navigating the world in a body that dominant design paradigms exclude [16, 23]. This perspective generated design decisions unlikely to arise from conventional

processes: prioritising touch between human bodies over cable connections, designing for embodied joy rather than competitive accuracy, and treating accessibility not as an afterthought, but as the generative foundation from which the entire interface emerged.

Three research questions, refined from an in-progress set developed throughout the project, frame the work: (RQ1) How can a designer with lived experience of disability create an alt.ctrl musical interface that broadens the design space of existing interfaces? (RQ2) What design values and methods does crip practice contribute to such an interface? (RQ3) What can the wider DMI community learn from this practice? The central contribution is conceptual: crip knowledge production is itself a generative source for musical interface design, not an accommodation of an existing paradigm. The technical and practice-based account of *Bot Party's* evolution is offered as supporting evidence. Section 2 situates the work; Section 3 sets out methodology; Section 4 presents the four design-evaluate-iterate cycles; Section 5 reports six themes from the reflexive thematic analysis of fifteen exhibitions; Section 6 discusses what crip knowledge production offers DMI; Section 7 addresses limitations; Section 9 sets out the ethical framework for the work.

2 Related Work

2.1 Accessible Digital Musical Instruments

Accessible digital musical interface research has shifted from niche prototypes to a substantial body of work that rethinks who digital instruments are for and how they can sustain long-term shared music making [8]. Lucas et al. argue for community-driven maintenance of bespoke accessible music technology [19]. Beyond interfaces made *for* disabled people, disability-led design has become a generative site for exploration. The *Bishop Boom Box* emphasises crip kinship, disabled joy, and the aesthetics and poetics of interaction as key design metrics, challenging conventional disability-design norms that have tended to focus on utility and usability [22]. Chang and Felt frame disability-led art and technology as *criptech*, arguing that these practices produce knowledge that is transformative rather than accommodating [7]. The Drake Music project, a UK-based disabled-led charity focused on making musical instruments, similarly positions disabled musicians as co-designers of music technology rather than as recipients of it [26]. However, there remains a shortage of research led by disabled practitioners building interfaces from the ground up. This paper aims to support the development of crip practices in DMI design by beginning with the embodied relationship of a disabled designer to sound and touch.

2.2 Embodied Musical Games and Alt.Ctrl Interfaces

The evolution of the game controller reveals three design patterns: handheld console controllers (button-based), natural controllers (diegetically mapped peripherals such as steering wheels) and embodied controllers (full-body input systems) [28]. Music games sit at the intersection of the latter two. *Dance Dance Revolution* and *Samba De Amigo* pioneered embodied musical interfaces using dance pads and motion-tracked maracas [1, 13]; *Beat Saber* extended the tradition to VR [14]. The DMI community has a parallel history of hacking interesting interactions out of game controllers, notably the Kinect and the Wii Remote [34, 40].

A community known for hacking and building controllers is the alt.ctrl game community. Works made with custom hardware

by independent developers demonstrate a tight structural coupling between controller, environment, and game system. From *PainStation*'s two burning plates, which punish players for missing a ball in a modified *Pong*, to *Johann Sebastian Joust*'s hacked PlayStation Move controllers, which ask players to dance and freeze to a soundtrack's tempo, alt.ctrl games show that complete freedom over game design and interface affordances opens new forms of play [6, 25, 39]. Rather than making the existing game paradigm accessible, alt.ctrl games can possibly queer it or reimagine it entirely [21]. The tradition of queering gave rise to the concept of *cripping*, challenging societal norms, and resisting compulsive ableism [23]. In this spirit, *Bot Party* challenges the design of standardised commercial controllers. By replacing individual precision with collaborative touch, competitive scoring with collective sound-making, and speed-based problem-solving with embodied discovery, it serves as a productive site for crippling normative game design. This work falls into the long history of crip hacking: interventions that use design and hacking to overcome the limitations imposed on a disabled person by their environment or society [41].

2.3 Crip Technoscience and Theoretical Framework

Crip theory reclaims the term *crip* as political and cultural resistance [16]. Hamraie and Fritsch argue that disabled people's technological practices (building, hacking, remaking the material world) constitute critical knowledge production [11]. Siebers articulates a disability aesthetic that positions the disabled experience as a distinctive creative orientation [35], and Joyce demonstrates how adaptive music technology can merge with disability aesthetics [15]. Mingus's notion of *access intimacy* [24] and Piepzna-Samarasinha's work on *care webs* [29] reframe interdependence as a generative condition rather than a deficit. Malafouris's Material Engagement Theory argues that cognition is distributed across brains, bodies, and artefacts [20]. Combined with Kirsh and Maglio's concept of Epistemic Action, in which physical manipulation is itself a form of thinking [17], these frameworks suggest that controllers designed by disabled bodies open new forms of musical cognition. Touching another body while holding a sound-making object is not only an input gesture; it is distributed musical thinking that arises from the material conditions of embodiment.

