Sonification as Negotiation - Learning from Translation Studies

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ABSTRACT

This paper introduces a first comparison between the research domains of translation studies and data sonification. This contribution explores the idea of considering the practice of sonification as an hermeneutic motion which entails the transfer of information across different media. Sonification is then envisioned as an adaptation concerned with the transfer of incoming data into sonic forms. Translation theories are used to reflect on various sonification approaches: three translation perspectives are discussed and compared to different sonification scenarios. The notion of negotiation is suggested to frame the translation of data into sound as a process by which the designer mediates between the source data and the target sound.

1. INTRODUCTION

This paper attempts to combine two apparently distant areas of research: translation studies and data sonification. The point of departure is that the mature corpus of translation theories could inform and enhance the much younger research domain of Sound and Music Computing (SMC). This contribution is a preliminary overview of such convergence: rather than proposing a structured framework, the intention is to introduce a set of reflections that, if further formalised, might unfold a walkable research path. This article is therefore conceived as an open-ended speculation to stimulate and better understand sonification research by expanding its frontiers and offering some alternative (raw) concepts. In order to better frame the scope of this contribution, the two main perspectives grounding the rationale for this research will be introduced.

Sonification is here discussed as a broad set of practices focusing on the *"transformation of data relations into perceived relations in an acoustic signal for the purposes of facilitating communication or interpretation"* [1]. The word *sonification* is then used as an umbrella term, roughly gathering diverse approaches that emerged during the last decades. These include auditory displays and icons [2, 3], earcons [4], model-based, parameter mapping and wave space sonification [5–7]. Sonification is also practised within art communities and it can be found across diverse creative disciplines (e.g. sound-art, music composition and musical interface design) [8].

This approximate perspective falls short in acknowledging the diversity of methods and purposes that characterise these research areas. However, notions from translation theories are proposed as versatile tools to comprehend various trends in sonification practices, despite their differences. This framing is grounded on the idea that both sonification and translation share a common element: they are ultimately concerned with the transfer of information from a semantic system to another. In the context of this paper, a semantic system can be considered as a set of information coherently organised (e.g. a sequence of data represented in binary numeral system). Although rather reductive, this premise allows to consider both sonification and translation as communication practices where information can be encoded (i.e. converted into another form of representation according to specific criteria) for transmission and interpretation.

Despite these working definitions, translation and sonification cannot be considered as equivalent. For instance, translation relates to the transfer of textual information from one language to another (i.e. the medium of text is kept), sonification instead comprises the transformation of data into acoustic signals where information traverse different media (i.e. from the digital medium to sound). It will be possible to reduce the gap between translation and sonification by considering translation as a process of adaptation: an act of interpretation that, while engaging and acknowledging the source material, might entail its modification. Adaptations involving the transfer of contents from one medium to another occur in disparate contexts, amongst others: theatrical adaptation, remake productions, parodies and collages, ekphrasis (visual description of a visual work of art), subtitles for the deaf and hard of hearing people, auditory feedback for visually impaired persons, etc.

In order to illustrate these concepts, translation theories are therefore discussed through the lens of cultural studies and, tangentially, philosophy of language [9, 10]. The literature considered ranges from the early contributions of Humboldt and Schleiermacher [11] to more recent cultural investigations, such as Venuti's reflections on the *"translator's invisibility"* and the need of accommodating domestic and foreign cultures while translating [12, 13]. Above all, the work of Umberto Eco [14] influenced the reflections proposed in this paper.

The two fields considered are characterised by strong mul-

tidisciplinary connotations, however, to the extent of my knowledge, a direct link between translation studies and sonification practices has never been explicitly proposed. Rather than suggesting an explanatory model for a systematic correlation between sonification and translation, the intention is to investigate a few elements that, due to their affinities, might be considered as useful devices to understand our practices.

The exploratory ideas here presented which might provide useful conceptual tools to better comprehend the diverse mindsets, methods and objectives that characterise current sonification practices. The concepts introduced are then discussed from a broad viewpoint, without engaging into the specificity of contexts and uses. Such a generic view clearly limits the depth of the paper and it demands further developments and careful reflections based on the particular cases, purposes and design applications.

