Experimental Cylinders

Experiments in Music Psychology around 1900

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Experimental Cylinders – Experiments in Music Psychology around 1900

Julia Kursell[1]

1. Introduction

In the first decade of the twentieth century, Ludwig Edinger visited Berlin. This professor of physiology from Frankfurt, famous for his insights into the evolutionary development of the brain and neural system, was invited to the Institute of Psychology of the Friedrich Wilhelm University, Berlin. His visit left an audible trace. Two researchers at the Institute, Erich Moritz von Hornbostel and Otto Abraham, asked him to participate in an experiment, in which they were making recordings with a group of singers who were asked to perform well-known songs. The researcher's aim was to measure and understand the extent to which singers deviate from what they think they are singing. Edinger was among the recorded singers.

The experiment was backed up by extensive research into music and its psychology as well as the resources of the recently founded Berlin Phonogram Archive. When the archive's establishment was officially announced in the *Internationale Wochenschrift für Wissenschaft Kunst und Technik* in 1908, its collection already held a thousand items. The article was written by the director of the Institute of Psychology, philosopher Carl Stumpf, who demonstrated great awareness of the conditions set by media technology for research into listening habits. The existence of recordings, he wrote, was about to change the ideas about "exotic music," because the phonograph – as opposed to traditional notation – was able to render its tonal and rhythmical structures accurately (Stumpf 1908: 225-226).

Stumpf himself had made the Archive's first recordings. In 1900, he and Abraham recorded performances by a theatrical troupe from Siam (now Thailand) that was visiting Berlin. Additional recordings soon followed, and the Berliner Phonogramm-Archiv became a center of early twentieth-century phonographic collecting activities. A trained chemist, Hornbostel – who became director of the archive in 1905 – developed a procedure for copying the fragile wax cylinders. Collectors from all over the world now sent their phonograms to Berlin to be copied. They obtained multiple copies, while the Berlin archive kept one copy for its own research purposes. In this way the archive eventually grew to more than 30,000 items (see Ziegler 2006).

The recordings of Ludwig Edinger's singing were filed in the Archive under the rubric "experimental cylinders" (*Experimentalwalzen*, see Ziegler 2006: 84). This category comprised some one hundred items that had been produced under a slightly different regime from that of the bulk of the ethnographical material. Unlike the case of the ethnographic material, no copies were made of the experimental cylinders, and their recorded sounds served different purposes.

This paper aims to reconstruct those purposes for one case: the Edinger recordings. My hypothesis is that this experiment marked a transition from the research program Stumpf had followed before coming to Berlin toward an engagement with Gestalt theory that was arising among a new generation at the Institute. At the same time, the cylinders provide some evidence of the enormous impact of media technology in this transition. Central to my argument is the analysis of the recordings themselves. I propose a re-listening that will detect traces of the experimental situation in which they were made and used.

The first part of this paper introduces the research program in which the experimental recordings were embedded. The second part discusses a change in the function of musical notation. It reconstructs how transcription became a basic methodological operation in the early days of comparative musicology, emphasizing the role that Stumpf's experimental psychology played in this process. In the third part, the recordings of Edinger are analyzed. A small hesitation in the announcement recorded on one of them will serve as a point of departure for a microanalysis addressing the relationship of this recording to Gestalt psychology.

2. Felt and Measured Intonation

In the late fall of 1906, the newly appointed director of the Berliner Phonogramm-Archiv, Erich Moritz von Hornbostel, traveled to Oklahoma. Among other items on his agenda was the study of indigenous singing at the Native American reservations of the region. As well as recordings, he also carried out experiments with various groups of schoolchildren and adults, using test questions and phonographic recordings he had prepared especially for the purpose.[2] He recounted his impressions in a letter to Stumpf, saying that he had been able to observe differences in musical aptitude among the "Pawnee children."

