Sometimes there are too many dancers on stage, confusing the piece, overwhelming the music
Twyla Tharp *The Creative Habit* p195

"Bandwidth" is a term used by sound designers to describe the "breadth" of a sound - how much of the available audible frequency spectrum does it occupy? Over a thirty plus year career as a sound designer, I have come to believe that performances and productions also exist within an "aesthetic bandwidth". The aesthetic bandwidth of a performance would encompass all elements, and once the limit of this available aesthetic space is reached, no space remains for additional elements.

Have you ever wondered why you don't see a major dance in the professional repertoire choreographed to Tchaikovsky's 1812 Overture? My former music professor at university, the late Dr. Derek Hyde, used to say that the 1812 Overture is already musically perfect and fully complete in and of itself, leaving no "space" for additional creative elements. In this sense, the aesthetic bandwidth available has been fully occupied.

This concept is very well understood in visual art and easy to see. The limit of the total bandwidth available is the size of the canvas and that area is further divided up into figure and ground. These areas of figure content or ground may occupy one place or be distributed throughout the painting, but together they fill the total available area. If I increase the area of the ground, I reduce the area available for the figure. Shifting the figure/ground idea to performance introduces the element of time, and we begin to think of the relationship of "fixed" aspects more conveniently as the ratio of each element to the others within the available bandwidth.

It would be nice to tell you that realizing this concept came about in a flash of divine inspiration, but that was not the case. In those early days, I started to notice that there were points in a script where, at the designer run I had identified the possibility of a sound cue, but when we came to the moment in tech with the set, costumes, lighting, and acting, I realized that there was in fact no aesthetic space left for my sound cue. Conversely, at other moments in a play where I had not originally thought to put in a cue, the moment seemed to demand sound, or some other production element to fill it up.

I started to imagine expressing aesthetic bandwidth as an area chart (*Figure 1*). The vertical axis represents the amount of available bandwidth and the horizontal axis is time. As the play progresses, the different production elements such as acting, lighting, sound, scenery, projections and costumes are contributing in their own unique way to this aesthetic bandwidth. When one production element contributes a lot, there is less room for the others and they need to adjust accordingly so as not to try and squeeze in more than will comfortably fit. We have a common saying for trying to squeeze in more aesthetic content than will fit, We call it *Gilding The Lily*.

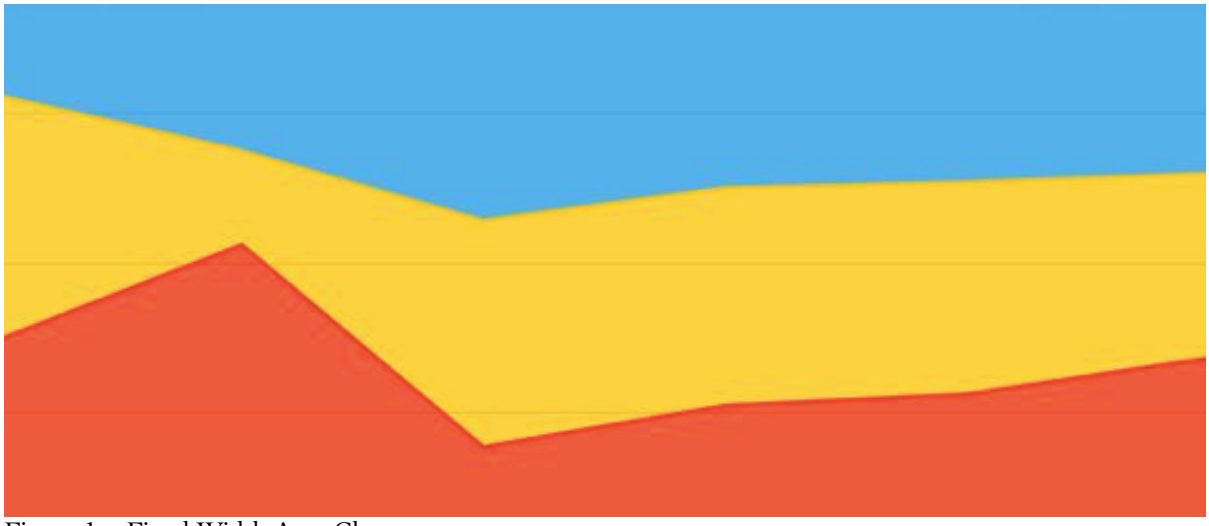

Figure 1. - Fixed Width Area Chart

Once I had stumbled upon this concept and started to understand its implications, I purposefully began to look for it in productions. Looking for the 'holes' in the aesthetic bandwidth revealed the places with no gaps left to fill as well as places with gaps that could accommodate more sound/music.

