

SOUND AND MUSIC IN INTERACTIVE SONIFICATION: A NOVEL WAY TO COMMUNICATE THE HEALTH RISKS OF ALCOHOL TO YOUNG PEOPLE

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ABSTRACT

Sonification designs have been increasingly used to complement data presentation and exploration in various disciplines. In medical research they have been applied as an aid for analysis and diagnosis, disease treatment, to assist visually impaired patients, and in physiotherapy. Interactive sonification as a communication channel has the potential to be used to describe health risk data to a range of audiences. The novelty of this approach, its interactive nature and ability to be combined with music may provide an effective alternative to the more dominant visual strategies (i.e. graphs, pie charts etc.), particularly when communicating with young people. In this project *Using Sonification to COmmunicate public health Risk data (SCORE)* we plan to test the role of sound, music and interactive sonification to communicate vital health risk information associated with alcohol consumption to young people.

1. INTRODUCTION

1.1. Alcohol misuse prevention

Health education programmes to fight alcohol misuse have proliferated in the last decades [1, 2]. This, however, has not significantly reduced alcohol consumption behaviors in young people [3, 4]. In fact, studies have indicated that those young people who drink alcohol, consume more than in previous years [5], which is likely to increase the incidence of serious consequences for individuals and society as a whole [6-8]. One of the major public health concerns regarding the misuse of alcohol in young people is binge drinking [9]. Binge drinking, which refers to consumption of eight or more units of alcohol in a single session for men and six or more for women [10], may lead to alcohol dependence [9], other substance abuse [11], crime, violence [12, 13], school problems [14], risky sexual behaviors [15, 16], as well as serious long-term health consequences, e.g. cancer [17], cardiovascular [18] or mental disorders [13]. Given the inadequacy of the presently available prevention measures, new ways of alcohol misuse prevention in young people need to be proposed urgently to remedy the problem. Communication through sound may be one such strategy.

1.2. Challenges of risk communication

The primary goal of any communication strategy for health risk situations (situations which are likely to be unusual and to have a considerable potential for both short

and long-term damage) is to provide people with meaningful, accurate and timely information in order to influence decision-making and to promote behavioral changes. Effective communication of risk relies on clearly stated objectives (which are continuously monitored and reviewed); accessible general assessment of the risk; a message that is clear and understandable by the public; as well as an explanation of the complexities and uncertainties of a particular risk [19]. Research has indicated that even in ideal conditions a significant proportion of the communicated information is not remembered, can be misremembered, or even misinterpreted [20].

There are a number of factors that affect risk communication. One of them is risk perception [21]. People's risk perception is usually conditioned by their beliefs about antecedents of an issue, whether it is voluntary or involuntary, and its consequences [20]. Considering their options, people usually employ heuristics and biases [22], such as *optimistic bias* (or *unrealistic optimism*) which causes the person to believe that they are not at risk, or that the probability of a particular threat is low [21, 23]. Understanding the risk depends also on people's ability to foresee or imagine the situation in which they experience the problem [20].

Another challenge in communication of risk is the way people react to it. Quite often people's reaction towards risk messages is defensive. Gerrard, Gibbons, Reis-Bergen [24] indicated that this scenario of reaction to the risk communication is particularly true if the message implies people's past or present unhealthy or unwise behavior. Moreover, decisions influenced by the risk communication are not only calculated rationally as there are also emotional and social components that influence them [25].

Effective communication of health risk information also depends on a degree of people's numeracy necessary to understand risk messages. It has been indicated that individuals with a low level of numeracy have difficulties with comprehension of risk comparison information [26]. For instance, the experiment conducted by Yamagishi [27] showed that death rates of 1,289 out of 10,000 were perceived as higher than rates of 24.14 out of 100. However, even though the use of qualitative expressions for the quantitative values in communication (i.e. frequencies and rates of occurrence) may carry the risk of underestimation and potential misinterpretation [28], the use of qualitative

expressions can improve understanding of quantitative statements in health communication, particularly by people with low numeracy skills [22] and thus, opting for qualitative messages or a combination of quantitative and qualitative messages may make communication more effective. One of the integral approaches to effective health risk communication is based on the assumption that an audience is not a homogenous group (i.e. people have different interests, values, levels of education, intelligence, understanding and culture) [29]. Consequently, information as well as communication channels should be adjusted to the particular audience's characteristics and when a specific subgroup of the audience has been identified (i.e. *audience segmentation*), a comprehensive communication strategy can be developed [29, 30].

