



SOUND DESIGN FOR THE PLURIVERSE - A DESIGN EXPLORATION OF SONIC HERMENEUTIC AFFORDANCES OF INTERACTIVE THINGS

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ABSTRACT

As designed sound permeates our daily lives, sound designers deal not only with questions of aesthetics, perception and cognition, but with cultural, social, ethical and political implications of their creations. As a result, more and more attention is being paid to the sound design process and its impact on the creation of meaningful sonic experiences, especially in participatory design settings. However, relatively little is known about how meaning is constructed and shared in sound design and listening experiences outside of codified and formalized media such as film, videogames or music. This paper summarises the findings from a grounded theory study on the emergence and co-construction of meaning in speculative prototyping and co-interpretation activities. I will outline dominant interpretive reference points, cultural biases, and stereotypes that I refer to as hermeneutic affordances. This work contributes to conceptual and methodological approaches to pluriversal sound design by uncovering the diversity of aesthetic, cultural and narrative references and biases in sound design, using methods for commoning of design and interpretation of sounds.

Keywords: *sound design, interaction design, hermeneutic affordances, sonic pluriverse*

1. INTRODUCTION

Sound Design is a fundamental element in audiovisual media production, but also in the design of products, services [1–3] and spaces [4]. Interactive, computational

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things raise fundamental sound design questions. First, these artefacts are procedural, functionally fluid and embedded in complex socio-cultural agencies [5]. Second, the sonic reality of such artefacts is essentially *schizophrenic*¹, merging sounds originating from material processes with sounds produced by electroacoustic means [5]. The potential integration of artificial sounds into interactive products and spaces and the related ubiquity of interactive sounds results in an ethical, even political responsibility [7], as the sounds of an individual's interactions become part of the soundscape of many. Understanding how people attribute meaning is an important step towards making sound design a common issue, and making it the object of an inclusive discourse and participatory design practice. This paper focuses on understanding interpretation of sounds in potential real-world interactions with electroacoustic commodities and the emergence of meaning in design of, and interactions with, functional sounds².

2. AIM AND METHOD

Meaning is not simply encoded into an artefact, and then decoded, but emerges in situated, aesthetic, interactional experience [9–11]. In order to investigate this experience driven interpretation, plausible and tangible interaction opportunities are required, and both the designer's and

¹ R. M. Schafer used the term "schizophonia" to describe the condition resulting from the electroacoustic separation and displacement of sounds from their "natural" sources [6].

² This paper is based on the findings of my dissertation [8], which have been continuously updated by ongoing design research and practice. The dissertation, including the original source quotations from participants, can be accessed from http://people.zhdk.ch/daniel.hug/CLTKTYCLACK_data_Hug_2017

user's perspective need to be included in a dialogical manner. For this end, a workshop format for the creation and evaluation of experience prototypes of speculative interactive sounding artifacts was conceived. Nine workshops (4-12 days) were held, resulting in 29 experience prototypes. A total of 91 students and 5 expert guests participated. About 1/4 of the participants had a background in sound design, the remaining had a background in arts, interaction or game design. In response to the methodical aims outlined above, an adapted Wizard-of-Oz [12] experience prototyping method was used. Participants were asked to create plausible interaction design prototypes using physical props and simulate the computational system by an invisible person while another person used the prototype. Sound was integrated using midi controllers, simple sound production software and small to medium size loudspeakers. Details about the prototyping method and the process are reported in [13]. In order to provide a thematic focus and ensure the comparability of cases, design briefs were provided, which covered smart home appliances, health related applications, social interaction, spatial navigation or mobility. Each brief was associated with a design space constructed around bipolar situational categories to support decision making in relation to interaction (individual vs. shared, private vs. public, focused vs. casual), or relation to the artefact ("expert tool", vs "smart assistant"). This framework was based on previous work [14, 15]. Each prototype was demonstrated to the workshop participants and a semi-structured plenum discussion was conducted. The discussions were recorded, transcribed and analysed following the grounded theory [16] approach.