Looking for holes was not as easy as it at first sounds. You may have noticed that I am using *visual* terminology… "look", "holes", as if it is something you can actually see. Of course, this is not strictly a visual phenomenon, and the mechanism by which we perceive it is not at all clear to me. But it seems that with experience and focused attention, as with most things in life, it gets easier for me to recognize the shape of aesthetic bandwidth and the opportunities it presents for sound in production.

At our very core, the human experience on this earth is a search for meaning and significance. Aesthetic bandwidth can define a framework within which we find that meaning in a specific experience. it helps to define the structure within which we sort and aggregate many small pieces of experiential evidence from the world around us. Along with evidence from our own past experience and training, we observe the current experience within the context of this aesthetic bandwidth. It provides the framework, essentially defines the theory that makes meaning out of all these disparate pieces of evidence and ties it all together into something useful.

Forming theories about the world around us helps us to control that world and affect desired change in it. The theory of Quantum Mechanics will not help me assess how many crew I need to move a large mixing console whereas the theory of Newtonian physics will. They are just theories and some are useful in some situations and others are not. The same thing happens with aesthetic bandwidth. In some situations it is useful and in others it is not.

Not only can we not visually *see* aesthetic bandwidth, it is not even a thing to *see* in the first place. It is the theory that helps direct our attention to some evidential aspects and shutters out other aspects that would not contribute to the thing's understanding. However, having said that, aesthetic bandwidth is easier to describe and unpack if it is discussed as a separate thing all of its own that has yet to be noticed. Interestingly, this is not so different from how audiences usually talk about contemporary art. Although we

talk about a work of art as a concrete thing, most of the language we use describes how it affects us, or how we respond to it. The aspects of the art that we discuss become objectified 'proxies' for how the experience of the art makes us feel. I call this *Aesthetic Synesthesia*.

The French have a word for things that have yet to be noticed. 'Inaperçu' means to go unnoticed even though it is right in front of you. Most theories start out inaperçu. Apples were dropping from trees to the ground a long time before Newton ever came up with gravitational theory to explain why. Gravity existed before it was noticed, it was just inaperçu.

As part of that journey of understanding what was happening with aesthetic bandwidth, I came to realize that the overall potential for aesthetic bandwidth actually changed throughout the show and was not fixed as shown in *Figure 1* above. Sometimes, during the show, the potential for aesthetic content expanded and at other points it contracted. The narrative obviously affects the aesthetic bandwidth potential. We talk about a narrative as having an overall arc, but really it is made up of many smaller shapes expanding and contracting at different points throughout the show. When taken together, these many shapes form an overall shape we call an arc. This expansion and contraction of the narrative within the overall arc also sometimes affects the bandwidth available for aesthetic content at various points during the show.

I find that observing the audience closely, especially during previews provides a lot of valuable information. The way audiences engage at different points of the show has an effect on how much aesthetic bandwidth potential there is at any particular moment. This led me to realize that how much aesthetic content can comfortably fit within a show at any point is partially up to how much the audience will allow to be squeezed into it.

So… It turns out that aesthetic bandwidth is actually much more like the more traditional area chart as shown in *Figure 2*.

