Big Stories in Small Spaces:

A History of the Orchestra Pit in the Light of Affordances

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1. Introduction

A few years ago, I visited the opera in Düsseldorf to see Giacomo Puccini's *Il trittico* (1918). It was the first time I went to the opera, and I expected a great musical spectacle on stage. Because seats in the parterre were too expensive for me at this time, I sat on the balcony, which provided an excellent view of the orchestra. During the course of the evening, I suddenly realized that my eyes kept on getting caught by the musicians in the orchestra pit. What happened in this small space during these three and a half hours was a lot more exciting than the events on stage: the conductor, who guided the musicians and the singers on stage so naturally, a young Asian girl who sat in the first row playing the violin and occasionally smiled at him, the turning of pages so neatly timed – there seemed to be a specific kind of silent communication I could not really follow, but which was fascinating to observe. I could only tear my eyes away from the scene once the last tone slowly evaporated in the hall and the audience started to applaud enthusiastically.

Only later did I learn that the orchestra pit is a highly unique place, posing constraints as well as challenges to the musicians within it and the singers on stage. Technically seen, the orchestra pit serves two functions, both of which are crucially important to the performance of opera. By placing the musicians in a sunken pit, the voices of the singers on stage are ensured to reach the audience behind it (Meyer, 1972). This would be more difficult if the orchestra was placed for example on stage, where it would block the singers' voices right away. As a side effect, the sound produced in the pit appears to be less loud on stage and in the audience, which results in a balance between the orchestral music and the singers (Beranek, 2004). However, the pit also visually conceals the orchestra, and thereby the attention of the audience can be drawn to the spectacle on stage (Barron, 1994).

In this paper, I want to demonstrate that the orchestra pit is a technological artifact that is a part of opera performance. It is, contrary to what one might first think, not an empty space in which music is made. Rather, the orchestra pit shapes performance practices of the different actors and is also shaped by these practices. It does so by its design, which is variable and thereby provides possibilities for different actions, behaviors, and practices. It is a material artifact that enables and constrains practices in the performance of opera and therefore constitutes itself as a part of it. It is, viewed from this perspective, not different from an instrument that occupies a crucial role in the performance of music through its materiality.

The material perspective on musical spaces lacks in written histories of opera. Although it has been widely acknowledged in the study of instruments in general, discussion of material spaces in musical culture lags behind. This is why it is relevant to look at the orchestra pit as a

material artifact in musical culture, specifically opera. It constitutes a striking example of a space in musical culture that, through its materiality, shapes this culture significantly.

This paper will therefore employ Gibson's (1979) concept of affordances in order to emphasize the materiality of the orchestra pit design. The aim of this research consists in presenting a history of orchestra pit design in the context of the practices and actions it affords. It also aims at outlining and entangling the various factors that have an impact on musical practices and opera performance within this musical space, for example other design elements that relate to the pit or the musicians and singers. Following from this, the overarching question of this research is "How does the orchestra pit shape the musical practices and performance of opera?" The question will be answered by analyzing different designs of the orchestra pit from the past as well as today with the help of the concept of affordances.

In the following section, I will elaborate on the concept of affordances and its use throughout this paper. Also, methodological implications will be outlined and discussed. Afterwards, I will introduce the history of opera, in order to clarify the emergence of the orchestra pit and its impact on performances of styles and genres. Special attention will be drawn to the orchestra pit of the Bayreuther Festspielhaus as designed by Richard Wagner, which is a perfect example of how the design of a musical space is capable of promoting certain practices while constraining others. Subsequently, I will outline what impact current orchestra pit design has on musical practices as performed by musicians, singers and audiences. At the same time, various factors will be illustrated that problematize and influence this interaction. The paper will end with some concluding remarks and an outlook on alternative placements of the orchestra in opera.

2. Methods

As already indicated, there is no theoretical concept per se that acknowledges the materiality of opera or its various elements. This is the reason why throughout this paper, the concept of affordances as coined by Gibson (1979) will be used as a tool in order to disclose how musical practices and performance of opera are shaped by the materiality of the orchestra pit. Originally, the concept was used in the context of psychology and ecology, and aims at defining the relationship between organisms and their environments. However, seen from a more general point of view, the concept of affordances aims at examining how objects can provide possibilities for actions and perceptions (Krzys Acord & Denora, 2008, p. 228). It is thus a concept primarily focused on the materiality of environments, and aims at discovering how these material environments shape the behavior and practices of organisms. This is reflected in the following quote by Gibson (1979):

> Different layouts afford different behaviors for different animals, and different mechanical encounters. The human species in some cultures has the habit of sitting as distinguished from kneeling or squatting. If a surface of support with the four properties is also knee-high above the ground, it affords sitting on. We call it a seat in general, or a stool, bench, chair, and so on, in particular (p. 128).

Thus, diverse designs provide various kinds of usability by their shapes, forms and conditions they pose, and thus also different behaviors and practices. The orchestra pit, as already mentioned, is in this regard not different from an instrument, or the previously mentioned chair: each of these artifacts affords certain uses and behaviors, while constraining others. According to Windsor and de Bézenac (2012), the concept of affordances has not received adequate attention when it comes to musical cultures (p. 102). Those discussions about affordances that are available in the context of musical cultures focus on kinds of perception and action that music and music-making leads to, thereby treating the specific materialities involved in this process as necessities but not as main issues (see Windsor & de Bézenac, 2012; Menin & Schiavio, 2012; Clarke, 2005). If materialities are acknowledged more extensively, it is usually in the form of instrument studies; discussion about material places has been, until now, barely touched upon. In this paper, I will therefore treat the materiality of a specific musical space as a main issue, and employ the concept of affordances in order to help close this gap. I will show how the materiality of the orchestra pit poses problems to the practices of musical practitioners in and around the orchestra pit, as well as the performance of opera throughout time.

