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Nobel Creations: Producing infinite music for an exhibition

Introduction

This article describes an artistic music production project that was a part of an exhibition on the Nobel Laureates in 2014: *Nobel Creations*. The exhibition's aim was to creatively interpret the various Nobel prizes in design, fashion and music. The exhibition took place at the Nobel Museum (fig 1.) in Stockholm and students produced the artistic content. The music productions, the empirical content described in this article, consisted of various compositions that were woven together and distributed by loudspeakers in the exhibit hall without interruption through the four months the exhibition lasted.

Figure 1. The Nobel Museum at Stortorget in central Stockholm. The Nobel Museum's aim is to, through creative learning and exhibition techniques as well as modern technology and elegant design, spread knowledge as well as to create interest and discussion around the natural sciences and culture. The inventor Alfred Nobel (1833–1896) wrote in his will that physics, chemistry, physiology or medicine, literature and peace would each year receive a part of the revenues of his fortune. More than 800 Laureates have so far been awarded the Nobel Prize.[1] (Foto: © Peter Schyborger)

1 "About the Nobel Museum," Nobel Museum, accessed August 30, 2015, http://www.nobelmuseum.se/en/about-us.; "Nobel Prize," Britannica Academic, accessed December 01, 2015, http://academic.eb.com/EBchecked/topic/416856/Nobel-Prize.

The ideas behind Nobel Creations

Can artistic representation explain a Nobel Prize? This question was a fundamental issue for *Nobel Creations* (2014.12.05-2015.03.01).[2] The exhibition took its starting point in a statement that over the years many of those who have received the Nobel Prize have shown an exceptional creativity in their research, writing or peace work. And in many ways their creativity can be compared with the cross border creativity that many artists, musicians or artistic creators, such as successful designers can express in their work. Therefore creativity unites the Nobel Laureates with artists and creators since their intrinsic creativity encourages them to think in new ways, to question established theories, and to innovative put together combinations of insights from different fields.

Similar projects have been on going since 2011, when the Nobel Museum initiated cooperation with Beckmans College of Design in Stockholm. Students of fashion produced six creations that were shown in the exhibition *Fashion Innovation* (2011.12.06–2012.01.22).[3] The first exhibition was followed up with *Fashion Innovation 2* (2012.12.04–2013.01.20)[4] and *Fashion Innovation 3* (2013.12.05–2014.05.04),[5] which also included interpretations in music composition created by students from the Jazz Department at the Royal College of Music in Stockholm – KMH.[6] In *Nobel Creations 2014*, four master students from the Music- and Media Department at KMH also joined the production team. Their task was to create interactive music for the exhibit hall. Music that was going to be heard without interruption all through the four months the exhibition lasted. Although previous research reports experiences of how music has been used in exhibitions at museums or how interactive media may be used in such contexts,[7] this project primarily has been based on experiences from projects at the KMH in creating music for film, video games and Web-based contexts as well as experiences at the Nobel Museum from the previous years' exhibitions about Nobel Laureates.

The Nobel Prize was instituted Alfred Nobel and why he donated his fortune to an international award can be explained by the way he lived his life. Alfred Nobel was born in Stockholm 1833. In his early childhood the family was very poor and moved to St. Petersburg when the father, Immanuel Nobel who was an inventor, got a major

2 "Nobel Creations," accessed August 30, 2015, http://www.nobelmuseum.se/en/exhibitions/nobel-creations

3 "Fashion Innovation," accessed August 30, 2015, http://www.nobelmuseum.se/en/exhibitions/fashion-innovation

4 "Fashion Innovation 2," accessed August 30, 2015, http://www.nobelmuseum.se/en/exhibitions/fashion-innovation-2

5 "Fashion Innovation 3," accessed August 30, 2015, http://www.nobelmuseum.se/en/exhibitions/fashion-innovation-3

6 Kungliga Musikhögskolan i Stockholm.

7 Antonio Camurri and Pasqualino Ferrentino, "Interactive environments for music and multimedia" in *Multimedia systems* 7(1) (1999): 32-47; Rita Kottasz, "Understanding the Influences of Atmospheric Cues on the Emotional Responses and Behaviours of Museum Visitors" in *Journal of Non-profit & Public Sector Marketing* 16:1-2 (2006): 95-121; Fredrik Lindstrand and Eva Insulander, "Setting the ground for engagement–multimodal perspectives on exhibition design" in *Designs for Learning*, 5(1-2) (2012): 30-49; Pam Meecham and Elena Stylianou; "Interactive Technologies in the Art Museum" in *Designs for Learning* 5(1-2) (2014): 94-129.

contract in Russia. Therefore Alfred Nobel never got education in school but received some private lessons during his years in Russia.