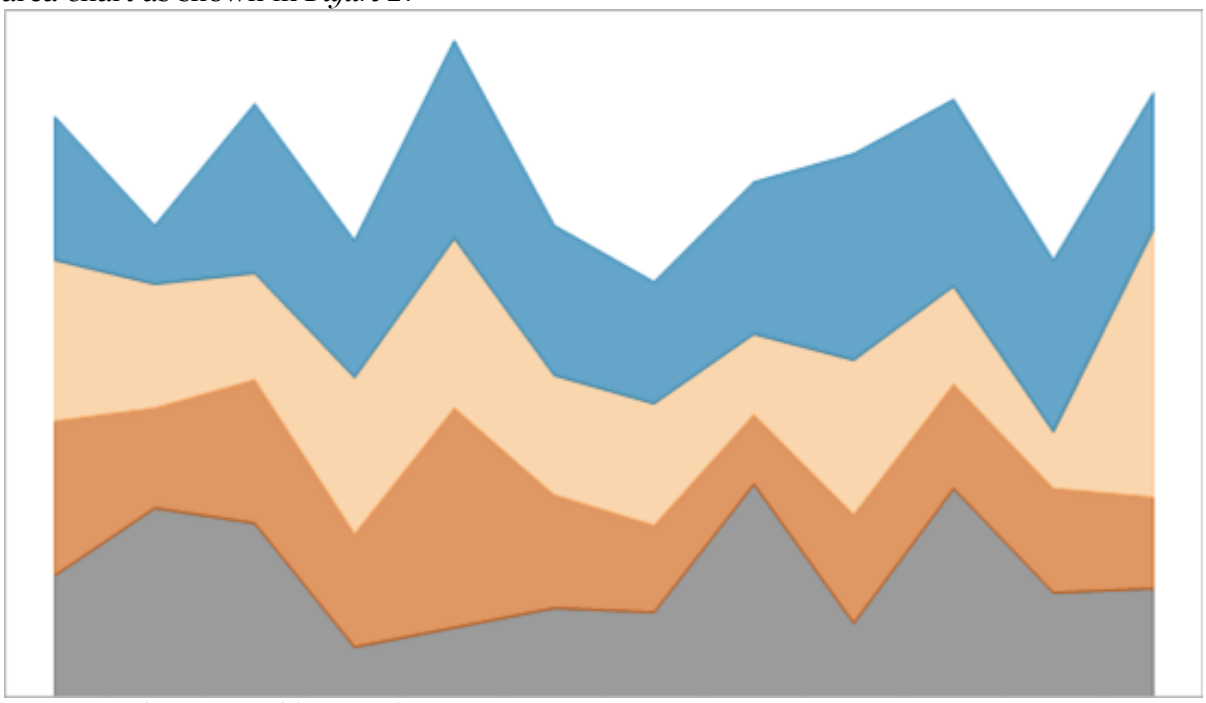

Figure 2. - Changing Width Area Chart

Interestingly, we have seen something like aesthetic bandwidth described before. In his 1992 book, *Sound Design in the Theatre*, Dr. John Bracewell takes us through his process for developing the sound design for Tennessee Williams' *The Rose Tattoo*. One of the things he does as part of his process is to plot the perceived tension between the characters over its course of the play from start to finish (*Figure 3)*.

