Auditory Focus
Sound environment and participation for pupils with visual impairment

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Abstract

This study investigates auditory accessibility and participation for pupils with blindness in everyday school situations. What opportunities do the pupils have to use their hearing to distinguish and gain access to social and educational processes in different sound environments? Auditory observations by researchers and pupils have been made in various school environments at five Swedish schools. At the same time, qualitative interviews have been conducted with five pupils aged 8–18 years. A theoretical model has been generated on the basis of grounded theory. This model describes auditory identification processes and cognitive processes for access to social and educational contexts in activities, which is the study’s main concern. The results of the study indicate that the pupils constantly use sound to gain access to both social and educational processes, and that sound is often their most important and only source of information. The study also shows that the sound environment is decisive in terms of the pupils’ opportunities to participate. In environments meant for social interaction (dining halls, after-school recreation centres, corridors) it is often impossible to distinguish friends’ voices and the context of activities because of the high sound levels, large number of people and large number of concurrent activities. This makes the sound information relatively anonymous, which in turn makes social interaction more difficult. An environment that is too quiet, without verbal communication, also becomes anonymous. However, the pupils’ chances of identifying voices, processes and contexts are very good in functional sound environments. Small, subtle details are often an important aspect of the auditory information. Cognitive processes, such as experience and inference, are important for piecing together the auditory information in a constantly changing sound environment. The results also point to situations requiring double auditory focus in the classroom that become difficult for pupils to manage. Results also shows that verbal information cannot be equated with written information in teaching situations when it comes to exposure time, overview, repetition and working memory requirements. The implications for organisational structure, educational working practices and the design of premises that can increase the pupils’ opportunities to participate are discussed in the study.

Keywords

Visual impairment, blindness, auditory accessibility, sound environment, participation, social interaction, school.
Outside the window spring is in full bloom. Now, as I come to the end and turn off my computer, the lush scent of cherry blossom, the birds’ ethereal twittering and the warm spring breezes await me. Completing this paper has been a long, laborious process, but also an extremely exciting and educational journey along unfamiliar, winding roads. It is with certain sadness that I bring this effort to a close. I am grateful to the many people who have provided me with assistance along the way.

First and foremost, I want to express my deepest and warmest gratitude to the pupils Molly, Jacob, Hilda, Kim and Daniel, who so generously shared their wise and important thoughts, for allowing me to join you in school. You are the very foundation of this paper and without you it would not have amounted to anything. I am also grateful to their teachers for welcoming me so warmly to participate. A huge thank you also goes to Kerstin for your wise and humble supervision, and for putting up with my obstinacy. Your knowledge and experience has taught me so much. Thanks also my employer, the Swedish National Agency for Special Needs Education and Schools, which has made it possible for me to undertake this study partly within the scope of my work. Another person who has been incredibly important throughout this work is my reader Sara. You have done a huge amount of work and been a great support. Thank you! Huge thanks also go to my colleagues Tina, Annica and Tove, who have been involved in the study as keen-eyed observers. Special thanks to Tove for your read-throughs and your commitment. You don’t realise how valuable you are. I hope we go on to have many more interesting conversations. I am also grateful to my colleague Kia; thank you for your unfailingly exquisite language suggestions.

Finally, I would like to thank my dear family – my children Linus and Matilda-Lo – for patiently putting up with an occasionally somewhat absent mother, and last, but not least, my husband and soulmate Greger. I am thankful for your eternal commitment, your loving support and your knowledge!

Sköndal, May 2014

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1. Introduction

The idea behind this study came largely from my own experience of having lost my vision. Twelve years ago, having previously had moderate visual impairment, I became completely blind. I had to learn many things all over again, but one of the most important experiences was how the significance of sound changed. From having had a great deal of focus on my remaining vision, I switched my attention to the perception of all the sound around me. This new way take in the world was transformative in many ways, and over the years it has given rise to many ideas and thoughts, song lyrics and discussions. A couple of years ago, I was given the opportunity to write a chapter about the significance of sound for a book about children and young people with visual impairment (Backström Lindeberg, 2013). The basis of this chapter was my own experience and what I had observed when meeting children with visual impairment through my work at the Swedish National Agency for Special Needs Education and Schools (SPSM), a government agency that provides support to municipalities on matters relating to special needs education. I then thought I would go on to a more detailed study of how pupils with blindness perceive and utilise sound in their everyday lives at school. I wanted to hear their stories and investigate what opportunities are provided in schools’ sound environments.

In the years I have been working at the SPSM, I have observed that the social situation for pupils with visual impairment in schools is the challenge most difficult to solve, and is also the factor that worries pupils, parents and educators the most. In 2011, I was given the opportunity to participate in a knowledge and development project within the SPSM concerning pupils with disabilities’ participation in schools. This resulted in an R&D report (Swedish National Agency for Special Needs Education and Schools [SPSM], 2012). Many of the issues reported to the SPSM relate to pupil participation and what can be done to address a lack of participation, both in school work and in more socially targeted contexts such as break times and other activities. This demonstrates that the ambition to support pupils in their desire to participate is great, but also that it is an area that is hard to deal with. Within the scope of this project we visited several schools in order to observe and interview pupils with visual impairment about their participation in different school situations. Further thoughts stirred within me concerning the significance of sound and sound environments when it comes to opportunities to participate.

One further observation I have made over the years is that the literature on visual impairment often highlights the importance of the visual and the difficulties associated with visual impairment. However, surprisingly little has been written about how people with visual impairment use sound in various everyday situations and social interaction. This is possibly a result of the difficulty to observe all the subtle signals that a complex and constantly changing soundscape gives rise to. It can also be difficult, from an outside perspective, to study how other people perceive and utilise all these small and large sound impressions in their day-to-day lives. Because vision is such a dominant sense for the sighted, it is also easy for sighted educators or researchers to look at what the child does instead of hearing what the child hears.

There are several reports highlighting the importance of an agreeable sound environment that is conducive to conversation in schools and preschools (Dellve, Samuelsson & Persson Waye, 2013; Gustafsson, 2009; Swedish Association for Hard of Hearing People [HRF], 2010; Lewin & Nyman, 2011; Sahlgrenska Academy at the University of Gothenburg, 2011). However, I have noted that pupils with visual impairment are not mentioned in these reports. This field has much development
potential, and cooperation is possible within various areas concerning disability and working environments in general.

In light of this lack of research, I have decided to investigate the significance of sound on opportunities for participation, making use of grounded theory as a methodology and with the help of the pupils’ own experiences.

2. Aim

The aim of this study is to shed light on the usability of different sound environments for accessing social and educational processes during the various activities that make up the school day of pupils with blindness.

No fixed questions have been in focus as the methodology used in the study is grounded theory, the entire basis of which is the empirical data. Nevertheless, the following questions have been used when designing the study, for example when choosing the method and drawing up the interview guides:
How can the pupil use sound as a source of information in order to gain an understanding of social and educational processes? Which sound environments hinder participation and which ones facilitate it? What characterises the respective sound environments that lead to either activity or passivity? How do pupils perceive different sounds and soundscapes in school?

3. Background

I will begin this chapter by briefly describing what sound is, and will touch on research concerning auditory perception and echolocation. Following that, I will discuss how the perception of sound and different sound environments can be linked to opportunities for participation. These concepts are central to my study of pupils with blindness. Sound and participation can be perceived as two widely different fields of research, but in practice they are closely related. This is understandable as it involves receiving, via soundscapes that have a complex composition and which are constantly changing, the information required to understand the context and thus take the initiative, contribute and participate in activities.

3.1 What is sound?

Sound waves are alternating compressions and expansions in the air, i.e. high and low pressure in relation to the normal/atmospheric air pressure (Elmerskog, 2008). Sound is generated by mechanical vibrations in objects or events. The vibrations are propagated in objects and then out into the surrounding medium, for example the air. The compression waves are transported with differing speeds, dependent on the density, temperature and acoustic absorption of the material (Gibson, 1969). In contrast to electromagnetic waves, which light is made of, the mechanical waves of sound cannot be transported in a vacuum. Sound spreads out concentrically from the source, i.e. like ripples on the
water when you drop a stone into it. A loud sound involves large pressure changes and a great deal of energy. This is illustrated as a curve with high waves. On the other hand, the pitch – frequency – relates to the number of pressure changes per unit time and is illustrated as closely or widely spaced waves. The wave front moves in a straight line from the source to the listener. Consequently, the wave front makes it possible to locate the source and find your bearings in relation to it. A wave field is composed of multiple wave fronts and is a copy of the mechanical vibrations in the source, which means that we are able to identify the sound (Elmerskog, 2008; Gibson, 1996).

Sound and light are two different physical phenomena with different properties. Sound is slower, more volatile and more vague than light, and it is not reflected to the extent light is. Nor is it possible to focus or differentiate the direction of sound to the extent possible with light as sound “intersperses”, even though several sound sources can be located at the same time. Gibson writes:

> The sound field that originates from what is happening in various places will partly merge with one another in the air. Wave fronts can thus reach a given projection point from different directions. To a certain extent, it is possible to listen to each individual even separately. But ambient sound is not at all comparable with ambient light in terms of the degree to which the various directions from which it may be coming can be determined. (Gibson, 1969, p. 28)

But Gibson also states that the wave field pattern of vibration in the air is an exact copy of the vibrations in the source, which means that we are able to identify it with a high degree of precision.

Sound, like light, is reflected in our surroundings and we can differentiate between direct sound and reflected sound. Sound is altered by the composition of the environment. For example, different frequencies are absorbed and reflected depending on the shape and material of objects. These changes become important sources of information for people with blindness (Elmerskog, 2008; Wiener & Blasch, 2010).

### 3.2 Perception and the auditory system

Gibson (1969) describes our senses as active, perceptual systems where the senses work together to search for and obtain information about our surroundings. In this context, it is interesting that the hearing and touch are, so to speak, related senses that are similar to one another in that they both register information via mechanoreceptors, as opposed to sight’s photoreceptors. Smell and taste both use chemoreceptors.

The auditory organ captures vibrations from the air and transforms them into nerve impulses. The two ears are physically separate, but their nerve impulses are intertwined in the central nervous system. The perception is then amplified and optimised with the help of movements of the body and head. Binaural hearing, i.e. hearing with two ears, is important for determining the direction from which a sound comes and for understanding speech (Litovsky, Johnstone, & Godar, cited in Wiener et al., 2010). Small differences in sound arise between the two ears as a result of the distance between them and the obstructive effect of the head. There are differences in terms of timing, volume, frequency and phase as the sound waves reach each ear. By turning the head, sound sources can be located and identified more effectively. The ear conch also helps to capture sound that comes from the front and screening off sound that comes from behind.

The reception and processing of information almost always comprises a component produced through the receiver’s own activity. Perception is thus a combination of externally produced and activity-produced stimuli. “The active and aware do not wait passively for stimuli, they seek them out”
Gibson (1969) distinguishes between hearing and listening; the former involves passive perception, while the latter is an active process. Our perceptual systems are developed through learning. Gibson (1979) coined the term "ecological approaches to perception", where he describes perception and activity as a cycle – everyone moves and acts in order to learn about their surroundings and we use what we have learned to take further action.

3.3 Echolocation and auditory assessment of distance for people with blindness

Echolocation involves us using reflected sound as a source of information for spatial perception without having direct contact with the object (Elmerskog, 2008; Schenkman & Nilsson, 2010; Wiener et al., 2010). Sounds such as footsteps, cane sounds and tongue clicking produced by the listener are often used as a means of actively searching for sound responses in the environment, but reflections from sound produced by other people and objects are also used.