The theoretical concept of affordances is complemented by three qualitative, semi-structured interviews. These interviews have been held with three sound engineers, of which two are working for the opera in Cologne (Stefan Reich) and the opera in Düsseldorf (Thomas Gabbert). Both of them have a deep and practical understanding of the acoustic design of the orchestra pits in these two places and how they shape performance practices. The other interviewee, Dagmar Birwe, is professor at the Robert Schumann University in Düsseldorf and will complement this practical knowledge with historical insights.[1]

In preparation for all interviews, a topic guide was set up. During the talks, I took notes and asked follow-up questions that are not included in the topic guide. The interviews were held in German and recorded with informed consent. Afterwards, they were transcribed, coded inductively, and analyzed. The quotes used throughout this paper have been translated by the author.

[1] Unfortunately, I did not manage to interview musicians, actors, or conductors. Yet, Reich and Gabbert both regularly work with each of these three groups, so that they could still offer useful insights about their problems and opinions for this research. As sound engineers, they additionally occupy a rather neutral role within the relationship between musicians and singers. This relationship can be very complicated depending on the compromises that often need to be made out of acoustic reasons.

3. A Short History of the Orchestra Pit in Opera

In order to understand the development of the orchestra pit and its different designs, it is necessary to take a look at how and in which forms it appeared throughout the history of opera.

Opera itself emerged between the fifteenth and sixteenth century in Florence, Italy. At this time, it constituted a very private musical culture and was mainly practiced in Italian courts. The first public opera house, the Teatro San Cassiano, was established in Venice in 1637 (Barron, 1994, p. 298). In contrast to Florence or Rome, Venice had no significant tradition when it came to music at private courts, which led to the establishment of the first theatre specialized for opera performances that was accessible to the public. The formation of the Teatro San Cassiano gave rise to an opera house boom in Italy during the following years. In terms of design, the Teatro San Cassiano was supposed to accommodate as many seats as possible, for commercial reasons (Forsyth, 1985, pp. 76-78).

For the first time, "the orchestra was placed in front of the stage, having previously sat at the sides, in galleries, or behind the scenes" (Forsyth, 1985, p. 76). The area in front of the stage is known to be the first orchestra pit; however it was not yet not sunken but placed on the same level as the audience, at the same time being separated by rail (see figure 1). Soon it had been recognized that by placing the orchestra in front of the stage, the sound of the orchestra was more brilliant and much clearer. Once public opera houses in Venice were commercially successful, the idea of public opera houses quickly spread to other cities, including the newly introduced orchestra pit (Forsyth, 1985).

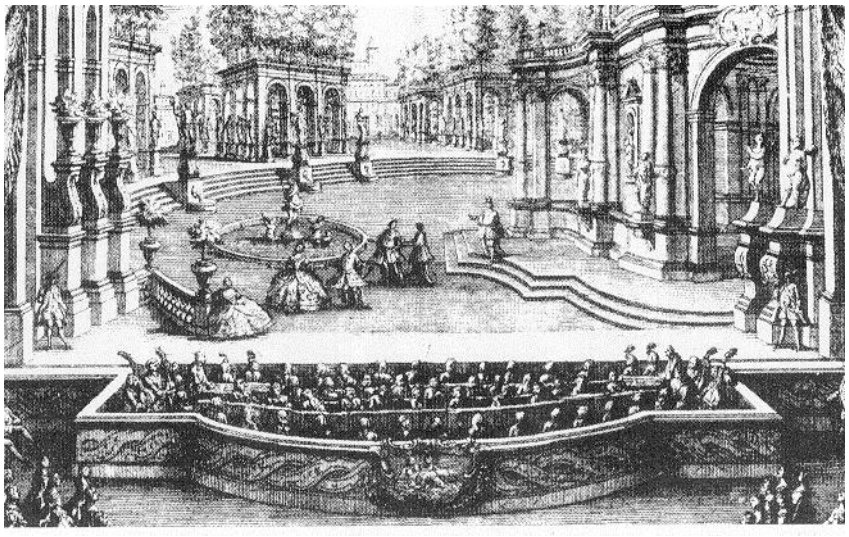

Figure 1: The placement of the orchestra in the Teatro San Cassiano, Venice; exact date unknown.

The idea of placing the orchestra in front of the stage in a pit was one of the ongoing and standardized features of Italian Baroque opera houses. In the Teatro Regio in Turin (1738-1740), for example, the orchestra also sat in front of the stage, but on two long tables. These required a certain seating order of the musicians for the whole orchestra to fit in the area. One row of musicians was thereby placed with their backs to the stage, whereas the other was facing the stage and turned their backs to the audience (see figure 2; Forsyth, 1985, p. 81). At the end of the table sat the conductor at the cembalo, together with the low-pitched instruments. This seating order prevailed partly until the nineteenth century, as in the Royal Opera House in Covent Garden, London (Meyer, 1972).

