Designing Creative Tensions between Concept and Embodied Practice

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ABSTRACT

We present the Magpick, a sensor-augmented plectrum for electric guitar, as a case study in designing research products which deliberately seek a creative tension between conceptual understanding and embodied practice. Building on the notion of "counterfactual artefacts", we seek to explore how the counterfactual might extend to embodied practice. Specifically, we seek to create an object which confounds established sensorimotor skills, even as it retains a familiar visual, tactile and cultural identity. The paper discusses the design process of the Magpick, its use by guitarists, and the emergence of different forms of human-technology relations which appear to depend on the specific sonic behaviour of the Magpick. We conclude with questions for workshop discussion about who we should work with and how when designing objects which have an unexpected or uncanny relationship between identity and use.

CCS CONCEPTS

• **Human-centered computing** → *HCI theory, concepts and models*;

KEYWORDS

embodied interaction; mediation; augmented instruments; counterfactual artefacts; design research

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1 INTRODUCTION

We are interested in the ways that the design of unusual or uncanny musical artefacts can serve as a mode of inquiry into embodied practices. As a case study we present the Magpick (Figure 1), a guitar pick (plectrum) with embedded magnetic sensing that modulates the sound of the guitar when the pick is moved in the vicinity of the guitar pickups.

The Magpick is situated within the field of New Interfaces for Musical Expression [3] and specifically in the domain of augmented instruments (see [7, 8] for related examples). Common NIME evaluation metrics include creative or expressive potential (however defined), dimensionality or nuance of control, or suitability for particular aesthetic contexts. In this workshop, we instead examine how design qualities of the Magpick can suggest particular patterns of interaction, potentially in conflict with the player's conceptual understanding of what the object is intended to do.

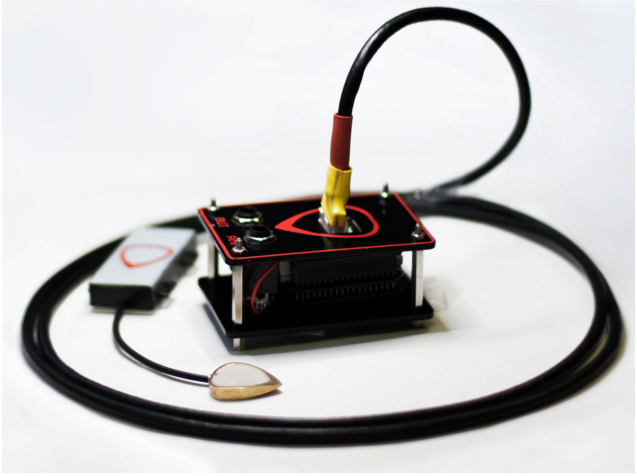
Our approach is inspired by the *counterfactual artefacts* of Wakkary et al. [9]. Grounded in postphenomenological theories of human-technology relations [2, 6], Wakkary et al. define the counterfactual artefact as "a fully realized functioning product or system that intentionally contradicts what would normally be considered logical to create given the norms of design and design products" which thereby "empirically investigate[s] multiple alternative existences (or what-ifs) as lived-with realities."

In this workshop we propose to discuss the extension of the counterfactual into the domain of embodied practice, with design research as a method supporting such inquiries. We take a familiar RtD approach in that our design phase precedes the delivery of a fully functional *research product* [5], but knowledge is generated through emergent human-technology relations that come from an object with an uncanny relationship between (mostly familiar) identity and (often surprising) use. Our design process seeks to carefully walk this boundary, drawing on our own experiences as performers and instrument designers to consider details ranging from physical materials to interactive behaviour.

2 THE GUITAR PICK

The plectrum is a simple artefact – typically just a triangular piece of plastic – but it is also a highly personal one. In guitar

Figure 1: The Magpick: an augmented guitar pick.



playing, the pick becomes figuratively and literally an extension of the body. Its texture and stiffness affect the response and tone of the instrument, to the point that different styles of music are associated with different picks. Beyond that, the size, shape, material and even colour of the pick can reveal a great deal about a player's personality and tastes.

The affordances of a generic pick are obvious to any trained guitarist (though an experimentally-inclined player can also discover hidden affordances or extended techniques, such as scraping the windings of the string). Moreover, the feel and appearance of a specific pick might carry more specialised cultural associations. The pick is thus more than a simple physical object: to the guitarist, it is an invitation to action, a suggestion of how the body might be extended and the linchpin of a complex gestural language. For these reasons, altering or even defamiliarising the design of the pick while preserving a recognisable "pickness" can suggest altered patterns of action which challenge assumptions and work with or against existing training.