In the article "Echolocation, an action-perception phenomenon" (Arias et al., 2012), the researchers describe echolocation as a phenomenon and the historical background to the research area. The authors argue that research into auditory perception has, up until now, focused largely on spoken language and music. There has been next to no research concerning the day-to-day auditory perception of non-verbal sound. Arias et al. also argue that research into echolocation requires an approach that embraces other fields of research such as neurophysiology, computer science, virtual environments and cognitive psychology.

Wiener, Welsh and Blasch (2010) present research showing that echolocation is improved through learning, but that it has also been demonstrated that children with blindness use it from as early as the age of four, and probably even earlier. In many cases, children with blindness make various sounds spontaneously when they move about in order to echolocate. These include stamps, claps, hops or various loud noises with their voice, which provides them with information about their physical environment via the sound that is reflected. Recently, it has also been suggested that the majority of sighted people use echolocation in everyday situations without being consciously aware of it (Arias et al., 2012).

Wiener et al. (2010) write about how it is possible to learn to aurally determine the distance to a sound source using the listener’s experience of the sound in question and the event itself, even though this is not as effective as determining the distance visually. What makes it possible to hear the distance from a sound source is the fact that the volume and frequency of the sound decrease with increasing distance, i.e. the sound becomes quieter and somewhat lower in pitch the further away you are from the source. However, Wiener et al. go on to write that distance sound is a combination of both direct sound and reflected sound, i.e. echo. For the sighted, the ability to judge distance with the help of sound is linked with perceiving sound at the same time as seeing the event or the sound source that caused it. We talk about audiovisual feedback (Elmerskog, 2008). In order to compensate for visual impairment, it is therefore important that children with blindness gain experience of linking auditory perceptions with distance assessment and tactile/haptic investigation of the sound source itself (Fraiberg, 1977). One phenomenon that is also used for determining distance to moving objects or when you are moving yourself is the Doppler effect. Several researchers address the Doppler effect as an important factor in echolocation and judging distance (Elmerskog, 2008; Schenkman & Nilsson,
By comparing, for example, the sound of their footsteps with the reflected sound of the steps and comparing the frequency and volume someone can determine the distance to objects such as a wall.

### 3.4 Sound environment

Sound environment is a key concept in this study, the aim of which is to investigate the usability of sound environments for pupils with blindness. Sound is a very important resource for the unsighted; it is a source of information and stimuli in all day-to-day situations. But distinguishing sounds required a sound environment that permits this.

There are standards and recommendations governing the acoustics of school premises (Gustavsson, 2009; Swedish Standards Institute, 2007). More recent surveys indicate that the acoustics in Swedish schools are generally poor (Gustafsson, 2009; HRF, 2010). Unclear regulations, a lack of expertise and understanding among politicians and administrators are listed as probable causes (Gustafsson, 2007). Background noise and reverberation time are the spatial properties described in acoustics as the most decisive in terms of how well the signal, normally speech, will be perceived (ibid.). Late reflections, i.e. long reverberations, have a tendency to mask subsequent direct sounds, primarily high-frequency sound such as consonants, which makes speech unclear (Ljung, 2010).

The number of children/pupils in the room and the activity taking place, combined with the room acoustics and size of the space, has a large impact on the sound environment of the preschool or school (Dellve et al., 2013; Lewin & Nyman, 2011; Sahlgrenska Academy at the University of Gothenburg, 2011). Additional factors mentioned are teaching methods, the awareness of a noise problem and noise from other sources such as traffic and ventilation.

A poor sound environment is a comprehensive environmental problem that is increasingly being acknowledged in society in general and in schools and preschools specifically. The Swedish Association for Hard of Hearing People (HRF) report *Kakofonien* [The Cacophony] (2010) indicates that the Swedish population regard the sound environment as a big problem in both offices and restaurants, and not least in schools. What is particularly startling, argues HRF, is the situation for teachers. Two thirds of teachers/preschool teachers believe that the sound environment at work is a problem every day/week (HRF, 2010). In schools, preschools and after-school recreation centres it is not uncommon for the average sound level to be 70 decibels, which is comparable with many manufacturing industries (Swedish National Board of Health and Welfare, 2009). The HRF investigations also reveal that nine out of ten respondents state that the sound environment should be given the highest priority when designing various interior environments. The HRF writes:

> Toughen up the requirements concerning premises for teaching and childcare. The sound environment has become children’s great environmental problem. Currently, the noise in many schools, preschools and after-school recreation centres is such that it harms both children and staff. It is also often far too poor in universities and other educational premises. This cannot be allowed to continue. We now have to have regulations requiring an optimal sound environment in all premises for teaching and childcare. (HRF, 2010, p. 11)

The HRF continues:

> The combination of voices, steps and other common sounds can become a loud racket in a room that is designed in the "wrong" way. A sound environment conducive to conversation is not achieved simply by suppressing or removing unwanted sound. The desired sound – not least speech – also has to be brought out in the right way. (ibid., p. 15)
The groups considered especially dependent on a good sound environment are people with impaired hearing, Swedish as a second language and neuropsychiatric disabilities (Dellve et al., 2013; Gustafsson, 2009; HRF, 2010; Sahlgrenska Academy at the University of Gothenburg, 2011). Children in general are also included in this group because a good sound environment is important with respect to language development (Dellve et al., 2013). It is notable that the group people with visual impairment is not mentioned anywhere in the literature on sound environment and noise problems in schools/preschools or society in general that I have read. It is my hope that this study will contribute to acknowledging the significance of the sound environment to pupils with blindness.

Other studies highlight noise as a chief source of environmental stress among children (SCB, 2005). A research team including representatives from the Sahlgrenska Academy in Gothenburg (Dellve et al., 2013) has used grounded theory as a method of investigating preschool children’s perception and understanding of their sound environment at preschool. This is a qualitative study in which focus group interviews have been conducted with 36 preschool children. The study was carried out with sighted children and is based on noise-related health problems, but is interesting in this context as few studies are undertaken in which children are interviewed about their day-to-day sound experiences. The study indicates that children experience both physical symptoms and emotional stress caused by the sound environment and that the sensation of lacking control is related to the stress experiences. Well-known sound is perceived as less disruptive, while sound the pupils find incomprehensible or unmanageable is described as more frustrating. Furthermore, loud shouting and sudden sounds were perceived as painful and frightening. Getting away and attempts to reduce the impact of sound were the most common strategies for dealing with the sound of other children shouting, but it also emerged that many children lacked any such strategies. The authors discuss how one way of reducing children’s frustration, aside from physical measures in the environment, could be to explain in simple terms the origin and occurrence of sound sources, as well as strategies for alleviating everyday sound. This would also increase awareness of the sound environment and make it more manageable for both children and staff at preschools.

Dellve et al. (2013) also point to previous research in which it was found that noise affects children’s sleep, memory functions, reading comprehension, educational performance and well-being.

More recent environmental psychology research also shows that the conditions of the sound environment such as background noise and reverberation have an impact on how auditory information is processed and stored in the brain (Ljung, 2010). Hearing and interpreting puts a strain on the capacity of the working memory and the memory functions are made worse if this becomes too taxing. This suggests that, even if a pupil in a noisy environment can hear what is being said, it is considerably harder to take in and remember the information than in a better listening environment (Gustafsson, 2009; Ljung, 2010).

### 3.5 Soundscape

A relatively new and increasingly well-developed field of research is soundscape ecology (Pijanowski, Farina, Gage, Dumyahn, & Krause, 2011; Schafer, 1994, 1996). The term soundscape was coined by Schafer (1977) and focuses on the listener’s perception of a surrounding collage of sound at a given point in time, which often involves a complex combination of sound at one and the same time. Schafer also describes an analysis of soundscapes in the form of background noise and foreground sound, with terms such as "key note", "sound mark" and "sound signal" making an appearance. This field of research has been defined in various ways, but common to these definitions is the goal of describing a
soundscape with all its elements such as human and biological sound sources, the soundscape’s acoustic impact, cognitive identification processes and changes to the soundscape in time and space.

A closely related field is ecological acoustics, which investigates how living beings relate to one another and their surroundings via the medium of sound. While there is much research describing the physical properties of sound and sound propagation, Gaver (1993) attempts to describe sound in the no man’s land between physical perception and human perception. What is interesting about Gaver’s research is that it investigated everyday sounds with the aim of categorising them. Gaver also argues that we cannot simply take into account the physical properties of the sound, but also have to take an interest in the sound source itself; its size, strength and material.

My study focuses on the significance of sound environments for pupils with blindness and how they can utilise auditory information in various activities to gain an understanding of social and educational processes and thus the opportunity to participate in them. The following section deals with the concept of participation.

### 3.6 Participation

Participation is a concept whose meaning changes depending on the context and perspective from which it is regarded. For example, it can mean various things depending on whether the focus is on the individual or societal level, and whether it is used in the context of treatment or a social context (Kroksmark, 2013). Participation is a key concept in the Convention on the Rights of the Child as well as the Convention on the Rights of Persons with Disabilities (Swedish National Board of Health and Welfare, 2009; UNICEF, 1989).

The International Classification of Functioning, Disability and Health (ICF) defines the term participation as "an individual’s involvement in a life situation" (World Health Organization [WHO], 2001, p. 7). The ICF is a comprehensive model for sorting information concerning the individual’s physical psychological and social situation. It is what the individual does together with others, how involved they are and what they perceive is a meaningful activity that is central. When an individual experiences problems in their interaction with others or in their opportunities to become involved in a situation, this means their participation is restricted (Pless & Granlund, 2011). A version of the ICF for children and young people, ICF-CY, was released in 2007 and published in Swedish in 2010 (Pless & Granlund, 2011).

Professor Ulf Janson from Stockholm University has developed a model for participation from a sociocultural perspective in which participation is seen as something that is created in social processes (Janson, 2004, 2005). Janson contends that it is not sufficient to look at participation simply on the basis of an individual’s involvement; rather consideration must also be given to an objective, observable part of the concept. Janson writes:

> For the individual to state they are involved in co-activity is thus not sufficient basis on which to conclude that co-activity actually exists. It must also be possible to observe such action. (Janson, 2005, p. 2)

Using empirical studies and theorising, Janson has developed a definition in which the concept of participation has been broken down into six aspects: affiliation, accessibility, co-activity, recognition, involvement and autonomy. This model of participation has subsequently tested and developed in terms of its use in everyday practice in both preschools and schools (Janson, 2005; Melin, 2013; SPSM, 2012). The three aspects listed first, affiliation, accessibility and co-activity, are seen as objective and
observable, while the three latter aspects, recognition, involvement and autonomy, are of a more subjective and self-perceived character.

**Affiliation** In order to participate, the individual has to be formally affiliated to the context in which the co-participants are present and the activity is undertaken. For example, this can involve being enrolled in a school or belonging to a class. Consequently, this aspect is mainly an issue of law and regulations such as the obligation to attend school and the right to education (SFS 2010:800, Chapter 7). In this sense, the majority of children with disabilities participate in the public school system.