Through the agency of his father, Alfred studied chemistry, an area he later would become very proficient in, but Alfred was also interested in literature and in his teens he would rather be a writer than anything else. The father, who became a successful and industrialist, not least when it came to producing armaments, sent his son Alfred on trips around the world to meet with various business contacts. During his travels, Alfred recurrently saw or heard of people getting injured in accidents related to blasting works where nitro-glycerine was used as an explosive. He took strong impression of such accidents and this resulted in that he a few years later provided great effort to invent explosives that were much safer to handle than nitro-glycerine. Alfred Nobel's most famous inventions: the dynamite and the detonator were very successful and were spread worldwide. Nobel created an international empire for the production and sales of explosives and built factories all over of the world.

Despite Alfred Nobel's lack of formal education, he gradually became a highly respected scientist. In 1884 he was elected into the Swedish Royal Academy of Sciences and in 1893 he was appointed Honorary Doctor of Philosophy at Uppsala University. In total Alfred Nobel had more than 350 different patents registered and over the years he became very wealthy. He never married and had no children and he did not want other relatives to inherit his wealth. In 1888, eight years before he actually died, a French newspaper by mistake published Alfred Nobel obituary. It was titled: *The merchant of death is dead*.[8] In the article Nobel was disconcerted and this made him concerned about how he would be remembered. Therefore Nobel in his will decided to institute the prices we now know as the Nobel Prize. He wanted his fortune to be used to create a series of international prizes for those who confer the *greatest benefit on mankind* in physics, chemistry, physiology or medicine, literature, and peace. Alfred Nobel died in 1896 and the Nobel Prize was first awarded in 1901, and over the years more than 800 laureates have been awarded the Nobel Prize for their creative work.[9]

The concept of creativity

But what is it that makes creativity so interesting that it needs an exhibition in a museum? Although people throughout history obviously has carried out creative actions and has been engaged in what we nowadays would call creative work, the concept of creativity, with its current meaning, is relatively new and contrasts to previously established views:

> The connection backwards was with the sense of creation involving some metaphysical force, as in the divine ordination of the world and all in existence

8 "Alfred Bernhard Nobel," *Britannica Academic*, accessed December 01, 2015, http://academic.eb.com/EBchecked/topic/416842/Alfred-Bernhard-Nobel.

9 Alexandra Selivanova, "Alfred Nobel". *Tekniska Museet*, accessed October 29, 2015. http://www.tekniskamuseet.se/1/1910.html.printable.

> within it. But this force was now located within the individual human being, becoming the object of personal spiritual search for those seeking the wellspring of truth and beauty. This organicist notion of creativity has had a powerful influence over the whole modern period, including among those who broke with Romanticism or developed aesthetic values counter to its central tenets. It distinguishes the artist as someone whose 'inner' voice emerges from self-exploration, and whose expressive power derives from imaginative depth. Artistic creativity has become synonymous with this sense of exploration and expressive power.[10]

Nowadays, creativity is instead expected to lead to a result or product and creativity should not to be understood as creation in a general sense, such as the human ability to create mental images, emotions and beliefs by imagination. Furthermore, creativity is understood as a creative process that firstly requires knowledge of the field in which the creative activity takes place; secondly, requires knowledge of, or methodical skills for, new ways of thinking and/or creative processes; and thirdly, creativity primarily requires internal motivation by the creative person rather than external motivation. The idea that creativity, by this definition, is more a knowledge and a skill rather than some sort of divine power and/or indication of high intelligence is primarily based on research carried out in the latter half of the 1900s. Jay Paul Guilford gave an important contribution in this direction as he highlighted that: "creativity and creative productivity extend well beyond the domain of intelligence."[11] At that time, creativity had been noted very little in the previous psychological research and Guilford was critical towards what he saw as too great confidence in what had been given to different psychometric intelligence tests and he meant that intelligence tests only could reveal very little about a person's creative nature. Although some of Guilford's research results arguably be can discussed, his contribution is important, not the least as he emphasized that:

> …creativity represents patterns of primary abilities, patterns which can vary with different spheres of creative activity. Each primary ability is a variable along which individuals differ in a continuous manner. Consequently, the nature of these abilities can be studied in people who are not necessarily distinguished for creative reasons.[12]

Guilford's approaches that both intelligence and creativity consists of multiple abilities are ideas that recur in later works and research. Such theories have not at least made a great imprint in teacher education, such as e.g. Howard Gardner's theory of multiple intelligences.[13] Modern research in creativity can be divided into three different waves. In the first wave researchers focused on studying the personalities of ex-