1.3. Channels of communication

A body of research on communication strategies has indicated that mass media interventions (such as television, radio, newspapers, outdoor media) alone or in combination with other preventive programs can significantly influence the health behavior of mass populations [31]. Entertainment education, through different forms of entertainment such as pre-developed programs (e.g. soap operas, popular music, theatre performances and books) or inclusion of health messages into existing programs, can influence people's awareness and behavior [31]. Visual aids (i.e. billboards, posters, leaflets) are another channel of health risk communication. The literature review of the effects of visual and graphical displays conducted by Lipkus and Hollands [32] indicated that this method of communication has a potential to affect perception of a risk and to eventually influence audience's behavior. Garcia-Retamero and Cokley [33], however, indicated that not all visual solutions are equally effective in conveying the risk information. In fact, the effectiveness of the visual displays depends on the accuracy and clarity of the portrayed information. Given that visual communication relies heavily on numeracy (as indicated earlier), it is not accessible to all members of the society and, thus, other channels of communication need to be explored.

1.4. Communication through sound

1.4.1. Sonification

Visual methods (i.e. graphs, pie charts etc.) have largely dominated presentation of numerical data. However, one of the novel approaches used in communication of data has been through the use of sonification design. Sonification is a subtype of the auditory display that uses non-speech audio to convey information [34].

Sonification designs have been increasingly used to complement data presentation and exploration in various disciplines. In medical research, they have been applied as an aid for analysis and diagnosis [35], potential disease treatment [36], help for visually impaired patients [37], and in physiotherapy [38]. A systematic search has identified no studies on the use of sonification design to communicate health risks data.

As a communication medium, in portraying health risks particularly to young people, interactive sonification

features several potential advantages over the dominating visual strategies (i.e. graphs, pie charts etc.). These include its novelty, which can attract attention of young people; interactivity, which allows for exploration of the messages related to alcohol consumption; reliability on technology, which is heavily used and favored by young people [39]; ability to combine it with music (supporting sound design of sonification), which many young people are interested in [40, 41]; and finally, lack of reliance on numeracy, which often is necessary to comprehend at least some risk messages. Therefore, studies exploring sound communication interventions may be an important step forward in designing future prevention campaigns to manage risk in young people.

1.4.2. Film music

Despite its inherent ambiguity, music as well as sonification can serve as a powerful communication channel, allowing people to share emotions, intentions and meanings [42, 43]. Film music can work particularly well in this respect, because it is designed not only to support film narration, providing an emotional amplification, but also to communicate messages vital for the narration [44, 45]. For instance, music informs the audience about the genre of the film (i.e. whether it is an action adventure or a psychological drama), and the general mood of the production (i.e. whether the on-screen events are supposed to be perceived as disturbing or comforting) [45]. Music can also provide insights of the characters' internal feelings, direct the audiences' attention to the specific event on the screen while acting as an agent of continuity for the whole story [46-49].

Even though the overall sound design of a film soundtrack may add an additional layer of narrative articulation to a story, of all the film soundtrack components, music has perhaps the greatest power of influencing perception of a film. This influence is often assumed and taken for granted [50], however, in the recent decades, experimental research in film music has shown music's significant role in supporting the narration as a communication channel and emotional signifier. For instance, experiments have confirmed that music has a stronger influence on the overall mood of the film than behavior of the film characters [51]; that music helps to interpret film character's emotions and whether the audience like or dislike them [52]; that music can alter the meaning of the film directly [53]; that the musical soundtrack influences whether we recall the events portrayed in the film [54]. The examples of the experimental research done on the influence of music on the understanding and interpretation of film content point to the conclusion that film music does indeed have the ability to impact and modify visual information and may act as a communication channel.

2. THE PROPOSED EXPERIMENT

In our project, we plan to compare the effectiveness of a traditional visual display of health risk communication (a slide presentation with text, images and various graphs) to a presentation augmented by sound (music and sonification) and interaction.

As it is unlikely that the sound will substitute visual representation of data as a universal mode of data representation, we decided to first explore the augmentation of a visual display rather than compare a visual-only to a sound-only display. It is hypothesized that a combination of sound design (sonification) and film music methods within an interactive sonification design will increase the effectiveness, accuracy and attractiveness of the overall presentation.

The experiment will take place at the Theatre, Film and Television Department at the University of York, in October-November 2014. The experiment will be built around a visual presentation, which contains selected data related to alcohol consumption by young people in the European Union and in the UK, and alcohol-related risks.