3. HERMENEUTIC AFFORDANCES IN DESIGN AND INTERPRETATION OF SOUNDS

The following sections provide a summary of interpretational patterns and reference points which emerged from the analysis of the experience prototypes and the related discussions. The analysis is based exclusively on the primary source data gained from the video recordings and discussions of the experience prototypes³. I borrow the term "affordance" from design theory [17] to describe how sonic qualities and associations directed interpretations without fully predetermining them.

³ While many of these findings can be related to existing theories of sound related perception and emotion, media and sound studies, it would go beyond the scope of this article to go into all of them. A detailed account can be found in my dissertation [8].

3.1 References to Basic, "Non-Mediated" Sound

This category refers to sounds and interpretations which were based on familiar everyday listening experiences as opposed to references to audiovisual media (see Section 3.2). Their meaning related to the everyday situations in which they occur.

3.1.1 *Water, Sounds of Domestic Actions*

A first subgroup comprises sounds that were reminding of water. Water is a strong sonic archetype but also a sonic symbol. In many cases the symbolic coding was dominating the interpretation. There were rather general symbols, such as "nature" and more specific (yet still complex) associations such as "health" or "purity". A special property of water sounds was its dynamic character, which in itself could afford interpretations, e.g. "waves of emotions".

Following the design briefs, some projects focused on domestic activities such as frying or boiling. The respective sounds could stand for cooking activities in general. They were used similar to water sounds, but not as symbols, but related to actions or setting.

3.1.2 *Clicks, Beeps, Computer Startup*

Similar, but with a very different range of reference, were sounds associated with an action or process related to the use of a computer. These sounds did not have to be exact copies of existing (computer) sounds, but could be based on shared general properties.

3.1.3 *References to Humans or Animals*

Anthropomorphism and zoomorphism were often present implicitly. They could emerge from subtle hints, e.g. to breathing or vocal utterances, or dialogical structures (see also Section 3.8). As opposed to water sounds, or sounds of frying, they required ambiguity to work. If those sounds became too figurative, the design quickly turned comical. Also relatively simple sound parameters such as pitch could lead to anthropomorphization, for instance when interpreted as exchange between "bassy male" and "treble female". One motivation for using anthropomorphisms was to make the artefacts more relatable.

Zoomorphisms were used for design and interpretation of engine sounds. In this case the effect worked based on a spectral similarity between actual engine sounds and predator growls and was supported by the association of predators with power or danger. This seemed to be motivated at least partially by filmic sound stereotypes (see Section 3.2). Another example of zoomorphisms with

symbolic meanings emerging from mass media was the sound of flies being associated with rotten food. Sounds of crawling insects were used and interpreted in a similar way. Other examples of zoomorphisms emerged in the design of textile artefacts. For instance, zipper sounds offered sonic patterns that could be merged with animal sounds to color the sound emotionally.

While the sounds mentioned in this section usually were familiar from real life, their meaning potential was strongly influenced by sounds we know from films. The next section is thus devoted to the impact of audiovisual media.

3.2 References to Sound in Audiovisual Media

The following sections report interpretations referring to audiovisual (mass)media.

3.2.1 References to Specific Movies or Film Sounds

In some cases, sounds evoked well-known sounds of artefacts or protagonists from popular movies. These sounds are widely known in European and Anglo-American cultures. The sounds did not have to be an exact copy of their film counterparts, spectro-temporal similarities were sufficient. These associations often were not intended by the designers, and such sounds often caused problems, as they would lead to re-framing the overall interaction experience with the filmic association.

3.2.2 Association with the “Filmic” or Film Genres and Styles

Some sound design and interpretation approaches used overemphasis and sonic density reminding of blockbuster films or advertisements. Even if the resulting interpretations were in line with the designer’s intention, such sounds often led to the sound being perceived as an emphasis or statement, rather than an integral part of the interaction. Such sounds worked best when used with large or loud artefacts, such as cars, but even then their symbolic power might distort the experience, or be lost when translated into an everyday interaction sound.

In other cases, specific sound qualities evoked filmic genres or sound styles. For instance, there were associations with 50s-60s SciFi when hearing pitch modulated sine waves, or with fantasy or horror movies when specific stereotypical chimes or screeches were used.