Overall, this paper avoids technical analyses, design implications or methodological guidelines. Instead, the goal is to examine different research concerns and attitudes that often precede design choices and inform sonification's purposes and scopes. The reflection focuses on (i) the intentions of the sound designer (the translator), (ii) the quality of the sonification task (the act of translating) and (iii) the communities of listeners (users, audiences, performers, etc.) to which the communication is addressed. Furthermore, the discussion should be intended in the context of non-speech sound and it is not concerned with the ways data are collected.

After covering relevant literature, three basic relations between input data (the source material) and sonic rendering (the target matter) are proposed: literal translation, semantic interpretation and critical interpretation. These relations will be illustrated with examples of sonic interaction designs found in the literature. Finally, in order to frame the opportunities and weaknesses that might arise with this approach, the concept of *sonification as negotiation* will be introduced.

2. BACKGROUND

2.1 Sonification or sonifications?

Since the first International Conference on Auditory Dispaly (ICAD) in 1992 [2], this field of research has seen a flourishing of viewpoints and methods. A well know example of such diversity is the article by Alexandra Supper on "Trained Ears" and "Correlation Coefficients", in which she observed the presence of two cultures within the ICAD community [15]. Auditory display related practices indeed comprise both systematic approaches - envisioning sonification as an instrument of rational knowledge [16–18] - and artistic perspectives - where neither sonification's disciplinary consistency nor its qualification as a scientific method are supposed [19]. In order to bypass the cultural divide between sciences and arts, Stephen Barrass advocated for a distinctive design-oriented alternative that complements scientific and artistic approaches [20].

ICAD research currently unfold a great variety of approaches beyond the art-science dichotomy. Roccheesso et al. [21] thoroughly illustrate the constellation of concerns and trajectories researchers are currently engaged with [1]. This inclusive survey comprises perspectives coming from embodied cognition [22], interaction design [23], pedagogy and disability [24, 25] (amongst others). These expansions and diversifications are often described in relation to the three "waves" of Human Computer Interaction (HCI), each supporting increasing levels of intellectual diversity [26].

In SMC contexts, the phenomenological discourse introduced by the third-wave HCI fosters researchers to open their views beyond the technical element and considers "sound in computation as a dimension of everyday life, with aesthetic, emotional, and cultural connotations" [21]. According to this ethos, cultural studies on sound and technology [27, 28] are increasingly appreciated as integrative and critical contributions even in research contexts mainly driven by techno-scientific concerns [20, 21].

This paper relates to these research trends sharing their overall sensitivities and concerns. In line with these scholarly and epistemological values, the intention is to add to this heterogeneous body of research by proposing a contribution that draws on literary and critical research domains.

2.2 Translation and adaptation studies

The discipline of translation is often framed as a *hermeneutic* process: an empathetic projection of the interpreter's desire to understand an activity [29, p.94]. Schleiermacher is one the first authors that discuss the practice of translation as an act of interpretation that makes a text conform to a target culture [30, p.141-166]. He suggests that a translator might approach this task in two different ways. Either making a text conform to the culture of the language being translated to - which may involve a loss of meaning from the source text - or deliberately breaking the conventions of the target language to preserve the source text and its particular connotations. In translation studies, these two attitudes have been debated for a long time but they were formulated in their modern sense by Venuti in his work "The Translator's Invisibility: A History of Translation" [13].

According to this perspective, translation is therefore considered as a process of mediation where the translator interacts with the culture that lies behind source and target languages [12]. Rather than objectifying a text - e.g. examining it with the methods of empirical science - translators imagine themselves inside the cultural system that produced the work and they speculate on the most appropriate ways to convey contents to the target community. This view is in line with Steiner's idea of translation as a *hermeneutic motion*: *"the act of elicitation and appropriative transfer of meaning"* [10, p.186]. According to Steiner translation entails an initial act of trust - *" we grant that there is 'something there' to be understood"* - followed by the attempt of comprehending and internalise the text. The text is then imported into a new form aiming to equalise source and target and create a faithful impression of the

[1] This paper in particular moves from a designerly way of practising sonification whit strong influences from electroacoustic music and New Interfaces for Musical Expression (NIME) research

original. Also Steiner acknowledges that, while moving texts and contents towards the target language, despite the translator efforts to restore the source material, the original work will be inevitably transformed [10].

