BODY STORY – USING TOUCH TO OVERCOME LANGUAGE BARRIERS

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Cum aţi interpreta o povestire care însoţeşte muzica dacă nu puteţi folosi vorbirea, dacă povestirrea ar fi prezentată într-un mod pe care nu-l puteţi auzi? Acest scenariu ar putea fi, de exemplu, muzica prin imagine dirijată (GIM) dintr-o anume sesiune de lucru (Bonny, 1989; 2002). Vocea terapeutului are nevoie să fie calmă pentru a conduce la o atmosferă liniştită, iar interpretul nu poate folosi vorbirea pentru a repeta povestirea, aşadar trebuie inventate nişe metode alternative. Singurul canal deschis pentru comunicare se dovedeşte a fi cel tactil, deoarece cel vizual ar fi fost prea vag. Primele mesaje bazate pe elementul tactil s-au bazat pe mişcările corpului şi pe senzaţii, cum ar fi căldura nisipului, soarele şi paşii în mişcare (Lahtinen şi Palmer, 2005). Mesajele bazate pe elementul tactil s-au dezvoltat între timp într-un sistem simbolic larg, incorporând 8 subcategorii specializate (Lathtinen, 2008). În acest articol ne vom referi la o asemenea subcategorie specifică.

Cuvinte cheie: tactil, atingeri, GIM, percepţie multisenzorială, comunicare interpersonală

1. Introduction

Where there is spoken language together with background noise or music the situation is challenging for a hearing impaired individual. In a Guided Imagery and Music (GIM) session music is a vital part, not just noise, nor is it in the background. This presents a second sound source in addition to the storyline. So, music and the story are equally important to create the atmosphere needed for a successful GIM therapy session. This setting proves difficult for a hearing impaired person as the dim lighting needed for the right atmosphere hinders lip reading even with normal vision, let alone in a case of visual impairment. Some aspects of the complex soundscape, even if it sounds perfectly balanced in loudness scale for both the therapist and the normally hearing client, may create a loudness imbalance for the hearing impaired client. This can be balanced somewhat with hearing aid device technology, but to overcome all challenges in the session, careful planning, co-operation and new methods in relaying information have to be considered.

The identification and recognition of using touch as an additional method in these situations will help the hearing and visually impaired or deafblind (both henceworth DB) person in saving energy and reducing stress. This collection of

touch messages, i.e. haptices arised spontaneously during these sessions and is here analysed further.

1.1. Hearing impairment and its effect on communication

All types of hearing impairment affect spoken language communication, be it restricted to certain situations as difficulty in group situations only, as in milder hearing impairments or a more profound effect in every day life affecting all situations as in severe hearing impairment. The challenges become multifold if there is additional visual impairment however minor it might be.

1.1.1. Speech perception in noise in hearing individuals

Listening in noisy conditions is one of the most challenging situations for an individual. That requires extracting speech from the masking noise in the first stage and only after that is one able to decipher the meaning in the message. The first step in the perception chain requires extra concentration and energy. The lower the SNR (signal-to-noise ratio) is the more difficult the first phase of the perception chain is. That is, the more noise there is in the environment, the harder it is to listen to speech in that environment (Lavandier & Culling, 2010 and others).

Different types of noise result in differencies in types of difficulty for speech perception. White noise covers the whole of the soundscape masking all frequencies equally while pink noise is concentrated onto speech frequencies. Thus white noise resembles GIM session (Bonny, 1975 and others) music in the background as a type of perturbation for speech perception. Babble noise, especially when in one's native language, is extremely disturbing for speech perception as it is so similar to the speech in source signal, i.e. conversation (Hawley et al., 2004). The human ability to be able to distinguish two or more spoken messages from each other is often referred as cocktail party effect (Bronkhorst, 2000 [here NB p. 124-125 on hearing impairment], Wood & Cowan, 1995, Hawley et al., 2004 and others). The ability to attend to one message also depends on the languages used – it is easier to listen to your native language and foreign language babble (Rhebergen et al., 2005 and others). Often when listening to speech in noise one uses so-called visemes to enhance the speech signal, that is, the articulatory patterns visible as mouth movements (Carney et al., 1990). This is sometimes called lip reading. If a person has a hearing loss, lip reading is used in all suitable lighting conditions. However, if the person has a visual impairment the possibility to use lip reading as an additional support for speech perception is not available.

