Tiny Touch Instruments: Composing for Collaborative Mobile Performance

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Abstract

This paper explores Tiny Touch Instruments (TTIs), a set of mobile instruments, and how they facilitate collaborative, unrehearsed music-making. Through the composition and performance of two pieces, *Skating* and *Skipping*, this work investigates how multimodal notation and instrument design can shape performer experience. Performances were documented through participant observation, interviews, and a survey, revealing key themes such as the role of notation in guiding improvisation, the balance between agency and unpredictability in digital instruments, and the recontextualization of mobile devices as musical tools.

Keywords

mobile music-making, graphic notation, composed instruments

1 Introduction

The ubiquity of mobile technology has created new possibilities for music-making. Mobile orchestras, beginning with the Stanford Mobile Orchestra (MoPhO) founded in 2007, explore these possibilities by creating and performing work primarily for mobile instruments [12]. Other ensembles have followed, as documented in [14].

Innovation in mobile technology has steered the trajectory of mobile music-making. For example, when mobile browsers began to adopt the Web Audio API in 2014-2015, possibilities exploded for web-based distributed mobile performance [18]. Essl and Rohs explored the limitations and affordances of mobile device sensors, focusing on sensor technology used in musical performances [5]. Taylor documented examples of distributed mobile performance, focusing on performance practices that treat an audience's electronic devices as a speaker array [16].

As part of my creative practice, which investigates collaborative musical experiences, I compose with a custom set of mobile instruments. The instruments, called Tiny Touch Instruments (TTIs), are controlled with touch gestures on mobile device touch screens. They live on a static webpage¹. The library p5.js² is used for graphics and interactivity, and Tone.js³ is used for sound generation.

Two pieces for TTIs, *Skating* and *Skipping*, experiment with methods of encouraging improvisation, collaboration and engaged listening among unrehearsed performers. Both can be performed by four or more people with mobile devices. *Skating*

¹https://tinytouchinstruments.com/ ²https://p5js.org/ ³https://tonejs.github.io/

NIME '25, June 24–27, 2025, Canberra, Australia © 2025 Copyright held by the owner/author(s). is notated as a graphic score including text instructions, and *Skipping* is a video score including graphics, animations, and text instructions.

In this paper, the product of practice-based research, I document the process of composing collaborative pieces for mobile instruments, and I examine participant experiences performing these pieces. In analyzing the results of these performances, I investigate the following research questions:

- What role does notation play in facilitating collaboration among unrehearsed performers using mobile instruments?
- What strategies encourage meaningful interaction among unrehearsed performers in mobile orchestras?
- How do performers navigate and engage with the affordances and limitations of simple, touch-based mobile instruments?

2 Background

Xambó and Roma outline some salient "composition dimensions" of participatory pieces for mobile ensembles. Some of the dimensions are strategies that mediate between participants and computer music systems. For example, participants must sometimes engage with scores or conductor systems. The systems in question can vary in the amount of structure or open-endedness they prescribe and how they unfold in relation to past events ("system memory") [18].

In the context of electronic music performance, researchers have broadened the idea of a score or composition to include the design of the electronic instruments themselves. Schnell and Battier introduced "composed instruments." Instrument design is a core part of the composition process for these instruments because their sound production and gestural performance are decoupled [3]. This design-as-composition paradigm is underscored by the fact that for many such instruments, as with TTI's, notation is made more meaningful with the context of the interface it is created for. For example, the notation might communicate instructions for physical gestures without describing the sounds to be produced. In electronic music performance, the decisions that constitute a composition happen at many different layers of an interconnected system, including instrument design, software decisions, and choices made during performance [2, 14].

Another interesting decision layer in composing for mobile ensemble is the orchestration of social and collaborative dynamics among performers. Pugliese et al.'s work on augmenting humanhuman interaction in mobile group improvisation highlights how mobile instruments can facilitate relational connections between performers [13]. Similarly, Fencott and Bryan-Kinns examine collaborative digital musical interactions and emphasize the importance of designing interfaces that support collective creativity and interaction [6]. Projects like The Smartphone Ensemble further explore how mobile devices can facilitate complex interaction within ensembles [1]. Research on game design principles applied to music-making applications suggests that establishing

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tasks and reward systems can enhance the expressive potential of musical interfaces [15, 17]. The two pieces described in this paper apply game design principles to collaborative music-making by suggesting interaction tasks for performers to engage with each other in.

Just as collaborative and social dynamics are shaped through interaction design, the visual layer of these systems further shapes performers' individual and collective experiences. TTIs use visual information in the interface and scores to communicate shared intention and provide participants with sensory feedback. Visual information and the use of camera and projection is often used to enhance mobile instrument performances [9, 18]. Visual feedback can also play a critical role in helping performers understand the relationships between their and others' gestures and the resulting sounds [4, 10].