The ideas introduced in this paper are inspired by the notion of hermeneutic motion, proposing that sonification can be considered as a transfer of information from the digital domain to sound. This conversion necessarily implies the alteration of the conveyed information. Although the extent of such transformation will vary depending on the sonification contexts and purposes, this modification will occur also due to the fact that information is conveyed across different media. In his essay "On Linguistic Aspects of Translation", Jakobson discusses three types of translation: intralinguistic (or rewording), interlinguistic (from one language to another) and intersemiotic. Intersemiotic translation can be defined as the *"transposition of meanings from one system of signs into another, for example, from verbal art into music, dance, cinema, or painting"* [31]. Eco explicitly refers to intersemiotic translation as the *"transformation of a novel into a film, a painting into a poem or a fairy tail into a ballet and so on"* [14, p.123].

In translation studies, researchers often mention intersemiotic translation as a translation carried out amongst multiple media. Thus, contents are conveyed through different semiotic systems, i.e. not just between the written or spoken languages, but also through sound and/or images. In this context, the emergence of new media strongly contributed to the creation of new paradigms alongside traditional translation theories [32]. These interdisciplinary practices include adaptation and interpretation studies [33, 34] - see the Journal of Adaptation Studies [2]. As an example, audiovisual translation studies are concerned with translations that take place in audio and/or visual settings, such as cinema, television and video games [35]. The contribution here proposed might be contextualised within the adaptation and intersemiotic frameworks: this paper is essentially a rather sketchy attempt to re-contextualise Eco's theories on interpretation and intersemiotic translation [14, 36] within the practice of sonification.

3. SONIFICATION AND ADAPTATION

3.1 Literal translation

An early concept advanced in translation studies relates to the *word by word* interpretation of a text: a *"word by word and line by line translation ... correspond to literal translation"* [37]. Berman refers to this modality as a translation that *"deals with texts that entertain a relation of exteriority or instrumentality to their language"* [38]. This systematic attitude might resonate with sonification practices concerned with accuracy and reproducibility.

A medical device that produces a tone varying in pitch with the level of oxygen in the patient's blood should render an objective and precise translation of data and sound. Similarly, the acoustic feedback of an altimeter is designed to convey a precise measurement of altitude. It is possible to imagine this rendering of information as a hermeneutic motion from the outer word (incoming data) to an inner understanding that enables a clear perception of tight and narrow task dependencies.

In the context of sonification, the concept of literal translation might be conceived as an interpretation characterised by precise and generalisable relations. The criteria governing the motion of information from data to sound are not limited to a particular context (e.g. the altimeter must function in the same way despite its location). As a literal translation exploits constant and uniform correspondences between words of different languages, a literal sonification seeks to establish unambiguous and faithful relations between data and sound. In sum, this literal approach to sonification fits to the goal of delivering *"reproducible results* and thus trust sonification as a systematic method *"to obtain insight into data under analysis"* [7].

3.2 Semantic interpretation and use

In "The Limits of Interpretation", while discussing interpretation with regards to communication theories and media studies, Eco distinguishes two levels of interpretation [36]. The first is described as a primary semantic interpretation: *"a process by which an addresser, facing a linear text manifestation, fills it up with a given meaning"* [36, p.54]. In the context of text, the writer guides the reader's interpretation to fall into the traps of the narration. For instance, the author of a mystery tale might develop narrative processes in order to elicit specific emotional and cognitive reaction to feel fear or to suspect the innocent one. However, any act of communication eventually entails a subjective semantic interpretation (e.g. the same book can be differently interpreted by different readers). Based on this circular process, Eco argues that, while interpreting we *use* the text. To use a text *"means to start from it in order to get something else, even accepting the risk of misinterpreting it from the semantic point of view"* [36, p.57].