3 Methodology

The overarching methodological framework is an extension of the Iterative Cyclic Web, a model for practice-led research in the creative arts developed by Smith and Dean [36]. Their model establishes a cyclical approach that flows between practice-led research, academic research, and research-led practice. This research extends the web by incorporating public exhibition, iterative game design, HCI data collection, and community engagement as additional nodes, so that each exhibition generates data that feed the next design phase. The designer's positionality and values as a disabled creator are constitutive of the methodology, not incidental to it.

3.1 Three Primary Methods

Within this extended web, the project draws on three primary methods: *autoethnographic design* grounds the work in lived experience; *iterative game design* structures the design–evaluate–iterate cycles; and *reflexive thematic analysis* provides the analytic framework. In turn, I elaborate on each one.

The autoethnographic design takes the researcher as the first user and primary participant of the system [10, 27]. Within crip technoscience this positionality is epistemologically productive: embodied knowledge of pain, fatigue, and non-normative affordances constitutes critical knowledge production inaccessible through observation alone [11]. Autoethnography also did analytic work in this study, not only methodological work: the designer's first-person experience of pain, joy, and contact with players is itself a coded data stream alongside the photographic, video, and social media corpus, and is reported in the findings as such.

Iterative game design follows the Salen and Zimmerman's cyclic model of prototyping, play testing, evaluation, and refinement [31]. In this research, the playtesting is transformed into a dialogue between the artist, their community, and the exhibition space, which becomes a site for the continued development of the design.

Reflexive thematic analysis (RTA) follows Braun and Clarke [5]. Data from fifteen exhibitions over seven years (Table 1) was processed in five steps: (1) audio–visual material was transcribed to text and combined with field notes and social media posts into a single corpus per prototype; (2) initial open coding was conducted on paper with highlighters and post-it notes; (3) the corpus was re-coded in NVivo for finer-grained categories; (4) codes were clustered into candidate themes that were checked back against the data and against the designer's autoethnographic notes; (5) themes were stabilised across prototypes by triangulating between modalities (video, photo, social media, designer reflection). The themes that emerged from the NPT data in version 2 (Emotion, Customisation, Strategies and Synchrony, Group Play, Gender and Gestures) directly informed the design choices made for version 3. The six themes reported in Section 5 are the stabilised cross-prototype set.

3.2 Crip Time and Distributed Labour

The development was also shaped by *crip time*, which Samuels describes as the bending of time to meet disabled bodies [32]. The designer's fluctuating chronic pain required distributed labour: collaborators stepped in for precision tasks during pain flares; deadlines flexed; level designer Charlie Ann Page co-designed levels for version 3; sound designer Frieda Abtan composed audio for version 2 and Brian Jackson took over the soundtrack for version 3 under the designer's creative direction. Care was not a value applied from the outside; it was the material practice that made the work possible.

4 System Design: Four Iterations

This section presents the four prototypes as design–evaluate–iterate cycles. Each subsection states the design intent of the version, summarises the hardware and software, and reports the evaluation moves that drove the next iteration; the cross-prototype findings are reserved for Section 5. Audio examples for each prototype are available at <https://phoenixperry.com/art-games/bot-party>.