In the tests, Hornbostel had the children sing notes that were presented in various ways to avoid them reacting to performative aspects of the samples rather than to their pitch. The samples were "1) sung, 2) whistled, 3) blown on a pitch pipe, 4) [and given in] rising and descending intervals, namely octaves, fifths, fourths, and thirds." Some children sang the notes as Hornbostel expected them to and as European children would have done. In the singing of others, however, he noticed features that he had not encountered in the singing of European test subjects. These "nonmusical" children, as Hornbostel called them, showed a general tendency to remain on a pitch once sung, especially when they reached the limit of their vocal range. Summing up his impressions, Hornbostel wrote to Stumpf: "The musical test of the Native children has shown once more to me the extent to which mass testing of nonmusical subjects will be necessary for further work. Perhaps Abraham will take care of this matter."

A year later, Otto Abraham began to record a series of intonation samples from various individuals, made with subjects of varying degrees in aptitude and experience and some professional singers. Abraham also recorded his colleague Hornbostel, who had absolute pitch. He asked him to sing a song several times, carrying out specific tasks in the process, such as transposing it by one major second, singing it in his lowest possible register and in falsetto, or whistling it. Abraham eventually published the study in a 1923 festschrift celebrating Carl Stumpf's seventy-fifth birthday, under the title "Tonometrical investigations on a German Folk Song."

The object of these investigations, Abraham explained, was the bandwidth of accuracy and constancy in intonation ("Reinheitsbreite und Konstanz," Abraham 1923: 1). In total, he made twenty-three phonographic recordings of a mixed group of singers. Two of the recorded individuals had absolute pitch – one of them being Hornbostel, the other one probably Abraham himself. Three subjects were trained professional singers, but without absolute pitch, and the remainder of the group possessed no special talent or training.

Abraham was not quite accurate in calling the recorded sample song a "folk song." He had asked his subjects to sing the "Deutschlandlied," a song originally composed by Joseph Haydn. It had been the imperial anthem for Emperor Francis II of Austria, and Haydn used it in one of his string quartets dedicated to Francis. With new lyrics written by August Heinrich Hoffmann von Fallersleben in 1841, the song came to stand for the German nationalist movement, eventually becoming the national anthem of the Weimar Republic in 1922, a year before Abraham published his study.[3]

Abraham could not, of course, have anticipated the infamous use of this very song in the Nazi regime, when von Fallersleben's text was reduced to the first stanza, or its re-use after World War II, when the text was cut again, but now to include only the third stanza. What concerned him was the singers' familiarity with the song. All of them were able to sing it from memory, he emphasized, and had sung it many times in their youth, regardless of how well.

In the recordings, the lyrics were omitted and the subjects asked to sing on the vowel "a"[4] instead. It is important to note that both the experimenter and the subjects had agreed on the song beforehand, and no sheet music was involved. Sheet music would have prompted the good singers to be exact and the bad singers to fail, whereas the familiar melody alone produced the features in their singing that Abraham wished to study.

By recording the intonation samples on the phonograph, Abraham was able, for the first time, to objectify intonation as a criterion of successful performance in Western music. At the time, intonation was generally held to be the decisive index for good singing. This judgment was based on the assumption that musical notation referred to unambiguous tone relations, that is to say, "pure" intervals: the better the intonation, the more it would be true to the written notation. Singers with absolute pitch were held to be privileged in this respect, as they would produce exact rather than intuited pitch relations. However, the results of Abraham's measurements revealed surprising deviations. Apparently, felt and measured intonation differed widely, and, by the same token, musical notation proved to be much more elastic than expected.

Among the singers Abraham investigated was one "abnormally nonmusical" singer (Abraham 1923: 21). To measure this singer's intonation with the methods used for the others would have been like "breaking a fly on the wheel," Abraham stated. There was no point in speaking about degrees of accuracy or elasticity in this singer's intonation, as he not only deviated strongly from the expected values but also proved highly inconsistent. When repeating a motif or melody, the singer never hit the same pitch twice. Nevertheless, Abraham nuanced his impression of this experimental subject. He wrote: "As to his characteristics, I should add that he is a music lover; he likes simple melodies and immediately recognizes them. When I once played him the melody 'Wir winden Dir den Jungfernkranz' from *Der Freischütz* on the piano, he recognized it immediately" (21). The fact that this singer could not reproduce intervals, then, did not mean that he had no sensitivity to them. The nonmusical singer might be a passable musical listener.