In sonification domains, similarities might be drawn when data are interpreted in order to *use* (interpret, alter or broaden) the original information in function of specific communicative purposes. This approach differs from literal sonification, as the transfer of information into sound is not any more a direct render of data. Rather, sonification is used to point the listener's attention towards new references which, although still linked to the original information, expand the semantic domain. This hermeneutic motion can be conceived as the designer intention to use data as a means to intertwine humans and objects (in a broad sense) through sound. Therefore, a semantic interpretation relates to a communication that introduces additional information in light of specific goals and contexts.

Sonification practices that aim to propose further contents or suggest imaginative and emotional allusions in relation to the input data are exploited in a variety of contexts. These include artistic explorations [39, 40], pedagogical investigations [41] and sonic interaction design research [42]. An example of this kind of approach is the work of Barras on acoustic sonification where a data-set is mapped onto the shape of a 3D printed singing bowl. This 3D printed sounding object incorporates time-series

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data about a chemoterapy treatment and the sound the object produces when striking, tapping or rubbing on it, is both informative and strongly emotional [43]. Researchers might privilege this approach while aiming at communicating rich, emotional and aesthetic contents. This kind of sonification might then facilitate the expression of subjective and situated meanings, a task that might be difficult to achieve with more rigid and systematic methods [44].

3.3 Critical interpretation

The second level of analysis proposed by Eco can be defined as critical interpretation. Critical interpretation is *"a metalinguistic activity which aims at describing and explaining for which formal reasons a given text produces a given response (and in this sense it can also assume the form of an aesthetic analysis)"* [36, p.54]. Eco suggests that the majority of texts implies the co-presence of both levels: *" a first level ... supposed to understand semantically what the text says, and a second level, or critical one, supposed to appreciate the way in which the text says so"* [pp. 54-55].

Such critical mindsets might be found in sonification contexts where sound and music are exploited to translate information generated through an expressive or creative act. Namely, when dealing with the communication of aesthetic and affective contents. Examples of this procedure might be found in movement and dance sonification research [45], audiovisual performance [46], circus art [47] and broadly in media arts. An example of such approach is the work of Wechsler et al. on the Motioncomposer: a device that turns movement into music using video-based motion tracking [48, 49]. The project, which has been used in both therapeutic and artistic contexts, is the result of an intense collaboration between dancers and music technologists involved in the practices of interactive dance, composition and affective computing.

This kind of sonification could be compared to a *sense for sense* translation [37]: a challenging act focused on the comprehension of creative and aesthetic contents. While investigating the nature of information conveying expressive meanings, a critical translation might also enquire the cultural contexts that produced the source material to be conveyed through sound. In comparison with translation practices, this process presents strong analogies with the difficult task of translating poetry (where the translator is considered as important as the author).

A well known concept in translation studies suggests that while looking for words that should transpose the original content, the translator might contribute to the growth of the target language. In the same way, the design of *ad hoc* sonic interactions driven by a critical attitude might enhance the experience of the original information as well as generate a unique musical aesthetic - *"a translation exists separately but in conjunction with the original, emerging form it and giving the original text continued life"* [9].

4. SONIFICATION AS NEGOTIATION

The idea of framing sonification as a form of translation is nevertheless rather problematic. We might consider the practice of organising sounds as a form of language but *"in saying so we use 'language' in a peculiar unstable sense. We may be using it either at the most technical semiotic level (both are 'sequential rule-governed sign system obeying certain constraints') or in a sense almost too large for proper definition (both can communicate human emotions and articulate states of mind')"* [10, p.445]. The elusive gap that divides language from the use of sound for communication purposes might shatter the reflections proposed in this paper.

Also, the fact that sonification implies the transfer of information across different media further complicates our discussion. In this regard, the motion of contents from one semiotic system to another (e.g. from one medium to another) might be better considered as an adaptation rather than a proper translation [14]. Eco outlines this problem as a *matter of matter* observing that *it seems difficult to translate in words the Beethoven's Fifth, as it is also impossible to 'translate' into music the whole Critique of Pure Reason"* [14, pp.156-158].