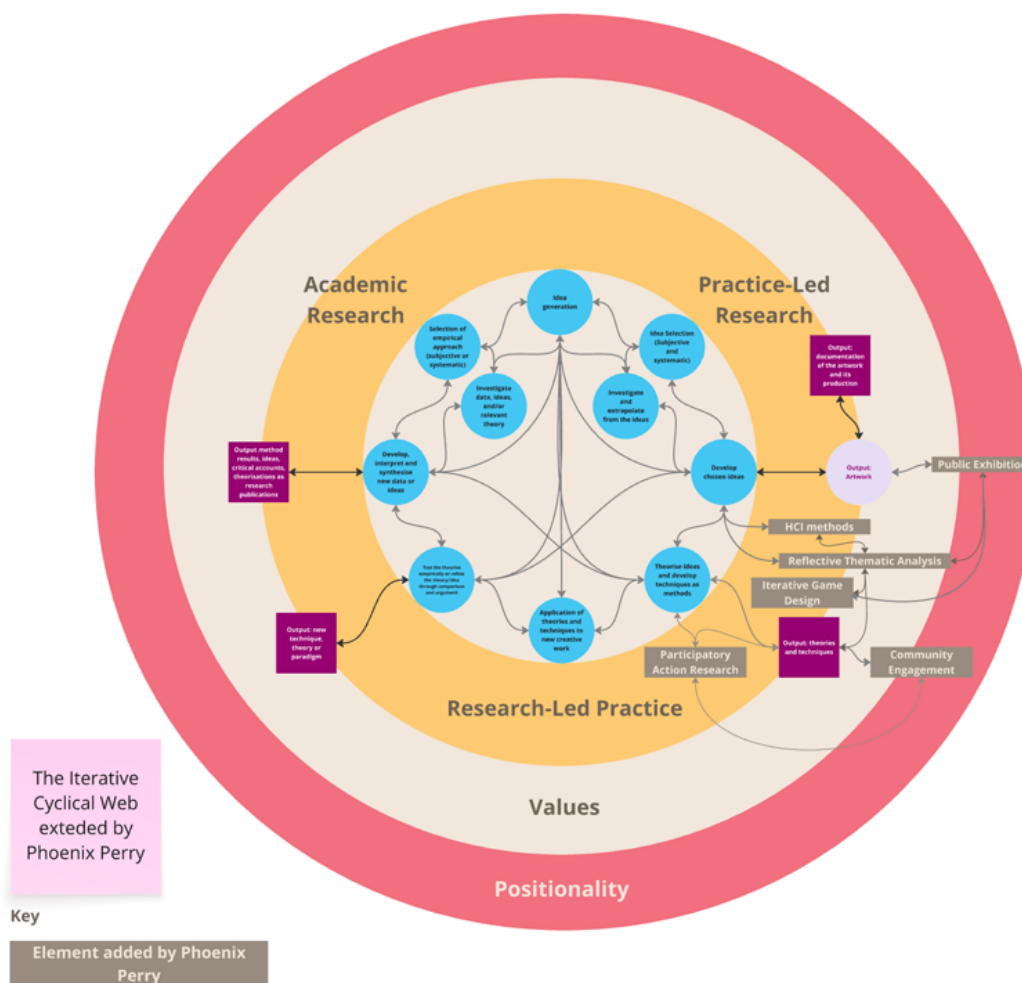


Figure 2: The Iterative Cyclical Web extended by the author to support practice-led crip research. Values and positionality form the outer rings, with public exhibition, iterative game design, HCI methods, and reflexive thematic analysis added as nodes within the cycle. A full-scale version is available at <https://miro.com/app/board/uXjVP8fkiHE/>.

4.1 Prototype 1: *Baby Bot*

Baby Bot consisted of two separate units: a DIY analogue step sequencer built from the Baby10 circuit (a Hackaday design using CD4017 decade counter chips) and a custom 555 sound synthesis unit based on the Atari Punk Console, pairing two 555 timer chips in an astable RC configuration to generate square-wave audio [38]. The two units were connected through control voltage; players controlled the sound using potentiometer knobs mounted on a heart-shaped breadboard layout. The enclosure drew on Cybertwee aesthetics, combining a gold head, soft pink body, and red-mirror heart [12]. This visual language was deliberate: it positioned the synthesiser as an object of care and intimacy rather than a site for technical mastery.

Included by curator Zuraida Buter in the exhibition *Women in Games and the New Intimacy* at the Incubate Arcade in Tilburg, *Baby Bot* was available for play to around 500 visitors over a four-day period. Playtesting revealed that players oscillated between solo knob exploration and group play, with multiple people crowding around the units. Children were enthusiastic but rough; several knobs were pulled off the step sequencer. The heart-shaped enclosure was too fragile to survive shipping. These

observations pointed to more robust enclosures, more durable interaction affordances, and a shift away from knobs toward a more social form of input, directly motivating handheld controllers and touch-based interaction in Prototype 2.

4.2 Prototype 2: *Bot Party*

Prototype 2 expanded the system to three handheld controllers, each built around a Teensy 3.2 microcontroller with an IMU, LEDs, and buttons. The controllers communicated wirelessly via XBee Series 1 radios and were linked during play using vintage telephone cables. Enclosure design iterated through cardboard, polypropylene, and wood before settling on 8×8×8 cm acrylic cubes determined by physical testing with different hand sizes. The critical advance was the removal of control-voltage cables and the addition of capacitive sweeping for inter-player touch detection, inspired by Disney Research’s Touché [33]. The microcontroller oscillates voltage on an output pin while reading the differential on an attached analogue input; expanding this to multi-player use required a custom bit-reduction filter and a low-pass filter to clean the signal. When players touch in one of the six possible configurations while holding a bot, the body’s

Table 1: Public exhibitions of *Bot Party*, 2016–2020. The Audience column reports the venue’s overall attendance figure (or, where festival statistics were unavailable, a qualitative descriptor); these numbers are upper bounds on potential exposure to the work, not counts of players. Across all fifteen exhibitions the work was rarely left unattended and frequently had a queue of players waiting; the designer estimates approximately 3,000 people actually played *Bot Party* in total. Data column codes: P = photographs, V = videos, SM = social-media posts, FN = field notes, IC = informal conversations.