3.2.3 Association with Filmic Sonic Narrative Devices

In some cases the interpretation followed narrative film sound conventions [18]. For instance heartbeats or breathing would be associated with the filmic stereotype for danger or ticking sounds were used to indicate passing time or temporality. Also in this case the sounds may work well in terms of decoding the intended meaning, but pointed to a different (filmic) context than the action presented.

3.2.4 Dramatization and Judgement of Action and Processes

Sound was often used to emphasize a visual action or an object. For instance metallic resonances could be associated with the gesture of pulling something out of a bag, similar to the sound of a hero’s sword being pulled from the shaft in a movie. Other dramatizations aimed to convey invisible energies, for instance when using a charging sound before an impact. Furthermore, there were references to filmic sound stereotypes associated with magic, such as chimes. This association also emerged with sounds which were perceived as pure or salient. In these cases the meaning resulted from an interplay of filmic listening experiences and abstract sonic qualities such as roughness, clarity and often a related (e.g. magic) quality of a gesture or object.

3.3 Analogy-Driven Design and Interpretation

A common approach to design and interpretation was based on analogies between sensory stimuli or the experiences associated with them. Two, sometimes overlapping, types of analogies could be identified. One referred to formal, or procedural analogies, the other to crossmodal analogies correspondencies [19].

3.3.1 Formal or Procedural Sonic Analogy

Formal or procedural analogies emerged from sounds which were similar or reminiscent of sounds associated with another process, or which reminded of process properties. For instance a gradual reduction of low frequency content might be associated with shrinking. A sound also could be shaped temporally to evoke a familiar sound pattern such as a stuttering car engine. Another category were sonic manifestation of physical processes, such as the changing pitch being associated with accelerating or decelerating engines or sounds reminding of common mechanical interactions, such as the use of locks. There were analogies with sonic manifestation of material states, such as dryness, which could be evoked by rustling sounds.

Also here the meaning potentials often were accentuated by filmic associations, as movies often present similar sounds in a clearly perceivable and understandable way.

3.3.2 *Crossmodal Analogies and Correspondences*

Examples of interpretations basing on crossmodal analogies were pitch modulations, which often were related to height, both metaphorically (“higher number”) and physically (e.g. “going up with an elevator”). However, pitch was seldom used as isolated sonic property as it leads to unpleasant sounds or was considered boring. Crossmodal analogies in relation to an object’s visual or formal quality were more common. For instance, brighter objects would be associated with brighter sounds. Large voluminous objects would have more low end frequencies and reverberation, small objects would sound thin. Other formal-aesthetic crossmodal analogies related to structural analogies, e.g. of a chaotic construction being associated with chaotic music and vice versa, the sounds becoming more homogeneous as the construction of form would become more geometrical and simple. In general, crossmodal analogies could contribute to experienced coherence by establishing common classifications of the artefact’s (sensorial) properties.

3.4 **Simultaneity of Abstract and Indexical Qualities**

Often there was no clear line between abstract and indexical qualities of sounds. Some interpretations focused on the sounds themselves, others emphasized concepts associated with sounds.

3.4.1 *Abstract Sonic Qualities as Interpretational References*

Abstract sonic qualities could suffice for interpretation, in particular if it was related to an abstracted process, such as increasing energy in an imaginary engine. Particularly fine, pure sounds or particularly “thumpy”, full sounds would be remarked as particularly relevant for the experience and interpretation processes. In some cases, the design was starting from a familiar (natural) sound which then was processed in order to focus on its abstract properties. In some cases the design and interpretation worked with synthetic sounds that carried spectro-temporal similarities to materials such as metal or wood.

The focus on abstract sonic qualities was also often used when looking for affective sonic qualities. For instance, a sound might resemble vocal utterances, exhibit

roughness, or convey instability, etc. Affective sonic qualities could also emerge from transformations, e.g. from a voluminous to fine, from harsh to dull, or from stable to oscillating, or contrasting juxtapositions. Also, the contrast of a sound with a sonic background in the mix could elicit affective responses.

As mentioned, there was no strict separation between indexical and affective qualities of a sound. It was the nastiness of the flies dissonant hum, and the gut-wrenching power of a tiger roar, which together informed the interpretation. Abstract sonic elements or qualities were often combined with indexical references. The interplay between these two seemingly differing references can be established within one sound, e.g. by modulation, or in the combination of two sounds. In the most successful cases, this combination resulted in a cohesive, yet multifaceted narrative, a sonic “character design” which supported establishing positive relationships with the user.