Notation for digital and electronically mediated performance has evolved to accommodate new performance paradigms. Experimental composers such as Cornelius Cardew (*Treatise*) and Earle Brown (*December 1952*) explored open-ended visual scores that prioritized performer interpretation. More recently, digital interfaces have enabled real-time, dynamic notation systems that respond to performers' actions. Hope's research on animated notation discusses its affordances [8]. Research has shown that networked notation systems can facilitate collaborative composition in live settings [7]. Such approaches emphasize performer agency rather than following a rigid pre-composed score.

In the context of these discussions, my analysis of Tiny Touch Instrument performance seeks to contribute to an understanding of how mobile technologies can be designed and utilized to enhance collaborative and interactive musical experiences.

3 Methodology

Skating was performed by 12 participants as part of a group show hosted by the Sonic Practice program at Dartmouth College. I conducted semi-structured interviews with three of the participants following the performance. *Skipping* was first performed with my colleagues (n=7) in the Sonic Practice program, some of whom had performed *Skating* too. Afterward, I conducted a group interview, mainly focused on composition feedback. I also conducted semi-structured interviews with two participants. I integrated feedback into a second version of *Skating*, which was performed as part of a workshop session at the Sound / Image Festival in 2024, hosted by the University of Greenwich. After the performance, I conducted a group interview and invited participants (n=12) to fill out an anonymous questionnaire. In total, 26 unique participants contributed to the study, some across multiple performances. Many had extensive musical backgrounds.

I conducted an inductive thematic analysis on the interview transcripts and written responses. This was a manual, grounded process: I first read through all responses and identified salient excerpts, which I then grouped and regrouped according to themes in the participants' experiences. This approach allowed themes to be drawn directly from the data rather than from a pre-established framework. I placed emphasis on identifying recurring ideas across multiple performances and participant accounts.

As the sole researcher conducting the analysis, I acknowledge the risk of bias, particularly given my dual role as composer and colleague to many participants. I sought to mitigate this by prioritizing themes that appeared consistently across different groups and modalities (e.g., both in surveys and interviews), and by cross-checking interpretations with the performance documentation. However, my positionality likely influenced both the design of the study and the interpretation of the data. Though the study's scale and my embedded role as composer and researcher introduce certain limitations, these very conditions also provide an insider perspective on how performers navigate and shape collaborative musical systems.

4 Composition and performance practice

For each piece, I created a new set of three TTIs. Within the website, users can navigate between instruments in a set and return to the menu (figure 1). The instruments are distinguished by background color, and these colors are referenced in the scores for *Skating* and *Skipping*. Each instrument is based on a simple touch-sound mapping, utilizing gestures like tapping, swiping, and holding. For example, the instrument "theremin" maps touch-screen space to the pitch and volume of a sine tone oscillator. Another instrument, "wind," uses a similar mapping but uses discrete pitches and a noisier timbre. "Kit" populates the screen with randomly placed circles that can be tapped to generate pitched drum sounds.



Figure 1: Menu and "ripple" instrument

Many of the instruments provide visual feedback as users interact (figure 3). When a user touches the instrument, "ripple," circles of increasing radii are drawn onto the screen, centered at the point of contact (figure 1). When the user releases, the circles are erased. With "sink," when users touch and drag on the screen, they draw a rectangle that sinks to the bottom of the screen when they release (figure 1). The size of the rectangle corresponds to how resonant the sound produced is.

Levin and Maceda describe their pieces *Dialtones* (2001) and *Ugnayan* (1974) in terms of sonic textures rather than melodies and rhythms, presumably because the systems don't allow for precise coordination between the sound-making devices [16]. The same is true for Tiny Touch Instruments, so I also opted to primarily explore texture in my pieces *Skating* and *Skipping*.

4.1 Skating

Skating was notated as a graphic score laid out in frames, with some accompanying text instructions (figure 4). The frames are laid out in minute-long increments, and performers were given stopwatches to follow along with. Each frame introduced new instructions, and the background colors of the frames corresponded Tiny Touch Instruments: Composing for Collaborative Mobile Performance



Figure 2: Interacting with the "theremin" instrument



Figure 3: Screenshot of the "sink" instrument

to choices of instruments that performers can navigate to. Shapes and lines drawn onto the frames represent touch gestures to be traced out on a screen. The performers were divided into two groups, alternating around the room, and given paper scores. Over the course of the piece, performers are asked to respond to and mimic or echo those around them and far away.