10 Keith Negus and Michael J. Pickering, *Creativity, Communication and Cultural Value,* (London: Sage Publications, 2004), 4.
11 Joy Paul Guilford, "Creativity" in *American Psychologist* Volume 5, Issue 9, (1950): 444–454.
12 ibid. 454.
13 Howard Gardner, *Frames of mind: The theory of multiple intelligences*. (New York: Basic books, 2011).

ceptional creators and in the second wave researchers focused on the internal, mental processes when people were engaged in creative activities. The third wave has a socio-cultural and "interdisciplinary approach that focused on creative social systems: groups of people in social and cultural contexts".[14]

The notion of creativity based on knowledge of or methodical skills for new ways of thinking and creative processes, and that creative work not only is reserved to the creative genius, is something that repeatedly has received attention in post Second World War educational research. Psychological theory can also be used to explain different aspect of creativity. Mihaly Csikszentmihalyi's flow theory is for instance an important contribution as the theory can explain how creative people achieve greater motivation when their skills are challenged.[15]

In research on music production, or record production, Philip Mcintyre argues that the romantic ideal to see creative activity primarily as self expressive "independent from any perceptible constraint"[16] appears to be a widespread opinion in the music industry, but that this opinion is based on myths, not on theories or empirical academic research. Instead McIntyre points out a background to creative activity in music production based on recent research that give possible explanations why and how, engineers songwriters, performers, and not at least music producers, "allow creative activity to occur"[17] during the music production process.

Also in musicology and research on music education the view has shifted in recent research away from the nineteenth century's Romantic tradition with the myth of the creative individualistic master genius. Pamela Burnard makes an important contribution when she, among other things, highlights the musical creativity as a collective or collaborative activity:

> Whether the collective process flavours listening, collecting, downloading, sampling, performing, mashing, DJing, dancing, or 'style mixing' […] at an urban dance music club, the way we think about musical creativity falls far short of grasping the potential multiplicity of musical creativity today. Yet music needs an audience. Audiences engage in 'a collective experience', and are a part of, 'doing' music.[18]

Further more, Burnard points out that complementarity and interplay of multiple types of creativity, such as individual and collaborative, cultural and intercultural, reception-venue and audience-generated, participatory and innovatory, are important for composers and that composers also use technology as a mediating tool to support innovation. Explanations of this kind corresponds very well with the way research-

14 Keith Sawyer, *Explaining creativity: The science of human innovation*. (Oxford University Press, 2011), 4.
15 Mihály Csíkszentmihályi, *Creativity: Flow and the Psychology of Discovery and Invention*, (New York: Harper Collins, 1996).
16 Phillip McIntyre, "Rethinking creativity: record production and the systems model", in *The Art of Record Production: An Introductory Reader for a New Academic Field*, ed. Simon Frith, and Simon Zagorski-Thomas, (Farnham: Ashgate Publishing, 2012),149.
17 ibid. 162.
18 Pamela Burnard, *Musical Creativities in Practice*. (New York: Oxford University Press, 2012), 14.

ers in other fields, such as Becker[19] on collaborative production of art and Burgess,[20] Howlett[21] and Moorefield[22] when they describe the music producer's operations and professional role. Thus, a music production activity that is characterized by creative collaborative innovative work where old structures for labour division no longer are valid. Instead music production is described as an activity that is characterized by creative collaborations, all in order to create the artistically and/or commercially successful productions as possible.

One aspect that recurs in contemporary research on creativity is that education in school rather than to develop children's and young peoples creativity and innovative abilities rather do the opposite. Burnard shows explicit criticism of the myths, teachers and others working in the educational field, may have on children's and young people's creative abilities by, referring to current research provide information "that goes well beyond many adult preconceptions and simplified definitions of what constitutes children's musical creativities".[23] But that schools fail to develop children's creative abilities also has attracted attention outside the field of music. Not at least Sir Ken Robinson has made this kind of knowledge widespread through his presentations in popular scientific contexts[24] by criticising the school systems' inability to make use of and/or to help to develop children's creativity.

> I believe our only hope for the future is to adopt a new conception of human ecology, one in which we start to reconstitute our conception of the richness of human capacity. Our education system has mined our minds in the way that we strip-mine the earth: for a particular commodity. And for the future, it won't serve us. We have to rethink the fundamental principles on which we're educating our children.[25]

But such opinions are unfortunately not new. Already sixty-five years back, Guilford was into similar thoughts by asking the following questions:

> Why is there so little apparent correlation between education and creative productiveness? Why do we not produce a larger number of creative geniuses than

19 Howard S. Becker, *Art Worlds*. (Berkeley: Univ. of California Press, 1982).

20 Richard James Burgess, *The Art of Music Production: The Theory and Practice*. (New York: Oxford University Press, 2013); Richard James Burgess *The History of Music Production*. (New York: Oxford University Press, 2014).