A special case were figurative sounds which aim to imitate some real world sound using synthesis. This can be interpreted as means to establish indexical associations while avoiding a naturalistic presence of the represented sound event.

3.5 **Other Types of References**

3.5.1 *Musical Codes and Conventions*

Musical conventions were always based on tonality, (western) harmony and melodic elements and the related stereotypes (e.g. major = positive, minor = negative). Another musical design approach was the use of stereotypical musical elements or instrumentation in order to establish a cultural or ethnological reference. This often related to a cultural bias underlying many sound design decisions, to which we will return later.

3.5.2 *Spatiality*

In some cases, spatial extension and perceived distance had an effect on interpretations. Sounds originating from a point in space, sounds that had no clear location, or sounds that surrounded the audience could be used to draw attention from general to specific listeners. Also spatial movement was used. Occasionally, sound qualities were interpreted as directional change, for instance when timbral shifts similar to phasing were understood as horizontal movement, without panning effect in a stereo setup. Reverberation was a special case of sonic manifestation of space, as it could oscillate between (musical) style, sign

(or symbol) and spatial phenomenon. This is another example of the close relation between the naturalistic and the representational use of sounds or sonic properties.

3.5.3 *Technical Effects and Sound Processing*

Some designs employed phasing, distortion, digital glitches or bit-reduction. These sonic phenomena are familiar because they are widely used in music or audiovisual productions. Another related sound cliché was the pitch modulations associated with audio tape or vinyl record manipulation to represent changing speed, and often led to a somewhat comical result. These processing effects were used for their sensory quality (e.g. making a sound more rough) or as support of a control task (e.g. transitioning from clean sounding to distorted when moving into the wrong direction) or they worked as iconic sounds indicating a system overloading or a radio transmission taking place. Their interpretation could depend on the expertise of the listener in terms of audio processing technology. If a processing technique was identified as such, in some cases this would distract too much from the intended message or effect. Similarly, such effects may lead to undesired secondary associations, e.g. certain digital glitch sounds might remind of the movie Matrix.

3.6 Establishing Source, Cause and Agency

Sound was often used to point to a source, or a cause. The references were not only the recording source of a sound file, but could refer to an object or location in space, a certain action, e.g. by the user, but also a system with no particular spatial location. These sources or causes always had to be established first before they could be used in an interaction context. As opposed to auditory icons, which rely on source identification, many ambiguities could be identified, which were not identification errors, but indicated a multitude of valid interpretational perspectives. The overall coherence between sonic elements was particularly relevant here. If a sound would not fit well to others, for instance because it was perceived as a filmic sound cliché, it would lose the intended causal attribution.

3.6.1 *Presence, Location*

In some cases, sound was used to establish a presence of an interaction system, which could be a human agent, a functional element, or “the system” as such. This presence could also be understood as a prompt to interact or provide input. Unlike common notification sounds, this effect often was achieved by means of continuous, rather

subtle sounds. Furthermore sounds could be associated with the setting or situation in which an interaction would take place. For the attribution of sound to a source the audible direction played a role, but was not necessarily relevant. Usually the visible action would bind the sounds to it, similar to the ventriloquist effect. On the other hand, enveloping sounds would afford the identification of an ubiquitous environmental system. Another factor could be the size of the visible object. A “large” sound associated to a small object would not lead to a breakdown of the interpretation, but redirect it towards, e.g., metaphorical properties, such as “powerfulness”.

In general, the re-configuration and re-attribution of object sounds in relation to object size was possible, if the motivation for the sound did not relate to a physical dimension or process, but to a “expressive quality” of the (inter)action, a semantic or aesthetic correspondence. It worked particularly well if the sound did not relate directly to an actual action or manipulation of the object, but rather to an asynchronous response, or “passive” presence, of the system.