Figure 4: Excerpts from the Skating score

Compositionally, *Skating* explores textural density. The piece begins and ends with cluster chords where performers all hold a pitch on the "theremin" instrument. The busiest and least interactive part of the piece is the climax, where performers are all asked to rapidly draw small shapes all over their screen. The piece resolves from there with more explicit instructions for interaction and listening as well as more intentional gestures.

4.2 Skipping

Skipping was notated as an animated score, implemented with p5.js, the same library that the instruments are built in. Performers follow along to the score projected or displayed on a large screen. The screen is split into two regions, left and right, and half of the performers follow the left side while the other half follows the right side. The background colors of each region correspond to the background colors of the instruments that the performers navigate between. The animated score employs static and animated graphics along with text instructions (figure 5). For example, boxes with dashed lines indicate that gestures should happen in a certain part of the phone screen. At one point, dots begin to fill up the screen, suggesting that performers should tap their screens with increasing frequency. In another section, a box flashes at a steady rate, cueing performers to tap together in time. On-screen text instructions sometimes serve to clarify visual instructions. The text instructions use words like "sporadically," "sometimes," and "rarely" to signal gradients in frequency and density.



Figure 5: Excerpts from the Skipping score

The sounds used for the *Skipping* TTIs are inspired by the experience of skipping stones on a lake. Delay effects are used to invoke water rippling, alongside sound effects suggesting rocks sinking and wind sounds heard outside.

The narrative structure of the piece asks three questions, in order:

- (1) What do these instruments sound like?
- (2) How do we sound together?
- (3) What can we do together?

This structure serves to familiarize performers with instruments that they are using for the first time in performance. At the beginning of the piece, they are asked to engage in specific ways ("tap", "swipe"). Then, they are asked to explore more ("wander"). After the novelty of new interfaces wears off and the performers have gained familiarity, they are hopefully prepared to more intentionally engage with one another ("mimic", "tap together", "respond").

5 Performer experiences

Between the three performances, participants generally reported that they enjoyed the opportunity for sonic play and collaboration. Some participants expressed frustration at how nondeterministic mappings took away from their sense of agency and some expressed appreciation for the simplicity of the interfaces. NIME '25, June 24-27, 2025, Canberra, Australia

5.1 Need for rehearsal

Both pieces are designed to be performed without rehearsal. Ideally, participants engage in a process of discovery as they perform and gain comfort with the instruments. After the first performance of *Skipping*, participants identified a tension between this kind of experiential discovery and performativity. One participant said "because I was figuring out instructions, it took me longer to open my ears and listen... some of the things you have to figure out are really fun but also slow down performance." [ID1].

Participants agreed that there was value in encountering the sounds and format for the first time during the piece. One participant appreciated the lack of rehearsal, noting that it allowed them to focus on gradual exploration rather than "playing it right." [ID2]

It was also noted that our daily experiences with mobile technology mean that participants "have already rehearsed whatever is coming up, which is basically swiping or...interacting with this machine" [ID3].

5.2 Facilitating collaboration

A major goal of both pieces is to foster a sense of collaboration among the performers, which seemed to be achieved in many respects. Eight of eleven survey respondents named collaboration or interaction as one of the most meaningful parts of their experience performing *Skipping*.

A prerequisite to collaborating in this musical context is the ability to listen to those around you. One participant observed that during *Skipping*, having both group's parts visible to all the performers simultaneously enabled more engaged listening. Being able to see their own part and the part the other group is playing allowed for "new or different ways of listening" to the other group [ID4].

In both pieces, it was helpful to explicitly instruct performers to interact with each other. This was achieved through instructions like "watch someone nearby and mimic them" and "draw a squiggle when you hear something you like." One participant explained that those kinds of instructions "shift your attention away from 'what sounds am I making on my phone?' or even away from 'what does it sound like in the room?' Rather, they ask 'what is that person doing over there, and how can I engage with it?'" [ID4] Many other participants agreed that they enjoyed having interactivity framed through tasks or objectives, or "thinking in terms of games" [ID3].

5.3 Multimodality

The scores for these pieces were multimodal, engaging with text, graphics, and animation. Participants discussed how different modes of communicating information had different strengths. They generally agreed that graphics and animations were often clearer than text instructions, which could be ambiguous. At the same time, text helped communicate instructions, such as interacting in specific ways, that would be difficult to communicate otherwise. Ultimately, using multiple modes of communication in combination allowed for more kinds of instruction than any individual mode would.

The instruments themselves are also multimodal since interaction produces both sonic and visual outputs. Participants appreciated the interconnected relationships between these outputs, which translates well to notation. For example, the shared background colors between the interface and score provided a clear indication of how performers should navigate the interface.

