"TRAINED EARS" AND "CORRELATION COEFFICIENTS": A SOCIAL SCIENCE PERSPECTIVE ON SONIFICATION

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ABSTRACT

This paper presents a social science perspective on the field of sonification research. Adopting a perspective informed by constructivist science and technology studies (STS), the paper begins by arguing why sonification is an interesting case study to reconsider the role of sensory representation in scientific practice, and in particular the creation of credibility in science. It then focuses on a debate in which the meaning of objectivity is negotiated within the sonification community, showing that different notions of objectivity and scientific quality co-exist within the community, which are linked to different research questions being asked with the sonifications, different users that are envisaged for the sonifications, and different disciplinary backgrounds of the sonification researchers.

1. INTRODUCTION

The vast majority of papers about sonification and auditory display to date have been written by authors who are active in the creation or evaluation of auditory displays themselves. Only rarely has sonification attracted the attention of scholars in the social sciences or humanities [1], [2], [3]. To be sure, a number of scholars from within the sonification community have started to give thought to the historical underpinnings [4], [5], the philosophical implications [6] or the sociological context [7] of sonification. However, these contributions have generally approached their topics from within the logic of sonification research; that is, they have taken up themes that emerged within sonification work and used concepts or knowledge from these social science or humanities disciplines to think them through.

In this paper, I want to begin by taking the reverse approach. By adopting a perspective in the social sciences and humanities – and specifically, science and technology studies (STS) – I want to first ask *not* how history, philosophy or sociology can help us to understand sonification, but rather, how sonification can help to deepen our historical, philosophical and sociological understanding of how science works. I do so not because I expect the ICAD community to be full of closet social scientists, but rather, because I hope that beginning in such a way will allow members of the community to comprehend why a social scientist such as myself might be interested in sonification in the first place, as well as to understand the perspective I have chosen in my research. By zooming in on debates about conceptions of objectivity within the sonification community, I then want to suggest how such STS research might also help the community to understand some of its own struggles. I do so by outlining two different perspectives on objectivity which coexist within the ICAD community, which I refer to as the 'trained ears' and the 'correlation coefficients' approaches.

2. RESEARCH CONTEXT

The research described in this paper is part of a larger project on the sonification of scientific data, adopting a perspective informed by science and technology studies (STS) [8]. Like sonification, STS is often described as an interdisciplinary field or an emerging discipline, encompassing perspectives from fields such as the sociology, history and philosophy of science and technology [9], [10]. The common denominator of STS work is an interest in the interactions between science, technology and society. Notably, these interactions cannot be reduced to talking about "societal impacts" of science and technology, but also involve the many ways in which the development of science and technology is itself shaped by societal and cultural aspects.

This project is dedicated to the study of the ICAD community (as the institutionalized embodiment of sonification) as well as examples of sonification from the world of electronic music and science popularization. It tries to understand the popular appeal and fascination of sonification, as well as its scientific legitimacy. In doing so, it adopts a constructivist perspective, assuming that what is or is not accepted as legitimate and credible science is not a matter of course, nor can it be determined by hard-and-fast universal criteria that distinguish science from non-science, but is in fact the product of an ongoing negotiation process [11]. Accordingly, my research attempts to trace how the scientific legitimacy of sonification is negotiated by various actors inside and outside of the sonification community.

Methodologically, the research described here is based on a qualitative analysis of a number of different empirical

sources: semi-structured qualitative interviews with practitioners of sonification; participant observation research at sonification-related conferences, workshops, talks and concerts; and primary texts, such as conference proceedings, journal articles and dissertations.

3. SONIFICATION AND THE HIERARCHY OF THE SENSES

Philosophers, anthropologists and historians of science and culture have agreed for a long time that there exists such a thing as a "hierarchy of the senses", and that the sense of vision possesses an established seat at the top of this hierarchy [12]. Sight has been argued to be strongly linked to rationality, detachment and science, in contrast to the supposedly more emotional and subjective sense of hearing [12], [13]. However, detailed empirical research in STS and the history of science has recently complicated and nuanced this picture somewhat, calling into question the inevitability of the development towards a visual culture of science. Instead, these researchers have shown that other senses also play a role in scientific practice [14], [15], as well as that the scientific status of vision, too, has been frequently contested [16], [17].