Speech recognition is reduced in noise despite the human ability to adapt speaking in noisy environment when having a conversation. This automatic ability is called Lombard effect, and it has applications in treating various diseases affecting articulatory muscles, such as Parkinson's disease (Adams & Lang, 1992 and others) or studying the effects of speech disorders (Howell, 1990 and others). The effect has also been called Lombard reflex to honour its discoverer Etienne Lombard (main publication on effect 1911), and has evolved to facilitate the mediation of an acoustic signal in noisy conditions (Brumm & Zollinger, 2011).

1.1.2. Speech perception in noise with a hearing impairment

One of the first arising issues when a person has a hearing impairment is that speech recognition in noise is reduced, in other words, having a conversation in noisy situation is difficult. Especially non-frequent words (e.g. champagne might be misheard as sausage) and similar-sounding words are difficult to perceive (five vs. life; sock, clock, lock vs. rock). These words and word groups are used in various audiological evaluation and speech perception tests (Mendel & Danhauer, 1997).

The confusion matrices of similar-sounding words are extensive and not all problems are solved by contextual information as a lot of words might be used in similar contexts in a conversation. That requires more also from the other parties in conversation – to make sure that the hearing impaired person gets all the information correct. This can be achieved by using different sentence structures and choosing easily distinguishable, synonymous words for concepts. Using top-down hierarchy within e.g. meeting planning helps as well as clear sentence and word stress patterns. Using visual clues to enhance structures will also benefit the hearing impaired person within conversation (Munhall et al., 2004). On the other hand, slowing speech-rate does not improve intelligibility (Nejime & Moore, 1998).

In milder hearing impairments it might be difficult for the others to notice that one of the conversation partners has a hearing impairment as its implications will only arise later, e.g. in a situation where the next meeting has been settled with time and date and only later one of the conversation partners is searching for confirmation for when the next meeting is or where will it be. Having information about the context, i.e. what is talked about, helps in deciphering what has been said.

Parity principle (Liberman, 1993; Studdert-Kennedy, 1998) and the human mirror neuron system (MNS), (Oztop, Kawato & Arbib, 2013 and others) enable the speaker to adapt to the hearing impairment of the listener, that is, to take into account the parameters in speech which help the listener with a hearing impairment (so-called clear speech).

In more severe hearing impairments clear speech and suitable environment might not be enough for spoken language communication, but alternative and augmentative communication methods (AAC) might be needed to support spoken language recognition and spoken language communication. These include various visual support methods, such as fingerspelling in its various forms (visual and tactile) and sign supported speech. Adaptation to a conversation partner with a severe hearing impairment includes enhancing spoken message with shorter, condensed sentences, clearer articulation patterns, but also verbalizing emotions within speech (e.g. I am smiling), because emotional context might result in unintelligible signal for a hearing aid or cochlear implant (CI) user (Lahtinen, 2008, p. 61). These are methods that interpreters working with hearing impaired and DB people use in ensuring the equal rights for involvement of their clients in the society.

1.1.3. Simultaneous use of music and speech as a soundscape for a hearing impaired person

Unfortunately, the simultaneous use of music and speech is relatively common in everyday life, e.g. shops tend to use background music in relatively high sound pressure levels (SPL). However, in some circumstances simultaneous speech and music are the core of a special setting, such as in a concert event or music therapy sessions. In these situations hearing impaired people are presented with challenging listening environment although for hearing people the environment is quite suitable. In relation to speech in noise research field, the music in the background here can be related to noise in the literature, though here music is not regarded as noise in the traditional sense of the word.

For a specialized, relaxing-oriented music therapy session, such as GIM (also please see chpt 1.2. below), hearing impairment represents a challenge, which requires additional thought about possible solutions. A client with a hearing impairment might not hear either of the precisely-thought sound sources required for a successful therapy session. The situation might be helped with technical solutions present in some of the modern hearing aid devices, such as telecoil options (T) or combinatory techniques with simultaneous telecoil and air-conduction

listening (M/T) or additional hearing solutions, such as conference microphones or personal FM devices attached to the client's hearing aids or CIs. However, these options are not available for everyone, nor do they solve the problem of multiple sound sources but partially (Limb & Roy, 2014, also Phillips-Silver et al., 2015).