21 Michael John Gilmour Howlett, "The Record Producer as Nexus: Creative Inspiration Technology and the Recording Industry." (PhD diss., University of Glamorgan 2009).

22 Virgil Moorefield, *The Producer as Composer: Shaping the Sounds of Popular Music*. (Cambridge, Mass.: MIT Press, 2005).

23 Burnard, "Musical Creativities," 278.

24 Ken Robinson, *Out of Our Minds: Learning to Be Creative*, (Oxford: Capstone, 2011); Ken Robinson, "Changing education paradigms", *RSAnimate*, 16 June, 2008, accessed October 29, 2015, https://www.thersa.org/globalassets/pdfs/videos/2010/10/rsa-animate---changing-paradigms/rsa-lecture-ken-robinson-transcript.pdf; Ken Robinson and Lou Aronica. *Creative Schools: The Grassroots Revolution That's Transforming Education*, (New York: Viking, 2015).

25 Ken Robinson, "Do schools kill creativity?," *TED*, February 23, 2006, accessed October 29, 2015, http://www.ted.com/talks/ken_robinson_says_schools_kill_creativity/transcript?language=en.

> we do, under supposedly enlightened, modern educational practices? These are serious questions for thought and investigation. The more immediate and more explorable problem is a double one: (1) How can we discover creative promise in our children and our youth? and (2) How can we promote the development of creative personalities?[26]

One possible way to develop creative abilities within the framework of projects in education and training is the use of structures and theory that underlie educational models for constructive alignment[27] since learners construct meaning from what they do in order to learn. The model is that teachers start with the outcomes that the students are intended to learn, and align teaching and assessment to those outcomes. Biggs & Tang emphasizes, with reference to recent research on learning and knowledge development, that the best learning experience for an individual often happens when he or she teaches someone else. That is one explanation why peer teaching is a particularly powerful way of learning. Activities of what people use and do in real life and what they talk about with others also results in good learning and a much better learning for most people compared with what is learned when they hear, see or read about something. Biggs & Tang also highlight the importance of multimodal learning: "We learn through activating different sense modalities: hearing, touch, sight, speech, smell and taste. The more one modality reinforces another, the more effective the learning".[28] Feedback is another aspect that Biggs & Tang bring forward as particularly valuable for individual knowledge development, but also is highly valid for collective learning. Formative feedback is particularly important in creative contexts when provided during the learning process, the formative feedback is telling the learners how well they are doing and what might need improving.

iMus – an interactive musical audio playback framework

Music requires that people act or interact. Musical instruments are designed for musicians to interact with and when musicians play with others they extend the interaction with each other. In some cases there is also an audience interacting with the musicians and in some cases the musicians interact with other creative people like dancers or actors for example. In the early days of movies there was no audio tracks and live musicians accompanied the silent movies. Later when film got audio, a whole new genre – recorded film music – was established. Over the years, film music, as a genre, has developed into an art of its own and today film music is a well-established field in academic studies and research.[29] Furthermore, since the soundtrack can be considered to have a decisive impact on a film's success, film music is therefore dedicated special

26 Guilford, "Creativity," 444-445.

27 John B. Biggs and Catherine So-Kum Tang, *Teaching for Quality Learning at University: What the Student Does*, (Maidenhead: Open University Press, 2011), 96.

28 ibid. 63.

29 David Neumeyer, ed., *The Oxford handbook of film music studies,* (Oxford: Oxford University Press, 2014), 3-6.

attention at, e.g., film festivals and film awards, and leading film composers can be accorded considerable media attention and also be given superstar status.[30] With this legacy of film music, composers and producers of new interactive environments like computer games, web pages and perhaps also exhibitions at museums try to integrate and use music in similar ways as in film music. The music is used to tell a part of the story, create an atmosphere or perhaps increase the experience for the viewer or user.

Nowadays, when computers and mobile phones and other mobile devices in general have very good audio quality and the bandwidth of Internet connections has been highly increased, it is in many cases possible to produce music that sounds good by means of new digital, interactive media. But still there are some challenges, though: Music in interactive environments or media needs to be able to change depending on events occurring inside the media and it is necessary that changes can happen in a similar way as if the music was performed by live musicians. Therefore music that is traditionally produced: composed, arranged, recorded and mixed for a linear context like tracks on a CD, can be difficult to use in interactive music and media production. In interactive media the music needs to interact with the user just like musicians interact with each other.

