Music Composition for Deaf and Hearing Alike; The Sense Ensemble, Study #1

- Merging Performance with Clinical Study to Examine the Cross-Modal and Intersubjective Nature of Musical Experience

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ABSTRACT

Music composition for the deaf is considered with a view to broadening the understanding of composition in general by regarding musical perception as a whole-body experience, i.e., a 'sense ensemble' involving all the senses in its creation and appreciation. This line of inquiry is grounded on the following arguments, derived from embodied cognition and neuroscientific research: 1) music is fundamentally a whole-body, physical experience, 2) the senses work collaboratively in the perception of music (cross-modality) and 3) the cognitive apparatus for experiencing music is developed from infancy into adulthood through specifically human relationships (intersubjectivity/social cognition). A compositional study was devised to test a cross-modal harmonic and intersubjective approach to music through an interactive performance that involved no spoken or written language. Qualitative assessment of this cross-modal, intersubjective experience was to be drawn through feedback from participant interaction during performance and from subsequent interviews. The results achieved suggest that the majority of the participants were musically engaged by the multi-modal presentations, even if they were aurally impaired. The study undertaken has presented one model for a multi-modal experimental method, and presents results that support the hypothesis that all music has a cross-modal intersubjective potential which can be appreciated by audiences irrespective of hearing ability.

I. INTRODUCTION: THE SENSE ENSEMBLE

This paper concerns a study undertaken in May, 2016, exploring an approach to multi-modal composition for a mixed deaf and hearing audience. Before presenting the details of the study, it would make sense to provide some background leading up to it.

The composer/researcher began working in 2010 at St Mary's School for Deaf Girls in Dublin, Ireland to investigate deaf participation in music and to explore an approach to music composition not restricted to audition. The researcher built instruments for the students and developed techniques that allowed them to work together as a performing musical group known as the Sense Ensemble - the name taken from their mutual feeling that all senses work cooperatively in the creation and appreciation of music. The ensemble performed in the Contemporary Music Centre in Dublin in May, 2011, and again in a series of outdoor performances in March, 2013 sponsored by Dublin City Council (see the LINKS section below for video footage of these and other relevant performances).

As a result of his work in the school, as well as of a review of relevant embodied cognition and embodied neuro-scientific research, the composer/researcher established the following premises on which to continue his work through a Ph.D. at Trinity College Dublin, with funding from the Irish Research Council:

1) Music is an active, physical, whole-body experience (Johnson, 2007).

Our senses do not passively take in musical stimuli, but rather seek it out in order to establish meaning (Gibson, 1979; Dewey, 1896). Moreover, music involves not only the sense of hearing, but the entire body: sight, proprioception in all the limbs and tactile sensitivity to vibrations through the skin (Kohler, 2002).

2) Musical experience is an evolving, cross-modal process.

Rather than working independently, the senses work collaboratively at both the peripheral and the central level to establish an overall sense of experience (Stein & Meridith, 1993). This cross-modal reality is well documented in mainstream neuroscientific literature as well as embodied cognition research. (Shams, 2002/2005; Stein & Meridith, 1993; Johnson, 2007)

3) Music is intersubjective.

One might expect a musical experience to be either a solitary affair (through headphones, for example) or a social encounter (in the case of a live musical event). In fact, whether through live performance or recording audition, a musical experience will always be intersubjective in that it semantically depends on either a direct, simultaneous communication with other people or, at the very least, a sensorimotor memory of analogous communication to be referenced (Uithol, 2015). It has been clearly shown in research that the cognitive apparatus for experiencing music is developed from infancy into adulthood through specifically human relationships (Stern, 1985; Johnson, 2007).

II. MUSICAL EXPERIENCE: LIMITING AND EXTENDING AWARENESS

While it may be demonstrated that the musical experience is active, multi-modal and intersubjective, it is rarely the case that an audience is alert to the breadth of phenomena involved. The fact is that many individuals operate under the assumption that music is a passive experience for the ears alone. That many hearing individuals are surprised that the deaf can have a musical experience at all seems convincing proof of this. The researcher suggests that this may be largely due to the primarily disclosive nature of language, and the power that words and their concepts exert in constituting our experience. The limitations of our conventional vocabulary for musical experience imposes analogous limitations on our understanding of it (Heidegger, 1971). That the mind has
discursive and representative faculties has been more recently indicated by the work of Daniel Kahneman, who distinguished between System 1 (Intuitive Experiential understanding) and System 2 (Analytic Representational knowledge) ways of thinking (Kahneman, 2011).