Therapist working with a client with a mild to moderate hearing impairment might benefit from using clear speech techniques, such as word selection by frequency and using clear word and sentence stress patterns or arranging the session so that lip reading can be used. Interpreting services might also benefit the client and reduce the need for struggling to hear. One method that has been used successfully in these situations is storytelling by touch (please see chpt 2.1. below)

1.2. Guided Imagery and Music (GIM)

The original concept of GIM stems from Bonny (1975, 2002). It is defined here as allowing an interactional process between therapist and client enabling the client to listen to music and/or for the therapist to either tell a story or evoke certain images using words which may allow the client to either reflect or come to terms with their own feelings or past experiences. It is not just the listening to music but to enhance music with vibrations as such.

Hearing impaired people rely on visual clues and lip reading. During the session the lights are dimmed to create a relaxing environment. This makes it very difficult to follow what the therapist is saying. For this reason some hearing impaired people use interpreting services but even so, it might prove difficult to follow the storyline. This is one of the reasons why and how the Body Story Creative Musical Images through Touch (CMIT) (henceforth BS) evolved (Lahtinen & Palmer, 2005).

In general music is present in the GIM session to provide a relaxed atmosphere and to evoke images. As the acoustics of the music per se cannot be heard by the hearing impaired person the person focusses on the vibrations and physiological and emotional responses created by the music. This can be defined as a "vibro-sensoric" experience. The word was coined within a meeting (Palmer & Ojala, 2016).

The purpose of a GIM 30-45 min. session is to get the client to a relaxed state

of mind and feeling safe about sharing the problems with the therapist. Bonny concentrates on normally hearing clients while this approach enhances the vibrations to create a vibro-sensoric experience for hearing impaired clients. Augmenting spoken story with touch elements enables the hearing impaired client to concentrate on relaxation as such without having to struggle with hearing either the spoken language story or the acoustics of music.

Music may be used as a tool to enhance the holistic experience. Bonny uses classical music which is suitable for hearing people whereas this approach uses New Age, avantgarde or pop music as the music needs to have a good vibrational pattern which can be felt through the body. Sometimes this style of music is referred as "open space music". This can be defined as a style where rhythm, tones, melody and dynamics of the music are clear and well-defined. Examples include Sky (1992), Vangelis (1992) or John Barry (1988) (popular music), Brian Eno (1987) or Steve Reich (1970/1971) (avantgarde). The music should be instrumental to avoid predetermined images or distraction to storytelling.

During one guided imagery course which was set up in a small room with 10 students the teacher had a music hifi centre with two speakers and in a GIM exercise the students were lying on the floor in a relaxed posture. The aim was to induce guided imagery using music. One student was hearing and visually impaired and was using hearing aids and a personal FM system. The student had an interpreter present. Unfortunately this student who usually relies on spoken language in communication was not able to follow the storyline of the GIM process even with the FM system as this would have disturbed the atmosphere. The student's language and communication methods included spoken language, deafblind manual alphabet, individual signs, visual and tactile body language and written language, none of which was feasible to use in this situation. At this point, new touch messages had to be created.

Furthermore, in order to hear and feel the vibrations, it was necessary for the student to be close to the speakers and in conjunction to use a balloon to enhance the vibrations (Palmer, Lahtinen & Ojala, 2014, p. 353). When the music was being played, the perception of the music by the student is perceived differently to a hearing student, depending on the type of hearing aid devices used, such as hearing aids or CIs. If using hearing aids, they may pick up more low frequencies than high frequencies while the situation might be vice versa for a CI user. This means the music perceived by the hearing impaired student has an artificial soundscape. In addition the student will have a vibro-sensoric experience (Palmer &

Ojala, 2016). Different types of vibrations may evoke different responses on the body (Palmer, 1999).

1.3. GIM – touch images

When a DB person participates in a GIM session he cannot hear the storyline nor the music as the hearing aid devices cannot properly cope with simultaneous multiple sound sources. When the GIM method includes simultaneous use of spoken storyline and music, it yields into a very challenging soundscape. The visual impairment manifests in difficulty in using lipreading and other visual methods. Thus the only information channel available is touch, i.e. the body. Music in the situation creates a vibro-sensoric experience in addition to the storyline being condensed and transferred by touch. BS provides additional techniques for this.