**Accessibility** involves having access to the activity’s physical, socio-communicative and symbolic context. Physical accessibility can, in the context of this study, involve the structure of the physical environment, assistive technology and adapted learning materials. Socio-communicative and symbolic accessibility is more concerned with the accessibility of that which is communicated such as language, body language, expressions, symbols and concepts. Traditionally, accessibility has often been limited to simply the physical environment, but Janson has expanded the concept by dividing accessibility into the three parts named above. He writes:

For children with disabilities, it has not been uncommon to expend effort and resources on environmental adaptations with the aim of providing accessibility. But cultural participation requires accessibility not simply to a physical space, but also to a social and educational context. Language, codes, symbols must be comprehensible and manageable if we are to consider the social and educational context accessible. (Janson, 2005, p. 2)

There is a strong relationship between accessibility and other aspects of participation (SPSM, 2012; Söderqvist Dunkers, 2011). A high level of accessibility often also leads to a high level of participation with respect to the other aspects. If accessibility is provided, autonomy becomes easier, which in turn can increase the chances of being accepted and acknowledge by classmates. Good accessibility also provides greater opportunities for co-activity, i.e. being involved in the same action as others.

**Co-activity** means being involved in the same action, for example in activities and read-throughs in the classroom, play in the schoolyard or conversations in the corridor and dining hall. Co-activity does not necessarily mean doing things in the same way; rather it means that participants are involved in the same activity and context. Being involved in the same activity is important both for being part of and feeling part of the group. But it is also important when considering what signals are sent to other pupils in the class when one pupil is separated from the group (SPSM, 2012).

**Recognition** involves the subjective perception and acceptance of those around you in various activities. For example, this can involve being accepted as a friend in a group of friends or being recognized as a pupil in the group by the teacher. Participation is dependent on becoming accepted and recognized as contributing and bringing something to the context. The peer-group culture’s tolerance of difference reproduces and recreates the values and norms that exist in schools. Accordingly, the schools’ organisational structure, values and norms are significant (Wrethander Bliding, 2007).

Involvement is an aspect of participation perceived by the individual, and is concerned with whether the individual feels involved and motivated in an activity. The individual’s perception is not always consistent with what is observed by others; accordingly, the individual must be asked directly in order to establish a person’s involvement. But establishing a pupil’s perception only provides a one-sided picture of participation if this is not complemented by the more objective aspects. "For example, a person with low expectations who is perceived objectively as being clearly marginalised may still state they have a satisfactory degree of participation" (Janson, 2005, p. 3).
Autonomy involves the individual having the possibility to decide their own actions. In schools there are rules and requirements that all pupils have to adhere to and, in this context, autonomy represents self-determination in the same way and to the same extent as a pupil’s classmates. For a disabled pupil, there is a risk of adult concern encroaching on their autonomy, which can have consequences in the peer-group culture. Adult care is often required to ensure pupil safety, and as a support, but it can be important to recognise that being taken care of by adults can also threaten a pupil’s integrity and hence undermine their autonomy (Melin, 2013; SPSM, 2012).

The form of participation that is possible for a disabled pupil in school is largely dependent on the prerequisites and demands of the activity (Janson, 1996; Söderqvist Dunkers, 2011). A school day consists of many different situations and activities in a variety of environments. There are various requirements for participation in these activities and the prerequisites for an individual’s participation can vary from moment to moment, from situation to situation. Consequently, participation cannot be regarded as something static in this context. Accordingly, the focus must be placed on the activity in order to look at pupils’ participation in school.

If the explanation for why the pupil has not achieved participation only focuses on individual circumstances and impediments, the individual pupil becomes the reason, i.e. the pupil is burdened with responsibility for the problem. If the explanation only focuses on the surroundings, the explanatory model will perhaps not be sufficiently differentiated; for example, the focus lands only on the placement of the handrail. The consequences vary depending on how we look at participation and which explanatory models we use. (ibid., p. 19)

![Diagram showing the relationship between individual prerequisites, surroundings, individual qualities, and participation or marginalisation.](Figure 1)

**Figure 1** Conditions for participation are created in social processes. (Söderqvist Dunkers, 2011, p. 18)

### 3.7 Different cultures in schools

Schools are places for learning, care, education and connecting with peers. Pupils move between different physical spaces and situations requiring a variety of attitudes. Here, we can talk about varying cultures and, at an overall level, differentiate between the educational activity’s teaching culture, care culture and peer-group culture (Janson, 2004, 2005; Melin, 2009, 2013).
Each culture has its own special role division, aims and expected behavioural patterns. Both the teaching culture and the care culture are based on vertical, most frequently adult-controlled relationships, while pupil relationships in the peer-group culture are primarily horizontal. What is valid in adult-controlled cultures does not apply in the peer-group culture and vice versa. As a result, opportunities for participation can look completely different in the three cultures as the interaction requires different capabilities. They do not exist in isolation, one at a time; they often occur in parallel, even though one culture tends to dominate in any one situation. One example is classroom situations in which the teaching culture is, as a rule, dominant, even though peer-group relationships exist at the same time in the room. Pupils are often aware of what is required in the different cultures and the attitudes that apply (Söderqvist Dunkers, 2011).

3.8 Social interaction and shared focus

Relationships and coexisting with other people in our surroundings can be regarded as vital to how we feel. But friends do not appear out of nowhere. Friendship is established through contact with others and through public collaborative processes that are often laborious (Ytterhus, 2003). The peer-group culture in schools often involves constantly working on relationships; work characterised by inclusion and exclusion in which relationships are cemented, maintained and broken up (Wrethander Bliding, 2007). In order for interaction to take place, the participants first and foremost need to have a desire to interact and be captured by the same notion. A shared focus point must be found to gain access to the conceptual context in question. Having a shared focus involves sharing and interacting with respect to a certain state of affairs. The need for a shared focus in various activities is described by Janson (2001). One example of a shared focus can be to understand the social and educational content of play, activity or discussion in the same way. This requires the participants to gain access to the information necessary to understand the social and educational content. This also encompasses communicating using common names and terms for common understanding. If there is a lack of a shared focus, it is difficult to undertake play or an activity in a meaningful way.

3.9 Participation for pupils with visual impairment

For pupils with visual impairment in Sweden, the transition from special schools to integrated schooling took place gradually, from the middle of the 20th century to 1986 when the special school Tomteboda was closed (Fellenius, 1999a). Since then pupils with visual impairment have attended compulsory and upper secondary schools in their home town. Overall, studies conducted into social participation for pupils with visual impairment in school paint a somewhat problematic picture of the peer-group situation for this group of pupils. This is shown by older studies (Janson, 1996; Svensson, 1988) as well as more recent ones (SPSM, 2012; Söderqvist Dunkers, 2006, 2011). International studies also leave a somewhat negative impression (Brown, Packer, & Passmore, 2013; McGaha & Farran, 2001; Vik, 2010; Warren, 1984, 1994; Webster & Roe, 1998). Much of the older research in the area of vision referred to in, for example, Warren (1984, 1994) is often based on a perspective on a problem in which the focus is on the individual’s behaviour and abilities. Pupils with visual impairment are often compared with sighted pupils and social participation problems are explained by the visually impaired child’s deficiencies and inabilities. In this explanatory model the individual is burdened with responsibility for the problem and solutions to the problem have also been sought at the individual level as a result. However, the later studies paint a different picture. In contact between sighted and unsighted pupils in schools, access to what is happening in the social space is different and
the conditions differ. Regarding the problem as being related to interaction rather than dependent on the qualities or prerequisites of one party or the other is highly significant to how inclusive environments will be assessed and taken care of (Janson, 1996). Janson’s study (1996), as well as that of Söderqvist Dunkers (2011) and the R&D report Där man söker får man svar [Answers are found where you are looking] (SPSM, 2012) all indicate that it is largely the activity and situation that determines the degree of participation.

These studies demonstrate a lack of information and a lack of access to the social and educational context. So what information is provided by sound in the various situations in schools, and how can pupils use sound to access social and educational contexts. It has been confirmed that pupils with blindness have a great capacity when it comes to auditory memory (Withagen & Kappers, 2013) and echolocation (Kellogg, 1962; Schenkman & Nilsson, 2010). This combination raises a number of interesting questions:

In which situations can pupils with blindness utilise their capacity in school? What can be perceived, what information does sound provide? What is difficult to perceive aurally? What could be used to promote opportunities for participation, both socially and in teaching, through a more accessible auditory environment? What is a usable sound environment for a pupil with blindness?

Both Janson’s and Söderqvist Dunkers’ studies demonstrate the central role played by accessibility in participation. This paper specifically highlights, studies and analyses auditory accessibility for pupils with blindness in the school environment with a strong connection to previous studies into opportunities for participation as this has not been investigated in the past.

4. Method

4.1 Choice of methodology and method

Because there is very little research covering the field of sound and sound environments for people with blindness in schools, the choice came down to grounded theory as the methodology with which to achieve the aim of this study. Grounded theory is based on an inductive approach in which empirical data is used as a basis for the creation of an individual theoretical model (Glaser & Strauss, 1967; Glaser, 1998; Guvå & Hylander, 2003; Hartman, 2001). According to Denscombe (2009), grounded theory is particularly appropriate when not much has been written about the area being studied. This opinion is shared by others (Guvå & Hylander 2003; Hartman, 2001).

Grounded theory was developed in the 1960s by the researchers Barney Glaser and Anselm Strauss, and they describe this methodology for the first time in the book The Discovery of Grounded Theory (1967). The general concept behind grounded theory is to use the collected data as a starting point and allow a theory to emerge with the help of coding at various stages. However, each of the originators, Glaser and Strauss, went on to develop the method in somewhat different directions over time. Glaser’s interpretation is considered to be closest to the original idea of grounded theory (Hartman, 2001). Glaser’s version forms the basis of this study and is also the version of grounded theory described below.
Grounded theory is primarily a method for inductively generating new theories, but provides clear instructions for how this is done in a systemic and structured way (Glaser, 2010; Hartman, 2001). The method was developed in order to be used in sociology, but in recent years it has come to be used in several different fields such as economics, nursing research and educational theory. Glaser and Strauss (1967) described how grounded theory can be used in both quantitative and qualitative research, but the emphasis has been on qualitative. Performing selection, data collection and analysis in parallel is central to grounded theory. It is an interactive process in which data collection and analysis have a reciprocal impact on one another. The researcher has an open, inductive entrance into the investigation, but as hypotheses are created the researcher returns to the data and tests them deductively. Accordingly, it is called an inductive method with deductive elements. This is a glorious third way in between inductive and deductive methods, a mixture of both (Glaser, 1978; Hartman, 2001). By constantly comparing data, through constant comparison, it becomes clear what is important in the collected empirical data and it is on this basis that the theory emerges (Glaser, 2010; Guvå & Hylander, 2003; Hartman, 2001). Validation of the theories created is carried out by testing these iteratively on the empirical data (Glaser, 2010).

A general description of the research process in accordance with Glaser is as follows:

First you perform what’s known as an open coding of the data, creating a large number of categories describing meaningful phenomena for the group of people being investigated. Then you discover the core variable; the category that is central to these people and describes their main concern. The coding then becomes increasingly selective as the researcher focuses on that which can be related to the core variable. What is known as saturation is reached, you enter the third phase, theoretical coding. This is where you find correlations and relationships between the different categories. Throughout the entire analytical process you make your own notes, called memos, which are also analysed and compared later on. You return to the data, collect more data if necessary and formulate hypotheses describing these correlations and processes. A theory has now been generated (Charmaz, 2006; Guvå & Hylander, 2003; Hartman, 2001).

Glaser (1967) differentiates between substantive and formal theories. A substantive theory describes one or more phenomena for a certain domain, normally a group of people. However, a formal theory describes phenomena more generally, not for a specific domain. The theory generated in this study must be regarded as substantive as it describes auditory accessibility and opportunities for participation in the day-to-day schooling of pupils with blindness.