#	Venue / festival (curator)	Location	Date	Audience (upper bound)	Data collected
1	Incubate Arcade, <i>Women in Games & the New Intimacy</i> (Buter)	Tilburg, NL	Sep 2016	~500 over 4 days	14 P, 2 V, FN, IC
2	Now Play This, Somerset House (Grazmazio)	London, UK	Apr 2017	2,639 over 3 days	35 P, 4 V, 4 SM, FN, IC
3	Feral Vector, Old Church	Hebden Br., UK	Jun 2017	~300 over 3 days	1 fan P, FN, IC (USB failure)
4	IndieCade <i>NightGames!</i> (Brice)	Los Angeles, US	Oct 2017	~1,000, 3 hr evening	8 P, 2 V, FN, IC
5	GDC Alt.Ctrl (Award nominee)	San Francisco, US	Mar 2018	~28,000 over 3 days	P/V/SM/FN aggregated [†]
6	Playful Arts Festival, Werkwarehuis	's-Hertogenb., NL	Jun 2018	festival audience	P/V/SM/FN aggregated [†]
7	Clujotronic, Goethe Institute	Cluj, RO	Sep 2018	festival audience	P/V/SM aggregated [†]
8	Playful Interfaces, Rich Mix (Artful Spark)	London, UK	Oct 2018	festival audience	P/V/SM aggregated [†]
9	PlayUK (British Council)	Skopje, MK	Nov 2018	festival audience	P/V/SM aggregated [†]
10	Dank Jank, Apex Art	New York, US	Apr 2019	gallery audience	P/V/SM aggregated [†]
11	We Throw Switches, Loading Bar	London, UK	Apr 2019	evening audience	P/V/SM/FN aggregated [†]
12	EGX Rezzed (Rock Paper Shotgun)	London, UK	Apr 2019	~20,000 over 3 days	P/V/SM/FN aggregated [†] , SK feedback
13	NYC Resistor, Solar Punk Show	New York, US	Apr 2019	evening audience	P/V/SM aggregated [†]
14	Now Play This, Somerset House	London, UK	May 2019	festival audience	P/V/SM/FN aggregated [†]
15	PlayUK, Kulture Centar GRAD	Belgrade, RS	Jan 2020	festival audience	P/V/SM aggregated [†]

[†] Because v3 hardware and software were unchanged across exhibitions 5–15, data from these venues was treated as a single corpus: 53 P, 11 V, 13 SM, designer field notes, and press from *Gamasutra*, *The Verge*, and *PC Magazine*. SK = Sightless Kombat (blind accessibility consultant), whose feedback at EGX prompted the v4 redesign.

conductivity produces measurable signal changes that identify which configuration is present. The interface can also detect whether a bot is simply being held by one player via the embedded IMU. Sound was a collaboration with composer Frieda Abtan, who created three sonic voices (a percussion track, a Markov-chain-driven melody, and a harmonic drone), each shaped by IMU data from a separate controller, drawing on a carnivalesque aesthetic.

Prototype 2 was exhibited at Now Play This (April 2017), Feral Vector (June 2017), and IndieCade *NightGames!* (October 2017). Open coding in NVivo of the Now Play This corpus (35 photos, 4 videos, 4 social media posts) produced six initial themes: Emotion, Customisation, Strategies and Synchrony, Group Play, Gender, and Gestures. Lab tests showed the capacitive circuit scaled to seven or more people. At Feral Vector, the Teensy’s USB port was torn free of its circuit board during transport, disabling the touch mechanic entirely; without touch, IMU-driven motion alone failed to hold player attention beyond sixty seconds. The contrast between Now Play This (group play, sustained engagement) and Feral Vector (touch disabled, engagement collapsed) yielded the strongest single piece of evidence in the project for the centrality of touch. Three changes followed: a complete hardware rebuild for robustness, a structured game level to give incomplete play sessions a satisfying arc, and a warmer sonic palette in response to feedback that the carnivalesque tone felt too dark for a game about connection.