These techniques consist of haptices produced on a neutral area, here arm or hand by an interpreter, i.e. an additional person ensuring the information flow as a whole. The client gives feedback to the interpreter instantaneously by naming it, acting on it or copying the appropriate body movements. The individual haptices are repeated until feedback is given. The spoken storyline is recreated with haptices onto the body.

The therapist tells the story in well-spaced, condensed parts. There are pauses in between these story parts with only music being played. This enables the interchange of story by haptices. This also allows the client to organise a logical mental storyline based on these haptices and later to give feedback to the therapist.

2. Social-haptic communication and its hierarchy

Social-haptic communication is based on a longitudinal process and development of communication using touch with DB people. The first article to describe some social quick messages was published in 1993, where the concept haptic was used as a framework for the first time (Lahtinen & Palmer, 1993, 1994). Haptic information is transmitted by skin, hands, arms, feet, legs and whole body (Gibson, 1966; Goldstein, 1989). Gibson and Goldstein have investigated how

different body areas are involved in information flow to the body. Raanes (2006) on the other hand examined how different body parts were included when using Norwegian tactile, hands on, sign language during a dialogue between two DB people. So called natural touch messages in family unit interaction were introduced for a wider audience for the first time within a lecture in a deafblind conference in 1996. The theoretical background work started in 1997 (Lahtinen & Palmer, 1996, 1997). After the theoretical framework had been established the methods were adopted by the DB community in different countries through courses and workshops. The first academic module on holistic and interactive communication methods was adopted within the curriculum at the University of Manchester from the academic year 1999 onwards (Lahtinen & Palmer, 1999). The widest collection of haptices was later published in a monograph (BS).

There are currently nine social-haptic communication research areas, each with its own set of haptices. They include: emotions, social-haptic confirmation system, social quick messages, messages when moving together, private messages, movements of the body, orientation in the environment i.e. drawing onto the body, contact to the people and the environment and sharing art and hobby experiences through touch. However, this has only been expanded after the publication of Lahtinen, (2008).

2.1. Haptices, i.e. touch messages

BS had bases for categories of haptices, how they are formed and what kind of natural components they have. Repeating haptices indicates qualitative or quantitative changes, such as heavy rain, high winds, stormy sea etc. Those are indicated with variations of speed, size or duration of touch. These are basic touch grammar elements called haptemes (Lahtinen, 2008, p. 147).

Haptices in the BS developed to encompass landscape and natural phenomena as the GIM lectures were based on stories about individuals enjoying nature adventure. In BS 44 haptices were presented. They were categorised into 6 groups as follows (p. 21-41):

1. general signals such as wait, start, music starting, breathing slowly, relaxing, thinking, listening, waking up and sleeping
2. nature and landscape elements such as island, beach, sand, sea, lake, hill, mountains, tree and river
3. weather elements such as rain, wind, storm, warm and cold

4. seasonal elements such as morning, evening, summer, winter, spring and autumn
5. images of kinaesthetic movements such as standing, walking, jumping up and down, sitting, lying down and two people walking
6. some advanced signs and elements such as fish, ants, crab, horse, snake, bird and boat.

Grouping and definition of haptices was still in process. At that stage the concept "signs" was used, which later was replaced by the correct definition haptice (Lahtinen, 2008, p. 147). The current analysis (2015) yielded 10 subcategories, all related to human reaction to weather elements and phenomena, interactive feedback, experiences and agreed messages of nature topography. The first haptices were copying actions and reactions to situations.

The 10 subcategories are presented with 44 haptices including pictures to illustrate the production and perception of haptices and their place of articulation and location on the body. The examples are presented in the same order as in BS.

1. Natural body reactions to heat, cold, etc. (rain, wind, storm, warm, cold,

summer, winter, spring and autumn).

Figure 1. Cold or chill – shaking of arm as if shivering (BS, p. 32)

2. Holistic description of a natural phenomenon – indicates how does rain and wind feel on the skin or face (sand, sea, rough sea, lake and river).