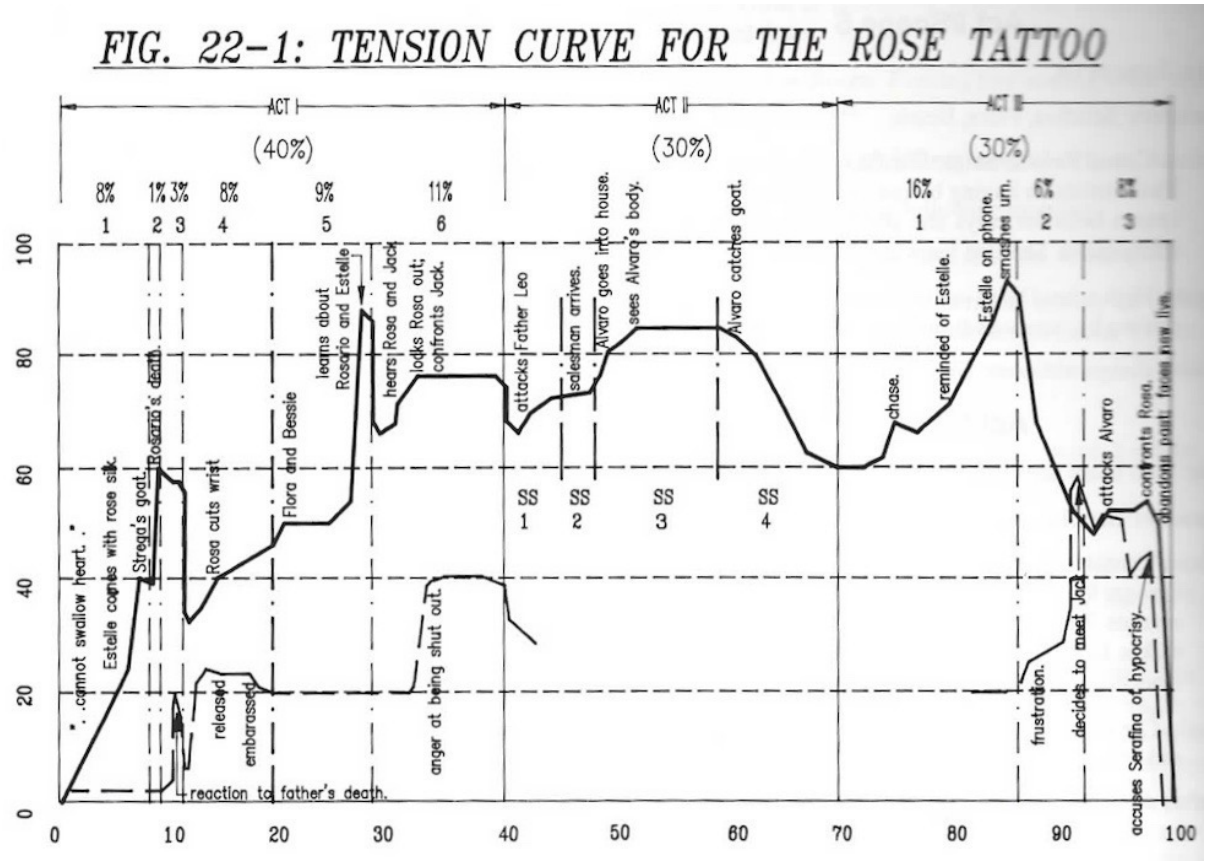

Figure. 3. - Tension Curve for The Rose Tattoo from *Sound Design in the Theatre* by John Bracewell.

Just as Bracewell's *Tension Curve* varies throughout the show, so does aesthetic bandwidth. In fact, I think his plotting of the tension between characters would more closely follow what I imagine to be the part of aesthetic bandwidth that the acting and characters contribute to. As I alluded to above, what determines the overall level of available aesthetic bandwidth moment by moment throughout the play has more to do with story telling and audience engagement than just the story content and acting alone. As such, Bracewell's curve diagrams an element of what is there and not what is not there that could be filled but is inaperçu.

Additionally, the points in the show where aesthetic bandwidth opens up and closes down are changing all the time. As tech progresses and we designers and the director all figure out what we have in front of us, our adjustments and changes are expanding and reducing available bandwidth all the time as we try to better tell the story and hopefully engage the audience more. A 'hole' in the aesthetic bandwidth yesterday may not be there today as lighting is now doing something different and filling it themselves.

As noted earlier, the way an audience engages with the show from moment to moment will also change the shape of the available aesthetic bandwidth . In my experience, by

previews I tend to be mostly reshaping and remixing the sound/music that I have already built but there are occasions when I have just had to cut a cue due to the 'hole' not being there anymore. On odd occasions I have had to come up with something new at the last moment as the engagement of the audience has made a hole suddenly appear that sound needs to fill. Since sound and lighting are the most immediately changeable production elements it usually falls to one, or both, of us to fill up the hole in the bandwidth that has appeared because of audience engagement.

Could I draw an *Aesthetic Bandwidth Area Chart* for one of the shows I have designed? I suppose I could if I put my mind to it. I fancifully imagine it would end up looking like the artwork by Sonia Delaunay-Turk on the poem by Blaise Cendrars in *Figure 4* below. In my case the words would be the script as it progressed over time and the sections of color would be the shapes of the different production values occupying their own aesthetic bandwidth.

Figure 4. - Sonia Delaunay & Blaise Cendrars. La Prose du Transsibérien and of Little Jehanne of France. Tate Modern. Photo by author.

But I don't draw it out!