4.3 Prototype 3: *Bot Party* (Arcade Cabinet)

Prototype 3 was a ground-up reconstruction in which no component or line of code survived from version 2. Developed for GDC Alt.Ctrl in March 2018, the system had to withstand a 14-hour trip from London to San Francisco as checked luggage and

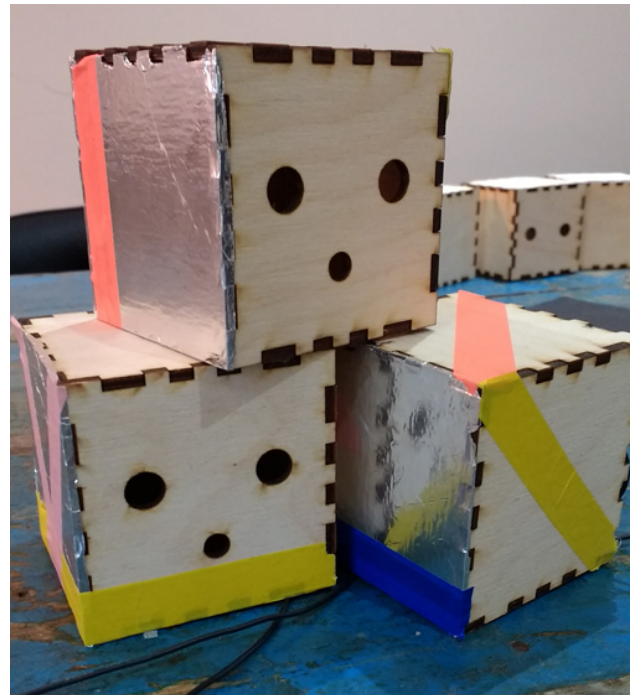


Figure 3: Bot Party Version 2 prototyping: wood-and-tinfoil test controllers used to validate hand size and capacitive sensing.

three days of continuous play before approximately 28,000 attendees. The Teensy was replaced by an Arduino Uno for a lower cost, simpler programming, and a more robust USB connection.



Figure 4: Bot Party Version 2 in play: three players touching while holding controllers linked by vintage telephone cables.

The XBee radios were removed; direct wiring through JST connectors streamlined development and allowed any component to be disconnected in minutes. Two professionally fabricated PCBs (an Arduino Uno shield and a separate bot board) replaced hand-soldered prototype boards. The software was moved from Max/MSP to Unity, allowing multiple game levels and two-way communication between Arduino and the game engine. Charlie Ann Page, a fellow game designer who lives with chronic fatigue and pain and a member of the non-profit Code Liberation, co-designed the level structure and built the event system. Brian Jackson took over sound design, using the Helm open-source synthesiser integrated via Ableton Live to create a warm, inviting palette that replaced the earlier dark aesthetic. Two game modes emerged: *Open Communication*, freeform sonic exploration, and *Little Secret Cyphers* (internally named *Touch Touch Revolution*), a structured three-minute level inspired by *DDR*'s choreographed sequences. In *Little Secret Cyphers*, a narrating bot character guides players through prescribed touch sequences, rewarding contact with a happy “Yep!” and missed connections with a crashing noise. The opaque enclosures were replaced with light-emissive laser-cut acrylic boxes that encouraged face-to-face interaction. The whole system was housed in an arcade-style tabletop cabinet with CNC-cut level buttons and a security lock for the laptop. A backup bot was added to the travel kit.

Version 3 toured eleven exhibitions between March 2018 and January 2020. Because hardware and software were unchanged across these venues, the corpus was treated as a single dataset (53 photos, 11 videos, 13 social media posts, designer field notes, and press in *Gamasutra*, *The Verge*, and *PC Magazine*). Re-coding stabilised the six cross-prototype themes reported in Section 5. The most consequential single piece of player feedback came from Sightless Kombat (SK), a blind accessibility consultant and gamer who played at EGX Rezzed in April 2019. His central observation was that the LED cues conveying game state were inaccessible to blind players, and that a home version would need to be repairable without sighted assistance. This drove the redesign of version 4.

4.4 Prototype 4: The Sightless Kombat Version

Version 4 integrates haptic motors that reproduce LED information tactilely. The circuit boards were substantially revised: Additional LEDs ports were added and each bot now connects



Figure 5: Bot Party Version 3: three LED-lit, transparent acrylic controllers in the arcade cabinet build.

to an external power source because the Arduino alone cannot drive motors, LEDs, and sensors simultaneously. The enclosures shifted from laser-cut acrylic to 3D-printed housings fastened with inset screws rather than super-glue. This addresses prior concerns that motor vibration could crack the acrylic over time, while making the bots openable and repairable. Where the acrylic enclosures had to be re-glued after any internal work, the new faces simply unscrew. The shift to 3D printing also reduced the construction time for a full set of bots from roughly forty hours of careful cutting, glueing, and assembly to a single day of printing and screwing parts together. This reproducibility, combined with the user-repairable design, reflects a crisp design principle that treats maintainability and autonomy as requirements rather than as add-on features. Version 4 is in continuous development; preliminary testing has informed the haptic-as-kerb-cut argument that I develop in Section 6, but full evaluation is future work.



Figure 6: Bot Party Version 4 in play: three players smiling while holding the 3D-printed, screw-fastened controllers.