A practical example of such linguistic limitations on experiential awareness presented itself repeatedly during rehearsals for the current study. Naturally, the researcher and assistants had the collective aim of addressing the musical experience as physical, intersubjective and cross-modal. As will be seen in the study, there were many musical elements which were based in physical gesture (one example being sign language), while other elements would have readily been considered more conventional expressions of music; e.g., performances on guitar, bass and drums. After the ensemble had rehearsed the 'gestural' aspects for a number of hours, it was not uncommon for one of the performers to remark casually, “Perhaps we'd better start working on the music now.” When eyebrows were raised, the offending party would quickly add, “You know what I mean.” Such a faux pas was telling. The performers were making determined efforts to expand musical awareness to encompass the non-auditory, but their language was profoundly embedded with the opposing notion: music is sound production, and gestures are just the means to that end.

Should it be a surprise that the language for music carries inbuilt limitations; focusing upon audition perhaps to keep matters more linguistically manageable? Music is already quite challenging to apply words to; arguably much harder than the visual arts, for example. A painting can be described directly in terms of colour and form, but the same cannot be done in the case of music. All of the language for music, in fact, has been shown to be based on metaphor that may be highly arbitrary, but which is frequently based on embodiment (Zbikowski, 2002; Cox, 1999). It is difficult enough to describe music in terms of hearing alone without trying to account for other senses involved. To make sense of the musical experience, it needs to be put into words and to do so requires that limits be imposed. It cannot be overemphasised that the consequences of how music is discussed, however, undoubtedly shape how it is experienced. Language literally defines experience, as was demonstrated by the experience of the deaf and blind Helen Keller when learning language (Keller, 1902). It follows that if music is described in terms of hearing alone, it will in effect become an experience for hearing alone.

This is not to cast blame on the listening public, but to point out a linguistic habit concerning music which has been culturally reinforced over time. People are of course entitled to think of music as an auditory experience if they choose. It seems unreasonable for anyone to insist that music should be one thing or another; the point is to suggest what it can be. The fact that listeners are active in their musical experience means they can be selective in terms of what they want to find out. Thus, they have a degree of choice as to what they attend to. If musical experience is not a unidimensional chunk of data to take in passively, but a vast, multi-dimensional spectacle, it is quite natural to leave parts of it unexplored. It is entirely possible to pay attention only to the sonic aspects of music, and to be unaware of the vibrations hitting the chest and fingers, as well as the way neurons are in effect imagining the origin of the sound generation (Uithol, 2015). On the other hand an added adventure is waiting for those who want to consider a broader expression of music; but it takes an effort on the part of the listener to break old habits.

A brief example is offered by an exercise the researcher often conducts in workshops, which anyone can try alone. While seated comfortably, listen to a familiar piece of music over a pair of average loudspeakers. As you do, notice to what degree you can feel vibrations in your fingers, hands and lap. Do not be overly concerned if you cannot feel any. Now blow up a balloon, hold it in your hands and repeat the process. You will likely find you can easily feel the vibrations passing through the balloon into your fingers, hands and lap. More importantly, you will still find yourself feeling the vibrations if you listen again to the music without the balloon. You will probably feel this awakened tactile sensitivity in fact for a certain time with many sounds around you, until you revert to a more exclusively sonic attendance to the environment; slipping back from the époché into what the phenomenologists call the natural attitude.