Figure 2. Rain – tips of the fingers tapping (BS, p. 30)

3. Movement transferred onto the body – how a moving animal would feel on the skin (ants, crab and snake).

Figure 3. Snake – a single finger slithering from side to side onto the arm (BS, p. 40)

4. Description of a body part - pointing the areas of the body involved

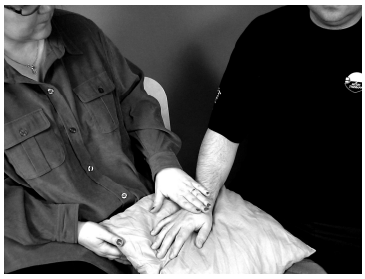
(breathing slowly, relaxing, thinking and listening).

Figure 4. Listening – pointing the side of the ear with fingertip (BS, p. 23)

5. Movements emphasising part of a whole (waking up, sleeping, standing,

walking, jumping, sitting, lying down, fish, horse, bird and boat).

Figure 5. Sleeping – thumb and index finger imitate closing of the eyes (BS, p. 24)



6. Reflex-like messages onto the body (wait).

Figure 6. Wait / stop – palm of the hand with pressure onto the body (BS, p. 21)

7. Interaction including feedback (start and music starting).

Figure 7. Start / yes - flat hand repeated tapping with rhythm of the head nod (BS, p. 21)

8. Indication of number (two people walking and forest).

Figure 8. People walking – two hands with two fingers as for walking (BS, p. 38)

9. Mental images, agreed and discussed together on context (tree, morning and evening).

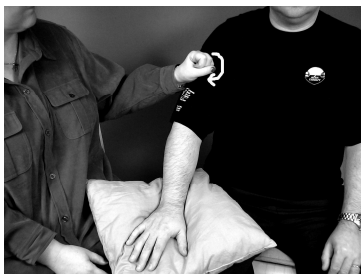


Figure 9. Tree – close fist, pivoting on the side of the hand to simulate a tree trunk (BS, p. 28)

10. Topography, landscape elements (island, beach, hill and mountains).

Figure 10. Hill – palm of the hand simulates the shape of the hill (BS, p. 27)

These 10 categories can be divided into 4 stages of information flow: natural and direct reaction on the body (1, 2, 3), movements on the body (4, 5, 6), interactive (7, 8) and agreed partial representations of a whole phenomenon (5, 9, 10). Thus, all of these categories are based on physical experiences, either reflexes,

communicative interaction or body movements.

3. Conclusions and discussion

Within the first GIM sessions introduced in BS first haptices were produced with music-induced rhythm and intensity, very similarly to a child imitating the speech of adults with movement envelopes with a meaning without specific inner structure, but the envelope more affected by the situation than specific, precise combination of elements. At the next stage these envelopes are treated as more specific independent wholes, condensed representations of natural elements. This is a similar development to what happens in a child acquiring a language. The main input for a developing system are repeated language elements from which the child induces the phonological system. Similarly, the haptice system has developed further as the elements have been repeated more and more times by first a core group, but at later stages of the development more and more people from different backgrounds have adopted the different categories for use. And similarly to language development there seems to be individual variation in producing and perceiving these touch elements called haptices.

This development can also be seen as a parallel to the evolution of language ability in human. Other such cognitive functions include mathematics, music and social intuition (Hauser, Chomsky & Fitch, 2002). Research has also revealed similar underlying features and structures shared by all these functions. Here, BS contains a set of condensed touch messages, which have combinatorial elements originating from both language (story-telling) and music. In the case of individual language development and word formation processes we can trace the individual word forms back to their hypothesised and older proto-languge forms (Paliga, 2007 and others). Here we are on the verge of a new, emerging system similar to the situation described by Goldin-Meadow (2003) in relation to the emergence of Nicaraguan Sign Language (NSL) from the individuals' so-called home-sign systems. She described the process of agreeing and discussing the signs, which have since then formed the basis of the new NSL. Recently the first native NSL signers have been reported.

By adopting some of these principles described in the beginning of the conclusions and incorporating them into the new haptice system allows the hearing impaired person to interact in the therapy session more without having additional

psychological and physiological stress. Combination of using haptices and feeling music (Palmer, 1999) was essential in the client's experience of the session. The process in which a person is able to feel music what is defined as vibro-sensoric experience (Palmer & Ojala, 2016), needs to be recognised with therapists and other professionals who are working with hearing impaired people. During the session it was noticed that the interpreter using haptices also had to consider the dynamics of the music, e.g. the rhythm of sea waves. That resembles "singing through touch". It means that music also is transferred via haptices. There are individual variations on how strong this tendency is.