3. Nonmusical listeners in the laboratory

This investigation of the nonmusical individual had a prehistory in the work of Carl Stumpf. In the two volumes of his *Tonpsychologie* (Psychology of Tones), published in 1883 and 1890 and encompassing more than fifteen years' research, Stumpf examined the psychological functions involved in hearing music. This extensive treatise started with the simplest element in music, the tone relation. The first volume discussed distances between tones, the second two notes sounding at the same time. Stumpf's main question was which cognitive processes such elements called upon. The elementary methodological operation he proposed to this end was to compare judgments by subjects who exhibited skill in music with those by subjects who declared themselves to be nonmusical. According to Stumpf, the differences in judgment between these two groups arose from their differing ability to "analyze" what they heard. The musically able ones immediately processed their sensations in terms of tonality and musical harmony, whereas the nonmusical subjects had no access to this code. Instead, they remained at the stage of sensation that, Stumpf assumed, preceded analysis.

This method eventually led Stumpf to propose his concept of fusion (*Verschmelzung*): two notes played at the same time produced the impression of being only one sound, depending on their degree of fusion. The explanation for this, according to Stumpf, was that all individuals at first sensed one conglomerate sound, which the musically educated subjects then went on to recognize as being an interval, in other words to analyze it according to the rules of music. The nonmusical subjects, in contrast, reacted directly to the degree of fusion: identifying the notes as two only if the degree of fusion was low and thinking of them as one sound if there was a higher degree of fusion.[5] For Stumpf, the comparison between the two groups yielded a clear result: fusion occurred in sensation, whereas analysis built upon sensation while simultaneously concealing it as an independent state of cognition. The musically schooled subjects were simply too quick at identifying a musical rule to become aware of their own analytic activity, and they took the outcome of this analysis to be a sensation.

While still working on the second volume of his *Tonpsychologie*, Stumpf realized that the clarity of his results was partly due to his experimental subjects' having been exposed exclusively to central European tonal music of the eighteenth and nineteenth centuries. He became aware of this as a significant restriction in 1885, when he attended the performance of a group of Nuxalk from British Columbia in Halle, which were then referred to as "Bella Coola Indians." He wrote about this in an article, "Lieder der Bellakula-Indianer" (Songs of the Bella Coola Indians) that appeared in the recently founded musicological journal *Vierteljahrsschrift für Musikwissenschaft*.

Listening to the performance of the singers from Canada, Stumpf noticed that he lacked the code for understanding their music. He therefore seized the opportunity to work with a member of the group and asked its best singer, Nuskilusta, to teach him the elementary rules of Bella Coola singing. In private sessions, Nuskilusta sang all the show's songs for Stumpf, who took down what he thought to be their melodies in traditional European musical notation. However, this proved difficult, if not impossible. Stumpf reported having to concentrate very hard in order to ignore his mental presets, which were looking for familiar tonal elements even when these could not be expected to occur.

After a while, Stumpf nevertheless felt more at ease with Bella Coola music. He admitted that the singing had initially appeared to him as "mere howling," but his training with Nuskilusta now allowed him to recognize tone relations that had been unfamiliar to him at first encounter. He noticed wrong notes in the next performance he attended, and he commented — turning the alleged offense in naming his colleagues 'unmusical' back to the offenders — that "even among the savage there seem to be nonmusical people" (Stumpf 1886: 408).

During his work with Nuskilusta, Stumpf also realized that European musical notation was incapable of accurately capturing the music. His note-taking was hampered not only by his mental presets, but also by the presets inscribed into the notation, which made it difficult for him to give an accurate account of the music. The code of European musical notation did not supply the symbols necessary to denote essential features of this music. Stumpf came up with a simple solution: he added extra signs for what appeared to be deviations from European tonality in the notated melodies. He used circles and crosses to indicate where the intended intonation went above or below the notated pitch.