It is well known that individuals with limited ability in certain modalities – e.g., blind or deaf people – often develop heightened abilities in some of those senses that remain – respectively hearing and sight. They naturally must rely on an increased sensitivity in their remaining modalities in order to operate in what amounts for them to be an altered experienced environment. Recent research suggests that reorganisation of the cortex for the impaired sense can provide the neural substrate to mediate compensatory functions in those senses still intact; offering what has been referred to as supranormal performance in those senses (Lomber, 2010). Many of those with experience of progressive blindness or deafness have argued, however, that neuroplasticity only accounts for a part of such improved performance in a real-world setting; particularly when the impairment is not congenital or early onset. Not only are such people compelled to improve other senses to survive, but they must also work hard at it (Higgs, 2009). It is an unquestionably active process which requires time and effort: months if not years of training in learning to attend to the altered experienced environment through adaptive techniques. Unlike a hearing person in the aftermath of the balloon exercise, however, they cannot revert back to the former ‘natural attitude’. They must maintain this heightened sensitivity; this époché will eventually become their newly adjusted natural attitude.

### III. CROSS-MODAL HARMONY

The true question for the current research is: what compositional strategies can be adopted to alert and sensitize a mixed deaf and hearing audience to the physical, multisensory and intersubjective potential of the musical experience; and how can the success of such a strategy be assessed?

Fortunately, as the balloon exercise demonstrates, increasing sensitivity in one modality is not dependent on disabling another. It is not necessary to become blind in order to hear better, or deaf in order to watch more carefully and feel more sensitively. Through attentive effort everyone can direct experience to a certain degree, and a balloon is not required. More importantly for the purposes of this research – which concerns composition – attention can be guided by what is presented to listeners rather than their own determined efforts. Here lies the composer’s job, in fact, whether writing for the ears or otherwise. Formally speaking, composers provide instructions for performers to execute, which in turn
provide conditions for an audience to have a musical experience. While composers by no means control the musical experience of their audience, they do their best to guide it by a highly involved strategy of pattern making (Meyer, 1956). It is beyond the scope of this study to go into depth concerning such a strategy. Suffice it to say that composers are in a position to present patterns, and play with the audience’s expectations to witness those patterns being repeated, varied or utterly changed.

What are these patterns exactly? For most composers they are perceived sounds. Thus, there can be patterns of non-pitched beats which create a percussive rhythm. There might be a sequence of different pitches which create a melody. Melodies might then be combined to create new, emergent patterns of harmony. Finally, all these parameters can in diverse ways be altered - either individually or collectively - in terms of tempo,loudness, instrument choice and timbre. What is musically crucial with all of these elements is how they interrelate; how their individual and combined patterns work together to gratify expectation or contrast with each other to create tension. They are all part of a harmonic fabric which composers present as a weave of sound (by convention at least) for an audience.

But what of patterns for the musical experience that exist in addition to and in combination with sound? For example, what if patterns in gesture – involving a sequence of different hand signals presented for different durations – were executed in a conscious relationship to patterns of sound? What if patterns of tactile vibrations were sent through the floor of a performance space; patterns which had a continuing relationship with the patterns in the other modalities? What if there was a musical conversation between these modal specific patterns; much the same as there is harmonic interplay between the sonic parameters in conventional sound-oriented composition?

Such an assembly of conditions would potentially constitute a cross-modal harmonic approach to composition. The following study is one such effort.

IV. THE SENSE ENSEMBLE; STUDY #1

The composer/researcher and 3 musical research assistants conducted The Sense Ensemble Study #1 on May 26, 2016 in the Printing House Hall in Trinity College Dublin (see the LINKS section below for video footage of the performance). 26 participants - 22 hearing and 4 deaf - were recruited through social networking and email with the clear knowledge that they would be participants in a multi-sensory musical study. Specifically, it was explained that the study was being devised to test a cross-modal and intersubjective approach to music through an interactive performance that involved no spoken or written language. Qualitative assessment of this cross-modal, intersubjective experience was to be drawn through feedback from participant interaction during the performance and from interviews directly following the performance.

Initial work was carried out between the composer, a choreographer experienced with deaf participants and a first-year student of Irish Sign Language in the Trinity College Centre for Deaf Studies (see ACKNOWLEDGMENTS section below for details). The composer asked the choreographer and the signer to come up with a sequence of four ISL (Irish Sign Language) signs, that would constitute a visual and, if possible, percussive rhythm; i.e., the gestures might involve an audible strike of the hands or body. It was agreed that the meaning of the signs, individually or collectively, should not factor into the choice. The signs would be chosen for their visual and percussive qualities alone, and their rhythmic (both visual and sonic) elegance in combination with each other.