3.6.2 *Attributing Sound to Agency of User or Artefact*

The attribution of a sound to agency of either user or artefact was relatively common. Several design strategies for differentiating user interface sounds from sounds attributed to system processes and actions could be identified. Attribution of agency to a human agent often was motivated by a gestural connection. On the other hand, if a sound was interpreted as expressing a quality of a system or process, a related sonic movement or transformation was associated with the agency of the system or objects. Musical sounds, or very resonant, spatial or low pitch sounds were often attributed to a system rather than a human. Attribution to user or artefact agency was not necessarily related to the question of who or what generated or controlled the sound, but to who was “responsible” for it. A user might advice a system to become active, or might execute a gestural control action onto a sound-producing process. Conversely, an artefact might call for a user’s action, e.g. by modulating an existing sound. Also the attribution could shift or oscillate between human and non-human agents, due to the dialogical nature of interactions. The sounds had to afford this change, e.g. by providing timbral content that allows to change without reducing the overall coherence of the sonic object. Temporal synchrony was relevant, but rather flexible: A delayed sound could be perceived as a system’s answer to an user’s action.

In general, it seemed that sonically manifested agency was attributed to an artefact if the human agency involved did not affect the artefact's sound, or if there is some kind of dialogical behavior, where human action results not only in a feedback sound, but in a sonically expressed action by the artefact.

3.7 Relationship of Sound with (Gestural) Action and Function

Some interpretations were associated with relations between sound, bodily action and gestures. There was a difference between action as visible, bodily movement, and the more general notion of (intentional, goal oriented) agency which was discussed in the previous section.

3.7.1 Direct and Indirect Action-Sound Relations

Sound sometimes supported continuous action-sound processes. For instance, musically meaningful repetition of individual sounds could motivate sustained activity. Repeated action could sustain or transform a continuous sound towards a (musical) goal. The relationship of an action with sound was not necessarily based on synchronicity and could be indirect. A relatively common pattern was that sound would “reply” to an action or that it felt like a consequence of the action or movement.

3.7.2 Impact of Action and Sound on Experience and Interpretation

In some discussions, there was a focus on the aesthetic quality of the relationship between gestural movement and sound. Observable action, gesture and the related functionality could guide and even define interpretation. A subtle gesture may attract attention to a fine sonic modulation which otherwise might go unnoticed. A slowly executed gesture might imply some resistance, which then coloured the sound interpretation. However, in general there was no simple unidirectional effect of gestures and actions, but a mutual interplay in an abductive process. For instance, a warning sound could be immediately evident to the audience, even if it would not sound like a common warning but rather because of “being out of place” in relation to the observed action, or the result of something not working or progressing as expected (e.g. in the logic of a tonal sequence).

3.7.3 Sound Qualities Motivated by Gestural Action

Sounds could be motivated by a gesture or an action. Interestingly, this was often achieved by an indirect map-

ping of the gestural movement to sound. In other cases, the connection emerged from narrative, or semantic relationships. For instance, some designs proposed touchless remote interaction where the sounds would relate to the dramaturgy of the implied action rather than the bodily (control) gesture. Mixed forms with elements of a sound related to the effect of the gestural action, and others elements representing the gesture, were common.

3.7.4 Gestural Sonic Affordances and Qualities in Sound

Gestural sonic affordances often played an implicit role. In some cases, sound motivated an action or movement, or the adjustment of an action, e.g. by perceived inertia of a system. An interesting strategy was to use an unpleasant sound which then could be made more pleasant by executing the appropriate action. There were also several cases where certain sound qualities lead to the perception of movement qualities. Participants sometimes found it easier to describe the experience in terms of movement qualities rather than sonic properties.

3.8 The Impact of Structure and Composition

Apart from an individual sound event also the temporal and compositional structure was relevant.

3.8.1 Temporal Development and Relationships

Structural properties involved sonic sequences, process dramaturgy (e.g. from tension to relaxation) and temporal properties (e.g. as phases or coherent flows). The sounds in these cases were considered individually, but also in relation to their predecessors. Repetition with or without variation and rhythmicity worked similar to musical composition. Another design strategy was to work with tempo (changes), rhythmic structures and event density. The sequencing of sounds might support interpretation even if individual sounds were not meaningful. The oscillation between reflecting individual sounds and their place in the sequence of events was common.