According to Stumpf, the resulting notation had a great advantage: it was easy for the European reader to understand. Not surprisingly, he did not believe that his notations would ever need to make sense to a member of the "Bella Coola Indians." Stumpf explained this in a later article, in which he compared his own notational style to that used by Benjamin Ives Gilman when commenting on Native American melodies collected by J. Walter Fewkes. Gilman, a former student of Charles Sanders Peirce, had also used European music notation, but unlike Stumpf, he wrote the melodies in such a way as to defamiliarize them for the European gaze. He achieved this by arbitrarily attributing new meanings to the available signs, including the accidentals. The resulting melodies looked as if they had arisen from a modernistic composing style with a preference for remote tonalities and were, accordingly, difficult to decipher (Stumpf 1892: 131).

Notation after Gilman, as printed in (Stumpf 1892: 131).

Gilman's defamiliarization of European musical notation did not appeal to Stumpf. A notation that did not convey at least some immediate impression of the music's sound was not appropriate for communication among the members of the scientific community, he thought; the reader should at least get some idea of a melody when looking at the printed notes. Although the mental presets had felt like an impediment, when he was trying to notate the unfamiliar music, Stumpf now advocated making use of them for reading music in print.

4. Melodic movement

Against the background of Stumpf's research on nonmusical subjects, Abraham's study of intonation appears in a new light. By the time he began collecting his series of samples, the two functions of recording and transcribing had entered the methodology of comparative musicology. In a number of coauthored publications, Abraham and Hornbostel had further developed a methodological tool kit for working with the phonograph. Parallel to this, they regularly published analyses of the music collected in the Phonogram Archive.[8] During this process, the function of musical notation fundamentally changed. If for Stumpf notation had previously served as the only means of referring to the sound of music, the referential function was now distributed among several media. Equally, the function of analysis could be isolated and further differentiated. In addition to transcribing the recorded music, measurements of rhythmical and tonal aspects were carried out on the recordings. A standard scale for measuring pitch with the unit "cent" was introduced that, although based on the tonal steps applied in the tuning of a piano, would allow for a more finely grained description of frequency relations in the recorded music and facilitate comparison with the European tonal system.

Equipped with these methods, Abraham turned to musical notation as an object of investigation in its own right. He questioned the validity of reference in notation, thereby inserting the problem of notation into a genuinely psychological research agenda. The exact measurements carried out on the heterogeneous materials of "exotic music" implied a great deal of exactitude in the performers who happened to be recorded. No one had asked, however, whether such accuracy could be expected in performance at all. Abraham hypothesized that the ethnographers tacitly assumed the execution of the recorded music to be "correct" in the sense of European notation being "correctly" executed by excellent musicians trained in the European tradition. This assumption deserved more attention, he argued.

Abraham thus turned to *subjectively* correct readings of musical notation, testing the elasticity of that notion, on the one hand, and the encoding of acoustic events in musical notation, on the other. He measured his samples and evaluated them statistically. His results were surprising: there were great deviations among the subjects, including those with absolute pitch. The deviations themselves were sometimes more than twice as large as the smallest interval in the tonal scale. This meant that the individuals experienced the intonation as being correct not only when they were freely interpreting certain intervals as slightly larger or smaller but also when they were actually transgressing the rules of tonal harmony. Abraham ascribed this effect to certain "essential" aspects in the melody that made singers and listeners accept as correct what went against the notated values. The strongest confirmation of such a melodic essence was to be found in the performance of the nonmusical singer. Even though his singing almost never coincided with the notated intervals, the direction of the steps was correct in most cases. The same held for the proportions. He sang large and small intervals where necessary, even if these were almost never correct. Finally, no deviations occurred in his rendition of the rhythm.

The recordings of Edinger are illuminating in this respect. Abraham did not reveal the names of his subjects, and the archival evidence does not suggest that this eminent brain physiologist and neurologist was the nonmusical experimental subject discussed in the article. Nevertheless, it is fair to assume that the recordings Arbaham made with Edinger played a decisive role in his study of intonation. According to the Phonogramm-Archiv documentation, experimental cylinders nos. 18–20 were made with Edinger. One of them contains his rendition of the commercium song "Gaudeamus igitur." Another cylinder presents the folk song "Kommt ein Vogel geflogen" and a further commercium song, "Ergo bibamus," based on a text by Johann Wolfgang Goethe. The third is labeled "Wagner-Motifs." No performance of the "Deutschlandlied" by Edinger is known to exist.[9]

Wax roll no. 18 begins with an announcement: "Second recording Professor Edinger, Frankfurt: Kommt ein Vogel geflogen." The song follows, then another announcement: "The same once again," and another rendition of the same song. The two performances are similar in that in both cases the intonation strongly deviates from the melody of the folk song. The singer's voice does not produce a tone with a clear pitch, but resembles speaking with a strong rhythmical structure and an eccentrically overstated melodic contour, as opposed to mere speech. As the repetition demonstrates, these features did not occur by chance, but are characteristic for this singer's performance.