This is not to say, however, that the sense of vision is unimportant in science – indeed, visual elements are ubiquitous in scientific practice [18]. It means that what kind of sensory representation or evidence will be accepted as scientifically credible is not a matter of course; rather than taking for granted that the sense of vision will always dominate, it is up to the STS researcher to analyze, based on detailed empirical studies, what is, or is not, accepted as part of credible and legitimate scientific research in certain contexts. Rather than assuming that vision will always be associated with detachment and rationality, and that sound will always create subjective and emotional experiences, it becomes crucial to study the historical and cultural processes in which precisely these connotations are created, strengthened, challenged or negated.

Sonification is a particularly apt case for such a study precisely because it questions the traditional hierarchy of the senses; that is, it calls into question the commonplace assumption that the only 'proper' way of dealing with scientific data is to visualize them. The rules and conventions that might otherwise remain invisible because they are taken for granted become explicit and observable when an alternative method for the representation of scientific data is proposed. Understanding sonification, and especially its scientific legitimacy and the strategies used to establish its credibility, therefore adds further nuances to the understanding of what is accepted as scientifically legitimate in different contexts, and how this sense of legitimacy is created.

4. A SHORT HISTORY OF OBJECTIVITY

The question of what does and does not count as a scientifically legitimate representation of data is closely intertwined with notions of scientific objectivity. Indeed, the terms "objective" and "scientific" are often used synonymously. However, STS researchers – most notably, Lorraine Daston and Peter Galison [19] – have argued that objectivity has not always been considered a defining ingredient of science, and indeed, that the concept of objectivity itself has a history: the term has been used to signify different characteristics in different contexts and settings. Instead of trying to identify whether particular scientific practices are or are not objective with the help of a checklist, these authors have argued that objectivity itself is a historically constructed and mutable concept; a concept that cannot be nailed down to one fixed meaning but is negotiated in relation to specific practices and representations.

On the basis of an analysis of images in scientific atlases, Daston and Galison trace the historical construction of scientific objectivity, showing how the "epistemic values" of science have changed over the centuries [19]. They focus on three such epistemic values in particular: truth-to-nature, mechanical objectivity, and trained judgment. The ideal of truth-to-nature guided science until the 19th century. In this regime of representation, scientific atlas-markers sought to abstract from the individual idiosyncrasies and imperfections that exist in nature, in favor of a higher plane of perfection and a depiction of ideal types. As an emblematic example of truth-to-nature, Daston and Galison discuss an image in a botanical atlas, in which "the underlying type of the plant species, rather than any individual specimen" [19] was depicted.

In the late 19th century, truth-to-nature gradually started giving way to the ideal of mechanical objectivity. With the emergence of mechanical objectivity, the presence of a human observer became problematic and the depiction of idealized archetypes was very much frowned upon; instead, the actual specimens, with all their peculiarities and irregularities, now moved to the front-stage. Letting nature speak for itself, with the help of machines that were supposedly uncontaminated by human influences, was now the goal of scientific depiction. To illustrate the representational practices of mechanical objectivity, Daston and Galison reprint an image of a snowflake, which "is shown with all its peculiarities and asymmetries" [19].

In the 20th century, yet another epistemic value emerged and took its place alongside truth-to-nature and mechanical objectivity: trained judgment. If truth-to-nature sought to distill the idiosyncrasies of scientific specimens into an idealized representation, and mechanical objectivity tried to do away with any kind of human intervention and interpretation in order to let nature speak for itself, then the emergence of trained judgment marked a point where human intervention and interpretation became permissible again. However, trained judgment was not oriented towards the creation of idealized images, but rather the detection of patterns and structures in large amounts of data. With the help of trained eyes and other tacit skills, scientific specialists learned to distinguish between relevant and irrelevant characteristics in the data, and no longer shied away from enhancing visualizations to better display the attributes of interest. As a characteristic image for the practice of trained judgment, Daston and Galison discuss a visualization of the magnetic field of the sun, in which "the output of sophisticated equipment [was mixed] with a

'subjective' smoothing of the data" to remove instrumental artifacts [19]. According to Daston and Galison, the emergence of this regime of representation was strongly linked to the existence of a new generation of professionally trained scientists brimming with self-confidence in their scientific judgment.