In order to clarify these controversies, it might be beneficial to consider Eco's idea of translation and adaptation as processes of negotiation. Negotiation can be understood as a dialogue by virtue of which, in order to get something, each party renounces to something else [14]. This practical attitude aims to reach a compromise between source and target texts. Borrowing from this metaphor, it is possible to frame sonification as a transfer of information by means of which something will be necessarily lost. The interpretation of complex and large data sources based on the isolation of *features* through digital signal processes can be consider as an example of such loss. For instance, while filtering and smoothing large data-sets we *ignore* a large amount of the original data, nonetheless, thanks to these processes, we are be able to discover and convey hidden information out of complex data.

Eco also discusses the notion of translation as negotiation from the cultural perspective, he does that through a complex analysis related to the production of *meanings* that is clearly out of the scope of this paper. In a nutshell, one of the arguments proposed by Eco refers to the idea that a translator *"moves within a framework of semantic systems that education, culture and history have organised for him"* [14, p.178]. Eco's notion of negotiation can be framed as the struggle of the translator to transfer a source message across cultural borders. As suggested by Venuti, this motion inevitably *"reflects the values, beliefs, and representations that the translator inscribes in it [the text]"* [12]. These qualities are inevitably *"linked to historical moments and social positions in the domestic [target] culture"* [12].

Sonification practitioners might learn from translation and adaptation studies the benefits of taking into account the pre-existing assumptions, knowledge and ways of knowing characterising the target community (e.g. specific users, personas or audience). According to this view, if the anal-

ogy with translation is still valid, there are no guarantees that the same sonification will be perceived in the same way by two different cultures. The perception of sound is indeed strongly shaped by cultural and social dynamics [50, 51]. As aesthetics and ethics change, a sonification realised today might be perceived differently in a couple of generations time. In this regard, amongst the approaches previously mentioned, the sonification of aesthetic contents (e.g. translating into sound the movement of a dancer) is probably the most provisional. As translating poetry is considered the most difficult type of translation, it seems appropriate to stress the fragility characterising those sonifications concerned with the interpretation of aesthetic contents due to their dense semantic import and stratification of meanings.

5. MAPPING AS HERMENEUTIC MOTION

Sonification is often conceived as a set of techniques in which data is mapped to sound to communicate information about its source to a listener [52]. Mapping can be understood as the process through which different relations are established between two given systems [53]. This procedure mostly relates to the technical need of organising complex realities by means of schematic representations. The notion of mapping generally unveils a procedural gaze directed towards the simplification (or modelling) of a phenomenon to facilitate its understanding.

Mapping procedures generally entail the definition of two systems with their parameters. In turn, parameters can be defined as numerical features through which it is possible to describe and manipulate the two systems. From a general viewpoint, the parameters of a system are useful when evaluating its performance and status. Although the notion of parameter has a techno-scientific origin, the terms is also widely used within the musical domains. For instance, the legacy of early electronic music [3], concerned with the organisation of musical materials starting from the generation of the single sonic components, still influences many sonification practices [54]. Furthermore, in music theory and production a parameter is frequently considered as a sonic element which may be manipulated (composed) separately from the others.

The discussion around mapping is very much alive and the "problem of mapping" has been debated from a variety of viewpoints, including perspectives coming from the arts and science [55–57]. Chadabe directly pointed at *"the limitations of mapping as a structural descriptive"*, considering it inadequate for complex systems which *"include large amounts of data, context sensitivity, and music as well as sound-generating capabilities"* - such as musical instruments [58]. More recently Roddy and Bridges proposed an approach focused on embodied cognition theories to match the *"cognitive–perceptual entanglement"* related to *meaning-making* in the context of sonification [59].

Drawing analogies between sonification and translation suggest a conceptual shift: rather than considering systems and parameters, designers might prioritise the transfer of information as the starting point. This attitude forces us to confront with a set of broader questions similar to those that translators are often struggling with. Reflecting on some of the issues that a translation demands might help to understand sonification as an hermeneutic motion where data should be interpreted in order to transfer information in the sonic dimension. The considerations introduced in the previous sections are an attempt to sketch a small set of concerns related to this perspective. It might be then helpful to organise these considerations in three levels of increasing abstraction.