What was special about the orchestra pit in the Teatro Regio was the fact that the architect had installed a semi-cylindrical resonance chamber under the orchestra, which connected to the stage via acoustic tubes. This was supposed to amplify and project the orchestra's sound and was a common feature to many Italian theaters (Baumann, 2011, p. 37). In general, Italian-style opera houses are known for their acoustic clarity, which depends on the materials being used and the audience being seated as close as possible to the stage – and thereby also the orchestra (Fortsyth, 1985).

Figure 2: Orchestra pit in the Teatro Regio, Turin. Painting by Pietro Domenico Olivero. Depicted is the opening night of the theater in 1740.

The first sunken orchestra pit was built only a bit later at the Theater at Besançon (1778-1784), France. The architect, Claude-Nicolas Ledoux, aimed at concealing the orchestra in order to increase the dramatic effect on the stage (Forsyth, 1985, p. 112). This anticipated Wagner's idea of the hidden orchestra pit already, however the theater still employed characteristics that were, until then, mostly found in Italian theaters. The back wall of the pit was of a semi-cylindrical form, in order to act as a reflector (see figure 3). Strangely enough, in practice this element was an acoustic disadvantage, for the musicians experienced the music as disturbingly loud. It did not even have an effect on the audience because the concave wall directed the sound horizontally, in such a way that it could not even reach beyond the pit. Also, the pit was built over an acoustic tube as in the Teatro Regio (Baumann, 2011, p. 38).

In general, the intermingling of different design components was nothing unusual in the history of opera house and theater architecture, because acoustic knowledge was not far developed. This is the reason why successfully perceived designs, for example specific auditorium forms or arrangements of boxes, were copied in order to achieve the best possible acoustics (Baumann, 2011; Beranek, 2004). Only in the nineteenth century, significant improvement in understanding of sound was to be recognized in the first mathematical publications that circled around pressure ways, problems of reflection and refraction and transmission of sound waves (Baumann, 2011, p. 34).

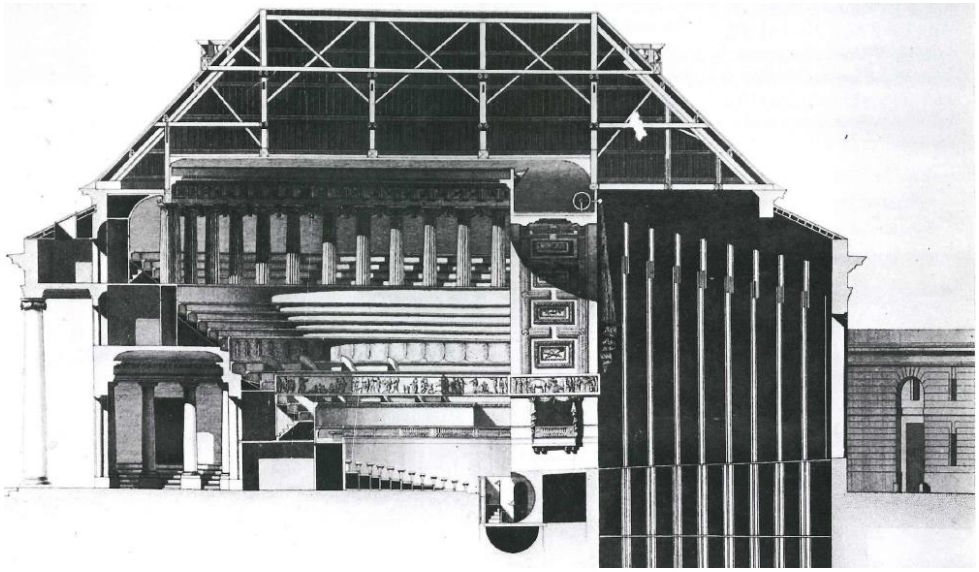

Figure 3: Theater at Besançon, 1804. Here the semi-cylindrical form of the back wall of the orchestra pit can be recognized.

The design of the orchestra pit has remained relatively stable between 1600 and 1800. However, as we will see in the next section, Richard Wagner introduced some interesting changes in pit design in the nineteenth century. It can be said that the emergence of the orchestra pit in

opera house and theater architecture is a materialization of the intention to amplify the orchestral sound in order produce a more coherent performance and a suited balance between orchestra and singers for the audience (Forsyth, 1985, p. 95).

In turn, it is recognizable that the orchestra pit of the past, with its differing design variations, afforded certain practices. For example, playing an instrument in the Teatro Regio in Turin differed from playing an instrument in the Teatro San Cassiano, for the reason that the dimensions of the pit in Turin required the orchestra and the conductor to sit in a different manner, and therefore also communicate differently among each other and the stage. Thus, in Turin, the pit could afford only one functioning seating order – which in general has a lot of impact on the practices and performance of music (Meyer, 1972, p. 303).

Also, different musical styles occupy an important role in this respect: in the eighteenth century, the relatively small Mozartian orchestras were placed in full view of the audience in order to achieve clarity in sound. Because instruments were quieter, they sounded more brilliant when the orchestra was placed in such a way that there was no obstacle between the musicians and the audience. A non-sunken pit was therefore the best solution to perform operas by Mozart. A sunken pit could not afford the musicians with being placed at the same level of the audience, and therefore constituted a disadvantage in achieving a balanced opera performance (Beranek, 2004). With a sunken pit, the musicians would have been simply too quiet and the clarity of the instruments would have drowned in the pit.