Daston and Galison's work, however, is based entirely on a study of visual representations of science, specifically the graphic illustrations used in scientific atlases; they do not consider that these, or other, epistemic values of science might also be linked to different forms of representation, such as auditory displays. In this paper, I want to extend their work on the historical constructions of objectivity into the domain of auditory representations. In particular, the concept of trained judgment will also come in useful for understanding sonification.

5. THE CONTESTED OBJECTIVITY OF SONIFICATION

The objectivity of auditory displays of scientific data is frequently contested. Many ICAD researchers have shared anecdotes about peer reviewers or potential collaborators who have dismissed the possibility of sonifying data out of hand, without even seriously considering its potential advantages. Interestingly, however, sonification is contested even among some of those scientists who do in fact make use of it.

That is to say, there are a number of scientists who work with sonification, while at the same time denying its scientific legitimacy. For instance, some asteroseismologists tend to play audifications of stellar oscillations while giving popular talks in order to convey something about their research to lay audiences, and yet insist that this has nothing to do with their actual research. They argue that these are just helpful gimmicks in the process of science popularization, but that sound plays no role in their analyses.[1] Sonification is thus used, but simultaneously disavowed as a serious scientific component.

By framing sonification in this way, these scientists do not call into question traditional ideas about vision as the only sense that is compatible with rationality, objectivity and serious scientific research; in fact, they reinforce them by making a clear distinction between proper science (characterized by numbers and images) on the one hand, and popularized science (which may also involve sound) on the other hand. And indeed, the fact that they frame sonification in this way shows just how deeply engrained these ideas about the hierarchy of the senses and about the subjectivity of sound have become in the minds of many scientists.

However, other framings of sonification and its objectivity also exist, and it is these that I want to turn to in the remainder of this paper. Particularly within the ICAD community, debates are taking place about how to position sonification in order to establish its scientific legitimacy and objectivity. These concerns are related to ambitions of formalizing the community and "to encourage increased standards and increased quality of the papers"[2] at the annual conferences, as Bruce Walker, then president of ICAD, put it.

6. "CORRELATION COEFFICIENTS"

This, of course, raises the question of what the criteria for a good publication would be. For Walker, who was trained as a psychologist and computer scientist, the question seems relatively clear-cut. He makes a distinction between contributions that contain research components and those that are just "doing show and tell" [3]. In this distinction, contributions with a research component are marked by their theoretical contextualization, and especially by efforts of evaluation. Another long-standing ICAD member talks about the importance of evaluations and user tests in similar terms:

> You need some way to measure what you actually achieve when you're using sonification. It's not enough that you say this, listen, this really sounds better than yesterday. That's not the result. But if you can show that when you have 10 people doing this task they do things 10% better when they're using the auditory display than when they're not using the auditory display – that's a result.[4]

In this quote, scientific quality is clearly defined in terms of quantification: the qualities of a good sonification can be demonstrated with the help of hard numbers and backed up by correlation coefficients and other measures of statistical significance. Essentially, this addresses the objection that sonification cannot be objective because the sense of hearing is subjective and because it cannot be guaranteed that information is indeed accurately picked up by listening. It does so by quantifying what the average listener actually hears in a sonification, or how he or she works with this information. For the sake of brevity, I have referred to this way of thinking about the scientific quality as the 'correlation coefficients' approach.

And indeed, it is not the only conceptualization of scientific quality that exists within the ICAD community; some members are very critical of the insistence on user-tests, claiming that there exists a tendency of "evaluating oneself to death."[5] This becomes most explicit in an anecdote about an argument related to peer review decisions at a previous ICAD conference:

> Many of the best sonification examples were curated out, peer reviewed away. (…) There is a central stream and poster sessions, and [many] good things were sent into the poster sessions. Because [the reviewers] had abstruse ideas about evaluability and intersubjectivity. So they said, if somebody makes a sound and did not make a series of user tests with 17 (...) test persons, then we cannot accept this, because that's not scientific. It's as if you would not have a graph printed if someone cannot prove that he let 17

[1] Interviews with the asteroseismologists Conny Aerts (March 2009) and Donald Kurtz (November 2009).

[2] Interview with Bruce Walker (June 2009).

[3] Interview with Bruce Walker (June 2009).

[4] Interview with Matti Gröhn (July 2009).

[5] Interview with Florian Grond (June 2008).