The four chosen signs, demonstrated below by the researcher in Figures 1-4, presented a compelling rhythm in 4/4 time. Three of the signs were percussive (numbers 1, 3 and 4), involving either the hands slapping each other, or one hand striking the upper arm. The silent sign (number 2) interestingly provided a provocative visual rhythm, which witnesses later claimed was the most musical of all! Several reported that they began to hear a sweeping sound the more they saw it during the performance.

![Figure 1. ISL Sign 1 (percussive); 'Beat' Left hand in a fist, right palm moves left to right striking top of right fist](image)
![Figure 2. ISL Sign 2 (silent); 'Hour' Right hand in letter 'H', palm facing body, moves swiftly anticlockwise in a circle](image)
![Figure 3. ISL Sign 3 (percussive); 'What' Palms to self in 'L'; alternately snap fingertips in one hand off fingertips in the other](image)
![Figure 4. ISL Sign 4 (percussive); 'Walk' Tap right fingers on left forearm twice.](image)

The rhythm suggested by the four signs was further developed into a four-bar pattern which was to be repeated at regular intervals throughout the performance (see Figure 5).

![Figure 5. The four-bar pattern using the four ISL signs. The first bar identifies each pitch with its respective sign. The pitch designation is purely arbitrary.](image)
The composer used this gestural/percussive pattern as a quasi-lyric from which to compose the music for the overall piece; i.e., he used the gestures to inform the composition in the same way lyrics would conventionally inform the music they are set to. In this way the 'signer' was seen as the gestural analogue to a 'singer'. The signer's job was not merely to perform the signs, but to teach them to the audience during the performance so that they could participate musically. This intersubjective aspect was further developed by the separation of the audience into groups, each learning a different sign. Upon entry to the venue, participants were met by the signer who directed them to 4 separate seating sections, and also taught each section one of the four signs - i.e., a different part of the overall pattern (see Figure 6).

Early in the performance, the signer demonstrated the entire pattern shown in Figure 5, and encouraged the separate sections to perform their signs at the appointed time in a form of gestural hocket. The degree of success or failure for this enterprise was to provide key feedback during the performance in several respects. First, how well or poorly the groups were able to perform their parts, and furthermore coordinate with the other groups, would give a sense of the intersubjective efficacy of the composition and its performance; i.e., were the participants able to follow and join in with the narrative flow? Moreover, post-performance questions concerning this experience would give a full picture as to the sense of individual engagement. Another key element to be addressed through this gestural intersubjectivity concerned ideas from the motor theory of perception, as well as social cognition. The question here would be whether performing gestures related cross-modally to the sounds they made - as well as the haptic element of striking one's own body in coordination with a large group - might establish an increased sense of unity with the rest of the participants and performers.

In the course of the 15-minute piece, these minimalist unimodal gestures evolved into a multi-dimensional composition comprising cross-modal variations of the four-bar pattern using the following techniques:

1) Low frequency vibrations

Related to the chords in the composition, low frequency sounds (41 Hz, 49 Hz, 55 Hz, 65 Hz and 73 Hz), were transmitted using two different techniques: a) 4 bass shaker speakers attached to the hardwood floor of the venue at strategic points, and b) a single subwoofer placed behind the stage area. The researcher was keen to discover which technique was more effective in performance, and conducted countless experiments with the placement of each.

2) Color coordination between seeds and 'section pole' flags

Upon entering the venue, each participant was handed a small seed, either a bean or a pea, with one of the following four colors: red, black, white or green. Along with their assigned gesture, the color of the seed designated the seating section for the participant. Each seating section was identified by a pole at the top of which hung a flag with a color corresponding to the seed color.

3) Section poles being stamped on the floor

The performers used the section poles to stamp the gestural rhythm in a hocket; lifting the weighty structures a few inches, and letting them drop onto the hardwood floor to resonate thunderously throughout the venue.

4) Vibrating objects in speakers

A naked speaker cone that pulsed infrasonically - so that it moved but made no sound - was brought around the venue. Each member of the audience was directed to drop the seed they had been given into the speaker. The addition of seeds caused the speaker to behave percussively; with the seeds bouncing off each other and hitting the speaker surface.