To begin with, as explained above, it would be out of date and therefore not very useful as soon as I had drawn it out as the aesthetic bandwidth is constantly changing throughout

tech and previews. But if I did try and draw it out, not only would it take an enormous amount of time away from other aspects of delivering my design, but it would become a beautiful thing in and of itself instead of just being the visual digram for me to understand and use to manipulate my design. How many people walking past Sonia Delaunay's piece have stopped to actually read the text and relate it to the choice and shapes of the adjacent colored areas? I have seen something similar happen with my students when we teach them to draw system diagrams in AutoCAD. Sometimes they end up with a beautiful AutoCAD drafting that, as a functioning sound system, doesn't make any sense at all. Spending all your energy on polishing something does not help what that something is meant to achieve and in theatre, time is very precious.

Over two decades ago, I taught something similar to Delaunay's technique as a way for my students prototyping their sound design before we had a sound lab and before they had individual computers to easily play their design ideas. The students assembled the opening storm pages of the script from *The Tempest* down one side and they used colored lines down the other side to represent the different sound elements they would use indicating where they sounds would start, stop and how they would fade in and out. It quickly became apparent that the better sound designs were not necessarily the prettiest picture, and as with the AutoCAD example above, I found the students started focusing more on the presentation of this prototype than the underlying sound design choices they were trying to map out. It became a thing in and of itself and therefore lost its usefulness.

By the way… as a complete aside… look at the date… 1913. The very birth of Abstraction! She was brilliant!

Figure 5. - Sonia Delaunay, La Prose du Transsibérien et de la Petite Jehanne de France, 1913, Los Angeles County Museum of Art, gift of the 2017 Collectors Committee, © Pracusa 2017632, text © Miriam Gilou-Cendrars

The main reason I use this concept of aesthetic bandwidth is to be constantly vigilant about the holes - the opportunities that open up that I can put sound into to help tell the story. I also use this concept to be aware of the shape of these holes - how the hole is

opening up and how it is closing down. Trying to tease out the shape of these holes helps me know how a sound cue should start, progress and then end. Also, assessing how my piece of bandwidth interacts with the bandwidth of the other design elements informs me about what my sound cue needs to be synchronised with. This informs me where the 'in' cue point of my sound cue should be as well as where my sound cue should end and how it should end.

For someone who wants to start experimenting with this concept of aesthetic bandwidth, I would suggest that it is easiest to 'see' at the top of the show. We don't necessarily have audience engagement at the top of the show but we do have audience anticipation, which for our purposes is similar - anticipated engagement. Let's take the opening sequence house to half, house out, blackout on stage, actors enter, lights up on stage, actors start performing and speaking as characters (*Figure 6*).