> people look at the graph to make sure they can see something in the graph. That is, I think, that's absurd.[1]

Several ICAD members have expressed criticism of such an insistence on user-testing, arguing that sonifications that are novel and innovative can be very valuable and inspiring to the community even if they do not come with an evaluation.[2] Besides, it has been suggested that user-tests often consist of rather trivial tasks focusing on the qualities that are easiest to measure rather than those that are in fact most relevant for potential users of the sonification.[3]

7. "TRAINED EARS"

However, the critics of (mandatory) user-tests in sonification research do not advocate that sonification should refrain from making claims to scientificity and real research. Rather, they offer an alternative conception of the objectivity and scientificity of sonification, one which is not necessarily linked to quantitative evaluation. In reference to Daston and Galison's 'trained judgment' [19], discussed in section 4, I have called this paradigm the 'trained ears' one.

Analogous to what Daston and Galison refer to as trained judgment, the supporters of a trained ears approach defend the acceptability of a certain amount of subjective decisions, provided they are made with the help of the trained ears of scientific experts. Subjectivity is explicitly embraced here – but paradoxically, without giving up claim to objectivity altogether:

> The reader may have the impression that such sonifications are so strongly tuned to the subjective preferences of the user that they may not be particularly 'objective' to communicate structural features in the data. However, sonification is actually always the result of strongly subjective tuning of parameters. Furthermore, each mapping is equally valid as true representation of the data. Only the combination of different (sonic) 'views' may yield a more 'objective' overall impression of structures in the data. [20]

In this quote, Thomas Hermann and his co-authors discuss a combination of different 'sonic views'. By changing certain parameters and listening to different versions of the same dataset, different acoustic perspectives are provided. It is through listening to many, many different sonifications (and possibly glancing at visualizations at the same time) that the researcher fully begins to understand the overall structure and patterns that are contained in the data. In contrast to the user-testing paradigm, emphasis is put not on the creation of intersubjectivity by having different test persons listen to the same sonification, but rather on having the same person listen to different displays of the same dataset. Every single one of these displays may be subjective, but a trained listener is able to detect patterns in the data.

The term 'sonic views' is also interesting because it explicitly likens sound to vision. Indeed, many proponents of the paradigm of trained ears invoke the authority of visualization. Often with reference to the fact that subjective decisions are widely accepted in data visualization and not usually second-guessed through perception tests,[4] it is argued that sonification should not be required to have to prove its usefulness time and time again. Instead, sonification experts should have the self-confidence to trust that sonification can in principle provide trustworthy displays of scientific data; and in order to really make the most out of a specific sonification application, the proponents of this approach argue, experts in the concrete research subject should be closely involved with the making of the sonifications. Once the expert opinions of domain scientists have been involved in this way, the argument goes, "there will be good reason to trust not only the judgment of a visualization expert about a picture, but also a judgment of a sonification expert about a sound" [21]. Since the number of relevant scientific experts is often too small to allow for a quantitative evaluation in the proper sense, quantitative evaluation may not necessarily be appropriate in such cases [22], [23]. Besides, especially when it comes to developing sonifications that are meant to be used in exploratory research, the kind of well-defined tasks that can be tested for easily may not really be of interest at all; it is difficult to devise quantitative tests for complex, unpredictable and long-term research questions.[5]

8. INTERDISCIPLINARY FRICTIONS

In the previous two sections, I have indicated that different conceptions of objectivity and scientific quality exist within the ICAD community. So far, I have only hinted at how these differences can be explained. Is this a case of irrationally feuding camps or of haphazardly differing epistemological tastes? In this section, I want to show that this is not the case; rather, both positions can be explained as outcomes of different research questions being asked, different users envisaged for the sonification applications, and different disciplinary backgrounds.

Research Questions

The ICAD community is connected by a shared interest in the usage of sound to convey information, but the underlying research interests that bring different individuals into the community may vary considerably. While some in the field are primarily interested in aesthetic issues, others might emphasize informational requirements; while some are interested in investigating general capabilities of the human auditory system and exploiting this knowledge by designing applications according to these features, others might be more interested in using sonification as a tool for the analysis of

[1] Interview with Florian Dombois (February 2008). The quote has been translated from German by the author.

[2] Interview with Thomas Hermann (October 2009).

[3] Interviews with Alberto de Campo (October 2009) and Florian Grond (June 2008).

[4] Interviews with Florian Dombois (February 2008) and Florian Grond (June 2008).