4.5 The Two Interaction Modes of *Bot Party*

Across versions 3 and 4, *Bot Party* operates through two paired modes. IMUs allow players to control musical instruments through movement; the game uses capacitive sweeping to detect and cue skin contact between players. Neither is *Bot Party* alone;

their combination produces the experience. Each bot has a distinct voice: percussion whose tempo responds to shaking force, a Markov-chain-driven melody shaped by movement, and a harmonic synth drone modulated by gesture. *Open Communication* provides freeform sonic exploration in which collective movement intensity locks the soundscape into a unified flow; when all three players are connected simultaneously, a generative rainstorm rewards sustained contact. *Little Secret Cyphers* lasts approximately three minutes (a pop-song length) and uses light and sound to cue prescribed touch sequences guided by the narrating bot, which tells players they are in the Human Intelligence Training Programme. A bridge section instructs players to shake their bots, integrating motion control and building intensity. The final section rewards both shaking and touching.

5 Findings

This section presents six themes from the reflexive thematic analysis of fifteen exhibitions, addressing RQ1 (what kind of interface emerges) and RQ2 (what design values and methods crip practice contributes). I organised the themes from the most clearly evidenced (touch as the carrier of affect and sociality) to the more interpretive (the body as instrument) and ground each in the literature reviewed in Section 2. Across the corpus, autoethnographic data was treated as a parallel coded stream: the designer's first-person accounts of physical contact with players, of pain, and of joy were coded against the same theme set as the visual and social-media data, and contributed evidence to themes 1, 2, and 6 in particular.

5.1 Embodied Joy as Crip Reclamation

Across every exhibition from version 2 onwards, the most consistent finding was that players displayed positive emotional responses tied specifically to the moment of inter-player touch. From version 2 forward, coding of photographic and video data showed smiling as the dominant expression and players negotiating each other's comfort levels through conversation. Once the version-3 sonic palette was redesigned to warmer tones, positive expressions intensified, and play sessions extended. A man playing version 3 at *Now Play This 2019*, fighting tears, shared that he could not recall the last time he had touched another person; the sonic reward for sustained contact appeared to give players a reason to maintain physical connection beyond what social convention would normally permit. This is not a generic finding on positive affect in play. It is specific to an interface designed by a disabled designer, where the touch mechanic was arrived at precisely because the designer wanted to play with others but could not use standard console controllers. The joy is the designer's exuberance at being able to play their own game, made transferable. This connects directly to May et al.'s framing of crip kinship and disabled joy as primary design metrics for the *Bishop Boom Box* [22], and to Siebers's disability aesthetic [35]: the affective register of the interface is not a side effect but a site of meaning.

5.2 Care as an Emergent Play Dynamic

Care was embedded in the design process through crip time and distributed labour, but it also surfaced as a play behaviour that nobody scripted. At *NightGames!* a child instructed her parents to kiss her at the same time to establish the skin contact the game required, returning the next day because she wanted to play again. Players in versions 2 and 3 were observed modulating

touch, adjusting grip, and pressure in response to each other's comfort. The generative rainstorm in *Open Communication* that rewards sustained three-way contact led groups to hold still and listen rather than compete, producing moments of quiet collective attention. The sonic feedback loop, with positive sounds for correct connections and dissonant sounds for incorrect ones, trained players toward careful, attentive touch rather than aggressive interaction. Care, here, was not a design value applied from outside; it emerged from the material conditions of the interface. This concretises Mingus's notion of access intimacy [24] and Piepzna-Samarasinha's care webs [29] in a sound-making artefact.

5.3 Distributed Choreography

The players invented physical configurations and play strategies that were not specified in the game design. Hand extensions, arm triangles for three-way contact, and physical bridges in which bystanders linked into a human chain all emerged without instruction. Version-3 exhibitions regularly produced circles of ten or more people collaboratively shaping the soundscape, a social formation made possible by the capacitive circuit's scalability (validated in lab testing with seven people and observed at *Now Play This 2019* with twelve). At GDC, two players invented a configuration in which one held a bot stationary in the centre of the group while the other two reached in order to make and break contact at specific moments. These emergent choreographies make Kirsh and Maglio's Epistemic Action visible in a musical interface [17]: players were not simply inputting commands but thinking through their bodies, discovering which physical configurations produced which sonic results. The touch mechanic, because it requires actual skin contact rather than button presses, made the players' spatial and gestural problem-solving visible in a way that screen-based interfaces typically obscure.



Figure 7: Distributed choreography at version 3: one player holds their hand still in the centre while the other two touch it at the right times.