Participants will be randomly allocated to three groups: 1) Group 1 will receive visual presentation of the selected data; 2) Group 2 will receive the same visual presentation supported by sonification (i.e. sonification of selected data variables) and music composed to support communication of selected variables; 3) Group 3 will receive the same visual presentation as the previous groups, augmented by sonification, music and interaction.

2.1. Sonification component

The sound design of the sonification will be created to best complement the content of the slides on alcohol health risks. A variety of sonification techniques will be utilized such as parameter mapping, in which data points directly drive selected sound synthesis parameters [55], model-based sonification, in which a data set is seen as a ‘material’ or ‘object’ that can produce digital sound when the user interacts with it [56], auditory icons and earcons, in which sound samples are associated to particular data points through a metaphorical or abstract association [57, 58]. For example, the slide dedicated to short-term consequences of alcohol use may be illustrated by sounds emphasizing the impact of alcohol on different organs and senses, while a traditional two-dimensional graph could be illustrated using a parameter-mapping approach.

Special attention will be paid to integrate the sonification sound design with the music so that, like in a film, music and sound design can communicate simultaneously complementary messages (i.e. the emotional and metaphorical content as well as the more literal information).

2.2. Music component

Due to the exposure of young people to media music (i.e. theatre, film, TV, video games), the language of film music used in this experiment is widely accepted and understood and lends itself well for application in communication strategies. The music component of the display (or intervention) will thus be based on functions of film/media music, which were experimentally tested and confirmed by cognitive psychology and musicology researchers as effective in communicating information and improving the interpretation of the message [50, 51, 53, 54].

It is assumed that the music will be used in two distinctive ways: 1) as an overall support for the sonification, creating an emotional context; and 2) an interactive accompaniment linked to sonification responding to participants’ actions.

In order to support the interactive design of the sonification, the flexibility of the musical structure will be an essential component. In film, in which non-linear editing practices often collide with the linearity of the music, application of modular structures has provided the flexibility needed during composition (fitting music to the film structure) and music editing [59]. For this reason, in our experiment, the music, supported by computer technology, will feature non-linear structures built from interchangeable modular components. Modular components will be created and edited in Logic Pro and Pro Tools musical applications whereas the final form of the musical accompaniment and the sonifications will be executed through real-time processing software such as Max/MSP and Ableton Live 9.

In terms of the music style, it has been agreed, that the music will explore subtler sound-design approaches to music rather than the mainstream Hollywood approach. There are several reasons to pursue this particular creative direction. Firstly, it will allow for a comprehensive blend of the musical accompaniment with the sound design of the sonification (i.e. minimizing the danger that sonic elements will compete for the participants’ attention). Secondly, Hollywood musical idiom, in particular the pompous action/adventure style, which is ubiquitous in countless films, TV programs, and video games, has significantly lost its impact, becoming sometimes too clichéd for the contemporary audiences. Additionally, complex orchestration, and emphasis on certain instruments, e.g. brass instruments or percussion instruments, frequent key changes, and complex rhythms may negatively impact attention of the user and, consequently, their comprehension of the portrayed messages. However, we intend to vary the musical stylistic approaches during the presentation in order to investigate which one is the most effective in supporting communication of the intended messages. Thirdly, this presentation, although it has storytelling elements, is radically different from a film-like narration, and therefore the narrative coding, which is characteristic of the mainstream approach, cannot be applied in the same way here as in film. Nevertheless, the overall approach will be “cinematic”, i.e. the visual presentation will provide the main layer of information, and the sonified data will be almost treated as dialogue in a film, i.e. directly communicating specific messages, whereas the musical component will provide emotional commentary and support for the “image” (visuals) and “dialogue” (sonification). Finally, similarly to the film scenario, music in this experiment should remain in the background and be absorbed by the participants of the experiment on the subconscious level.

2.3 Interaction component

Interaction plays an important role in facilitating users’ engagement with presentations of data [60]. Sound and music have their own intrinsic relationship with time

therefore, in order to put the user in control of this relationship, we need to allow them the possibility of interacting with the way in which sound and music are played back. In this project we will provide different ways of interacting with music and sonifications which will include: 1) repeated listening, 2) single and simultaneous listening of data streams, 3) single data point listening, 4) choice of listening order, and 5) variation of speed (e.g. the user will be able to slow a sonification down).