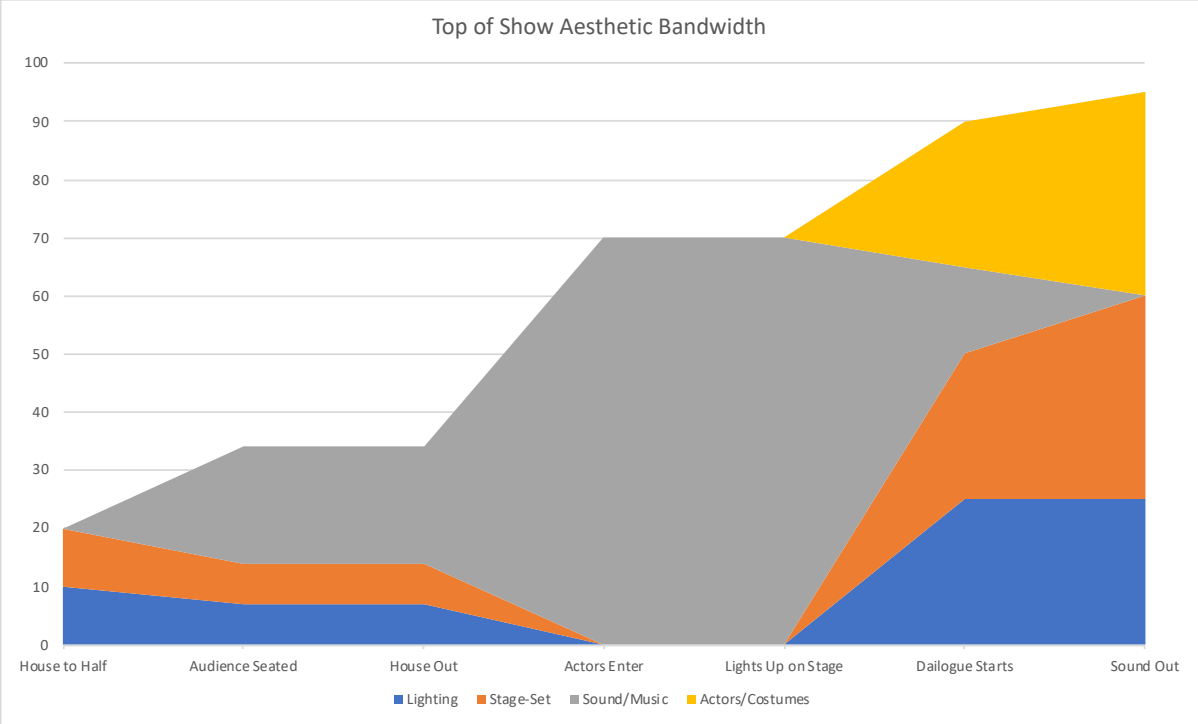

Figure 6. - Aesthetic Bandwidth diagram for a typical opening sequence of a show.

These days, the only three production bandwidth elements before the blackout are the set on the stage (but not yet believable as setting or scene), the lighting and the sound/music. After the house announcement, on the stage manager's cue, the house lights start dimming to half intensity over 5 seconds and the sound usually starts with the top of show music (or similar). The start of 'foreground' sound/music as opposed to background sound/music as with the pre-show, along with the lights dimming, are to get the audience back in their seats. From an aesthetic bandwidth point of view, the opening sound cue and house to half increases the overall audience anticipation bandwidth which is being filled now by a band of sound while the band of lighting and stage-set that was previously there takes slightly less space as they diminish.

The house to half cue is briefly held at this point for the stage manager to make sure every member of the audience is at least climbing into their seat and it is safe for us to take the house lights to a full blackout. At this point the sound, lighting and stage set bands are

unchanging and remain the same as before.

With the stage management cue to go to blackout I usually either have my music fade up louder or if already loud, transition from a vamping intro into the full main musical tune of the show. The house lights now fade to blackout over 3 seconds as do any lights warming the set. So the bands of stage-set and lighting also reduce completely over 3 seconds and the overall bandwidth increases further as the audience anticipation increases.

By the time we are in blackout, the only thing occupying the whole of the bandwidth is sound. There is no other production element to be seen and hopefully the opening music is such that you cannot hear the footsteps of the actors entering the stage to take up positions. Best not to destroy the *willing suspension of disbelief* before it has even started by having the audience hear the footsteps of actors rather than characters!

Once the actors are in position, with the cue for lights up on the scene, the stage lighting fades up. This allows the stage-set band to take up increasingly more of the bandwidth than it did before the blackout when the set was just under set warmers. The show lights also allows the actors in costumes to become visible. Their bandwidth is potentially very large, and will increase further when they start moving and talking and we figure out who they are representing and we start to believe (or at least not disbelieve) their characters.

There are so many bands starting and increasing at this point that it would be easy to think that sound should give-up its bandwidth to make space for them, but in reality the sight of the costumed actors and set under gorgeous show lighting increases the overall audience anticipation/engagement bandwidth to accommodate these other production elements. Sound could get quieter at this stage or thin out into an "outro" (opposite to an intro) but at this point sound needn't go away completely.

It is only when the actors start acting and talking that that sound needs to drop out completely or reduce its width to the bandwidth of an underscore - waves, cicadas, traffic etc. Since it takes about half a sentence before a competing noise starts to impede audience efforts to understand what is being said by a character, sound should usually fade out or fade down over around 3 seconds under dialogue. There are occasions when this wont be the case. Fir instance, when we are playing music that a character is meant to sing to or sounds that the character is meant to acknowledge in some way " Loud waves tonight, Bertram!". 3 Seconds is a good starting point.