Different frameworks or software has been developed to try to solve the challenge of having the music responding to events in a musical way, like for example changing instrumentation or harmony on the next bar-line by trigging audio files with music and make crossfades between different audio files.[31] In general, such audio frameworks have neither been standardized nor music-composer-friendly and therefore many composers have not been composing for interactive media. One example of this is Microsoft Direct Music that was released in 1996 along with the music production tool Direct Music Producer (DMP). The aim of this software was to provide a useful tool and a standard for music to be integrated into productions using Direct X.[32] DMP had a steep technical learning curve and there was an obvious risk that composers would lose their musical creativity having to overcome too many technical obstacles in the workflow.

Thus, there has been a lack of effective tools to compose for interactive media, where the composer's creativity and experience of already existing music production tools could be used, and that the tools could be used to build effective bridges between the composer and the programmer of interactive media. Wwise[33] and FMOD[34] have recently been developed and these two software tools are widely spread but lim-

30 Dean Keith Simonton, "Film Music: Are Award-Winning Scores and Songs Heard in Successful Motion Pictures?", in *Psychology of Aesthetics, Creativity, and the Arts* 1, no. 2 (2007): 53-60.

31 Johnny Wingstedt, "Making music mean: on functions of, and knowledge about, narrative music in multimedia" (PhD diss., Luleå tekniska universitet, 2008).

32 "DirectX Audio: Making Audio Special FX", Microsoft, last modified July 19, 2011, accessed October 29, 2015, https://code.msdn.microsoft.com/DirectX-Audio-Making-48867ceb.

33 "Wwise Empowers Audio Creators" Audiokinetic , accessed October 29, 2015, https://www.audiokinetic.com/download/documents/Wwise_Brochure_March2014_en.pdf.

34 "Introducing FMOD Studio", Firelight Technologies, accessed December 1, 2015, http://www.fmod.org/products.

ited when it comes to features driven by musical needs, perhaps because these tools rather are developed for use in computer games than for creative musical composition work. Other recent examples of new software for interactive music are e.g. ELIAS – Elastic lightweight integrated audio system[35] that is aimed for use in different platforms and Dinahmoe Labs who have created an audio framework and different software for web technology and their software mixer "The Rick Astley Remixer"[36] provides the user with an entertaining example of how technology of this kind can be used for real-time playback and processing of musical content. Interestingly enough, both ELIAS and Dinahmoe Labs are developed and based in Stockholm.

In Nobel Creations a special framework and software, iMus, was used. iMus, which is developed by Hans Lindetorp and the result of an artistic research project at KMH, was redesigned for the project.[37] Over the years, students from the Music and Media Production Department at KMH have been working with several interactive music production projects in different context. Due to the lack of efficient software for interactive music production iMus was developed based on knowledge and experiences from many of these student projects. The technology being used in iMus is Web Audio API, a high-level JavaScript for processing and synthesizing audio in web applications.[38] What makes iMus useful is that it is designed to be easy to apply in different contexts and therefore very suitable for an interactive music production project in a museum such as Nobel Creations. Further more it is web based which makes it easy to use on all kinds of platforms and units. iMus will be described in depth on another occasion, but briefly, it solves the challenge that music in interactive environments needs to be as if it was uniquely composed to the linear course of events that are the results of the users interaction, including control of optional external parameters as input as well as the randomised playback of programmed events. iMus also has special features to solve the pulse-based music challenges in interactive contexts.

The music production project

Since 2011 the Nobel Museum has staged an exhibition about the new laureates. For the exhibition in 2014-15 *Nobel Creations*, product and interior design and fashion students from Beckmans School of Fashion expressed their interpretation of the different individual prizes and respective laureates in creating garments and a variety of complementing graphic objects. To accompany the designs, students studying jazz at KMH composed different pieces of music, inspired by the prizes. Their music was played in headphones by the different displays (Fig 2.). In addition to this a production team of mas-

35 "Adaptive Game Music", ELIAS – Elastic lightweight integrated audio system, accessed October 29, 2015, https://www.eliassoftware.com/.

36 The Rick Astley Remixer", Dinahmoe Labs, accessed October 29, 2015, http://dinahmoelabs.com/rickastley.

37 Hans Lindetorp, *Documentation iMus*. KMH: Stockholm, accessed December 1, 2015. http://momdev.se/interactivemusic/documentation.html

38 Paul Adenot and Chris Wilson, *Web Audio API: W3C Editor's Draft*. WC3, last modified, December 1, 2015, accessed December, 1, http://webaudio.github.io/web-audio-api/.

ter students from the Music Production program at KMH: Ivan Höglund, Julia Jonas, Anton Näslund and Joakim Persson, created interactive music for the exhibition hall.