Like the folk-song recording, Edinger's "Wagner-Motifs" recording starts with an announcement. Again, the singing is preceded by a note that is provided by the supervisor of the experiment. Ironically, in this case the note – normally played on a pitch pipe and intended to indicate the correct replaying speed – is sung here. Whether it was Abraham or Hornbostel who made the announcement (both were probably involved in the recording session, and both had absolute pitch), it seems that they found their own singing accurate enough for the precision needed for this purpose.

Four different motifs are then heard, each performed twice. Edinger imitates instrumental parts on syllables such as "daa dadida dadida dadiii" and sings the opera's text for the vocal parts, such as "Goldne Äpfel wachsen in Freya's Garten." He obviously sings them from memory, as he deviates slightly from the original libretto.[10] After this, the announcer enumerates the motifs that have already been heard, identifying them as being from *The Ring of the Nibelung*. The recording shows that Edinger is acquainted with Wagner's music – to the extent of knowing its leitmotifs. He is even able to reproduce these well enough for the supervisor of the recording to recognize them. He utters them correctly in terms of rhythm, although the pitches are reproduced in the same peculiar way as before, which is closer to speaking than to singing.

A small hesitation in the announcement of the motifs suggests the unrehearsed nature of the recording situation.[11] The announcer does not seem to be quite sure of the motifs in question; his intonation suggests that he seeks confirmation. One imagines Abraham looking at Edinger, who nods when he says "Waldvogel." A faint undertone of laughter in the announcer's voice is reminiscent of the effect that Hornbostel displayed in a recording of his own singing in the highest register. Barely reaching the highest note of the "Deutschlandlied" when he sings it in falsetto, Hornbotel bursts into laughter and has to start the melodic phrase again.[12] Edinger reaches a falsetto as well when he tries to imitate the color of high notes rather than attempting to convey the pitch relations among them. His singing of the "Waldvogel" thus ends both times on a squeaky long "diii" syllable that hardly translates into any pitch.

What these moments of spontaneity seem to convey is that the choice of the music was left to Edinger. He sang music that he knew well and felt able to reproduce. Yet Wagner's music is not conducive to humming along. Edinger attempted to sing motifs that were written for instruments rather than voices and the range of which far exceeds the capacities of even a trained singer. In Wagner's music, the live experience of opera and its reproduction at home had drifted apart. The Wagnerphile *Bildungsbürger* may have sung and played the music in piano reductions, but in that enterprise both the singing and the piano served as a memory aid in recalling the original, rather than providing a full substitute of the original.

Wagner's music itself questioned the seemingly evident and natural connection between performing and listening. Even before the phonograph, the link between these two competences had been severed. The *Ring* was composed for listeners in the first instance. The motifs – which the opera visitor could follow with the help of various supplementary publications, such as the Reclam pocket edition of the libretti with a leitmotiv-foldout – were meant to be detected and understood. To sing them was as difficult as it was unnecessary.

The intonation samples of Edinger's voice held in the Phonogram Archive thus reflect a development in the history of both music and its media. Wagner's music addressed an audience of listeners, but a listener who wanted to hear it or be reminded of it outside the opera house still needed to use a piano reduction. Together with the piano or the libretto, musical notation granted repeated access to the music. This was at the cost of all those properties of the music that the notation did not cover, such as the timbre of the sounds.