During the SoniHED conference we will present an example of the visual presentation augmented by the sonification of the data and musical underscore.

3. CONCLUSION

To conclude, taking into account the potential advantages of interactive sonification in facilitating communication, our group has proposed to experimentally test the role of sound and music within interactive sonification to portray vital health risk data associated with alcohol consumption in young people. Film music was selected as an addition to interactive sonification as it may support communication but also because it is widely accepted and understood by young people. In addition, as sonification and music are both elements of the presentation 'soundtrack', they can complement each other influencing the overall aesthetics of the design, which in turn may increase enjoyability and reduce fatigue of the potential user.

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5. REFERENCES

- [1] P. Finn and J. Brown, "Risks Entailed in Teenage Intoxication as Perceived by Junior and Senior High School Students," *Journal of Youth and Adolescence*, vol. 10, 1981.
- [2] E. R. Weitzman, T. F. Nelson, H. Lee, and H. Wechsler, "Reducing Drinking and Related Harms in College Evaluation of the "A Matter of Degree" Program," *American Journal of Preventive Medicine*, vol. 27, 2004.
- [3] D. R. Foxcroft, D. Lister-Sharp, and G. Lowe, "Alcohol misuse prevention for young people: a systematic review reveals methodological concerns and lack of reliable evidence of effectiveness," *Addiction*, vol. 92, pp. 531-537, 1997.
- [4] C. S. Stockley, "The effectiveness of strategies such as health warning labels to reduce alcohol-related harms — an Australian perspective," *International Journal of Drug Policy*, vol. 12, pp. 153-166, 2001.
- [5] E. Fuller, Ed., *Smoking, Drinking and Drug Use Among Young People in England in 2012*. London: NHS Information Centre for Health and Social Care, 2012, p.^pp. Pages.
- [6] F. M. Gore, P. J. N. Bloem, G. C. Patton, J. Ferguson, V. Joseph, C. Co ey, *et al.*, "Global burden of disease in young people aged 10-24 years: a systematic analysis " *Lancet*, vol. 377, pp. 2093-2102, 2011.
- [7] J. McCambridge, J. McAlaney, and R. Rowe, "Adult Consequences of Late Adolescent Alcohol Consumption: A Systematic Review of Cohort Studies," *PLoS Medicine*, vol. 8, 2011.
- [8] J. Rehm, C. Mathers, S. Popova, M. Thavorncharoensap, Y. Teerawattananon, and J. Patra, "Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders," *Lancet*, vol. 373, pp. 2223-33, 2009.
- [9] R. M. Viner and B. J. Taylor, "Adult outcomes of binge drinking in adolescence: findings from a UK national birth cohort," *Epidemiol Community Health*, vol. 61, pp. 902-907, 2007.
- [10] NHS. (2012, 12.04.2014). *Binge Drinking*. Available: <http://www.nhs.uk/Livewell/alcohol/Pages/Bingedrinking.aspx>
- [11] G. Hagger-Johnson, S. Bell, A. Britton, N. Cable, M. Conner, D. B. O'Connor, *et al.*, "Cigarette smoking and alcohol drinking in a representative sample of English school pupils: Cross-sectional and longitudinal associations," *Preventive Medicine* 56 (2013) 304-308, vol. Preventive Medicine, pp. 304-308, 2013.
- [12] J. Lindsay, "The gendered trouble with alcohol: Young people managing alcohol related violence," *International Journal of Drug Policy*, vol. 23, pp. 236- 241, 2011.
- [13] D. Newbury-Birch, E. Gilvarry, P. McArdle, V. Ramesh, S. Stewart, J. Walker, *et al.*, "Impact of Alcohol Consumption on Young People: A Review of Reviews," *Institute of Health and Society at Newcastle University*, 2008.
- [14] M. R. Hayatbakhsh, J. M. Najman, W. Bor, A. Clavarino, and R. Alati, "School performance and alcohol use problems in early adulthood: a longitudinal study," *Alcohol*, vol. 45, pp. 701-709, 2011.
- [15] A. Parkes, D. Wight, M. Henderson, and G. Hart, "Explaining Associations between Adolescent Substance Use and Condom Use," *Journal of Adolescent Health*, vol. 40, pp. 180.e1-180.e18, 2007.
- [16] A. Stueve and L. N. O'Donnell, "Early Alcohol Initiation and Subsequent Sexual and Alcohol Risk Behaviors Among Urban Youths," *American Journal of Public Health*, vol. 95, pp. 887-893, 2005.
- [17] P. Boffetta, "Alcohol and Cancer," *Lancet Oncol*, vol. 7, pp. 149-56, 2006.
- [18] D. Davitson, "Cardiovascular Effects of Alcohol," *West J Med* 1989, vol. 151, pp. 430-439, 1998.
- [19] HealthProtectionNetwork, "Communicating with the Public About Health Risks," Health Protection Network, Glasgow2008.