5) Choreographed assembly of a performance structure

As the performance progressed, a scaffolding structure was erected on the stage by two of the performers, and musical instruments – electric guitar, bass guitar and drums – were installed. This construction process was highly choreographed, so that the movements of the 'builders' were in keeping with the ongoing rhythms.

6) Performance by guitar, bass and drums

While the signer brought the audience in and out with their gestural hocket, the three other performers took up their instruments and played a piece of music that fit in with the gestural rhythm (see Figure 7). This piece of music had memorable melodic and harmonic content (rich, chopping guitar chords), as well as a strong groove (a syncopated, staccato bass line). Audience members later described it as 'lyrical funk'.

Figure 6. Signer teaching a participant Sign #2 when entering the venue (still image from video footage, see LINKS section below).

Figure 7. The signer performs the gestural rhythm while the 'backing' ensemble fits into her 'groove'(still image from video footage, see LINKS).
7) Smoke rings; rhythmic and arhythmic

The signer shot smoke rings across the venue from a vortex cannon (see Figure 8). These smoke rings occasioned a rhythmic dichotomy: i.e., they could be ejected rhythmically but their movement across the venue was temporally independent; giving the effect of an expressive, ghostly rubato. It should be mentioned that the smoke rings constituted not only visual and sonic expressions (by the sound of the cannon being struck). They were also tactile, by virtue of the smoke rings palpably striking the audience; and olfactory, in that the smoke had been scented with a mild vanilla essence.

8) Shadow-play semaphore

The piece culminated with the signer lowering a sheet, and performing semaphore signs with her body. Back-lighting caused her form to be in silhouette, thus creating a shadow-play dance (see Figure 9). The idea here was to investigate if the audience found the two dimensional semaphore silhouettes more or less expressive than the 3 dimensional signs, which included facial expression.

All of these techniques were carefully orchestrate to work together in a cross-modal harmony. A sense of how this harmonic integration was approached is given in Figure 10.

V. RESULTS

A. Overview

Each audience member individually filled out an anonymous questionnaire immediately following the performance, and then all stayed behind for a discussion led by the researcher. This discussion began with specific questions by the researcher addressing audience experience, and later broadened into an open conversation concerning the performance and musical experience in general.

The overall response, both through questionnaire and discussion, was that the audience felt connected to the musical performance – irrespective of hearing ability – and had an awareness of the different senses working in combination in their musical experience (see Figure 11 for initial questions).

The responses to the initial questions clearly confirm both deaf and hearing being musically engaged, and being more aware of non-auditory expressions of music. This was overwhelmingly reinforced in the post-performance discussion. Here are example comments from two separate participants:

“The lack of speech meant I was ready, senses engaged, and open to what came next.”

“Having to interact in a new way without preparation immediately turned on a section of my brain to do with communicating that is normally switched off. I was alert from then on, and everything I saw became more important.”

Figure 8. Smoke rings fired across room and at audience (still image from video footage, see LINKS).

Figure 9. Shadow play semaphore: the signer performs semaphore signs behind a sheet with back-lighting (still image from video footage, see LINKS).

Figure 10. Excerpt from score showing cross-modal harmonic relationships, giving the sense of how the gestures related to the diverse other musical techniques described above.

Figure 11. Initial audience survey questions and their results.

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>Yes</th>
<th>No</th>
<th>Abstain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you deaf or hard of hearing?</td>
<td>15%</td>
<td>85%</td>
<td></td>
</tr>
<tr>
<td>Did you feel musically engaged by the performance?</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did you feel a heightened awareness of senses beyond hearing for your experience of the music?</td>
<td>92%</td>
<td>8%</td>
<td></td>
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</tbody>
</table>
B. Gestures

The audience's success at performing their individual gestures as part of a group constituted a vital form of intersubjective feedback, i.e., the signer communicated a pattern successfully to the participants who in turn performed the pattern as a coordinated group. The post study questionnaires offered key insights as to the intersubjective and cross-modal awareness of participants (see Figure 12). The majority of participants felt the signs were musical in nature, and also felt themselves members of their seating section by virtue of their shared gestural function in the overall rhythm.