Also here, it is noticeable that the different positions of the orchestras, as dictated by the orchestra pit design, played a major part in the performance of opera music. Different orchestra positions resulted in different atmospheres and shades of clarity, which both are crucial to how the audience perceived the musical performance; it had, basically, the same consequences for clarity and atmosphere as for example the use of different instruments or styles of playing. Yet, this connects also to the fact that opera houses were usually built for contemporary operas and therefore required certain architectural elements to suit the music that would be played in the house (Forsyth, 1985, p. 73). Thus, affordances of the orchestra pit design were, to a certain extent, constructed in order to achieve specific results for the acoustics or the social structure of opera going (Johnson, 1995, p. 9).

However, as we will see, although affordances were constructed, this does not mean that they cannot be problematic for the practices. In turn, composers often wrote pieces of music for specific opera houses, although it remains unclear to what extent the composers really paid attention to the acoustic requirements of the specific opera houses.

4. A Break in Opera House Design: Wagner's Orchestra Pit at the Festspielhaus in Bayreuth

When Richard Wagner appeared on the scene in the nineteenth century, opera house design took a turn. It was in 1850 that Wagner planned to establish a temporary wooden theater near Zürich, a theater that was thought to be suited for his staging of *The Ring:*

> Here a temporary theatre was to be built, as simple as possible, perhaps merely of timber, and calculated purely in terms of the functionality of its interior; I had already spoken to an experienced and intelligent architect and discussed with him a plan for a theatre of this kind, which would include an amphitheatrically-shaped auditorium and involve the great advantage of an invisible orchestra (Wagner, 1962, Homepage Bayreuther Festspielhaus).

Yet, it took some detours and time until the Festspieltheater opened in 1872 in Bayreuth, with the help of the architect Otto Brückwald. The result was a theater that was designed entirely around Wagner's music drama, and has mostly remained like this until today (Forsyth, 1985, p. 186).

The amphitheatrical form of the auditorium, for one of the first times in opera house history, provided all visitors with equal sightlines. The stage was relatively large. Its size was emphasized by a double proscenium[2], which additionally created the effect of watching the drama from an illusionary distance for the visitors (see figure 4). They were looking at the space beyond, the distance thereby aiming to generate tension (Barron, 1994, p. 316). Dimmed auditorium lights added to the suspenseful atmosphere.

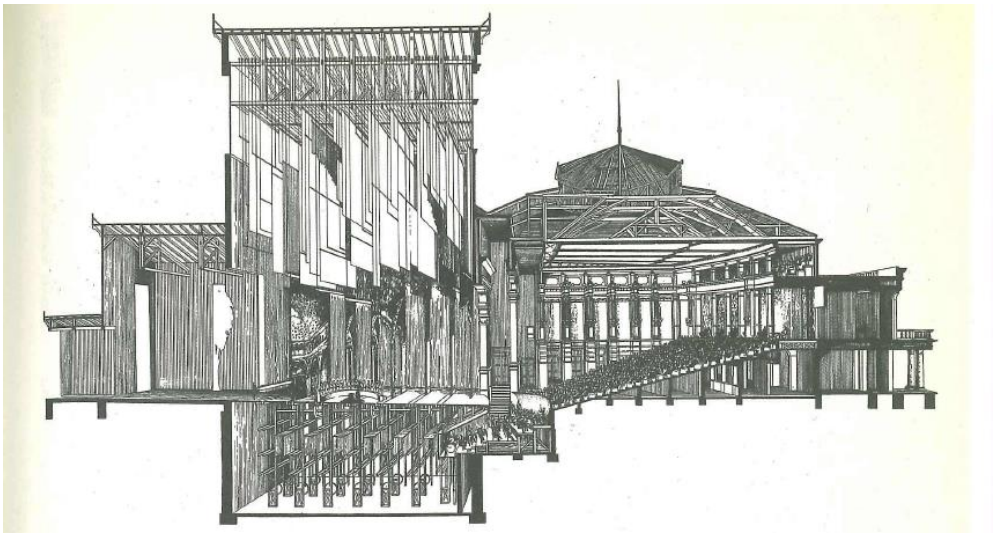

Figure 4: Cross section of the Festspielhaus in Bayreuth, dating from 1882. Here, the depth of the stage and the orchestra pit are very well visible.

[2] The proscenium is usually an arch surrounding the stage opening in theaters and opera houses. It is the forepart of the stage and located between the stage and the orchestra.

However, one of the most remarkable design features Wagner and Brückwald employed in order to create this illusionary and dramatic atmosphere was a deeply sunken orchestra pit (Spotts, 1994). This orchestra pit, to Wagner, was a crucial element in achieving the dramatic effect he aimed at while planning the theater: "This was the structure's central feature, and Wagner essentially built his theatre around it. By constructing the pit below the level of the auditorium and partially covering it with a hood, he made the orchestra invisible and was able to plunge the theatre into complete darkness" (Spotts, 1994, p. 4). The pit, indeed, was very different in terms of design from the ones that had prevailed until then. It descended under the stage on six levels and could hold up to 130 musicians, which is the standard size of the Wagnerian orchestra. The walls and ceiling were painted black, and the pit was almost entirely covered by a hood that reached from the rail next to the audience in the direction of the stage, so that the orchestra remained entirely invisible (Forsyth, 1985, see figure 5).