Another central element of grounded theory is theoretical sampling. This sampling method involves taking a conscious, goal-oriented sample from different sources of data successively with the aim of obtaining as much information as possible about a question specified during the research process. Data is collected until nothing new appears. At this point theoretical saturation has arisen and a kind of guarantee of the theory’s validity exists (Guvå & Hylander, 2003, Hartman, 2001). Glaser (1998) contends that it takes about one year to conduct a study using grounded theory, which is not possible within the scope of a master’s degree project. Consequently, this study does not claim to fulfil all the requirements placed in terms, for example, of theoretical saturation; instead it should be regarded as a modified version of grounded theory. Nevertheless, on the whole the method and analytical process are in line with those of grounded theory.

Both observations and interviews have been used as methods of data collection. In order to answer the questions concerning the participation of pupils with blindness, a subjective aspect (what the pupils themselves perceive) as well as an objective, observable aspect of participation have to be studied.
(Janson, 2004, 2005). The observations have consisted of auditory observations made by me, and auditory observations made by the pupils themselves. Visual observations have also been made by sighted companions, but these have been separated from the auditory observations. Their contribution is described in more detail in the sections covering implementation and processing and analysis. Unstructured observations have been chosen, in accordance with grounded theory, as no predetermined categories have been found (Bryman, 2011; Charmaz, 2006). The pupils’ observations have been initiated by my asking them to describe what they hear at a given moment in different situations. Follow-up questions have also been asked during the pupils’ auditory observation of processes.

Qualitative, semi-structured interviews have then been conducted separately in order to capture a deeper, more comprehensive picture of the pupils’ perceptions of soundscapes and sound environments and how they utilise sound as a source of information (Kvale & Brinkmann, 2009).

### 4.2 Target group and selection

For this study I have carried out a goal-oriented selection in accordance with grounded theory. Because the aim of the study is to shed light on different sound environment’s usability for pupils with blindness, the choice has come down to children with blindness/young people, with or without light perception, i.e. category 4 and 5 according to the WHO definition¹ (Swedish National Board of Health and Welfare, 2011), who at the time of the investigation attended compulsory school or upper secondary school. Pupils of different ages and at different stages of their schooling were chosen in order to achieve a large variation with the aim of achieving theoretical saturation (Thornberg & Forslund Frykedal, 2009). The whole group of pupils with blindness in Sweden is small and the SPSM, where I work, is aware of the majority of these. The selection has been carried out based on those who have been in contact with the SPSM in the past decade. The target group consisted of five pupils with blindness aged 8–18 years. The pupils attend compulsory schools and upper secondary schools around the country.

It has been important to select pupils who do not have any visual perception, possibly aside from light perception, as this probably affects auditory perception. Three of the pupils have had a blindness since birth and two have become blind between four and six years of age. This can involve differences in the perception of sound and soundscapes connected to conceptual and spatial perception, which has been taken into account in the analysis and discussion.

### 4.3 Selection of environments and situations

The environments and situations I have chosen both for my observations and those of the pupils are lessons in classrooms, break time in corridors or cloakrooms and lunch in the dining hall. These environments have been observed for each of the pupils. Additional environments observed are after-school recreation centre, schoolyard, library and woodwork workshop. Because of the large quantity of data, the focus of the analysis has been placed on classroom, corridor, dining hall and after-school recreation centre. The environments and situations have been chosen partly in order to capture different types of sound environments that pupils experience during a school day, partly to look at common activities and situations during the school day. Sound environments and activities are bound

¹ [http://www.socialstyrelsen.se/funktionshinder/fn](http://www.socialstyrelsen.se/funktionshinder/fn)
together because the sound environment is largely shaped by the activity taking place and how many people are currently in the environment (Dellve et al., 2013; Lewin & Nyman, 2011; Sahlgrenska Academy at the University of Gothenburg, 2011).

The pupils have as a rule had a special needs teacher or an assistant to support them throughout the school day. A two-teacher system, with shared responsibility, was used in two of the schools.

4.4 Implementation

First, the guardians and the older pupils were contacted by telephone. Then information along with a written invitation was sent out by post to all (App. 2). A separate letter in braille was sent to the children/young people (App. 2). I used these letters to provide information about the aim of the study, how the data would be used, about confidentiality regulations and that participation was voluntary and could be withdrawn at any time (Swedish Research Council, 2007).

The class teachers/mentors and principals at each school were contacted and then informed by e-mail (App. 2) and/or telephone. The pupil who was over 18 gave consent themselves. I travelled to the pupils’ schools in order to collect data and spent an entire school day at each pupil’s school.

Data collection was divided up into three parts, described in more detail under the headings below:

1) Auditory and visual (unstructured) researcher observations during the school day.

I was responsible for the auditory observations and an accompanying, sighted colleague made the visual observations in order to capture both of these perspectives in the observations. Because of administrative circumstances, three different sighted observers have been used when making the observations.

2) Auditory observations by the pupils on a number of shorter occasions throughout the day.

These have taken place by the pupil first having listened for a moment to the environment/situation and immediately thereafter, in the same place, answered questions about what they have observed aurally in that moment and what impression the sound gives them.

3) Qualitative, semi-structures interviews (App. 3).

I have also conducted longer individual interviews (c. 30–60 minutes) with the pupils on separate occasions in order to capture a more detailed, more comprehensive picture of the pupils’ perceptions of soundscapes and sound environments in schools and how they utilise sound as a source of information.

All of the interviews and observations have been recorded using stereo sound recording equipment. All recordings have then been transcribed verbatim. In certain classroom situation I have also made written observation notes as it was not appropriate to take notes using sound recording, as this would have disrupted the class. I began transcribing, coding and analysing the data immediately after the first investigation was completed. The analytical process has then taken place in parallel with data collection. The analyses have governed subsequent data collection to some extent, primarily in terms of the structure of the interviews. The analytical process has also been altered for each investigation. This is described in more detail in the section covering data processing and analysis.
4.4.1 Researcher observations during the school day

I have made observations throughout the majority of the school day. I have made notes in the field about what is happening and taking place in different situations. I have strived to make my observations as objective as possible on the basis of what I hear. I have made these notes using either a braille digital note-taking aid or by recording my voice on sound recording equipment. I have recorded sound environments, activities, conversations and teaching situations on a large number of occasions over the course of the day, for example when the teacher is going over something, or dialogue between teacher and pupils. These recordings have then been transcribed verbatim. In order to capture the soundscape as experienced by the pupil themselves, I have been forced to place myself not too far away from the pupil. However, this was not for the entire day, as presumably the pupil would not be comfortable with this. On the other hand, the sighted, accompanying observer has often been a little bit further away. They have made written observations using pen and paper. In certain situations, I have asked for an on-site audio description from the sighted observer. But I have been careful to keep this separate in my observations in order to preserve the auditory observations as specifically auditory.

In this study the acoustic sound environment is only described on the basis of what could be perceived visually and aurally. What I mean by this is that overall assessments were made on site, but no acoustic measurements or investigations have been undertaken or taken into account.

4.4.2 Auditory observations by pupils

On several short occasions during the school day, the pupil and I have stood up and listened together for a few minutes. I have then asked the pupil questions about what they hear. I have asked the pupil to describe this in as much detail as possible and have asked follow-up questions about the pupil’s perception of the sound environment and how they interpret and can make use of the sound they hear. These short interviews have lasted about five minutes. The observations have been performed by all of the pupils and the places and situations used have been lessons in classrooms, break times in corridors and lunch in dining halls. In some schools, observations by pupils have also been made while they are at after-school recreation centres, break time in schoolyards, lessons in woodwork workshops and PE lessons indoors and outdoors. Because the schedule for the day has differed from pupil to pupil, and because the pupils are different ages and have different types of activities at break time and after school, these places and situations have not been represented for each one of the pupils.

In the dining hall situation, the pupil observations have been made close to the counter where the food is served. The pupil and I have simply taken a couple of steps to the side of the food queue in an attempt to capture the soundscape the pupil is in in this situation. We have also made a short observation at the dining table. In the corridor situation, we have stopped by the pupil’s hanger or locker between two lessons or on the way out during break time. In the classroom, the observations have been made at the pupil’s desk, where we had to conduct our conversation in whispers. Both pupils and teachers have, however, been prepared that this would take place and given their consent. All observations by pupils have been recorded with sound recording equipment and then transcribed verbatim.

4.4.3 Separate interviews

A longer, semi-structured interview, about 30–60 minutes, has been conducted with each pupil following the end of the school day. These have taken place in separate rooms with only the author and the pupil present. The interviews have been recorded and transcribed verbatim. I have prepared an interview guide for these interviews, with various themes to ask questions about. Because data
analysis has taken place in parallel to collection of new data, in accordance with the principles of grounded theory, the interview guide (App. 3) has changed somewhat over the course of the study in order to better achieve the aim of the study. The interview questions have also been changed depending on the age of the interviewee.

4.5 Ethical aspects

There is only a small number of pupils with blindness (without other disabilities) in Sweden and this group is often "subjected" to various investigations and research projects, which could constitute a burden for the participants. I have taken this into account in conversations with their guardians prior to consent being provided. I have assessed that the pupils’ own perceptions and experiences will contribute to providing important knowledge about this area and have therefore judged that there are justifiable grounds for having "taken" their time and attention for this purpose. The participants themselves have also felt it is important and exciting to talk about the subject of sound and sound environments as this is a large part of their everyday lives.

The principles of ethical research in accordance with the Swedish Research Council (2002) have been applied to the extent possible. The four main principles – the information requirement, utility requirement, consent requirement and confidentiality requirement – have been taken into account. Each of the participants has been information about the aim and structure of the study and how the data will be used verbally and in writing. Participation has been voluntary and written consent has been provided by the participants’ guardians. The participants have been informed that the recordings will be erased once the investigation is completed and that the transcripts are edited to ensure anonymity. Because the group of subjects is small, there is an increased risk of identification, which has been taken into account. All names of individuals, places and schools are fictitious and sensitive information and information that could reveal someone’s identity has been left out.

I have been careful in the interviews with the pupils to ask questions in such a way that they would not feel they were being questioned or that they needed to be proficient at listening in school.

4.6 Data processing and analysis

Transcription, coding and analysis of the first investigation began and were performed in parallel with further investigations. When coding and analysing the first set of data, categories have appeared that to some extent governed the subsequent investigations (Hartman, 2001) A clear difference between the pupil’s observations and my own sound observations was made when transcribing the observations. The sighted observer’s notes were read and coded at a late stage in the analytical process in the desire to retain the auditory impression as specifically auditory. The visual observations are only considered in this study when they differ from the auditory on important points.

Pretty much all the recorded material, a total of about 13 hours, has been transcribed. In order to limit the quantity of data, I have chosen not to transcribe certain recorded situations, which I deemed not to contribute anything new to the study. Recordings were transcribed verbatim on a computer. Pauses, sighs, laughter and hums have also been written out in order to capture pupils’ expressions as much as possible. The transcription process led to 280 pages of text. The analysis has resulted in about 150 pages of memo notes and the sighted observer’s notes cover 10 pages.
I have chosen to present many quotes and have transcribed them verbatim in order to allow the pupils’ voices to be heard. According to Article 12 of the UN Convention on the Rights of the Child (1990), all children have a right to express themselves and make their voices heard in all matters that concern them. Furthermore, the child’s opinions have to be given due weight in accordance with their age and maturity. Therefore, I feel that it is of the utmost importance that the pupils are given an opportunity to talk about how they perceive their sound environment in school, as it is a large and important part of their everyday lives. Since 2010, this main principle has also been included in the Swedish Education Act (SFS 2010:800, Chapter 1). The quotes I have chosen have in some respects been modified by the removal of some coughs, hums and repetitions, if I have not judged these to be important for expressing what the pupil is trying to say.