Initially, the phonograph did not change this situation. Complex orchestral music such as Wagner's could only be recorded once microphony became available and only reached a reasonable level of what came to be called "fidelity" with technologies such as full frequency range recording, multi-taping and the mixing console. Nevertheless, the phonograph enabled Abraham to assess musical performance in a new way: as the acoustic token of a subjectively correct rendition of music. For the first time, this token became accessible to measurement. In the experimental recordings of Edinger, what the phonograph brings to the fore is Edinger's "listening" in the sense set out by Peter Szendy (Szendy 2007). Even though his rendition of the "Wagner-Motifs" does not fulfill the requirements of the code of music, it does indicate that he has listened to Wagner, knows the music well, and has precise ideas about its sound. Through the phonograph, Edinger articulates himself as a listener.

Returning once more to the nonmusical individual in Abraham's study, the analysis of this subject's singing reveals the emergence of a new object of study. A regular stave of five lines is sufficient to "denote his mistakes," Abraham states; in other words, he takes down this subject's singing in regular notation. The resulting melody, however, shows the limits of melodic recognition. This melody is no longer tonal, as it escapes the rules of tonality, but it shares its contours with the original tune: "as far as the ups and downs of melodic movements are concerned, this singer performs correctly and almost without mistakes" (Abraham 1923: 22).

In allowing for contour as a criterion for musical performance, Abraham to some extent removes melody from traditional musical notation. The contour can be conveyed more easily by a diagram than in traditional notation, and that diagram—which, according to Abraham, is rather like a "fever curve" (ibid.: 7)—resembles the graphs that had been omnipresent in experimental physiology and psychology since the mid-nineteenth century.

(Abraham 1923: 7).

In the traditional encoding of a melodic line, only the tone relationships are encoded. The melody thus looks like a sequence of dots or beads on a string, and the transition from note to note must be inferred from the relations given between the dots. The curve, in contrast, draws a continuous line between small dots that indicate the stable pitches in the melody; it appears as if the melody were gliding from tone to tone. In such a diagram, the encoding of deviations would not distort the melodic contour; they would simply appear as a change of scale. The diagram turns melody into a gestalt.

From recording, transcribing and re-encoding, Abraham obtained a property of melody that he called "melodic movement." This property is accessible to the nonmusical subject, and it is a property that also characterizes Edinger's recordings. It came to be called a Gestalt quality of melody. Not unlike Stumpf's concept of fusion, which logically preceded the categorization of intervals and therefore could not be detected by the judgment of musically trained subjects, the melodic contour as a property in its own right was difficult to detect. When subjects with musical training wrestled with the more fine-grained aspects of correct singing, they related their achievements in intonation to the notated intervals rather than the melodic contour. The underlying melodic contour would arise from the intervals in any case, when sung correctly.

Yet, this contour came to the fore even in strongly deviating intonation. The contour, in the new sense of a Gestalt quality, had escaped attention as long as the musical code was not confronted with the phonograph, i.e. with a way of accurately reproducing its subjectively correct rendition.[13] From a present-day perspective, the singing of the nonmusical subject also showed that what united the musically trained singers, despite the "enormous" deviations from notation, was the melodic contour. And although the contour as such was not subject to the rules of tonal music, it was still a genuinely musical phenomenon.

5. Conclusion

Abraham's collection of intonation samples pits the nonmusical medium of recording – the phonograph – against the nonmusical experimental subject. The first does not rely on the rules of tonal music for registering music; the second does not rely on those rules to produce a recognizable melodic contour. Whereas Stumpf aims to reveal the conditions upon which cognition operates and uses music for this purpose, Abraham discovers the recognition of melodic contour a specifically musical trait that is found in human cognition and of which European tonality is one special case. The phonograph assumes a different type of agency within the two experimental constellations. Stumpf – and with him the early comparative musicologists – sees it as making the pre-analyzed state of musical artifact available to the researcher for reiterated processes of analysis. In Abraham's experiment, the "nonmusical" subject conveys his subjective way of listening through the phonograph. Abraham uses measurement and a new visualization of melody (as a curve, guided by melodic contour rather than the conventions of musical notation) to handle this new relation between listening and reproducing. Because, and not although, the phonograph "listened" without encoding the music, it was able to make audible what one might hear when listening to contours. If the phonograph was considered to be radically nonmusical, melodic contour turned out to be genuinely musical. The phonograph revealed a new sense of musicality – as a manifestation of listening.

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