3 THE MAGPICK

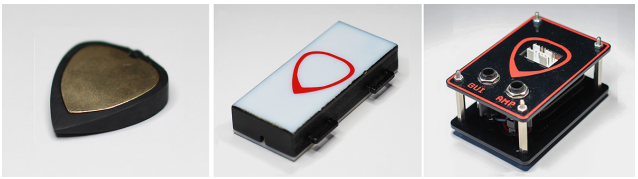
Principle of Operation

The Magpick is a 3D-printed plectrum with a hollow cavity containing 4 turns of copper magnet wire. It operates according to Faraday's law of electromagnetic induction, whereby a wire moving in a magnetic field sees an induced voltage proportional to the product of the velocity and the field strength. The magnetic field in this instance is provided by the permanent magnets found in typical electric guitar pickups, and the (very small) voltage induced in the wire is amplified by a custom low-noise integrating preamplifier.

A full engineering account of the sensor's operation is beyond the scope of this paper. Here, its crucial features include: that a signal is created only when the guitarist plays over the pickup area (and not over the fretboard); that it responds to the intensity of movement with a wide dynamic range; and that it responds to motion above the strings (not touching them) as well as to strums and plucks.

The amplified signal from the pick can then be used to modulate the sound of the guitar in one of three sound designs. In the *volume swell* condition, the amplitude of the guitar sound is modulated by the pick, enabling subtle shaping of the sustained part of a note, but requiring constant motion from the player for any sound to be heard at all. In the *harmonised delay* condition, plucking the strings creates a series of delayed harmonics of the guitar signal whose amplitude is controlled by the pluck strength and the proximity to the pickups. In the *scrambled delay* condition, waving the pick modulates the amplitude of a 5-second recorded buffer of the guitar sound; the buffer is played randomly such that the guitarist cannot choose what is played but can alter its volume.

Figure 2: The Magpick; wrist-mounted preamp; stompbox



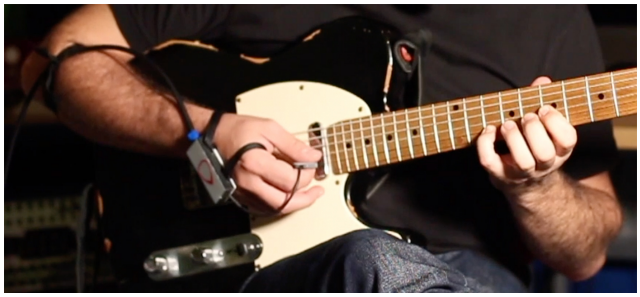
Design Considerations

Figure 2 shows the main components of the Magpick. We strived to give the guitar pick and the ancillary devices a finished quality which finds a sweet spot between familiarity and unfamiliarity. Guitarists should recognise the Magpick as the object they normally use to play the guitar, while at same time it must present itself as a different object.

The pick needed to be made of a durable material to withstand constant friction with the guitar strings, while also allowing a wire to be coiled inside. We initially used paper and clay prototypes and later moved to 3D printed model.

Figure 3: The 11 Magpicks given to participants of our study.

Figure 4: A guitarist using the Magpick system.



The final shape (Figure 2 left) is thicker than normal picks but has a pointed tip that allows for fast picking. A cap covers the hollow cavity and gives the object a distinctive aesthetic. We tested a few different materials for 3D printing or injection moulding. The final choice of materials was informed by their durability and grip, as well as by aesthetic and tactile qualities. We produced 11 picks (Figure 3) with different combinations of the two parts in acrylic (white, black, and grey), brass, and sandstone, which differed in texture and weight.

The housing for the preamp is designed to strap to the player's wrist with velcro (Figure 4), minimising cable length for a sensitive signal while staying out of the way of the fingers. The combination of pick and guitar signals takes place in a floor-mounted case resembling a familiar guitar stompbox, though without the typical on-off stomp switch: the effect is engaged all the time, and it is up to the player to adapt their playing to control it. In this way, the Magpick is not a pure extension of guitar technique but something that can also redirect and even frustrate traditional techniques, depending on the sound design.

4 USE BY GUITARISTS

We recruited 11 skilled guitarists to undertake weeklong playing explorations with the Magpick, a full account of which is beyond the scope of this paper. Each player was given a single physical version of the Magpick with a single sound design. In an initial video-recorded encounter, the player was left alone for 10 minutes to discover for themselves the Magpick's behaviour, after which point they were interviewed. They were then given a series of daily tasks to complete at home, and they returned at the end for a final interview.

Initial Encounter

During this initial exploration, 6 of 11 guitarists played mainly standard guitar repertoire and techniques, while the other 5 engaged in focused exploration of its affordances. All of these guitarists eventually discovered at least part of the new interaction possibilities offered by the instrument, which usually manifested as a moment of epiphany visibly marked by body language indicating surprise, facial expressions and/or exclamations such as: "*Aha!*", "*I see, I see...*". A notable result was the speed with which some guitarists (particularly on the *volume swell* condition) went from the moment of epiphany to incorporating the new techniques fluently into a complex performance also containing traditional techniques – in one cases, less than 5 seconds.