Initially I performed what is known as open coding of the transcribed data (Glaser, 1978; Hartman, 2001; Thornberg & Forslund Frykedal, 2009). A large number of main and subordinate categories have appeared during this process. Initially there we about 30 of these, but subsequent coding has been more selective (ibid.), with several categories being merged and altered. This resulted in the following 12 categories:

- Se – sound environment, background, whole
- Ia – information about the activity, tempo, flow
- Iw – information about who, personal identification, recognition
- Seo – sound environment orientation, spatial perception, direction
- Tv – teacher verbal, verbal communication teaching
- Pv – pupil verbal, verbal communication peer-group culture
- Af – Auditory focus
  - Interaction – opportunity for interaction, access to social and educational context
  - Learning/experience – understanding and identifying voices, activity sounds, objects and reverberation
  - Atmosphere – information about atmosphere, character, meaning
- Ss – sound as a stimulus
- Sd – sound discomfort, fear, stress, sound fatigue

Each of the categories encompasses many different processes and elements; these are described in the results section. Throughout the entire coding process I have made notes, called memos (Guvå & Hylander, 2003; Hartman, 2001; Thornberg & Forslund Frykedal, 2009), in which I have written down thoughts, ideas and analyses. These have then also been coded and compared.

While processing, I have excluded anything that does not deal with sound and sound environments. Much of what has been excluded deals with participation, but not directly with auditory circumstances. But because the study also deals with opportunities for participation, much of this will be included in the discussion.

Having consistently returned to the raw data and made constant comparisons according to the principles of grounded theory during the analytical process, it became clear that the participants’ main concern (Glaser, 2010; Guvå & Hylander, 2003; Hartman, 2001) was gaining access to the social and educational context to make possible interaction and participation. All categories could be grouped
into a common category: Access to the social and educational context. This category is called the core variable in grounded theory.

When the core variable had been found, the next stage was the theoretical coding. By returning to the data and comparing codes, categories and analyses in memos, different correlations and relationships between categories have stood out. Various processes have become clear. This has resulted in additional memos and many smaller models describing these correlations and processes. The data has generated a comprehensive theoretical model describing auditory accessibility for opportunities to participate, which is presented at the beginning of the results chapter. Several smaller models describing how the different categories interact have also emerged. There is an account of these in the various chapters of the results section.

5. Results, Theory and Analysis

The first part of the results section describes the concepts that appear in this study. In turn these concepts build up the theoretical model (Fig. 2), which emerged from the empirical analytical process. The second part of the results section (Chapters 5.2–5.7) contains chapters with more detailed descriptions of the processes and factors, as well as the relationships between these, exemplified with quotes from interviews and excerpts from observations. Each one of these chapters spans several concepts from the theory generated.

5.1 General description of the model

The aim of the model is to describe the diversity of auditory factors and processes affecting the pupils’ opportunities to participate and access social and educational contexts in the school environment. The model can be regarded as a process map with the physical sound sources at the top and the pupils’ opportunities to participate at the bottom. The process chart can be looked at from top to bottom (from environment to individual), even though the correlations between the different factors and processes, individual and sound environment, move in different directions. The upper part of the model consists primarily of the components from which the sound environment is built, while the lower part describes the individual’s processes for aurally identifying what is happening in situations in school. It is possible to compare the upper part of the model with a mixing desk, with sound sources (verbal information and other auditory information) that is taken into the desk via cables. The three factors (supply, activity structure and room acoustics) can be seen as levers on the mixing desk that can be used to alter the three parameters. The resulting mix results in the soundscape that comes out the "speakers", i.e. the sound environment that is offered to pupils in a given situation, from which different things and processes are then to be identified.

If we now look at the lower part of the model (Fig. 2), we can imagine that an individual has their own surrounding soundscape in a given situation as their starting point. This soundscape is subjective, and it is perceived, interpreted and used in different ways by different people for different purposes. In the analysis, various parts of the whole have appeared; these need to be identified in order to gain access to the social and educational context. These identification processes are shown in the large oval. The identification processes are also related to each other and to other cognitive processes such as
experience/learning, inference/elimination method and stimulus/motivation. All the factors and processes listed above are described further in subsequent sections.

5.1.1 Factors that create a sound environment

Gaining access to the social and educational context is a prerequisite for participating in the common activities and for access to social interaction. For people with blindness, this a large part of this accessibility relates to auditory information. The question is what auditory information is provided by the various sound environments of the school; what can be distinguished and used in different situations. The sound environment is built up from a large number of different factors that interact. It is important that these factors can also be influenced.

**Sound sources**
A sound environment consists of different sound sources that provide us with information via our perceptual systems. It is reasonable to differentiate between sound sources consisting of verbal information, comprised of linguistic messages and other auditory information. Verbal information is

*Figure 2 Auditory accessibility for the opportunity to participate.*

![Diagram](image.png)
that which supplies content and message via spoken language. Other auditory information is, quite simply, the sound that comes from other sound sources. This may be sound from an activity that one or more people are involved in, perhaps involving objects that make different sounds when used, someone writing with a pencil or on a computer, someone stacking plates, someone walking up the stairs, etc. There may also be machines that make sounds such as extractor fans or dishwashers. Most often, the sound of an activity consists of both of these sound sources, verbal information and other auditory information, together. Some children are playing tag, and the children’s footsteps as they run around together with their verbal communication, for example someone shouting "tag", can be heard. The combination of this information allows the listener to understand and figure out what is happening based on their experience.

So we have sound sources, but there are also other factors that have a great influence on the sound environment. They can be divided into three categories: supply, activity structure and reflected sound/room acoustics.

**Supply**
Supply involves the number and type of sound sources in, for example, a room or in the environment a person is in a particular situation. If there are thirty children in a room, the sound environment will be very different to that in a room containing only two. If there are also thirty children talking and playing with a large number of different objects, the sound environment is again completely different. The supply thus consists of different types of object or sound source, which is vital to distinguishing and discriminating between sounds in a mass of sound. If there are many sounds of the same type, it is very difficult to discriminate one individual sound, but if there is one of these it is perhaps simply to distinguish it from the mass of sound. One example is that it is easier for pupils in the study to discern the teachers’ voices in the classroom that those of their classmates, partly because there are only one or two adult voices in this environment and situation.

**Activity structure**
The type of activity and how this is structured is also vital to what sort of sound environment is created in the room. A large number of people running around in an unstructured way, for example during a game in the sports hall, create a completely different sound environment to a gathering in a ring on the floor. In the running game, the sound sources are mobile and move around in disorganised directions, while those in the ring have a fixed position. Different activities also produce quantities of sound. For example, compare individual, silent work in the classroom with classroom work in pairs or groups. This is not to say that complete silence is always preferable (further information in Chapter 5.2.1).

The structure and requirements of the activity are completely decisive in terms of the pupil’s requirement for auditory information in the situation. For example, if the activity is independent work in the classroom and the pupil has the teaching materials in braille on paper or on a computer, there is not much need for auditory information. However, the situation in the after-school recreation centre environment is completely different. Here, the pupils are completely dependent on sound information in order to gain access to the social and educational context.

**Reflected sound/room acoustics**
The sound produced by the sound sources bounces off different surfaces and objects in the surrounding environment. The sound is reflected in the space and forms echoes and reverberations. The reflected sound sounds different depending on the material, shape and position of the surfaces. Consequently, this is a factor that is vital to the overall sound environment in a situation. In spaces
with a long reverberation, it is most often difficult to understand speech, for example, as the reverberation partly marks and drowns out subsequent sounds. But reflected sound is also something that people with blindness make a great deal of use for spatial perception and to orientate themselves in an environment (further information in Chapter 5.3).

5.1.2 Processes for gaining access to the social and educational context

What then are the processes that enable a person with blindness to understand and gain access to the social and educational context and what is taking place in different situations in schools? What information do different sounds provide and what does this information mean to different people? The following section will describe various processes, divided on the basis of the categories that have emerged from the empirical data during the analytical process. These are shown in the lower half for Figure 2. In somewhat simple terms, it can be said that the following needs to be known in order to understand the course of events in a situation:

- What are people doing? What is happening? Who is there? Where are they? How is it done and why?
- Feelings, atmospheres. When is it happening and at what tempo? What content is being supplied?

Accordingly, there are a range of identification processes taking place. These are shown in the large blue oval in Figure 2. But various entirely cognitive and emotional processes are also vital to these processes. This involves learning/experience, inference/elimination method and motivation/stimulus (Fig. 2). To identify a sound you have to know what is making the sound and connect it to the sound source and its conceptual world. You have to have heard it before, perhaps many times, in order to understand the full character of the sound. Consequently, you have to have been given the opportunity to learn sounds and voices in different sound environments. Motivation and stimulus are also factors that have been shown to influence the identification processes. One further process that emerged clearly from the study, and which has proven very important for understanding what is happening, is the inference process. Based on that you are hearing and what you know, you can work out what is happening in the situation. The inference/elimination process becomes relatively strong for the unsighted as they often have very little information that is sometimes muddles because of problems with directional focus in the auditory medium – who is talking to whom? This process is related to experience, for example that you know how people usually behave or how activities are usually performed. The structure of the activity has also been shown in this study to be vital to the opportunity to draw conclusions. This is easier for a clearly structured and recurrent activity. The supply is also vital. This study has demonstrated that if there are only a few of a thing that makes a sound, it is easier to draw conclusions. As a result, both the identification and learning processes are closely related to the factors that create different sound environments mentioned previously. For example, activity structure and supply are closely linked to the opportunity to learn to recognise voices and what people sound like.

**Identifying activity and tempo**

When analysing the data, it emerged that there was a clear distinction between sounds that indicate what is being done, but not who is doing it, and sounds that are person-specific. Activity and flow identification deals with sound information that is anonymous. The pupils’ constantly use everything from loud sounds to sounds that are very quiet and detailed to give a combined impression of what is taking place and what people are doing. This is a very important source of information for the pupils. But whether this information reaches its destination and is heard is dependent on the sound environment in the situation. Important details cannot be heard in excessively noisy environments and there is no sound information at all in completely silent environments. The opportunity to identify and
understand what is making sound is also, as noted, related to processes involving learning and experience. Unfamiliar voices or voices that cannot be distinguished because of the sound environment are also contained within this category as it is not possible to identify the owner of an unfamiliar or indistinguishable voice. An interesting result of the study is that it is the great majority of the sound information for pupils with blindness in many school environments is of the non-person-specific type. The reasons for this will be discussed later on, in the detailed results section.

All activities have a tempo, a flow and a form and the pupils use sound to identify, for example, the beginning and end of different activities. However, much of this delimitation of activities is difficult to perceive aurally. It is based on visual information; you see what others are doing and do the same, and this often needs to be reinforced using verbal information. This information gives shape to existence, which is important for feeling secure. If there is a lack of structure and intelligibility, there is a danger of developing anxiety and an excessive need for control.

**Identifying people**
Knowing who is around you, where they are and thus being able to relate to them and instigate contact is a given for many people and a prerequisite for participation. However, this is what the pupils regarded as most difficult in many school environments. For the unsighted it is primarily the voice that makes it possible to recognise different people; although there are other factors and processes, which are described further in the detailed results section.