Sequentiality also influenced the interpretation of sound qualities by directing the listening focus onto particular sonic qualities, or by placing a sonic quality in a special segment of a sequence. As a simple example, two pitches approaching harmony would take the focus away from the rather banal pitch modulation as such and emphasize the notion of “fusion”. Sounds were often used to convey transitions and transformations, which required a perceivable temporal development. Transition sequences could be open ended or aimed towards a (sonic) goal.

3.9 Grouping: Foreground and Background, Semantic Links

Structural sonic relations could play an important role for establishing semantic relations, also with abstract sounds. By systematic and persistent combination of sonic elements, belongingness and structure of temporal processes could be conveyed. Sonic elements in repetitive structures or in sonic categories (e.g. by virtue of source attribution or cross-modal analogies mentioned earlier) could work like theme and variation in a musical composition. Grouping, especially into foreground and background, could also establish hierarchical structures. Foregrounding of sounds was often achieved by using tonal or timbral contrast, for instance by suggesting materialities, establishing “outstanding” or unexpected sonic references, using salient resonances, or culminating in a complex harmonic chords. Perception of similarity or continuity between two states is also a prerequisite to perceiving transformations. Sonic grouping effects were also essential for the attribution of agency, e.g. to a system or human agent.

4. DISCUSSION

The present report is an attempt to decipher and summarise the rhizomatic diversity of tacit concepts and patterns of interpretation as they emerged from the design cases and the related discussions with the designers and listening “users”. Three aspects seem to be particularly relevant for the discourse and design practice.

First, the *normative power of filmic sound design and interpretational patterns* onto the interpretation processes was remarkable. Films and western sonic or musical stereotypes are particularly powerful in establishing interpretational “standards”, thus they were seen as “safe basis” for unambiguous sonic communication, satisfying the desire to “be understood”.

Second, *naturalistic and indexical sounds are of limited value*. They may be efficient to support understanding, but the range of sounds which are a priori identifiable and the range of potential applications, is limited. Furthermore, both, filmic and indexical everyday sounds had a tendency to distract from the actual artefact, task and scenario.

Third, the *interpretations were not linear decoding processes, but they were negotiated and co-produced*. Ambiguity cannot be avoided, hence the goal of design should be to provide multiple converging hermeneutic affordances that can be picked up by diverse individuals

from their respective backgrounds and situational listening modes.

This research shows, that meaning emerges from the experience of sound in a socio-culturally situated process. Any attempt to convey and understand meaning has to embrace the diversity of interpretational perspectives. This resonates with the understanding of the world as *pluriverse*, where multiple ways of creation and understanding are possible and even required, and where relationality rather than institutional or corporate power becomes a driving force in attribution of meaning and value to phenomena, things and beings [20]. This puts an emphasis on a main problem of this study: like most of the literature in auditory display it has an implicit or explicit focus on western, anglo-european media products and soundscapes. Following Arturo Escobar, I propose to explore a sound design imagination and design practice that contributes to a sonic pluriverse rather than a normative sonic universe. Escobar envisages a new role for design as participatory, inherently social, place-based, and open-ended practice which is not based on the notion of a singular line of technocultural progress driven by the west, but the co-existence and equivalence of a multitude of cultures and value systems.

5. CONCLUSION

As consequence, future work needs to address the theoretical and practical implications of adopting a pluralistic, diverse and inclusive approach to the design of functional sounds. This requires re-listening, un-learning, and decolonizing what we seemed to know about sound, sonic aesthetics, semiotics and what constitutes “good sound design”. An emphasis on emerging non-western sound studies [21], decolonized community led audio practice [22] and the recognition of aural diversity [23] is called for. Apart from an ideological and conceptual reorientation, also a methodical reorientation is needed. A central concern will be to establish participatory and inclusive design processes and ways for commoning design and interpretation of sounds. Preliminary steps in this direction have been done with the project *Peripher_ies*, which included participants from Africa, Australia, Asia, Europe, North America and Australia [24] and will be continued in the context of international Shared Campus activities at Zurich University of the Arts⁴ and an ongoing study on principles of participatory sound design building on the

⁴<https://shared-campus.com/>

results of the project “Participatory Approaches to Sound-Driven Design”⁵.

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⁵<https://cordis.europa.eu/project/id/893622>