Adaptation of information - Envisioning mapping as a motion of contents from one medium to another means to recognise that, during the transfer, there will be a loss of information - that is to acknowledge the *"matter of matter"* introduced by Eco. Overall, if the medium is the message, changing medium will change the message [60]. Sonification can be understood as a process of adaptation that might privilege specific subsets or features out of complex data-sets and identify an appropriate sonic vocabulary to render them. The sound designer is then in charge of negotiating data sources and target sounds to facilitate the transfer of information.

Contexts and purposes - One of the risks technologists might face while approaching a sonification task is to jump straight into the engineering of the system without first considering underlying contexts and purposes. In translation, the interpreter might intentionally *use* a text (i.e. carefully alter a text) to better match a target context. Clearly, when sonification aims to be literal, consistency in translation is valuable and the relations between sound and data should be unambiguous. On the other hand, when designing sounds to interact with aesthetic artefacts or complex environments, a composer might adapt the incoming data to explore a novel musical lexicon. A careful reflection on the contexts and purposes of a sonification might open design spaces, allowing for interpretations and actual alterations that are advantageous for the particular situation.

Cultural values and communities - The process of negotiation that any adaptation entails must acknowledge the role that culture plays in any communication. Many sonification research suggest that sound perception is highly dependent on cultural factors [59]. In this regards the argument advanced by Roddy seems particularly appropriate: *"the key point is to choose a sonic complex and sonic dimension that creates the right conceptual metaphorical mapping for a given listener allowing them to interpret the sonification on the basis of a familiar domain of embodied experience for them"* [59]. Translaiton studies stress the importance of this issue. If the goal of sonification is to communicate something, designers might find beneficial to reflect on the values and assumptions that characterised the target community, audience or users.

Given the difficulties (and sometimes impossibilities) that characterise translation, it is common practice amongst trans-

[3] I particularly refer to the *elektronische musik*'s attitude which strongly inherited from serialism.

lators to acknowledge the limitations encountered and reflect on the proposed solutions (e.g. with the use of footnotes or appendixes). Another lesson we can learn from translation and adaptation studies is the importance of being open about what a designer has chosen to prioritise or to eventually lose. The ideas presented in this paper are also meant to be read as a set of hints that might help designers to get this reflection started.

Finally, considering sonification as a process of adaptation allows a freedom for practical explorations which might not be justified by more rigid approaches. While providing a permissive mindset for the search of suitable solutions, this perspective also *"moderates expectations of creating extensible and verifiable theory"* [44].

6. CONCLUSIONS

The purpose of this paper is to contribute to the research domains concerned with sonification by discussing its affiliation with translation and adaptation studies. The considerations developed investigate the idea of sonification as an act of interpretation concerned with the adaptation of information into acoustic signals. While attempting to establish analogies and similarities between sonification and translation, three perspectives on sonification have been discussed: (i) literal translation (concerned with a transparent sonic representation of data), (ii) semantic interpretation (the deliberate alteration of the source information in function of specific uses and contexts) and (iii) critical interpretation (examined as the sonification of aesthetic contents).

The three approaches described were presented in an abstract fashion as conceptual tools for the understanding of sonification practices. The reflections sketched in this paper do not intend to propose either an explanatory model of sonification as a whole nor a reductive categorisation of diverse sonification practices. A particular sonification design might combine some of the approaches here discussed as well as integrate completely different mindsets and attitudes. Furthermore, this paper does not engage with the vast literature on semiotics research concerned with the production of meaning in sound and music domains (e.g. Schaeffer [61], Chion [62], Nattiez [63] and Tuuri et al. [64]). Such theories remain highly interconnected with the considerations here proposed but out of the scope of this contribution.

The main concept proposed relates sonification to a hermeneutic motion. This framing can be considered as an alternative to the technical notion of mapping where functional relations are established between data and sound. Considering sonification in terms of motion might help to better understand existing sonification practices and potentially explore novel sonic interactions. In particular, the notion of negotiation is suggested to appreciate the transfer of information from data to sound. According to this mindset, the process of sound design can be conceived as mediation: a tentative compromise between source data and sonic contents that takes into account both contexts of use and target communities.

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