From a hearing impaired person's perspective this allows them focus more on the human responses instead of having to rely on different forms of technology in the situation, i.e. it allows the person to be free to enjoy the holistic experience and to concentre on the therapy itself. In other words, the use of haptices enables a harmonious therapy session.

This method is adaptable to use and can be applied with a wide range of people. As the method of BS has since been adopted by a wider audience with regards to story telling by touch, a new textbook on the principles has been published (Lahtinen & Palmer, 2014). It promotes the user's participation in art activities (Lahtinen, Palmer & Ojala, 2014; Palmer, Lahtinen & Ojala, 2014; Lahtinen, Palmer & Lahtinen, 2010). Furthermore, the BS haptices can be applied to overcome the language barriers.

References

A. Literal references

Adams, S.G. & Lang, A.E., (1992). Can the Lombard effect be used to improve low voice intensity in Parkinson's disease?. *European Journal of Disorders of Communication*, 27(2), 121-127.

Bonny, H.L., (1975). Music and consciousness. *Journal of music therapy*, 12(3), 121-135.

Bonny, H.L., (2002). *Music consciousness: The evolution of guided imagery and music*. Barcelona Publishers, USA.

Bronkhorst, A.W., (2000). The cocktail party phenomenon: A review of research on speech

intelligibility in multiple-talker conditions. *Acta Acustica united with Acustica*, 86(1), 117-128.

Brumm, H. & Zollinger, S.A., (2011). The evolution of the Lombard effect: 100 years of psychoacoustic research. *Behaviour*, 148(11-13), 1173-1198.

[BS] Lahtinen, R. & Palmer, R., (2005). *The Body Story. Creative Musical Images through Touch (CMIT).* Cityoffset Oy, Tampere.

Carney, A.E., Kienle, M. & Miyamoto, R.T., (1990). Speech Perception with a Single-Channel Cochlear Implant. A Comparison with a Single-Channel Tactile Device. *Journal of Speech, Language, and Hearing Research*, 33(2), 229-237.

Gibson, J.J., (1966). *The senses considered as perceptual systems.* Prospect Heights, I.L. Waveland Press, Houghton Mifflin Co. Boston, USA.

Goldin-Meadow, S. (2003). *The Resilience of Language: what gesture creation in deaf children can tell us about how all children learn language. Essays in Developmental Psychology.* Psychology Press.

Goldstein, E.B., (1989). *Sensation and perception*. Brooks/Cole Publishing Company, USA.

Hauser, M., Chomsky, N. & Fitch, W.T., (2002). The language faculty: What is it, who has it, and how did it evolve?, *Science*, 298, 1569–1579.

Hawley, M.L., Litovsky, R.Y., & Culling, J.F., (2004). The benefit of binaural hearing in a cocktail party: Effect of location and type of interferer. *The Journal of the Acoustical Society of America*, 115(2), 833-843.

Howell, P., (1990). Changes in voice level caused by several forms of altered feedback in fluent speakers and stutterers. *Language and Speech*, 33(4), 325-338.

Lahtinen, R., (2008). *Haptices and Haptemes - a case study of developmental process in social-haptic communication of acquired deafblind people*. Academic dissertation. University of Helsinki. Cityoffset Oy, Tampere.

Lahtinen, R. & Palmer, R., (1993). Communication with Usher People, practical ideas for the family and professionals. *7th EUSSG, Potsdam, Germany*.

Lahtinen, R. & Palmer, R., (1994). Communication with Usher People. *Deafblind Education, July-December, 7-9.*

Lahtinen, R. & Palmer, R., (1996). Holistic Family Communication, Spoken Language by Touch is More than Just Words. *4th European Deafblind Conference Espoo, Finland*.

Lahtinen, R., & Palmer, R., (1997). Theoretical Basis of Holistic Communication for Dual-Sensory Impaired People & Family Members. *EUSSG & DBI Proceedings, Madrid, Spain*.