**Identifying atmosphere/feeling**
Gaining access to the social and educational context also requires knowledge of the feeling or atmosphere of a situation or of what is being communicated. Aurally, this information is primarily provided through verbal communication and tone of voice. But sound from body movements is also a factor. Visual communication such as body language and facial expressions is often something that needs to be verbalised in order for the pupils to gain access to the reactions, feelings and atmosphere of their surroundings.

**Auditory focus**
Focusing aurally is difficult; it is not possible to compare it to focusing visually. Hearing cannot be used to exclude extraneous information in the same way as is possible with sight. The gaze has a direction and demarcated visual field, while auditory perception is all around. Hearing cannot be turned off as sight can by closing your eyes. A classroom environment with some talk and sounds all around is not usually difficult for the pupils with blindness in this study; instead it promotes participation as sound provides important information about who is there and what is happening. But certain learning situations proved difficult, as they required taking in and processing verbal information from several directions at the same time, or involved one sound source taking over and masking another. To a certain extent it is possible to develop strategies to deal with double auditory focus, but these situations can become overwhelming, regardless of age and experience. Motivation and stimulus are also factors that impact on auditory focus. The most decisive element, it appears, is the sound environment with factors such as activity structure, supply and the spatial conditions; factors that can be influenced and controlled to avoid subjecting the pupils to overwhelming double auditory focus.

The unsighted often have their auditory attention constantly turned on, which is not necessarily the case for the sighted people around them. Without sight, the attention is less directional and a great deal is registered aurally, more or less consciously. There is uncertainty among the pupils with blindness
about what sighted people around them are focusing on. The pupils can also get the impression that the sighted are sometimes unaware of the pupils’ auditory focus.

**Identifying the content of information**

Aside from understanding what others are doing, you also need to gain access to that which is being supplied and communicated, i.e. the content of the information itself. For example, it is not sufficient simply to hear that the teacher is writing on the board or that some people are playing games on their mobiles. You also need to find out what is being written or the content of the game in order to access the social and educational context. Observations and interviews in this study have shown that the content of information is often provided visually, leading to the pupils having a lack of information if this is not verbalised or made accessible in a tactile format.

**Identifying the space and direction**

Auditory information contributes to providing an understanding of your surroundings. Information about the shape, size, position and movement of various objects is provided by both direct and reflected sound, helping you to understand where you are, and where other people and things are. Reflected sound is used by the pupils in order to identify spaces, walls, stairs and doorways. But direct sound from footsteps and voices is also important to spatial orientation and directional perception, which is indicated in the interviews and observations.

The forthcoming detailed presentation of the results is not set out on the basis of the categories in the model. The chapter is instead divided up on the basis of various elements or environments in which many processes are taking place at the same time. Links between categories from the model (Fig. 2) are described and made clear using analysis in the text and with the help of mini models illustrated by images and with hyperlinks to descriptions of the images (App. 1).

### 5.2 School sound environments and opportunities for interaction

In this study, the school sound environment has proven to be a decisive factor affecting blind pupils’ opportunities for social interaction. However, there are many other factors involved, but which are not directly related to sound, and therefore not described here.

The study has shown that a usable sound environment for social interaction is one in which it is possible to distinguish, identify and determine the direction of all the sounds that unsighted depend on. This means that the background noise mustn’t be too loud. It must be possible to hear who is who and where they are, what is happening and what is being done, as well as auditory orientation points. There needs to be just the right amount of sound to provide information, but not so much background noise so as to obstruct differentiation. What most frequently create problematic background noise in school environments are large premises with many people talking, combined with long reverberation/poor acoustic conditions. Under these circumstances, all the voices form a dense carpet of sound from which not much can be distinguished. The usability of such sound environments is very low. Some pupils say it is comparable to darkness or fog for a sighted person. Daniel, 18 years old, talks about his dining hall:

Daniel, 18 years old: "It … er … it kind of sounds like a fog, you know. I often say that carpets of sound are like fog to us.”
This study also indicates that good soundproofing of premises is beneficial for pupils with blindness. This is mainly because good acoustics make it easier to distinguish and discriminate between voices and sounds from activity. Long reverberation masks important sounds such as consonants and high frequency sounds. But long reverberation is also tiring for the pupils as they need to concentrate harder to distinguish different sounds. Kim, 15 years old, gets tired because of the long reverberations in her school, which is largely built of stone, with stone floors and bare walls.

Kim, 15 years old: The confounded echo in this school can drive me mad. […] Well, it just really annoys me you know. Everything is so loud. I feel like all sounds are doubled. And because the sound gets so loud, everyone talks even louder. […] So: classroom, completely fine, but out in the corridors I sometimes think that it’s horrible.

Kim also has her own ideas about how the school’s sound environment should be:

I: Is there something you would like to tell adults, something you think the adults should think about, that you consider important.

Kim: Sure, absolutely, what I think is … it’s, you know, sound environments. I don’t understand what the people who built this place were thinking, for example. […] Yeah, I know exactly what I would like the school to be like. I would redo everything so that there was, you know, wood floors, or plastic floors, and these sort of wooden walls.

The study also indicates that in large halls, such as dining halls where many people are talking at the same time, the problem with discriminating between sounds remains, even when the space has been soundproofed. The sound environment’s usability was very low, even in the soundproofed dining halls. The existing soundproofing certainly improved the sound environment, but was not sufficient to prevent everyone’s voices forming a carpet of sound. Jacob, 10 years old, talks about his dining hall:

Jacob, 10 years old: "I don’t know what I can use my sounds, or these sounds for. I mean there is so much noise that it’s pretty hard."

All the pupils in this study think that the classroom is the easiest and most accessible sound environment in school. Corridors are significantly more difficult, while dining halls and after-school recreation centres are the most difficult and least accessible sound environments. (Several pupils also state that sports halls are very difficult, but this environment has not been included in the study.) It is notable here that the environments intended for social interaction, in which you are to integrate and make contacts, are the least usable for these pupils.

Thus we can see that in spaces such as dining halls where the activity is social interaction, play and communication, the supply, i.e. the number of people, is completely decisive in terms of the sound environment’s usability for pupils with blindness. However, the spatial acoustics also play a large role in terms of auditory accessibility.

![Figure 3: Mini Model 1](image-url)
The pupils have difficulty locating people and knowing who is who in school. This is clearly evident from the study. A couple of the pupils say that this is the most difficult of all. There may certainly be other reasons for this, which are not covered by this study, but difficult sound environments resulting from a large number of people, i.e. a large supply, and disorganised activity structures have been shown here to be a major contributory cause.

One important overall result relates to the majority of sounds in school environments being sounds that pupils with blindness cannot identify as belonging to an individual. In this way, environments can become anonymous. This situation differs greatly from that of sighted peers in terms of opportunities for social interaction. Factors that affect this are described in the sections below covering each of the spaces.

The pupils’ autonomy is related to the sound environment. In difficult sound environments the pupils become dependent on assistance. Easy sound environments contain the prerequisites for independence. Difficult sound environment are made easier by well-known and structures activities and support from adults or peers.

An environment that is too quiet can also create problems for pupils with blindness as silence provides no information about the surroundings. This leads to uncertainty about who is there and what is happening.

5.2.1 Classrooms

As has been mentioned, the classroom is the sound environment pupils consider the easiest and most accessible of all the school environments. The classroom observations from this study seldom contain disruptive background noise, and this is not something any of the pupils address as being a particularly big problem. They can usually hear what the teacher and their classmates are saying in teaching situations. They report that they can sometimes be disturbed by, for example, loud shouting, but that this situation is no different from what a sighted person would experience. However, what every one of the pupils brings up with regard to the classroom is how difficult it is when it gets too quiet. Silence is perceived as a vacuum in which there is no information or contact. Sound creates and maintains contact. This replaces visual information such as eye contact and body language and it creates an awareness of there being other people around. Kim usually identifies people and locates teachers aurally in the classroom, but this is difficult if it is too quiet. It is possible that not even the teacher is making any sound:

Kim, 15 years old: But sometimes it’s like you’re completely taken out of play because it’s totally quiet. Because when it’s totally silent in the classroom – if you don’t even know if the teacher is there. That situation! You’re sitting there with your hand in the air. Hello, teacher? And they sit there like, "er, she’s not here“ and I’m like "Righto" (laughs in a way that indicates she finds this embarrassing). Or if they sit there reading a book and don’t look up. And then you don’t hear them, you know. It’s, that’s the kind of stuff I think can be really tough.

Chatter in the classroom is sometimes of great benefit to the pupils in many different ways. Voices not only provide information about people, but also about where they are in the room and about what is happening and the atmosphere. Forms of teaching in which pupils voices are heard, and the pupils are allowed to speak and express themselves were also shown to prompt opportunities to recognise people and interact socially. The pupils in this study who went to schools focusing on quiet, individual study knew less about their classmates than those in schools with more verbal communication.

I: Can you hear who is sitting where?
Jacob, 10 years old: It depends, because er, it’s only if they are talking that you can hear them. […] It’s, you know, it’s not that it has to be quiet so that you can hear, ’cause that’s weird. It has to be quiet so that you can hear. (laughs)

Following analysis of the data it appeared that the structure of the activity combined with how well the pupil knows everyone’s voices governs the degree of person-specific information. If the activity is individual work, the quantity of such information is very low, while work in groups and pairs and verbal forms of teaching provide a significantly greater quantity and are thus less anonymous for pupils with blindness. If the pupil cannot recognise the voices of their peers, the situation becomes anonymous, even if there is verbal information. How well the pupils are able to recognise and distinguish their classmates’ voices depends on several factors (see Chapter 5.6).

Kim says that she usually has a pretty good idea of where people are. Much in Kim’s classroom situations relates to her being given great opportunities for interaction and access to the social and educational context thanks to the way the teaching is structured, the rich verbal environment from both teachers and pupils, a well-known structure and access to braille.

A couple of pupils in the study also say that they find staff members’ frequent corrections to the sound environment, hushing and commands, as tiresome. The “angry” and often relatively loud commands are in themselves a disruptive sound in the soundscape. The teachers should say something, but not “nag” so much, states one pupil. Aside from these sounds being disruptive, several pupils are also worried that the teachers correct the sound environment for their benefit. Quietening their peers for their benefit can be perceived as a form of discrimination. On a couple of occasions it has also become clear that staff members’ correction of other children has led to reduced opportunities for social interaction for the pupil (see the section below on after-school recreation centres).

5.2.2 Corridors

The pupils generally regard corridors, cloakrooms and locker rooms as relatively difficult sound environments with many people talking at once. The acoustics are often worse than in classrooms and the spaces are often larger. In addition, these are places where you are expected to be social and come into contact with others. There is often little access to the social and educational context in corridor situations as the opportunities to identify people and activities are often limited.

Excerpt from a corridor observation at Daniel’s school:

There is a large atrium in the middle of the school with a café on the lower floor and stairs up to galleries where the classrooms are located. The space has a stone floor and stone walls, aside from the café area, which has a plastic carpet. We are standing in one of the galleries outside the classroom. The reverberation is very long and typical of a very large hall with a high ceiling. All the voices form as large, long carpet of sound. But the volume is still manageable close up and we have no problem standing here talking.

Daniel, 18 years old: Well, you know er … it’s a shaggy carpet of sound.

I: Mm. Can you distinguish voices in this carpet of sound?

Daniel: No. Well, not when they are more than a few metres away.

I: What sound is there here that you could make use of then, in different contexts?

Daniel: Well, the first is really people coming and going. So I can avoid banging into them.