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>Yes</th>
<th>No</th>
<th>Abstain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did you feel the gestures the signer was performing were musical in nature?</td>
<td>96%</td>
<td>-</td>
<td>4%</td>
</tr>
<tr>
<td>Did you feel yourself to be a member of your section (where you were sitting) when you were performing your signs?</td>
<td>96%</td>
<td>-</td>
<td>4%</td>
</tr>
</tbody>
</table>

Figure 12. Audience survey questions concerning gesture and its results.

The post-performance interviews gave a more thorough sense of the audience reaction to the gestures. The researcher asked whether the audience would consider the gestures to be a form of voice. The reaction was overwhelmingly in the affirmative, with the specific comment being made: “I felt I was listening to the signer's movements; I'm even talking about the stuff you couldn't hear.” Both hearing and deaf members of the audience agreed that the signer's gestures constituted a clear rhythm. In particular, as it was mentioned in an earlier section, the silent sign (Sign #2) came to be appreciated as somehow the most audible; being described as a “sweeping sound”.

C. Other Musical Techniques Relating to Gestures

In the post-performance discussion, the researcher asked members of the audience to comment on the success of the other compositional techniques that were informed by the gestures (see Figure 13 for table of results).

It is clear that the subwoofer was highly effective in offering the audience a tactile experience of the low frequency pulses, while the bass shaker speakers could not cover the large floor area. Furthermore, the table indicates that participants were moved by both the performance with the poles and the ensemble of bass, guitar and drums. As for the former, the audience felt the pole rhythm's direct relationship with the gestural rhythm (see score in Figure 9) helped reinforce the pattern in their minds. The audience was moved by the ensemble musicians' performance, especially the manner in which their individual movements related to the gestures of the signer. An interesting fact that the table accounts for is the audience reaction to the shadow-play semaphore. Many commented that the movements of the signer's silhouette were emotionally potent, but lacked the communicative essence of her earlier signing. As one described it:

“I felt the signs in person [not shadows] were really talking, or even singing to me. The shadow forms were beautiful, but didn't speak in the same way.”

![Table of results](image)

Figure 13. Response to other techniques in post-performance discussion.

The most surprising feedback, however, concerned the vortex cannons. The audience was not merely taken with the smoke rings as a novelty feature, they also reported delight at seeing the rings shot from the cannon in time with the music, the feeling of the rings hitting their faces and even the sudden impact wash of vanilla scent! They were cognisant of the rings' rhythmic duality, mentioned earlier in Section IV: i.e., the rings' being projected in strict time from the cannon by the signer, but thereafter adopting their own rhythm across the venue. This feedback from the audience was entirely in keeping with the researcher's musical reading of the rings' behavior. It was surprising, still, just how effusive the audience were on the subject, with one individual coining the phrase, 'the smoke's poetry of movement'.

VI. CONCLUSION

Based on an interest in music for deaf audiences, the researcher has been investigating the cross-modal and intersubjective aspects of music perception using an unorthodox investigative methodology (cross-modal harmonic technique) to reveal the extent to which music appreciation is multi-modal. Sense Ensemble Study #1 presents one model for a multi-modal experimental method, and offers results that support the hypothesis that all music has a cross-modal, intersubjective potential which can be appreciated by audiences irrespective of hearing ability. Further studies would be recommended that might 1) attempt to take a more detailed look at the successful techniques used in this study for cross-modal musical composition, 2) provide more precise qualitative data concerning those techniques, 3) explore additional techniques not used in this study and 4) work with smaller audience numbers.

ACKNOWLEDGMENT

The researcher would like to acknowledge:
- The Irish Research Council
- The Trinity College Dublin Visual and Performing Arts Award
Performers in The Sense Ensemble: Caoimhe Coburn-Gray (signer); Diarmuid O'Connor (guitar, assistant signer); Noah Higgs (bass guitar, assistant signer); George Higgs (drums)
Consultant Choreographer: Jessica Kennedy
St Mary's School for Deaf Girls

LINKS
The Sense Ensemble, Study #1, video of performance: https://www.youtube.com/watch?v=91bKShl94so&t=18s
The Sense Ensemble, Contemporary Music Centre performance: https://www.cmc.ie/features/machinesong-george-higgs
The Sense Ensemble performing as The Lost and Found Sound Assembly, outdoor performances: https://vimeo.com/65599696

REFERENCES