Figure 2. The Nobel Museum exhibition hall. (Foto: © Peter Schyborger)

A challenging objective

The objective was to create a soundscape in the room that would be played six days per week for four months. The music would be played through a total of 18 speakers, including two subwoofers. Four of the speakers, seen in green (fig. 3), played a continuous background soundscape composition. The six "blue" speakers, spread out around the exhibition hall built into big pieces of foam, played triggered sound effects and musical parts, based on the prices they represent, all while doing so in time and key with the backgrounds.

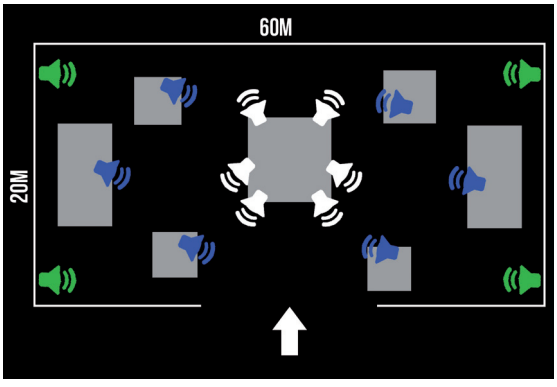

Figure 3. Speaker set up in The Nobel Museum exhibition hall. (Foto: © Anton Näslund)

In the centre of the exhibition hall, there were six iPads, one for each Nobel Prize category, with interactive menus and information about the laureates and their respective prizes. When a visitor touched the screen of the iPad to change it from the menu to a submenu or to the next page of information, different versions of the musical parts coming from that particular speaker was played .

When all six iPads were active at the same time they would play like a small ensemble with six different musical parts and six different instruments, all in sync and in key. Six iPads were used and each iPad had five sub menus (Fig. 4). In a total, 30 different musical parts could be played in any combination with the background music also in sync. All this was made possible through the iMus audio engine.

Figure 4. iPads used in the exhibition hall. (Foto: © Peter Schyborger)

The production and composition process

The composition process started when the nominations of the 2014 Nobel Prize laureates were announced including presentations of their work for which they were being awarded. The production team discussed possible influences that could draw on musically, and decided that each music producer would work separately, creating four individual soundscape compositions for the exhibition. Next the production team visited the museum to check out the acoustics of the exhibition hall. The room is rather large and reverberant, which led to the preliminary conclusion that it would be preferable to avoid using a lot of effects and instead to try to keep the sound quite dry. There

were some background noises observed in the room that might interfere with the music, most notably an air-condition system that hummed at different frequencies at different times. This was noted but an assumption was made that the music probably would mask the background noises quite easily, which later turned out to be correct.

The objective was to vary the music throughout the day by dividing the different compositions into three sections that followed a cadence in the key of F major. The fourth composition would be used as a background for guided tours and would interrupt the other compositions whenever there was a tour. This composition remained at a lower intensity level at all times and left more space in the frequency range used for speech.

The next phase was to make demos of some parts of the music with something for each part of the exhibition hall; a background that played from the speakers in the four corners of the room, triggered sounds for any of the six displays and ensemble parts for the central iPad section containing six speakers. The music demos were tested in the museum and played back in speakers and evaluated by the production team. At this time just a few speakers were used in approximate locations in the room.

Figure 5. The dimensions of the room and the hard acoustics were challenges for the composers. (Foto: © Peter Schyborger)

The dimensions of the room proved to be a bit problematic, because the sound coming out of the corners of the room and the sound emanating from the iPad-section in the middle of the room appeared slightly out of time when the listener moved closer to one or the other (Fig. 5). This made the production team decide to limit the

use of percussive sounds only in one side and to use tousling sounds with longer and smoother attack in the other.

One challenge was to accomplish variation and change without having to compose extremely lengthy pieces. The precondition was that the music would play six days a week for four months, so we couldn't allow it to get on peoples' nerves nor could it sound exactly the same at all times. The solution was to use compositions that could be divided up into flexible building blocks and then be combined in many different ways, all of them musical sounding. The way to do this was to keep it simple. Quite paradoxically, the simpler the music was composed, the more ways it could be combined and varied. Some of the compositions will actually play for years before repeating themselves.

The general idea behind the soundscape was to create an airy, interesting and pleasing atmosphere that left space for the visitors to communicate with each other in the room. The soundscape gave the exhibition an inviting, ethereal feel. The compositions contain blend of traditional instruments like live string instruments and modern software synthesizers. The idea behind this was to show openness to multiplicity and to create a link between old and new, a nod to the history of the Nobel Prize.

The compositions are filled with details that are musical interpretations of the Nobel Prizes; the sweeping movement of a microscope appears as a sweeping filter sound, hexagonal patterns in the brain appear as musical sixths and sextuplets, high frequency blue light from an LED lamp appears as high pitched blue notes.

The music was composed and arranged with a special technique. The different tracks were cut into parts and pieces to fit into the programming part. The music was composed so that the parts could be mixed with each other in any order.