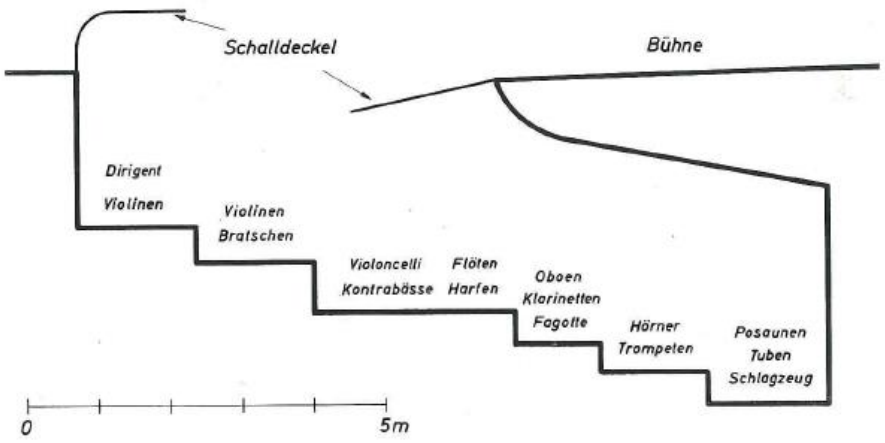

Figure 5: Cross section of the orchestra pit at the Festspielhaus in Bayreuth.

The orchestra pit in Bayreuth was regarded by Wagner as a "mystischer Abgrund" – a mystical abyss – between the performers on stage and the audience (Barron, 1994, p. 316). As a side effect of the visual concealment of the pit, the music emanating from the orchestra is quieter and thus the balance between the singers and the orchestra can be maintained. Also, the sound that reaches the audience is reflected by the walls and ceilings and therefore is entirely indirect and blended together. As perceived by the audience, the sound is of a "mysterious, remote quality" (Forsyth, 1985, p. 187). In fact, many conductors enjoy performing in the orchestra pit at the Festspielhaus Bayreuth: "Every note can be heard at the podium. The orchestra can 'let out

the throttle' and not drown out the singers. They feel that, because the blending of the sound takes place in the pit, it merges in the form intended by the composer" (Beranek, 2004, p. 287).

The orchestra pit is a fascinating example for the intertwinement of music and materiality, especially when it comes to spaces where music is made. The pit was and still is a crucial element in the performance of Wagner's operas. Without the pit, the performance of the Wagner operas would certainly lack the dense atmosphere from which they feed: "I really must say it instantaneously gets you excited, the lights are being dimmed, and then the orchestra starts so unbelievably soft, this prelude to *Lohengrin* – and that you cannot see the orchestra really is an important part of this experience" (interview Birwe, 2015).

The pit itself is, as planned by Wagner, a crucial element in distinguishing his musical drama performances from other composers or musical styles in opera. It constitutes the decisive design component that characterizes a Wagnerian opera in Bayreuth and generates a very different sound from other pits. This is visible in the fact that it fails to adequately support music written by any other composer (James, 1997). It is simply not suited for a more general musical repertoire, because of the atmosphere but also because the string tones would become too muffled and the orchestra would take on an eerie sound (Beranek, 2004, p. 568). Also, the depth of the pit makes it almost impossible for smaller orchestras to produce a sufficient sound level for the audience to hear it.

The orchestra pit in Bayreuth embodies specific affordances that pose specific circumstances to the musicians. The design of the pit is a mixture of acoustic requirements as posed by Wagner as well as the dramaturgical criterion that the pit needs to afford a certain atmosphere in order for the audience to be drawn into the performance, as well as it characterizes the performance. The affordances embodied by the pit are a careful construction of Wagner, aimed at the unification of his music and drama. In this case, because of the overhang (which is both an acoustic and a dramaturgical element), the orchestra pit affords the musicians to play freely, and the conductor does not primarily need to pay attention to the danger that the orchestra could overpower the singers (Beranek, 2004, p. 287). The size of it is suited to accommodate a 130-piece orchestra, but cannot be reduced so as to accommodate smaller orchestras and still produce a satisfactory acoustic result.

In general, orchestra pits in opera houses or theaters are able to afford different styles of playing which depend a lot on the seating order of the musicians and size of the orchestra. Thus, "ordinary" orchestra pits enable the performance of different styles of music, mainly because they are flexible in their acoustic design. The orchestra pit in Bayreuth is a very specific acoustic design, which does not allow for flexibility. This is the reason why until now, it remains unique in its design and has not been copied (Barron, 1994).

5. The Orchestra Pit: Design, Practices & Performance

As already mentioned, orchestra pits nowadays need to primarily afford flexibility. This view is shared by the sound engineer Birwe, who thinks that Wagner's pit suits its own purposes, "But I would not see it as the ideal orchestra pit. It is simply not flexible enough. Suited for Wagner operas, but not any others" (interview, 2015). Today, lifts are usually integrated into the orchestra pit, so that different podiums can be elevated independently of each other.