- [20] A. J. Rothman and M. T. Kiviniemi, "Journal of the National Cancer Institute Monographs," *Journal of the National Cancer Institute Monographs No. 25, 1999*, 1999.
- [21] E. Aakko, "Risk Communication, Risk Perception, and Public Health," *Wisconsin Medical Journal*, vol. 103, pp. 25-27, 2004.
- [22] E. Maibach and D. R. Holtgrave, "Advances in Public Health Communication," *Annual Review of Public Health*, vol. 16, pp. 219-38, 1995.
- [23] N. D. Weinstein, "Unrealistic optimism about future life events," *Journal of Personality and Social Psychology*, vol. 39, pp. 806-820, 1980.
- [24] M. Gerrard, F. X. Gibbons, and M. Reis-Bergan, "The Effect of Risk Communication on Risk Perceptions: the Significance of Individual Differences," *Journal of the National Cancer Institute Monographs*, vol. 25, pp. 94-100, 1999.
- [25] B. Fischhoff, A. Bostrom, and M. J. Quadrel, "Risk Perception And Communication," *Annu. Rev. Publ. Health*, vol. 14, pp. 183-203, 1993.
- [26] C. Keller and M. Siegrist, "Effect of Risk Communication Formats on Risk Perception Depending on Numeracy," *Medical Decision Making*, vol. 29, pp. 483-490, 2009.
- [27] K. Yamagishi, "When a 12.86% Mortality is More Dangerous than 24.14% Implications for Risk Communication," *Applied Cognitive Psychology*, vol. 11, p. 495±506, 1997.
- [28] F. Mosteller and C. Youtz, "Quantifying Probabilistic Expressions," *Statistical Science*, vol. 5, pp. 1-158, 1990.
- [29] M. W. Kreuter and S. McClure, M., "The Role of Culture in Health Communication," *Annual Review of Public Health*, vol. 25, pp. 439-455, 2004.
- [30] M. D. Slater, "Theory and Method in Health Audience Segmentation," *Journal of Health Communication: International Perspectives*, vol. 1, pp. 267-284, 1996.
- [31] L. C. Abroms and E. W. Maibach, "The effectiveness of mass communication to change public behavior," *Annu Rev Public Health.*, vol. 29, pp. 219-234, 2008.
- [32] I. M. Lipkus and J. G. Hollands, "The Visual Communication of Risk," *Journal of the National Cancer Institute Monographs*, pp. 149-163, 1999.
- [33] R. Garcia-Retamero and E. T. Cokely, "Communicating health risks with visual aids," *Current Directions in Psychological Science* vol. 22, p. 392-399, 2013.
- [34] G. Kramer, B. N. Walker, T. Bonebright, P. Cook, J. Flowers, and N. Miner, "The Sonification Report: Status of the Field and Research Agenda. Report prepared for the National Science Foundation by members of the International Community for Auditory Display.," NM: International Community for Auditory Display (ICAD), Santa Fe 1999.
- [35] A. D. N. Edwards, A. Hunt, G. Hines, V. Jackson, A. Podvoiskis, R. Roseblade, *et al.*, "Sonification Strategies For Examination Of Biological Cells," presented at the The 16th International Conference on Auditory Display, Washington, 2010.
- [36] T. Hinterberger and G. Baier, "Parametric Orchestral Sonification of EEG in Real Time," *IEEE*, vol. 12, pp. 70 - 79, 2005.
- [37] M. Berndt-Schreiber, W. Lesiński, and Ł. Trzciałkowski, "Image Data Sonification In Medicine," *Journal of Medical Informatics & Technologies*, vol. 12, pp. 177-182, 2008.
- [38] K. Vogt, D. Pirrò, I. Kobenz, R. Höldrich, and G. Eckel, "PhysioSonic - Evaluated Movement Sonification as Auditory Feedback in Physiotherapy," presented at the ICAD, Washington, USA, 2010.
- [39] C. Clark and G. Dugdale, "Young People's Writing: Attitudes, behaviour and the role of technology," National Literacy Trust, London 2009.
- [40] A. C. North, D. J. Hargreaves, and S. A. O'Neill, "The importance of music to adolescents," *British Journal of Educational Psychology*, vol. 70, pp. 255-272, 2000.
- [41] P. Nuttall, "Thank you for the music? The role and significance of music for adolescents," *Young Consumers*, vol. 9, pp. 104-111, 2007.
- [42] I. Cross, "Music and meaning, ambiguity and evolution," in *Musical Communication*, D. Miell, R. MacDonald, and D. J. Hargreaves, Eds., ed New York: Oxford University Press, 2005, pp. 27-61.
- [43] D. J. Hargreaves, R. MacDonald, and D. Miell, "How do people communicate using music?," in *Musical Communication*, D. Miell, R. MacDonald, and D. J. Hargreaves, Eds., ed New York: Oxford University Press, 2005, pp. 2-25.
- [44] M. Chion, *Audio-Vision: Sound on Screen*. New York: Columbia University Press, 1994.
- [45] S. D. Lipscomb and D. E. Tolchinsky, "The Role of Music communication in Cinema," in *Musical Communication*, D. Miell, R. MacDonald, and D. J. Hargreaves, Eds., ed Oxford: Oxford University Press, 2005, pp. 382-.
- [46] R. Davis, *Complete Guide to Film Scoring*. Boston: Berklee Press, 1999.
- [47] C. Gorbman, *Unheard Melodies: Narrative Film Music* Bloomington: Indiana University Press, 1987.
- [48] Z. Lissa, *Estetyka muzyki filmowej*. Kraków: PWM, 1964.
- [49] R. M. Prendergast, *Film Music: A Neglected Art: A Critical Study of Film Music in Films*. New York: W.W. Norton & Company, 1992.
- [50] A. J. Cohen, "Associationism and Musical Soundtrack Phenomena," *Contemporary Music Review*, vol. 9, pp. 163-178, 1993.
- [51] S. Holicki and H. B. Brosius, "Der Einfluß von Filmmusik und nonverbialem Verhalten der Akteure auf die Wahrnehmung und Interpretation einer Filmhandlung.," *Rundfunk und Fernsehen*, vol. 36, pp. 189-206, 1988.
- [52] S. L. Tan, M. P. Spackman, and M. A. Bezdek, "Viewers' Interpretations of Film Characters'