[…]

I: If you wanted to make contact with someone then? A friend or someone here. What would you do then?
Daniel: That, on the other hand, is more difficult. Actually it’s nearly always difficult. That’s the worst thing for us. Making contact.

Daniel doesn’t have any specific tricks for finding people in school environments. You have to know people already or have a friend from before he says.

Daniel: No, I don’t actually have any tricks. What I’m saying is that it’s generally really difficult to find your way about, as I said. You have to be a little bit pre ... preacquainted. I don’t know like ... know people in advance you know, from before.

Jacob also perceives his corridor as loud and confusing. He has difficulty distinguishing who and what is involved in the interactions there. But he has a couple of classmates he usually spends break times with, making it much easier for him in difficult sound environments. He cannot find them in the corridor, but he solves this problem by finding them when still in the classroom. Consequently, he is not as disturbed by the sound level in the corridor.

Jacob: But it doesn’t, you know, it doesn’t matter that much because all I do there is put on my clothes. So it doesn’t bother me.

I: What do you do there to work out where someone is then?

Jacob: So before we go. Like just before we leave the classroom, I have almost always found someone to play with. So that, er... I never find anyone there.

The corridor situations vary greatly for the pupils depending on how many people are in the corridor at the time. When there are fewer people, it is usually possible for them to identify a great deal of what is happening and who is there.

5.2.3 Dining halls

The dining hall environments are one of the least accessible sound environments of the ones studied. The pupils’ experiences of this soundscape are remarkably similar and the usability is low for every one of them. Familiar voices can only be distinguished within 1–2 metres. Otherwise they hear dishwashers, the clatter of cutlery, glass and a carpet sound made up of voices.

From the dining hall observations with Molly, 8 years old:

It is very loud. A large room with a high ceiling and many children in it. A hard and clattering sound in the room. A lot of clattering of cutlery and plates. But the dominant sound is absolutely a loud carpet of sound made up of children’s voices. It sounds like several hundred (c. 200 according to a sighted observer). I ask Molly to describe what she hears:

Molly, 8 years old: Children clattering cutlery ... And children talking.

(Molly hears and names two familiar voices that are just next to her.)

I: Is it possible to hear anything else in here?

Molly: Nah.

I: Can you hear where you get food from?

Molly: No.

The pupils’ dining hall environments are relatively anonymous to them. It is mainly non-person-specific sound that can be distinguished. Personal sounds can only be discriminated close up. This distance is related to whether or not you can find people on your own. Every one of the pupils says that they couldn’t find peers on their own in the dining hall. Fixed locations and structure make things easier in difficult sound environments. The younger pupils have fixed places in the dining hall and they know exactly who sits at their table. This makes the supply smaller, making it easier to identify people. Both of the youngest pupils initiate contact with their peers at their table. Consequently,
assigned seating gives them the opportunity to interact and talk with peers despite the difficult sound environment. However, the older pupils do not have fixed places, which is thought to increase the risk of becoming isolated and being reduced to interacting with adults if they do not have a friend to sit with. Two of the three older pupils sit and eat with their special needs teacher. The third older pupil has a friend to sit with.

The food situation in every one of the pupils’ schools is such that it is not possible to be independent. However, this is not just because of the sound environment, but is also due to it being difficult for them to serve themselves food. A well-ordered structure also helps here. Kim thinks that their system works well. She goes to the dining hall with her friend and sits down to eat with friends, but her special needs teacher helps her to get food.

### 5.2.4 After-school recreations centres

The two pupils, Molly (8 years old) and Jacob (10 years old), who go to after-school recreation centres at the end of the school day find this tough due to the difficult sound environment. Hilda, 12 years old, says the same about her previous visits to after-school centres. What is most difficult for the pupils there is that they cannot hear where people are and what they are doing. The sound environment, combined with disorganised and inaccessible activities makes it difficult for them to initiate and participate in social interaction.

Jacob, 10 years old: Like, the hardest part is that I loose people. I mean, it feels like I can’t find anyone. And … mm, yeah. You can’t, like, talk with each other because it’s so noisy. […] I don’t know. I usually ask one of the staff. But another thing is that, it’s that I don’t know what people are doing.

Jacob says that in quieter sound environments he can hear where his friend is, but that is not the case at the after-school centre.

Jacob: If it wasn’t, you know, I’d hear when he left. It’s like, I maybe hear if he’s talking and then says that, he maybe says to someone else that he’s leaving. I don’t hear that over there.

It is important here to add that the activities offered at Jacob’s after-school recreation centre are not accessible to him. A combination of a lack of accessible activities and inaccessible sound environments in this case create passivity and a low level of participation. This inaccessible sound environment also creates a low level of participation for Molly.

From observations at the after-school recreation centre with Molly:

There is a large number of children, c. 45 in a room with a stone floor and really difficult acoustics. The children are playing in various parts of the room. A loud carpet of sound made up of voices from which only voices that stand out can be distinguished. In this sound environment it is impossible for me as an observer to locate Molly. No important sounds get through. My sighted observer helps me to find her. Molly sits alone on the floor and plays with tactile materials. I sit next to her. We have to talk loudly in order to hear one another. I ask her what she hears.

Molly: Children talking.

I: And what else do you hear?

Molly: What else do I hear?

I: Can you hear anything else?

Molly: No. Nothing else.

The sound level suddenly drops a little. I hear a group of children a little bit further away in the room who are jumping around and letting out happy cries. I guess that this is the group (Molly’s
classmates) who are playing charades, which M and I were told about by the centre’s staff when we arrived. M was invited by the staff to join in, but she chose to play with the things instead.

I: Do you hear what they’re doing?
M: Playing and stuff.
I: Can you hear what game they are playing?
M: No, not really.
I: Do you recognise any voices here?
M: No. It’s a bit tricky when there are so many.

Molly hears nothing more than a carpet of sound. She points out several times during the interview that she finds the sound at the after-school recreation centre tough. The auditory usability is very limited, except if someone were to make contact with her and be very close. She says that she does not know how she would find people and make contact in the after-school centre environment. In this situation, Molly is socially passive, plays with tactile material by herself. She does not participate in the others’ activities or interaction. In many other activities she is social and instigates contact. She knows everyone in the class’ voice and she perceives a great deal in the classroom and in the corridor when it is less busy. The after-school centre is the most difficult school sound environment for Molly. At the same time, it is at the after-school centre that you are supposed to play, socialise, make contacts and interact with peers. Neither Jacob nor Molly has any functional strategy for finding friends in this environment. "You can’t stand up and shout here at the after-school centre", says Molly. In some respects, you can see that the staff have attempted to make the after-school situation accessible for Molly. They provide verbal information about what she can do, about what is going to happen, for example, when it is snack time. There is also an organised game, charades. But the situation is still inaccessible for Molly because of the sound environment. The reason why she says no to charades is unknown in this example and can only be speculated on. However, what can be established is that, in order to play charades in this sound environment, the communication in the game is based on visual communication such as body language and facial expressions.

A couple of the children feel that it would not be practical for the staff to quieten down the other children in order to improve the sound environment. In certain cases this can have the opposite effect in terms of opportunities for social interaction. This is precisely what happened during the observations at Jacob’s school. When he arrived at the after-school recreation centre there were a number of children being noisy and playing in the room. The staff told them in a biting tone to be quiet "because Jacob’s arrived". The children immediately went off to another room and Jacob was left alone. The ambition of the staff to provide a sound environment that was better for J instead resulted in eliminating his opportunities for interaction.

5.3 Spatial perception and social and educational context

In order to understand and gain access to the social and educational context of a situation, you also need to have information about the spatial conditions. Each of the pupils in the study uses auditory information in order to orient themselves in their physical environment, both for navigating and getting around, but also for getting a general perception of where they are, where other people are and how the environment is structured.
5.3.1 Auditory spatial perception

All pupils were thought to use auditory spatial perception; walls, doors, stairs, the size of the room and its characteristic acoustics. They make use of echoes from sounds made by themselves and others. The direction of footsteps and voices can also help.

Conversation with Hilda, 12 years old:

I: Can you hear in which direction the stairs are?
Hilda: Mm, that way.
I: That way. How can you tell?
Hilda: You know, there are children running.

Sounds made by themselves and others are reflected by walls and other surfaces, which the pupils use when they orient themselves in the school premises and for recognising where they are. Kim talks about when a new wall had been put up in the locker room and how the altered soundscape was completely disconcerting.

Kim, 15 years old: I remember the first time I went down here and wasn’t used to it, so the sound was completely different. Because there’s a wall here. There isn’t otherwise. So I thought I was in the wrong place.

Daniel also describes how useful he thinks that sound reflection is and how he also hears differences in level.

Daniel, 18 years old: So when you walk straight forward and then come to a stairway, you hear a difference in level, right? You’ll hear that next time. Yes. And then you know: OK, now I’d better turn and go up the stairs. So it’s really useful.

I: So you use the sound of the walls and stairs to orient yourself then?
Daniel: Oh my goodness, yes! Yes, absolutely.

The room acoustics are usually perceived as similar from classroom to classroom, but completely different in corridors and other spaces. However, human voices are used to differentiate classrooms from each other aurally. You know and recognise those who are usually in a particular classroom. Thus we see that a combination of reflected sound, room acoustics, human voices and walking direction provides a big help in orientation, moving around and spatial perception for pupils with blindness, contributing to their understanding of the social and educational context.

5.3.2 Awareness, learning and strategies

The older pupils seem to be more aware of using reflected sound, and they find it easier to put the phenomenon into words. On the other hand, the youngest pupil was not at all aware that she used echoes, despite the observations indicating that she does. In several of the observations of the younger pupils, it became clear that they, for example, located doorways with the help of echoes, despite saying themselves that they follow tactile objects such as a shelf or a radiator, which they did not actually have any physical contact with on that occasion. Accordingly, this awareness is related to experience and age, but its utilisation is also thought to increase with age, probably in line with the pupil finding their bearings more independently.
Kim describes how it has taken time for her to understand she is actually using sounds in various situations.

Kim: Well, you know. You make sounds all the time. And it’s the same when I’m riding and whatnot, I know that the wall is close because I can hear it, you know. But it took quite a long time before I understood that this had to do with sound.

This perception often happens unconsciously; "You just hear it" according to several of the pupils. A couple of the pupils are using echolocation more consciously as a strategy in certain places by snapping their fingers, clicking their mouth and using the sound of their cane or footsteps. For example, Daniel hears how his cane and footsteps bounce off furniture, particularly solid furniture. He says that tables with steel legs are more difficult.

Daniel: When you step and it makes a sound, well it sort of bounces. Then it depends on whether it’s, if it’s a cupboard, then, or a low table with quite dense shapes, then that’s better than a steel table, you know, with steel legs, ’cause then it would just vanish.

When it is quiet, Jacob can locate a post in his corridor with the help of smacking sounds he makes with his mouth.

Jacob, 10 years old: "I hear a post. I mean, I kind of hear the sound when I, I usually smack my lips twice, then I hear it."

You can also consciously use your own voice for echolocation when talking. The voice has a good resonance, says one pupil. Another strategy is to take advantage of sounds that other people make in the environment, for example letting someone walk ahead of you or carry out a task first. However, several pupils point out that the auditory aspect is only one part of orientation and much of it relates to having learned the route and knowing what to do. Smells and temperature differences are also mentioned. It has been shown that in certain places, having practised and walked a route with tactile route markings and orientation points, the pupils gradually abandon the tactile aspect and rely heavily on the sound. This happens more or less consciously and it can take time to become so familiar and secure with the soundscape in the location that you can rely on important auditory details. Daniel has consciously reflected on this process.