So, using this concept of Aesthetic Bandwidth, what would happen if instead of the houselights going to blackout over 3 seconds there was an immediate DBO (Dead Blackout)? The stage-set and lighting bands would immediately end. It would be quite exciting for an audience so their anticipatory bandwidth would increase sharply and the only thing that could fill the void would be sound bandwidth. There is nothing else. As a designer I would bring other sound elements in immediately or immediately bump up the sound to fill the gap. I believe that if I didn't fill the gap immediately it would have an adverse effect on the potential audience engagement. The audience would feel that they have somehow over-anticipated and would be wary in the future of committing the same mistake again.

You can also do a similar thought experiment at the end of the blackout. Supposing the

blackout ended with a bump to full show lights instead of a 3 second build. What would you do with the sound/music? Once again, it would be quite exciting for an audience so the overall available bandwidth would immediately increase. However, the bands of the other production elements - lighting, set, costumes, actors - would also immediately increase. Do those elements totally fill all the available bandwidth or is there still room left for sound? The answer to this would inform you if the sound needed to end immediately/ snap off or just snap down and then fade out.

Since we are not all watching and discussing the same show we cannot take this thought experiment any further. However, it does show that the best place to start looking for aesthetic bandwidth is at the top of the show and in other similar situations such as tops of other acts and even transitions. Once you feel you can perceive the shape and extent of the bandwidth associated with each production element in these obvious situations then I suggest you go looking for them in other less obvious situations within scenes such as during underscores and sound effects cues, entrances and exits.

So, how would you know if a bandwidth is already full and cannot support an additional element such as sound? The answer is surprisingly simple and alluded to at the top of this paper where I explained that as far as I was aware no major professional dance company has successfully attempted to choreograph a dance to Tchaikovsky's 1812 Overture for their professional repertoire. We experienced professionals all unconsciously know when one element is attempting to *Gild The Lily,* especially the director and the other designers. If they also think it should be cut then I cut it. More usually this happens in tech notes after a preview. As one of their notes, the director announces that they want to cut a certain sound cue. These days, I am usually in agreement with them and it is on my list of cues that I don't think are working and need to be cut rather than be reimagined.

There is usually no harm in experimenting during tech. If you think there may be some available bandwidth for you to fill, try putting a sound/music cue there. Most of the really collaborative directors encourage the element of play and experimentation that needs to go on in tech (as long as it doesn't waste any time and is not too close to first preview where the stress goes up exponentially). As you play the cue, look at the director and the other designers who are actively engaged in what is going on on-stage. What does it look like they think about it? Depending on what you think they think about it, next time push it further or back it off a bit. Find the limits of the hole or even if the hole is there at all. As with anything, the more experience you have, the better you will become at 'feeling' it for yourself. Even now, at this point in my career, if I am unsure, I try and see how other are reacting to the cues inclusion.

This brings up a very important point. I am really big on using sound/music not just as a statement but as an exploratory question when in the design phase. Instead of playing initial sound/music ideas to a director to try and get their approval to move forward, try putting together sounds that will 'prod' the director as questions. What do you think about this? What aspect of this do you like or do you hate? Why? If you honestly put your choices together as questions rather than statements then you will exit that director meeting with them not having chosen any of the examples. With good sound/music ideas as questions, you get a lot more information than mere approval of one out of a multiple choice of sound/music cues.

There are certainly other elements that also affect the aesthetic bandwidth potential. Even the production elements themselves can increase or decrease the space available for additional aesthetic content. For instance, as another thought experiment, if a fully made up and costumed Lady Gaga suddenly entered into the middle of the stage in one of the shows you were working on, you would probably feel the need to add a musical crescendo or a fanfare or similar. You would rightly feel that a little harpsichord motif or cricket chirping would not be enough. Her entrance would have increased the aesthetic bandwidth at that point and begged for the other production element to match her entrance.

Supposing now, instead of a musical crescendo or a fanfare accompanying Lady Gaga's entrance, the production really went over-the-top and had confetti cannons, fireworks and a laser show fill that moment instead. It is now these production elements that would have filled the increased aesthetic bandwidth on her entrance. I would probably initially not add any sound elements to that moment because although I recognize that the addition of over-the-top production elements increased the overall aesthetic bandwidth they also completely filled it.