The music had to be arranged so that it could be played for hours and still never to give the listener feeling of being repetitive. Most of the compositional work was done in Apple Logic Pro, both in the compositional stage and for editing (Fig. 6).

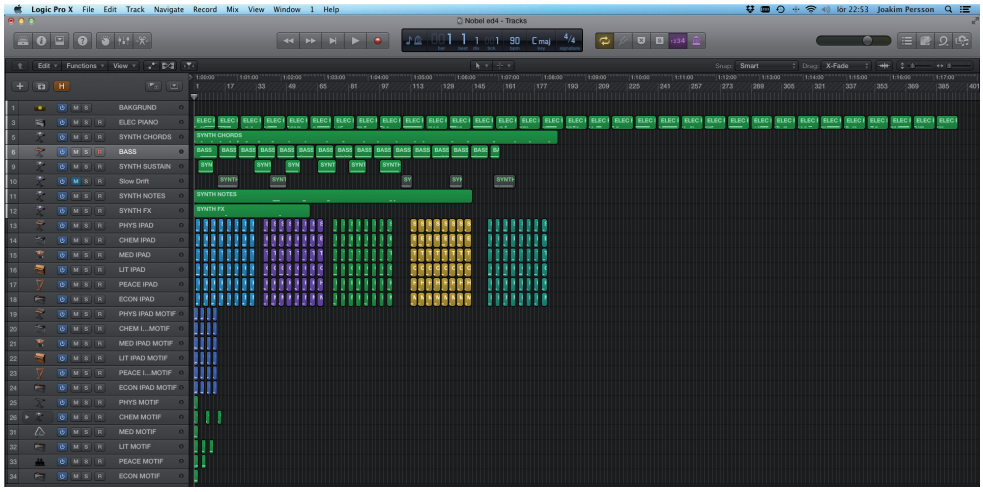

Figure 6. A screenshot of the Apple Logic Pro project in the compositional stage. (Foto: © Anton Näslund)

The iMus audio playback framework[39] was used to play music in the museum hall. With iMus it was easy for the production team to make prototypes during the production of music and try out different ideas in different pieces in the exhibit hall in the Nobel Museum. In iMus, audio files are used for playback. The file can be a musical phrase, one bar of drums, a hit or a sound of any kind. To make it work within the software the composer has to break down the music into small pieces, or fragments, and when it's played back the software puts it back in order. The smallest piece or musical phrase, the file, needs to have some kind of musical information and it is divided into three parts: an upbeat of any length, the phrase itself with a predesigned musical length depending on the tempo chosen, and a tail of any length (Fig. 7).

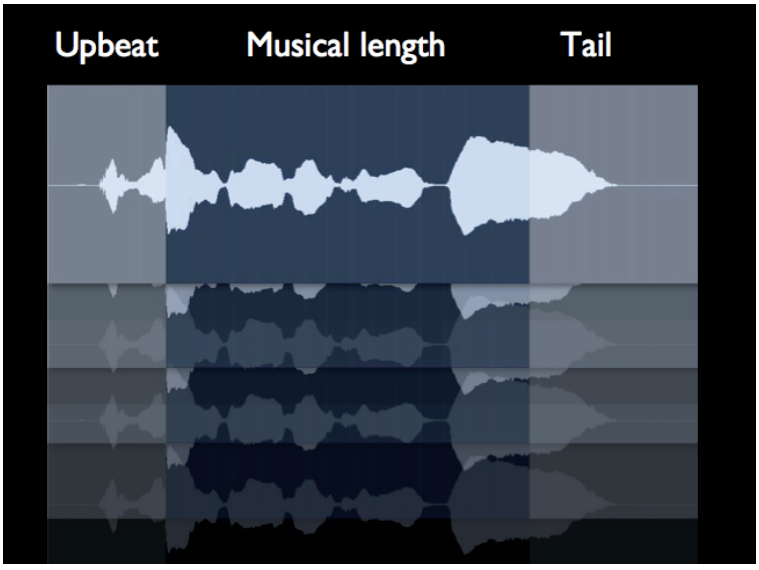

Figure 7. Example of the files cut into parts and pieces, an upbeat of any length, the phrase itself with a predesigned musical length. (Foto: © Anton Näslund)

This particular format makes it possible to stack or sequence the files and secure that they can overlap in an understandable musical context due to the fact that they have a specific musical length, for example a bar or a beat. A random selection of files can be added and played back similar to an arrangement window in a Digital Audio Workstation, DAW, with any number of tracks or parts. It is also possible to use different lengths of loops on the different tracks. There can also be any number of arrangements. This all together makes it possible to, at one event, to go from one arrangement to another, or at another event, for example, mute a track. All music files were exported into mono aiff-files with their reverb tails intact so that transitions would be seamless. While composing the production team had to try different combinations during the process to hear that all parts would be compatible with one another as they were to

39 Lindetorp, "Documentation iMus".

be put together by a randomizing algorithm when performed. During the project the iMus system was further developed in close cooperation between the programming designer Hans Lindetorp and the production team who composed the music.