[5] Interview with Alberto de Campo (October 2009).

complex data; while some use sonification to build audio interfaces for particular devices, others concentrate their efforts on exploring particular datasets via sound.

These different research interests also entail different requirements of empirical verification, and therefore rub off on what the researchers consider appropriate standards of valid scientific research. For instance, for someone who is primarily interested in auditory perception research, it is essential to find out general features of the human auditory system, and it is therefore plausible to involve relatively large numbers of subjects when putting a sonification to the test, as the perception of human subjects is at the very core of the research interest. On the other hand, for someone who is primarily interested in the development and implementation of new techniques for data mining and display, such user tests may be a means to an end or a nice extra, but they are not an essential component of the research itself. Just how important it is considered to involve large numbers of listeners in testing sonifications is therefore very much related to the precise research questions being tackled through sonification.

Sonification Users

Another difference exists in the people that the sonification researchers have in mind as (potential) users for their applications. Some ICAD members explicitly follow a 'universal design' approach.[1] This term specifically refers to the equal inclusion of people with and without disabilities – in the case of sonification, in particular the inclusion of blind as well as sighted users – but at the same time also suggests broader implications: the user being targeted is, for all intents and purposes, 'everybody'. Now, if 'everybody' is intended as a user of a sonification, it also makes sense to try to involve 'everybody' in the testing of a sonification. While actually involving everybody is impossible in practice, large-scale user tests are built on the idea of providing an approximation of this: if not everybody, then at least the average user.

On the other hand, there also exists a tradition of developing sonifications specifically for expert users, such as scientists working on a specific line of research. As mentioned above, these cases may be less amenable to quantitative testing, as the targeted user group may be too small to allow statistically significant quantitative evaluations. What is more, the ideal image of this type of sonification research is often built upon an intensive and sustained collaboration between sonification researchers and scientific specialists.[2] In those cases, evaluation may happen in much more informal and incremental forms in the course of the collaboration, and a formal evaluation may be deemed unnecessary or an unwanted burden for the scientific specialist who already invests a lot of time and effort into an unusual type of research with uncertain results. For exploratory scientific research, the best empirical evidence of the usefulness of a sonification may not be an auditory perception test, anyway, but rather the discovery of a new scientific insight by means of listening, which could then be substantiated by other means and lead to theoretical advances.

Disciplinary Backgrounds

The different views on the necessity of user-tests are also related to different disciplinary orientations that co-exist within the ICAD community. Of course, this aspect is not independent of those discussed above; for instance, the type of research questions being asked are very much related to disciplinary perspectives. But different disciplines not only bring different research questions to the table; they also have their own, not necessarily compatible, quality standards and conceptions of objectivity [24], [25]. And yet, these standards are often taken as self-evident and universal.

For instance, the requirement of user-testing is often taken as inevitable due to one's disciplinary training; as one ICAD member reflects, "I'd been kind of trained in the way, from the viewpoint that you always have to do an evaluation, otherwise you can't state whether you've given a contribution or not."[3] From within a particular disciplinary perspective, a particular type of testing may seem like the most natural and unavoidable thing in the world, yet discipline-specific standards should not be mistaken for universal ones. The user-testing paradigm, for instance, is in fact strongly related to a psychological tradition of quantitative experimentation. Not only is it connected to one particular scientific discipline, rather than to general scientific principles, but even within the discipline of psychology, the development of such an experimental tradition was a contingent rather than an inevitable one.

As historians of psychology have shown, psychologists have drawn upon strategies of standardized testing and quantitative measurement in an effort to demarcate their discipline from the muddy waters of the humanities and common sense. Instead, a close alignment with the natural sciences was sought by emphasizing methodological similarities. In short, then, the strong reliance on tests and experiments was a particular historical strategy to establish the cultural authority of psychology by emphasizing its affinity with already established natural scientific disciplines [26], [27].

My claim here is not that user-testing is a phenomenon exclusive to psychology; indeed, the practice has taken strong roots in other disciplines too, including some – such as human-computer interaction – that have a strong foothold within sonification. Nor do I want to call into question the value of such tests. I do, however, want to point out that they have roots in a very specific historical and cultural context, and should not be mistaken for inevitable and universal ingredients of scientific work.

It has become clear in this paper that such an approach is not shared by everyone within the ICAD community. Specifically, I have sketched out an alternative to the 'correlation coefficients' approach, which I have referred to as 'trained ears'. It is more difficult to associate this approach

[1] Interviews with Bruce Walker (June 2009) and Stephen Brewster (November 2010).