On the one hand, this serves to facilitate moving larger instruments into the pit. On the other hand, with the help of the lifts, the size of the pit and seating height of the musicians can be adjusted. This enables different acoustic effects to appear, depending on the kinds of musical styles that are to be played. For example, Baroque and Renaissance operas are often played with the pit completely elevated, because they require fewer musicians than a grand Verdi or Wagner opera and thus are in general less loud. Also, these pieces are often played on period instruments that in general can be considered as less loud than modern instruments (James, 1997). As a consequence, there is less danger of overpowering the singers, and the orchestral sound is clearer and more brilliant for the audience. Here, music and materiality are again intertwined, the materiality of the pit providing the opportunity for different musical performances by allowing for a certain flexibility in design.

Yet, there are other factors that play into the relationship between affordances created by design and the practices. A highly debated factor in this regard is the construction of the instruments that are being played in the pit. According to James (1997), "It should be remembered that many of the instruments of the time were very much quieter than their modern counterparts" (p. 7). Thus, when the orchestra pit was introduced, instruments were comparatively quieter than today. This leads to the assumption that the first orchestra pit designs might have been constructed with regard to the sound level produced by the instruments; the orchestra pits therefore were shaped by the affordances of the instruments.

As James (1997) suggests, the development of instruments has been matched by expanding the sizes of auditoria, yet, the orchestra pit did not drastically change when modern instruments entered the scene. Many of them have been extended in size, yet this extension is always restrained by other factors as well. In general, this discrepant development has resulted in an increased level of loudness in the pit, which, as we will see, poses several problems to the musicians. Birwe comments: "Well, the instruments have become louder, and most probably not at the same time when the orchestra pits were introduced, but a bit later. And yes, I do think that this results in a higher strain in the pit" (interview, 2015). This story could be a striking example of how affordances interfere or restrict each other; or more specifically, how the affordances of

the materiality of the pit become seemingly contradictory to the affordances of the material instruments.

Yet, there is a debate about to what extent the instruments really have become louder. Stefan Reich, sound engineer of the opera Cologne (interview, 2015), does not think that modern instruments are drastically interfering with the size of the pit. According to him, instrument construction has resulted primarily in a clearer brilliance in tone of the instruments, which creates the subjective impression of the instruments being louder. This thesis is supported by Meyer (1972). However, it is questionable if instruments have not, despite this argument, become stronger in sound.

As Lawson & Stowell (1999) claim, due to the increasing sizes of opera houses in the nineteenth century, improvements of instruments usually sought to achieve greater power. The introduction of new materials like metal in for example the construction of flutes supports this claim (interview Birwe, 2015). This is also the case for Barron (1994), who states that "For the orchestra, as well as changes in numbers of players, the lowered orchestra pit since the nineteenth century has reduced sound levels, while development of instruments has made them louder" (p. 335). Also for Gade et. al. (2001), it is likely that changes in performance style and developments in instrument technology over the last half century are the main reasons for some of the problems encountered in the pits. Although the difference might concern only a few decibels, these few decibels still might make a big difference when it comes to big orchestras. What is unquestionable is the fact that in this regard, musical practices have developed as well. According to all three interviewees (interviews Gabbert, Birwe & Reich, 2015), the level of precision of playing instruments has increased. As Gabbert, sound engineer of the opera in Düsseldorf, claims, "musicians nowadays play a lot more precise than they did before. I do not want to suggest that the orchestras of previous centuries could not play well, but the level of mastery is definitely more sophisticated" (interview, 2015).

Still, what must be acknowledged in opera house design in general is the fact that their architecture, together with all their acoustic features and elements, are highly individual and unique places. It needs to be underlined that no opera house built is exactly the same, and no pit is. Despite the instruments, there are many other important factors that influence how and in which quality sound from the pit is distributed across the hall (Drotleff et al., 2004). These factors, in turn, shape the acoustic design of the pit, which primarily varies in its size and materials. All these elements – instruments, walls, ceiling, stage, shape and size of the auditorium, the arrangement of balconies and the pit – create a complex interplay between different affordances that shape musical practices, performance, and each other. They create a complex network that does not allow for arbitrary modification. Changing one of these elements also

means changing the others, which results in manifold consequences that may not have been anticipated before.

In the opera in Düsseldorf, for example, the ceiling did pose problems to the reflection and diffusion of sound, so that musicians could not hear each other within the pit. It therefore has been equipped with concave sails, in order for the sound of the orchestra to be reflected back at the pit in order to ensure a functioning communication between the musicians (interview Gabbert, 2015). The sails enable the musicians sitting at different ends of the orchestra pit to hear each other, and therefore facilitate playing (see figure 6).

Another interesting example is that in the Musical Dome in Cologne, which serves only as a temporary accommodation for the opera because the main house is currently being renovated, the orchestra pit has been built only retrospectively (interview Reich, 2015). The pit is – as it is only a temporary room – highly un-flexible and too deep in comparison to the other elements in the hall (see figure 7). The walls of the pit are parallel, so that sound is only reflected within the pit, which is approximately four meters deep. Thus, too little sound does actually reach beyond the pit, which makes it impossible for the singers on stage to even hear the orchestra without acoustic amplification by speakers (interview Reich, 2015).

Figure 6: At the top of the picture, the concave sails of the opera in Düsseldorf can be recognized. These facilitate the communication among the musicians by reflecting sound back to the pit.