During the try-outs and tests several modifications were made. For example, the background music that was played while guided tours were being held was chopped up into individual notes and bars to make it more responsive to actions in the room and the more people who moved about in the room, the more stems in the background music would be triggered, increasing the intensity of the background music. In the ceiling, there were infrared sensors picking up the movements when visitor walked about in the room, controlling both the background music and the motion triggered sound effects played from the different display stations.

Figure 8. The final set up of iPads in the centre of the exhibition hall. (Foto: © Peter Schyborger)

Completing the project

Everything came into place within the last couple of days before the opening ceremony (Fig. 8). The materials used in displays and installation of a carpet in the exhibition hall changed the acoustics to a much drier sound than what it originally sounded like. This made it possible to play music a little louder than what was planned and programmed. But the acoustic changes in the exhibition hall also had the effect that the music sounded a bit dryer than expected.

The opening was a big success and the museum was packed with people. When the exhibition closed four months later the staff at the museum told us that they had enjoyed the music, and that people had come to the exhibition just to listen to it, which was wonderful for us to hear. This was the first time in the history of the museum that they'd had music playing through speakers in the exhibition hall. Because of this, there were some initial worries that it might not work to have music playing there, but everyone was very happy in the end. The tour guides were very pleased with the music and was happy to talk to visitors about it. The staff actually said they would miss the music once it was gone.

Final reflections

This project shows that people together can be very creative. And by combining different art forms, using well thought through teaching methods and structured project planning which aims to develop creative actions, young people, students in learning, together can create artwork that far exceeds what they individually could cope.

Another key experience is that it is possible to compose and produce music that is playing week after week in an exhibition hall where staff members work for many hours daily, and that they after four months of listening still had not got tired of the music. How is that possible? Perhaps one explanation is how the music was composed and produced. The production team knew that their compositions would be played for many hours each day in the museum hall and therefore they put special effort to make music that was possible to listen to for a long time without the listeners would become tired of it and maybe even become annoyed. None of the members in the production team had ever composed music in this way before. Even if they all, in different ways and other genres, are experienced as composers and producers, it was a true creative challenge for them to compile their compositions and productions during the project and perhaps that extra ordinary challenge contributed with flow and creativity. The design of the project, with tight time schedules, is perhaps also one possible explanation why the music production processes actually allowed creative activity to occur similar to the theoretical framework described by Philip McIntyre.[40] Overall, the project thus shows good evidence that the romantic ideal, that creativity and creative capacity would be something individual, inborn and inherent in creative people, not

40 McIntyre, "Rethinking creativity," 160.

is valid since the participating composers and music producers clearly developed their creative capacity during the project by cooperating with each other. By composing music in a genre they never worked in before, in an environment that they not previously had created music for and with newly developed software and audio equipment used in innovative ways, the project has given the participants unique experiences that they can add to their repertoire of generic skills. And such skills may certainly be valuable for them in future music production projects. Another important aspect to highlight and reflect upon is that education, according to Ken Robinson, may lead to that pupils and students creative ability is hampered.[41] It is therefore important, especially in compulsory school but also in higher education, to create conditions that develop creative abilities of those who participate in training by allowing creativity to occur.

iMus,[42] the technical framework and software that was used during the project, has been further developed as a result of the experiences and new knowledge the production team gained during project. Furthermore the results of the project give clear support to theories of learning showing that peer teaching and activities of what people use and do in real life and what they talk about with others provides good conditions for learning and development of new knowledge.[43] And the basic educational idea for this project was to try, as far as possible, to emulate how composers and music producers work in real life. During the project, different things happened that led to unexpected problems. And these problems had to be solved. The production team had challenges of various kinds, not the least of time pressure. Therefore, the project sent the participants on a journey that wasn't an emulation of real life. It was real life for composers and music producers. And to learn in real life is probably one of the best ways to create new knowledge and develop creativity.

Perhaps we also can learn something from what Alfred Nobel did and the way he lived his life. Although he lacked formal training school and had no higher education, he learned in his own way and became very successful. And by learning and experiencing different cultures in real life, Alfred Nobel developed an outstanding creative ability.

41 Robinson "Do schools kill creativity?".
42 Lindetorp, "Documentation iMus".
43 Biggs and Tang, "Teaching for Quality Learning at University".