I am starting to push this particular Lady Gaga thought experiment further than it can comfortably go, but I want to make one last point… If we were an hour into a Eugene O'Neill two hander and Lady Gaga entered as above, the bandwidth she brought with her on her entrance would be more than the overall bandwidth of the play could probably tolerate. You can stuff aesthetic bandwidth and make it bigger at points if you need it but you cannot do that continuously otherwise you will overstuff the sausage and it will burst.

Sound designers work alone. We usually only get to see from the inside the shows we work on, but for the last two decades I have also watched shows that are designed by my students. Because the students are still learning, along with their successes, they also make all kinds of mistakes. Just as they start to get some control over the quality of their contribution, they graduate and I get to watch another set of students make similar mistakes. Groundhog day! However, one advantage is that over the years I get to see similar mistakes made over and over again and I get to watch how audiences react to them and I get to ponder the reason why.

The word 'ponder' used above is very important. Sometimes it takes me 24 hours or more to deconstruct all the elements in my head and figure out what is going on. Over the years I have built up the ability to replay in my head the sound cue and everything else that was happening around it - in essence to re-experience the moment - including the audience reaction and then deconstruct into its constituent parts and to reassemble it again in order to conduct thought experiments on it.

Some of you will notice the absence of Projection Design in this description of bands that contribute to aesthetic bandwidth. As projection makes its developmental journey from setting (projected scene painting) to narrative, its contribution to aesthetic bandwidth disengages from the band allowed for stage-set and/or lighting and becomes a band all of its own. These are very exciting times for projection design and I think the combination of time based aesthetics and technology are in some ways very similar to that of sound. I have had the best conversations with projection designers as, like me, they also work in the fourth dimension. Sadly, I have personally never been on a show where WatchOut hasn't

crashed at some point, so it is hard for me to fully assess projection design's contribution to aesthetic bandwidth. But make no mistake, the future of theatre belongs to Projection Design!

I have come to appreciate that the difference between a good design choice and a bad design choice is reflected in how the audiences engage with the production at each particular moment in the show. I have taught myself to conceptually 'see' that this can be described by an overall audience engagement bandwidth that is constantly changing moment by moment throughout the show. I have also taught myself to conceptually 'see' that each production element, including acting and narrative, help support and fill up that overall bandwidth. I have taught myself to conceptually 'see' that they each have a bandwidth of their own that is also constantly changing over time and has an overall shape. Finally I have taught myself to conceptually 'see' if there is any room left and what the shape over time that opportunity offers. Lastly, I have taught myself to design sound/music to fill the shape of that 'hole' that has opened up until it finally closes down.

This conceptual 'seeing' of Aesthetic Bandwidth has taken me a professional lifetime to achieve and I am still not 100% perfect at it. I still get tripped up every now and then - luckily, not very badly these days. if someone told me about this at the start of my sound design career, I'm not at all sure I would have believed them. If I had, I would have tried to use it, but the first time it failed, I would have given up and retreated back to the familiarity of the knobs, lights and kit. The value of this particular concept only became apparent to me after I had tried many other ideas over the years to explain my failures and my successes. Concepts can be learned in an instant but they have to be practiced for a whole lifetime to be able to use them effectively to control the world around you.

One final thought… For those of you that are familiar with the West Coast design company IDEO, you will know that their particular way of Industrial Design involves a team of non-specialists coming up with many wild and diverse ideas, writing them on a Post-It note and sticking them to a wall while succinctly explaining their idea to the group. After all the ideas have been shared with the group and the wall is filled with Post-It notes, then they go through the rest of their design process of combining the ideas that are similar, restating them, voting on them and selecting the ideas to take onto the next round. This idea about Aesthetic Bandwidth is like the first Post-It note on the wall. Other ideas and concepts need to be added to the wall and the process of grouping, restating, selecting and developing further still needs to happen. So, I implore everyone who reads this paper, don't waste your time proving that this concept doesn't work for you… add more Post-It notes to the wall. Let's move this forward so we can all be more in control of what we are doing.

I gratefully acknowledge and thank all those who have read the drafts and responded with advice.