Lahtinen, R. & Palmer. R., (1999). Holistic & Interactive Communication Methods with Acquired Deafblind People & Families - A Practical Approach. Joint Training Initiative, Distance Learning Course (incl. Video). *Manchester University, UK.*

Lahtinen, R. & Palmer, R., (2014). Kehotarinoita haptiiseilla - kosketusviestejä kaikenikäisille. Lönnberg Print & Promo, Helsinki.

Lahtinen, R., Palmer, R. & Lahtinen, M., (2010). *Environmental description for visually and dual sensory impaired people.* Art-Print Oy, Helsinki.

Lahtinen, R., Palmer, R. & Ojala, S., (2012). Visual art experiences through touch using haptices. *Procedia-Social and Behavioral Sciences*, 45, 268-276.

Lavandier, M. & Culling, J.F., (2010). Prediction of binaural speech intelligibility against noise in rooms. *The Journal of the Acoustical Society of America*, 127(1), 387-399.

Liberman, A.M., (1993). In speech perception, time is not what it seems. *Annals - New York Academy of Sciences*, 682, 264-264.

Limb, C.J. & Roy, A.T., (2014). Technological, biological, and acoustical constraints to music perception in cochlear implant users. *Hearing research*, 308, 13-26.

Lombard, E., (1911). Le signe de l'elevation de la voix. *Ann. Maladies Oreille, Larynx, Nez, Pharynx*, 37(101-119), 25.

Mendel, L.L. & Danhauer, J.L., (1997). *Audiologic Evaluation and Management and Speech Perception Assessment*. Singular Publishing Group, London.

Munhall, K.G., Jones, J.A., Callan, D.E., Kuratate, T. & Vatikiotis-Bateson, E., (2004). Visual prosody and speech intelligibility head movement improves auditory speech perception. *Psychological science,* 15(2), 133-137.

Nejime, Y. & Moore, B.C., (1998). Evaluation of the effect of speech-rate slowing on speech intelligibility in noise using a simulation of cochlear hearing loss. *The Journal of the Acoustical Society of America*, 103(1), 572-576.

Oztop, E., Kawato, M., & Arbib, M.A., (2013). Mirror neurons: functions, mechanisms and models. *Neuroscience letters*, 540, 43-55.

Paliga, S., (2007). *Etymologica et Anthropologica Maiora*. Fundatia Evenimentul, Bucharest.

Palmer, R., (1999). *Using music with sensory impaired people including those with profound learning disabilities.* Course unit leisure and relationships involving people with complex learning disabilities. University of Manchester.

Palmer, R., Lahtinen, R. & Ojala, S., (2012). Musical experience and sharing musical haptices. *Procedia-Social and Behavioral Sciences*, 45, 351-358.

Palmer, R. & Ojala, S. working notes 5.1. 2016 (unpublished).

Phillips-Silver, J., Toiviainen, P., Gosselin, N., Turgeon, C., Lepore, F. & Peretz, I., (2015). Cochlear implant users move in time to the beat of drum music. *Hearing research*, 321, 25-34.

Raanes, E., (2006). *Å gripe inntrykk og uttrykk. Interaksjon og meningsdanning i døvblindes samtaler: En studie av et utvalg dialoger på taktilt norsk tegnspråk.* Academic dissertation. NTNU, Norwegian University of Science and Technology, Trondheim.

Rhebergen, K.S., Versfeld, N.J., & Dreschler, W.A., (2005). Release from informational masking by time reversal of native and non-native interfering speech. *The Journal of the Acoustical Society of America*, 118(3), 1274-1277.

Studdert-Kennedy, M., (1998). Chapter 13. The particulate origins of language generativity: from syllable to gesture. In: Hurford, J., Studdert-Kennedy, M. & Knight, C. (eds.), *Approaches to the Evolution of Language*. Cambridge University Press.

Wood, N.L. & Cowan, N., (1995). The cocktail party phenomenon revisited: attention and memory in the classic selective listening procedure of Cherry (1953). *Journal of Experimental Psychology: General*, 124(3), 243.

B. Musical references

Barry, J., (1988). Film Music of John Barry. Music CD.

Eno, B., (1987). Ambient 1. Music for Airports. Music CD.

Reich, S., (1970/1971). Drumming. Music CD.
Sky, (1992). Sky 2. Music CD.
Vangelis, (1992). 1492 Conquest of Paradise. Music CD.