5.4 Sociality as Circuit Property

From version 3 onward, 65% of observed interactions were group play. The Feral Vector failure, when the USB port was torn free and only IMU-driven motion remained, collapsed engagement to under sixty seconds, providing inadvertent counter-evidence: touch was not one feature among many but the mechanism through which the interface generated sociality. The bridging mechanic, in which additional players link into the human chain to extend the capacitive circuit, allowed the system to scale beyond its three-player design without any hardware or software modification. A wheelchair user identified the GDC installation as the only accessible booth in the Alt.Ctrl exhibit, a consequence of the designer's own body demanding a lower table height; this small change benefitted players of shorter stature and those using mobility aids. The disabled body shaped the physical setup and the physical setup in turn shaped who could participate. This finding supports Hamraie and Fritsch's argument that disabled people's technological practices generate access conditions for others rather than only for themselves [11].



Figure 8: Bridging at version 3: twelve people collaborating across an extended human chain that scales the capacitive circuit beyond its designed three-player structure.

5.5 Touch, Permission, and Transgression

The interface created a context for physical contact that re-shaped normative social boundaries. One player with self-described touch phobia chose to play *Little Secret Cyphers* with two strangers, driven by his curiosity as to whether he could; he completed half the level before retreating with a startled yelp. His decision to participate at all suggests that the sonic reward created permission that social convention alone could not. At a queer games event, *Bot Party* was used repeatedly as a platform for flirting and expressing affection, with visibly queer couples sharing intimate moments through the interface. The sonic mediation of touch reframed physical contact from a social act governed by convention into a musical gesture governed by the game's reward structure. This finding draws Puig de la Bellacasa's argument that touch always carries ethical and political dimensions [30] into the DMI design space, and resonates with Ahmed's queer phenomenology [2] in showing how an instrument can re-orient bodies toward one another.

5.6 The Body as Instrument

A dancer playing *Open Communication* commandeered all three bots and performed a slow movement sequence that produced melodic structures specific to his gestures, qualitatively different from the exploratory shaking and tilting observed among most players. He treated the IMU-driven interaction as a performance instrument, with the body as an expressive mechanism. This is Material Engagement Theory made visible [20]: cognition distributed across the dancer's body, the bots' IMUs, and the resulting sound. Other players in versions 2 and 3 developed emergent gestural vocabularies, discovering that rapid shaking produced rhythmic intensity while slow rocking generated ambient textures, and adjusted their movements accordingly. The IMU mode allows the body itself to become the instrument, completing *Bot Party*'s paired interaction model: if touch creates the social connection, gesture creates the musical expression.

6 Discussion: Crip Knowledge Production as DMI Design Source

The central claim of this paper is that crip knowledge production is a generative source for musical interface design, not an accommodation of an existing paradigm. The six above findings support this claim. Joy, care, choreography, sociality, transgression, and the body-as-instrument are not features bolted onto an existing instrument; they are the emergent properties of an interface whose constraints, materials, and reward structures were derived from the lived experience of a disabled designer. Now, I develop four implications of this claim for the wider DMI community.

6.1 The Kerb-Cut Effect at the Hardware Level

The themes share a structure: each describes an interaction that emerged from the material conditions of crip design rather than from deliberate specification. The designer did not design for distributed choreography or build a game for couples to flirt; they explored alternatives to standard controllers, and that constraint produced inter-player touch as the primary mechanic. This supports Hamraie and Fritsch's argument that disabled people's technological practices constitute knowledge production rather than accommodation [11], and extends it to musical interface design. The progression from Prototype 3 to Prototype 4 makes the generative logic concrete. Sightless *Kombat*'s feedback did not produce a blind-accessible mode bolted onto an existing design; it prompted haptic motors that enriched the experience for all players by introducing tactile information the LED-only system lacked, and 3D-printed, screw-fastened enclosures designed for blind self-repair that also halved production time and simplified maintenance for sighted users. This is the kerb-cut effect that operates at the hardware level: centring the needs of a blind player yielded a more repairable, more reproducible and more tactile instrument for everyone [4]. The design heuristic on offer is straightforward: start from the body that existing interfaces exclude, and the resulting instrument is likely to be richer for all bodies.

6.2 Interdependence as Design Knowledge

Western musical tradition has long valued solo virtuosity, and much DMI research inherits this orientation: instruments serve individual expression and are evaluated by how well a single player can master them. Crip epistemology offers an expansion. *Bot Party*'s core mechanic cannot produce its full sonic output

with one body; three players holding three bots is not a multi-player mode added to a solo instrument but the minimum configuration for the system to function. This architecture emerged from a designer whose own body sometimes requires other bodies to function in daily life. Disability studies theorise this condition as *interdependence* rather than dependence [24, 29]. *Bot Party*'s touch mechanic materialises this: the system assumes you will need other people, and rewards that need with sound and (in version 4) vibration. Designed from this premise, instruments open new interaction possibilities: collective sound-making, emergent choreography, and care as play.