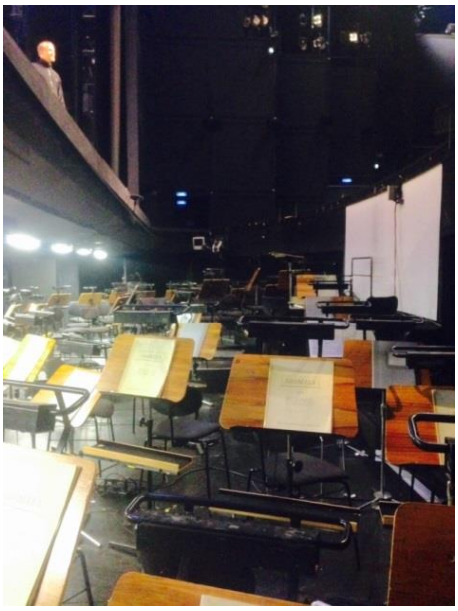

Figure 7: The orchestra pit in the Musical Dome, Cologne.

These two examples show that although the different affordances as materialized by the different architectural elements are constructed, it does not mean that they do not pose problems to the practices and performances executed by the musicians and singers. In the case of Düsseldorf, the sails have helped to balance the disadvantages the affordances of the pit posed for the musicians. The orchestra pit in Cologne was built retrospectively and therefore its design was dictated by the affordances of all other elements in the hall, setting narrow limits to design and usability. This illustrates the argument that opera house design is strongly limited and the most constrained design form within musical architecture. For example, a proscenium is necessary for the singers and the orchestra to see the conductor, therefore the orchestra pit needs to be placed in between the stage and the seating (James, 1997). That is the reason why the orchestra pit has a maximum size, which musicians still perceive as too narrow in most cases (Lawson & Stowell, 1999).

In fact, because opera house design is such a constrained form, many opera houses struggle with the same problems. For the musicians, these are the communication among each other, the restricting space, sightlines to the conductor and most importantly, the sound level within the pit that can reach up to 115 dB (Meyer, 1972, p. 302). Gabbert, who himself played in an orchestra pit once, describes his experience:

> So I went in the orchestra pit this one evening. And at the moment in which the orchestra started playing – and I mean I thought I knew this room, I always listened to the orchestra – but I never experienced how loud it actually is. And me as a guitar player, well, they outacted me. And I was confused because of the sound level that suddenly

> went down on me, and then I understood how the musicians in the pit must feel. Playing in the pit is really hard work (interview, 2015).

Playing in the orchestra pit is different from playing on a podium, as for example in a concert hall. A podium affords a different kind of playing. According to Reich, playing in the pit requires a greater dependency on the conductor, mainly because there is not enough space for the musicians to hear how the sound of their instruments develops through the room (interview, 2015). According to Gabbert and Birwe, it is also not uncommon for the musicians to feel separated from the stage and the audience in artistic terms: "I hear that often. […] The musicians do not have that contact to the audience, and of course they have this feeling of separation, like 'I need to play, but I'm not even visible.' And yes, I think that has a strong impact" (interview Birwe, 2015). Here, the materialization of the pit even touches upon the qualitative playing experience of the musicians, which might in turn affect their style of playing.

However, the affordances of the pit do not only pose difficulties to the musicians, but also the singers on stage. This is the reason why compromises need to be made regularly in many opera houses. For the singers, it is especially the balance between themselves and the orchestra that is of utmost importance; the singers need to overpower the orchestra and reach the audience over the pit (Meyer, 1972). Also, their communication with the conductor and the musicians is hindered by the orchestra pit, why it is the case that often, the conductor is displayed on small monitors across the hall and the stage for the singers to be able to follow his instructions (interview Reich & Gabbert, 2015).

Additionally, the orchestra pit creates a certain distance between the singers and the audience, a distance which can potentially leave the audience with a less enjoyable performance: "The orchestra pit generates the impression that there is a distance to the singer. The wider it is, the more problematic it becomes. It's like the singer lives on a different island. And if can you bring him closer to the audience, a totally different effect is created. They leave even more enthusiastically compared to when they only see it from far. […] As it is now, you just look at it, like a screen. Cinema. But when you can almost touch the singer, it's different" (interview Gabbert, 2015).

To sum up, the orchestra pit is a part of the performance of opera, just as in instrument is. It affords various practices while constraining others, and thereby shapes the performance of opera crucially. If the pit poses acoustically problematic circumstances, then the performance becomes problematic as well – for the singers as well as the musicians.

6. Conclusion

When understanding the orchestra pit as a part of the musical performance, it seems even more natural that I was so inspired by what happened in it when I visited Puccini's *Il trittico* in Düsseldorf. The silent communication that had mesmerized me so much was, as I recognize now, perfectly adjusted to the acoustic design of the pit. Yet, it is only one of the many examples of how the materiality of the orchestra pit affords certain practices, actions and behaviors.

This paper has illustrated that differing designs of orchestra pits throughout history enable different kinds of musical practice, for example as it is the case with the pit at the Bayreuther Festspielhaus. Also, it has become clear that the orchestra pit is affected by many other acoustic and architectural features; or, to put it differently, distinct affordances of distinct artifacts shape each other. Consequentially, this can lead to affordances restricting or contradicting each other to some extent, as we have seen for example in the case of instrument construction. This case also shows that the developments of related artifacts and their affordances do not always happen simultaneously, but that they interfere with each other while still being intertwined. If one is changed, it will affect the other, and subsequently influence the acoustics as well as musical practices.