[2] Interviews with Thomas Hermann (February 2008), Florian Grond (June 2008) and Alberto de Campo (October 2009).

[3] Interview with Paul Vickers (January 2011).

with any particular type of evaluation practice; after all, one of its tenets holds that a systematic evaluation might not be necessary as the involved researchers should trust their own expert judgement. Where close collaboration between sonification researchers and domain specialists is sought, the quality standards of the involved domain science (be that neurology, seismology, sociology or chemistry) might be as relevant as whatever standards the ICAD community can come up with; this is especially true when a publication in an academic journal in the data domain is aspired. It is therefore no surprise that some researchers within ICAD are more reluctant about favouring the quality standards of any particular scientific field.

This does not mean that the debates about the need for evaluations within the sonification community run neatly along disciplinary lines, nor that there exist two full-fledged and clearly defined competing camps. However, the difficulties of finding agreement on the appropriate quality standards is rooted in a scientific culture in which different research interests and disciplinary backgrounds meet, and in which no consensus has been established about what the standards for good scientific work could be. This is not unusual; sociological studies have shown that agreement on quality standards in interdisciplinary fields is often difficult, because different disciplines come with their own ideas and standards of quality. In fact, this is particularly true for fields that also involve input from outside the confines of academic science [24], which is the case for sonification with its strong connections into art and design. It is no surprise, then, that the method of user-testing as evidence for the scientific quality of sonification is controversially discussed within the ICAD community.

9. CONCLUSIONS

In this paper, I have highlighted one angle from which sonification can be a fruitful object of studies for STS. As I have argued, sonification can be interesting to the STS researcher because it opens up new perspectives on the types of representations that are considered permissible in scientific practice. The case of sonification shows that it is not self-evident that scientific analyses are made and scientific results presented only in a visual form, as sound can also be used to represent scientific data. At the same time, however, it also shows that scientific conventions favor visual rather than auditory displays. Auditory displays tend to be marginalized in scientific practice, and those researchers who do want to make use of them adopt different strategies to counter this marginalization. It has not been my goal to predict the success of these strategies, but rather to examine the logic according to which they operate.

While my starting point was a perspective asking how sonification can be of interest to STS, rather than how STS can be useful for sonification, my paper can also contribute to the discussions and self-reflection of the sonification community. Specifically, by analyzing the debates about objectivity within the ICAD community in terms of two conflicting paradigms – which I have termed 'trained ears' and 'correlation coefficients' – I have elucidated some of the positions that are taken within the community. I have not only sketched out these two paradigms, but shown that each of them can be explained in terms of different research questions, different envisaged users, and different disciplinary backgrounds. Most importantly, I have shown that each of these traditions of thinking about the objectivity of sonification research has a history and has to be understood in a particular historical and cultural context. It is in this way, I believe, that STS research of the kind I have undertaken here can be of interest to the ICAD community, as it shows how positions taken in such debates are shaped by sociological and historical factors.

Above, I have referred to the two paradigms as "conflicting", but this is not meant to imply that they are incompatible by definition; indeed, there is nothing in these two positions that would preclude them from co-existing peacefully within the same community. To do so, however, both would have to be accepted as valid and equitable scientific approaches by everyone in the field. In the current constellation, the two are often pitted against in each other in the search for appropriate quality standards for the field as a whole.

This desire to agree on quality standards itself has to be understood in a particular historical and cultural context. It forms part of an ongoing process of professionalization, in which the community strives for clearer professional standards and markers of quality. This process is so urgent precisely because what is at stake is not just the acceptance or rejection of specific papers at the conference; what is at stake is how the field presents itself to the outside (scientific) world, and the standing of sonification research as a whole. The fact that it is difficult to agree on shared standards of quality has much to do with the interdisciplinary nature of the sonification field. There seems to be much awareness within the community of the fact that evaluation criteria differ between scientific, engineering and artistic projects, but little explicit attention has been paid to the fact that even the criteria of different scientific fields may differ; let alone to how these differences specifically play out in debates within the community or in peer review decisions. In this paper, I hope to have elucidated some of these differences and thus to contribute to the community's process of self-reflection. More than anything, though, I look forward to discussing my findings with the ICAD community.

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