6.3 Exhibition as Expanded Evaluation

The alt.ctrl game community designs for exhibition by default. Every alt.ctrl work assumes a public venue, a queue of strangers, rough handling, and no instruction manual. The DMI community already values public performance and demonstration; what the alt.ctrl tradition and my extended Iterative Cyclic Web suggest is that exhibition can also function as a structured evaluation method that surfaces phenomena complementary to those found in controlled settings. A man who had not touched another person in years would not appear in a recruited study. A player with a touch phobia who chooses to participate despite his fear is not a screenable participant. A wheelchair user identifying the installation as the only accessible booth in a major venue is a finding about spatial politics that emerges from the context of the exhibition itself. Benford et al. have argued for research-in-the-wild as methodologically distinct from lab-based HCI [3]; this paper formalises what the alt.ctrl and performance communities practise informally: the venue is not where the creator shows the finished work, but where the work reveals what it is in its social context.

6.4 Touch as More Than a Sensing Modality

When the DMI community discusses touch sensing, it typically means capacitive pads, pressure sensors, or force-sensitive resistors mounted on a surface. Touch is treated as an input modality, an option in a taxonomy of sensing strategies. My findings suggest that when touch means skin-to-skin contact between players, it carries dimensions that technical descriptions of sensing do not address. The player with touch phobia who chose to play was negotiating his bodily boundaries through the game's reward structure. Queer couples used *Bot Party* to perform intimacy in a public space. These are not edge cases; they are the primary data. Puig de la Bellacasa argues that touch is never simply a matter of information transfer; it always carries ethical and political dimensions that technical descriptions of sensing tend to leave implicit [30]. Ahmed's work on queer phenomenology describes how bodies are orientated toward or away from each other through social structures that feel natural but are produced [2]. *Bot Party*'s capacitive sweeping circuit makes those orientations visible by restructuring the social conditions under which contact occurs. When a designer chooses how an instrument detects the body, they are also choosing which bodies are welcome and what forms of relation the instrument makes possible.

7 Limitations

This work has several limitations. Methodologically, it is a single-designer autoethnography supported by exhibition observation; it does not include a controlled comparison group, and it makes no claim that the findings generalise to all disabled designers

or to all players. Reflexive thematic analysis is interpretive by design, and the designer's positionality both enables the analysis (through embodied access to the design space) and constrains it (the same body cannot stand outside its own categories). The exhibition setting limits data collection: ambient noise, time-bounded curation slots, and the curator's parallel programme reduced the number of structured conversations possible at most venues, and demographic statistics were unavailable from most festivals. Structured surveys were not deployed because they were judged intrusive in the exhibition flow, a defensible choice in context but one that trades depth for breadth. Technical limitations specific to individual versions have been reported alongside their iterations: at version 2 the Teensy USB failure at Feral Vector prevented full evaluation of touch and IMU together; version 4 is in active development and its haptic findings here are preliminary. Finally, the disability framing in this paper is grounded in my specific lived experience of EDS, chronic pain, and nerve damage. I have flagged where findings are tied to that specificity and where they invite extension; I do not treat one disabled designer's perspective as representative of all crip practice.

8 Conclusion

Bot Party began as two separate knob-controlled sound units and evolved, over seven years, four iterations, and fifteen exhibitions, into a touch-based sonic game where skin is the interface. That trajectory was not incidental to the designer's disability; it was produced by it. The capacitive circuit made sociality a technical property of the system; gesture turned the body into a musical instrument; and the affective register of joy, care, and transgression became a register of the design, not a side effect of the play. These findings point toward what crip knowledge production can offer DMI more broadly: a kerb-cut effect at the hardware level; interdependence as a generative architectural premise; exhibition as a venue that surfaces phenomena controlled studies structurally exclude; and a politicised vocabulary for touch sensing. The next generation of accessible musical interfaces is unlikely to emerge from the retrofitting of existing paradigms. It will emerge from disabled creators who play, dance, and invent their way into design approaches that do not yet exist.

9 Ethical Standards

The PhD thesis from which this work is drawn underwent formal ethics review at Goldsmiths, University of London, which covered the public-exhibition data collection reported here. Each exhibition venue displayed signs indicating that participation in the work entailed possible photography or recording. Because the designer ran the play sessions themselves, each player was given a verbal description of the activity, told that they were free to leave at any moment, and asked for verbal consent before play began. Photographs and videos used in this paper are either the designer's own, of consenting players whose images have been shared publicly via the festivals' own channels, drawn from press coverage, or framed to anonymise participants. Social media posts cited as data are public posts made by attendees on their own accounts; they are paraphrased rather than quoted to reduce identifiability. The author declares no conflicts of interest, financial or non-financial. The research did not involve animals. No external funding supported the writing of this paper; the underlying PhD research was self-funded and conducted at Goldsmiths, University of London, with continuing development at the Creative Computing Institute, University of the Arts London.

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