- Emotions: Effects of Presenting Film Music Before or After a Character is Shown," *Music Perception: An Interdisciplinary Journal*, vol. 25, pp. 135-152, 2007.
- [53] S. Marshall and A. J. Cohen, "Effects of Musical Soundtracks on Attitudes toward Animated Geometric Figures," *Music Perception*, vol. 6, pp. 95-112, 1988.
- [54] M. G. Boltz, M. Schulkind, and S. Kantra, "Effects of Background Music on the Remembering of Film Events," *Memory & Cognition*, vol. 19, pp. 593-606, 1991.
- [55] F. Grond and J. Berger, "Parameter Mapping Sonification," in *The Sonification Handbook*, T. Hermann, A. Hunt, and J. G. Neuhoff, Eds., ed Berlin: Logos Verlag Berlin GmbH, 2011, pp. 363-398.
- [56] T. Hermann, "Model-Based Sonification," in *The Sonification Handbook*, T. Hermann, A. Hunt, and J. G. Neuhoff, Eds., ed Berlin: Logos Verlag Berlin GmbH, 2011, pp. 499-430.
- [57] E. Brazil and M. Fernström, "Auditory Icons," in *The Sonification Handbook*, T. Hermann, A. Hunt, and J. G. Neuhoff, Eds., ed Berlin: Logos Verlag Berlin GmbH, 2011, pp. 325-338.
- [58] D. McGookin and S. Brewster, "Earcons," in *The Sonification Handbook*, T. Hermann, A. Hunt, and J. G. Neuhoff, Eds., ed Berlin: Logos Verlag Berlin GmbH, 2011, pp. 339-362.
- [59] B. P. Walus, "Modular Structures in Film Music: The Answer To Synchronization Problems?," *Journal of Film Music*, vol. 6, pp. 125-154, 2011.
- [60] A. Hunt and T. Hermann, "Interactive sonification," in *The Sonification Handbook*, T. Hermann, A. Hunt, and J. Neuhoff, G., Eds., ed Berlin: Logos Verlag Berlin GmbH, 2011, pp. 325-338.