Participants noted that the visuals helped reinforce the connection between gesture and sound. As one performer explained: "I think [the visuals] help ground the sound in a really important way. Obviously, anyone can sort of figure out that the sound changes when they move their finger around, but I think the visuals really help to anchor that in something a little more accessible" [ID4]

Another participant [ID5] reflected that the visuals gave them an additional dimension of engagement. At points, they found themselves interacting with the goal of producing specific visual outputs, like trying to cover the entire screen. This suggests that the instruments encourage a multimodal approach to performance, where visuals and sounds are equally motivating factors.

5.4 Resituating technology

Mobile devices are deeply embedded in many of our lives, and this work recontextualizes them away from being sources of disengagement. For some, this shift in perspective was initially disorienting. One participant described feeling a sense of boredom at first, likening the experience to aimlessly using their phone. However, as the piece progressed, they began to appreciate how the performance "repurposed a really dopamine-driven device, where we're constantly like, next next, into something where we're collaborating... what a nice subversion of this technology" [ID6]. Others noted how the performance reframed the phone as a playful, interactive object, recalling mobile gaming apps [ID5].

A key aspect of this recontextualization was the realization that mobile devices already contain sound-making capabilities. As one participant put it, "People already have this sound-making machine in their pocket" [ID3]. Another reflected that by stripping away typical functions like texting or emails and focusing solely on sonic interaction, the performances temporarily redefined the role of the phone [ID7].

6 Future exploration

These performances revealed several areas for further exploration, particularly in relation to embodiment, agency, and control.

6.1 Desire for embodiment

While these pieces center on mobile devices as instruments, some participants expressed a desire to extend the performance beyond the phone's interface and engage more directly with their own voices and bodies. After performing *Skating*, one participant noted that they wanted to move away from the screen at some point, transitioning into an embodied, physical interaction, perhaps using voice or movement after an initial phone-focused section. This feedback informed the composition of *Skipping*, which concludes with an instruction to turn phones off and hum together for a minute.

This moment of embodied participation was well received. One performer reflected that they enjoyed the transition away from the phone and would have liked it to be an even more substantial part of the piece: "People were kind of warmed up for it, and it does create a communal experience, a vibration feeling that's very lovely and very powerful" [ID8]. This suggests a potential direction for future compositions: exploring how the structure Tiny Touch Instruments: Composing for Collaborative Mobile Performance

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of a piece can gradually shift from screen-based interaction to more direct physical engagement, using the phone as an entry point rather than the sole focus of performance.

6.2 Agency and control

The set of TTIs used for *Skating* and *Skipping* feature simple, intentionally limited interfaces. Some of the mappings include elements of nondeterminism. This design decision elicited a range of reactions from performers.

One participant expressed frustration, saying, "I was very confused because I didn't feel like I could really control things. I felt like it was very random" [ID5]. They elaborated that they wanted to be able to repeat specific sonic gestures in response to what they were hearing from others, but the interface did not always allow for precise repetition. This highlights an area for refinement—how to balance unpredictability with a sense of agency, ensuring that performers feel they can engage meaningfully with both their own sound production and the broader musical texture.

On the other hand, some participants appreciated the openended nature of the mappings. The unpredictability encouraged them to focus less on exact control and more on exploration, responding intuitively rather than planning their actions. This aligns with broader questions in new instrument design: to what extent should an instrument provide direct control versus invite serendipity? Future iterations of the TTIs could explore adjustable levels of determinism, allowing performers to engage with the instruments at different levels of precision.

7 Conclusion and discussion

This work examined the experience of composing and performing with Tiny Touch Instruments (TTIs) in two notation-driven collaborative pieces, *Skating* and *Skipping*. Through performer feedback and observation, I identified key themes related to multimodal notation, collaboration in unrehearsed performance, and agency in digital instrument performance.

The findings suggest that multimodal notation can enhance accessibility and engagement, particularly in unrehearsed performances. However, the balance between structure and spontaneity is an important design consideration. Additionally, the limited control inherent in the TTIs led to a mix of reactions, reflecting broader tensions in digital instrument design between predictability and exploration.

This study highlights how repurposing mobile devices as musical instruments can transform performers' relationships with everyday technology. Participants described a shift in perception, engaging with their phones not as passive devices but as expressive tools for collective music-making.

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9 Ethical Standards

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This study emerged as part of my artistic practice, where I engaged with performers through collaborative creation, observation, interviews, and surveys. While the study was not initially

conceived as formal research, I later realized that the collected materials provided insights worthy of analysis.

All participants provided informed consent to be observed, recorded, and interviewed, and they were aware that their contributions could be analyzed and shared in academic contexts. This study aligns with the ethical guidelines outlined by the NIME Ethics Statement [11], emphasizing transparency, participant autonomy, and ethical engagement in artistic research.

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