Also, affordances materialized in acoustic design elements are subject to their own time and place, and are socially constructions within the musical culture of opera. Yet, only because affordances of musical artifacts are constructed by man, this does not ensure an unproblematic interaction between them and the practices and performances of opera. Sometimes, they unexpectedly collide, causing problems for musical practices and performance. However, the next step, raising a more important question than the mere collision between affordances, is how these enable perception and action in the current practices of music-making in the orchestra pit. To answer this question, further research could employ a more substantial practice-based and ethnographical approach that investigates how these restrictions are actually dealt with by musical practitioners who stand in relation to the orchestra pit. This would consider not only looking at how the practices of musicians and singers are shaped by the materiality of the pit as showed in this paper, but taking into account more extensively and elaborate how these actors actually try to solve the problems posed by the material design of the pit in the realm of their musical practices nowadays.

Gibson's concept of affordances (1979) has helped this study to investigate how practices and actions are shaped by material artifacts. Still, first and foremost it has underlined that the orchestra pit can be seen as a material artifact, constituting itself as a crucial actor in the practices and performances of opera. The returning problems that the pit poses in the opera houses

nowadays for musical practices, however, raise the question if a reconsideration of its acoustic design is needed. Did the acoustic design of the orchestra pit break away from the musical practices that are executed within it?

This question is difficult to answer, for so many factors play a role in it; for example the constraints of opera house design in general or the overall aim to improve the acoustics to the best possible extent for the audience (that sometimes only can be achieved at the expense of the musical practices by the musicians and singers). If the acoustic design of the orchestra pit should be reconsidered in order to make it easier for musicians and singers to engage in musical practices, what could actually be changed without downgrading the overall acoustic situation?

According to Gade et. al. (2001), "Conscious changes in musicians' attitude regarding choice of instruments and performance style are probably the only lasting solutions to these problems" (p. 1). Is it thus the practices that need to adjust to the acoustic design? According to Birwe, this suggestion will not do the trick. Because the number of musicians is specified by the composer and can only vary in the number of string players, one of the little options left is based on the musicians simply playing less loud (interview, 2015):

> We could think about a situation in which we could open up the orchestra pit completely, also eliminating the rail that separates the musicians from the audience, and music could be played on an overall less loud sound level. That would be possible […], but of course, as a consequence, the musicians would only give 50%. And this in turn has consequences for the musical and artistic expression. So when the musicians constantly have to restrict themselves, and are not allowed to give 100%, then it will have consequences in the sense that the performance simply will be not as expressive anymore.

As this potential solution does not seem to work out, instrument construction could be changed in order to create less loud instruments. This is, however, not very likely to happen (interview Reich & interview Birwe, 2015). The last option, then, would consist in placing the orchestra somewhere else and get completely rid of the pit. In Düsseldorf, the orchestra for example has been placed on the stage for a performance of *Ariadne auf Naxos* by Strauss (1912): "The director wanted it to be like this […] because he wanted everything to be visible, that's why the orchestra was placed on the stage. And the effect was – with singers in the front and the orchestra in the back – that the balance was excellent" (interview Gabbert, 2015). This, however, also portrays that the placement of the orchestra is additionally bound to the ideas and vision of the director of the performance.

To sum up, "It is inevitable that during the lifetime of a pit that changes will be made" (Barron, 1994, p. 336). Yet, how the next changes in design are going to look like is still subject to the complex entanglement between material design elements, practices, and performance.

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Interviews

Interview with Thomas Gabbert, April 27, 2015. Düsseldorf, *Deutsche Oper am Rhein*.

Interview with Dagmar Birwe, April 29, 2015. Düsseldorf, Institut für Musik und Medien, office Dagmar Birwe.

Interview with Stefan Reich, April 30, 2015. Cologne, Musical Dome, control room.

Images

Title: Orchestra Pit Royal Opera House Covent Garden, London. Photo by Sim Canetty-Clarke (2014). Retrieved May 28, 2015 from https://www.flickr.com/photos/royaloperahouse/15681716139/

Figure 1: Teatro San Cassiano, retrieved May 15, 2015 from: http://ospitiweb.indire.it/~mitd0022/4f_eco_delle_papere/from_the_court_theatre.htm

Figure 2: Teatro Regio, retrieved from Forsyth, M. (1985). Buildings for Music: The Architect, the Musician, and the Listener from the Seventeenth Century to the Present Day. Cambridge: MIT Press, p. 81.

Figure 3: Theater as Besancon, retrieved from Forsyth, M. (1985). Buildings for Music: The Architect, the Musician, and the Listener from the Seventeenth Century to the Present Day. Cambridge: MIT Press, p. 113.

Figure 4: Bayreuther Festpielhaus, retrieved from Spotts, F. (1994). Bayreuth: A History of the Wagner Festival. Yale University Press, p. 9.

Figure 5: Cross Section Orchestra Pit Bayreuth, retrieved from Meyer, J. (1972). Akustik und musikalische Aufführungspraxis : Leitfaden für Akustiker, Tonmeister, Musiker, Instrumentenbauer und Architekten. Verlag Das Musikinstrument, p. 305.

Figure 6: Concave Sails in opera in Düsseldorf, Retrieved May 15, 2015 from http://www.peutz.de/info/newsletter/Peutz_Aktuell_2012_03/orchestergraben.html

Figure 7: Picture Orchestra Pit Cologne Musical Dome, taken April 30, 2015.