Patterns of Human-Technology Relations

Examining the emergent patterns of interaction through Ihde's levels of human-technology relations [2], many players demonstrated *embodied* and *hermeneutic* relations. In the embodied mode, the pick assumes the role of bodily extension, as is commonly found in traditional acoustic instruments. The player's focus of attention appears to be not *on* but *through* the pick toward an imagined sonic result. The embodied mode was characterised by rhythmic control and fine-grained intermingling of traditional and new techniques.

The hermeneutic mode (in which a technology is encountered through symbolic interpretation), we instead saw the guitarists' attention directed toward the pick itself, either continuously or intermittently. The Magpick's appearance in the foreground of attention might reflect a disruption of existing sensorimotor skill around traditional picks. These players nonetheless appeared to develop a conceptual understanding of the Magpick's function, sometimes expressed in interviews in simplified binary form (e.g. playing near the pickups or the fingerboard turns the effect on or off). A common pattern of interaction was for the guitarist to play a passage with traditional technique, then direct their attention to moving the strumming hand to a different part of the strings as if operating a stomp switch, before returning to traditional technique.

We also observed characteristics of *alterity* relations, in which surprising or difficult-to-predict behaviour led the player to ascribe to the Magpick a sense of *quasi-otherness*. In interviews, some guitarists used language similar to how they would describe interacting with another musician (*"when you're playing it you're sort of duetting with it"*). Finally, in a few cases the guitarist departed from the traditional role of the pick, for example plucking the strings with the left (fretting) hand only while waving the pick above the strings to modulate the sustain, or holding the pick in the palm of the hand while plucking with the fingers.

While observations from 11 players cannot generalise to all guitarists, sound design appeared to influence the type of relations that emerged. Players with the *volume swell* condition tended toward the embodied approach while hose with the *harmonised delay* approach tended toward the hermeneutic. Of course, Ihde's human-technology relations are not

fixed, nonoverlapping categories, and each player demonstrated a range of approaches at different times.

5 DISCUSSION

The Magpick aims to occupy a space which is conceptually familiar while challenging certain facets of embodied practice. It presents itself visually and by feel as a pick (the wrist-mounted preamplifier box notwithstanding) and thereby inherits various cultural connotations of a pick. The material and aesthetic design choices are integral to this presentation. However, its behaviour is often unfamiliar (though largely deterministic), challenging established training.

The result is that the Magpick is familiar at a conceptual level: after a relatively short time, it is possible to verbalise how the effects work, but at the level of sensorimotor pathways, the Magpick does not act as the expected extension of the hand: knowing how it works is not always equivalent to being able to play it, and so we see the emergence of different playing strategies, some involving considerable conscious attention, others thinking through the artefact toward an imagined sound.

Another example of a non-equivalence of concept and practice can be found in a violin with the strings put on in reverse order [4]. Violinists easily understand the transformation, but its incongruence with established sensorimotor skills means that violinists struggle to play it and find the experience frustrating and exhausting. From a design perspective, the quality of construction and finish is crucial to presenting a believable instrument to the player; a semi-finished research protoype might elicit a different reaction.

Though we are interested to explore how counterfactual artefacts could be extended into scenarios where the original class of artefact is the locus of a specific embodied and cultural practice, our scenario differs from Wakkary et al.'s Tilting Bowl [9] in several respects. The Tilting Bowl was the object of *co-speculation* with philosophers; we instead work with skilled musicians. Although both are engaged in their domains of expertise, we might expect to find more focused insights through physical demonstrations and vocalisations rather than linguistic explication. Our participants' engagement also took place over a shorter time (1 week). It would be interesting to observe whether over a longer term, we observe feelings of personalisation and attachment that we saw in a previous study of simple instruments [10].

Topics for Workshop

In the studio critique session, we are interested to explore how design processes and material factors can maximise the creative tension between concept and embodied practice. We took an iterative approach to producing a research product, guided by our own experience, but a discussion topic might be whether other musicians can or should be involved in the creation of uncanny instruments designed to challenge expectations.

We are also interested to discuss the role of interactive behaviours in RtD processes. We saw that for the same physical artefact, different behaviours gave rise to different relationships with the artefact. A possible discussion topic is how sculpting interactive behaviours in an RtD context differs in process from convenional interactive system design in HCI.

Finally, we would like to discuss how the scenario of musical performance might create particular types of engagement with design artefacts that are not present in more open-ended encounters [1, 9], and conversely how our design approach and observations might generalise to other domains.

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