Daniel: You know that when I first arrived, like when I started here, so a few metres in front of the stairs, to the left, there are these doors that lead outside. And there are rugs and whatnot. So in the past, you know, about two weeks into the term, last term, I went up to them and then I walked. You have, I don’t know if you do it, but I am vain. And it means that I want to walk with style, for some damn reason. I don’t like to stumble about. And not take these long detours and, yeah, I think it has to look natural. And I think that’s why it was quite embarrassing; I walked up to that rug and then turned.

I: So now you’ve learned to walk guided by the sound, or what?

D: Exactly. And then you can avoid this damn problem. And then the vanity, er, what’s the word … in any case, your self-esteem is intact.
The pupils often feel that abandoning tactile route markings and orienting more using auditory signals is quicker and smoother as you, for example, avoid having to walk along the walls in a corridor where there may be furniture and people. During this kind of orientation, it is common to snap, stamp your feet, use the sound of the cane or talk in order to elicit the desired sound response. Kim, who is now aware that she can hear the walls, reflects on how this phenomenon can appear incomprehensible to others. "If you say to the sighted that you can hear the walls, they don’t understand", she says.

5.3.3 Sound environment and auditory orientation

It appears from the observations that each of the environments has certain principal auditory orientation points. For classrooms, aside from the voices of teacher and pupils and the direction of voices, these are the classroom door, sound outside the window and sound from a group room, if there is one. In the corridor, they consist of pupils’ footsteps and walking direction, exterior doors and echoes from footsteps and voices in the stairs. In dining halls, they are dishwashers/the sound of running taps in the kitchen and the sound of glasses and cutlery being gathered on trays. It becomes clear that the possibility to use orientation points is relative to the factors that make up the sound environment, with supply being the most influential factor. In inaccessible sound environments with a lot of background noise, it is difficult for the pupils to use auditory orientation points and reflected sound. This applies most of all in dining halls and corridors, when they are loud and full of people. Jacob talks about his corridor:

Jacob, 10 years old: "And then there’s maybe so much other sound on top that you can’t hear because there’s so much sound. I mean, there’s lots of people talking and stuff."

All of the pupils have difficulty finding things in the dining hall and the sound environment is said to be the primary cause. It is not possible to "go by the sound" there, say several pupils. The only auditory orientation point heard in the dining hall, common to all the pupils in the study, is the dishwasher, which is also where dirty dishes are left. The four older pupils can find this place by themselves. However, none of the pupils can hear where, in relation to their place at the table, you get food or drinks, i.e. they cannot use auditory orientation to collect food or drinks because of the high level of sound. Only the loud, high-frequency sound of the dishwasher gets through.

I: Can you hear where you get the food from?

Jacob: No, I guess not.

I: Can you hear where you get drinks from?

Jacob: No.

Can you hear where anything is at all?

Jacob: Er, yes, where you leave your tray. I can hear that. There’s a little counter there and the dishwasher is behind it. And that’s why you can hear it […] I mean, there is so much sound that it’s pretty hard. […] yeah, when you, when you have to find things in here. It is pretty difficult. You can’t, here you can’t find things using sound. Here you just have to learn the way.

Even though certain routes can be rehearsed tactilely, all pupils are dependent on help to get food, find their place, find friends and get second helpings. Kim has a rough idea where she has to go in the dining hall, but a combination of unassigned seating and a difficult sound environment means that she needs help to find where her friends are sitting.

Kim, 15 years old: It would be difficult because there are so many people, so you couldn’t really listen to find your table. But there’s a lot of other stuff too you know. Like getting your own food and getting in the queue and things like that; there’s no way.
Several of the pupils have ideas about what they would like the sound environment in the dining hall to be. A quieter environment is something they would all like. Some propose a little music at a low volume where you take food as an orientation point and stimulus, as well as for being good for the atmosphere. One pupil proposes creating smaller spaces within the room using curtains to screen off area.

5.4 Verbalisation

The study confirms that verbal communication is a basis of social interaction and often the most important factor in allowing the unsighted to gain access to the social and educational context, and an opportunity to participate. What happens around you us largely interpreted on the basis of voices and verbal communication. Communication between people often contains many visual elements such as body language, facial expressions, etc. This is where verbal information plays a very important role. Blind pupils’ chances of participating improve greatly if the visual aspects of communication are verbalised as much as possible.

Verbal information permeates the entire process surrounding auditory accessibility to enable participation (Fig. 2). It is decisive in terms of identifying people, activity and tempo, space and direction, understanding the atmosphere, feeling and character and, not least, for gaining access to the content of the information, i.e. the information provided, for example, in a lesson.

5.4.1 Verbalisation and access to the content of information in lessons

The study has revealed many situations in the classroom that are problematic for the pupils due to a lack of information. It has also become clear how verbal information can promote participation and access to the social and educational content in various ways.

A relatively common classroom situation that leads to a lack of information for a pupil with blindness is when the teacher conveys some information by writing on the board and the pupil does not have the same information in a tactile form. The verbal information provided in these situations is often insufficient. It may, for example, involve the teacher forgetting to provide verbal descriptions, or giving a fragmented description, so that the complete picture does not become comprehensible. Something that often also happens in such situations is that the pupil is excluded from the collective interaction of the class relating to what is on the board, for example when the rest of the class laugh, comment and react. This also becomes an emotional exclusion.

In the following example, the teacher prepares the class for a group exercise that the pupils will be undertaking. She draws on the board and asks if the pupils can see what it is.

From the observations. Molly, 8 years old:

Teacher: What is this? (She draws on the board) F, do you see it?
F: It’s a sandwich.
Teacher: It’s a sandwich. What is it Y?
Y: Er, it’s a square.
Teacher: So we’ve had a couple of different offers there. F said a sandwich and Y said a square. And what does A say?
A: Ladder. Tiny little ladder.
Teacher: aah! And you know what? In actual fact, it is one of these things: Dododoo! (She draws something and sings a little tune. The class begin to talk and comment, but what they are saying can’t be heard.)

The result is that everyone in the class, except Molly, can take in the information and actively participate. They are all focusing on a common idea, some informative content, and they interact with respect to this, but Molly is not involved and is not focusing on the same thing. The teacher’s intention is to get the pupils to understand something by looking at what she draws. What happens with Molly is that she becomes passive, not answering any questions. After this, Molly says in the interview that she thought the situation was difficult because she can’t see. In this situation it appears that a low level of verbal information makes it difficult to identify the content of the information and then the social and educational content becomes inaccessible, influencing the opportunity to participate.

Figure 5

Consequently, it is very important for the pupils’ participation that teachers describe and explain what they are doing. This appears in every one of the study’s investigations. Jacob describes how much better he thinks this works in his current school than in his old one.

Jacob, 10 years old: You see, they tell you exactly what you have to do, and they explain it in a good way so that you understand. And, like, not just write on the blackboard the whole time, you know, like some do. […] It was like that before, in my old class. They just wrote on the blackboard and would show everything. And I just had to wait for someone to explain to me what was going on.

I: So did someone have to sit next to you and interpret what they could see?

Jacob: Mm. You know, my special needs teacher. Now I don’t need that.

The quote above makes it clear that the verbal information provided by teachers creates accessibility, which also increases the pupils’ degree of autonomy. Jacob is no longer dependent on having a special needs teacher sit beside him and interpret what they see.

Something that also becomes clear in several observations is that auditory information cannot be equated with visual or tactile information when it comes to gaining access to the content of the information. These media have different properties. Verbal information is transient, while text, whether visual or tactile, is more durable. Text on a board, screen or paper remains there, so to speak, for the pupils, but vanishes immediately if read aloud, if you only receive the auditory information (if you’re not able to take notes). Several pupils state that they have a good memory, but the conditions are still not equal. The teaching situations in the study where the pupils have the highest level of participation are the ones where the activity is structured in such a way that everyone is in the same situation – verbal teaching for all, and braille for the pupil when the others are presented with text.

The following example specifically demonstrated that the media are not equivalent. The teacher says what is written on the board, but this happens to quickly and the situation becomes unequal. The verbal information here is no substitute for text.
Excerpt from an observation, Hilda, 12 years old:

Teacher: Listen up! Now, er, there is a little text here on, on the interactive whiteboard. And … I have to make it a bit smaller, so that everything can be seen at once. Er, first we have some terms. The thing is that within each subject, there are certain words and certain names that are really, really important to know and understand, in order to have any sort of understanding of it, the subject or the period or whatever you are working on. That's the case in science and social studies etc. And these are some of the terms that I, that you need to know to get through the period of the Swedish Empire. And it says:

(The teacher reads out ten terms in quick succession and Hilda isn’t able to note them down. Hilda doesn’t have them in front of her on her computer or on paper in braille.)

Teacher: Then I’ve also written down some questions. Er, (the teacher reads out seven questions, also in quick succession). And I would like you to discuss these terms in pairs.

(The teacher talks more about national tests and how important knowledge and repetition is. Some pupils ask questions. Hilda still doesn’t say anything. After a while I ask her:)

I: Did you get these words on your computer? The words she wrote on the board?

Hilda: No.

I: OK. Were you able to write them down?

Hilda: No.

As I said, the auditory medium is transient. If what is provided is to stick, it has to be remembered, stored in the mind. This is impossible for Hilda in this situation as there are ten terms and seven questions delivered in quick succession. The other pupils sit and read the terms and questions on the interactive whiteboard while the teacher is talking. They can read them over and over again, compare them, connect them and get an overview. In addition, they are confident that the information will remain on the board while they are working in pairs. Hilda does not get anything like the same exposure to the important terms and questions as the other pupils. When working in a pair, Hilda is then dependent on her classmate reading the words to her. Here too she is at a disadvantage. She has not had time to think about them in advance. Nor does she have any form of overview. If she had been given the terms in braille or on the braille screen in front of her, the conditions would have been more equal. In this situation the auditory medium is not sufficient, despite the teacher being verbal.

Furthermore, it is easy to imagine that Hilda would expend a lot of effort trying to remember everything. The classmate also becomes the one who propels the conversation forward, perhaps because it is she who has the terms and reads them to Hilda.

On one occasion, the teacher shows a map of Sweden during its period as a great power. She describes the map, but the information is fragmented and on several occasions she says "here" and "there" and "up to here". The auditory information is not sufficient to create a comprehensive internal picture of the map. Compared to those who see, Hilda receives an appreciably more limited amount of information.

In several observations, however, it becomes clear that when the teacher provides verbal information to everyone this problem does not arise as the lesson is structured in a verbal way and there is no visual information. The teacher then changes how they express themselves and the information becomes less fragmented.

Consequently, different forms of teaching affect the verbal communication in the classroom and the pupils’ access to the social and educational context and opportunities to follow the lesson in on more equal terms.
On several occasions in both Kim’s and Jacob’s classes, the teaching methods used have been largely based on providing verbal information to everyone. One example is from one of Kim’s English lessons. The class is taking part in a verb relay involving irregular verbs. Everyone receives pieces of paper with a few inflected verbs and Kim receives these in braille. The class has done this before and Kim knows exactly how it works. The relay is then based on verbally tagging the next person. They record the time and try to beat the results of another class. The class has fun doing this together. The relay is an activity in which Kim has the opportunity to participate on the same terms as the others. She has her cards in braille and she has time to read them. Nothing is written on the board. All are dependent on everyone speaking clearly and there not being any disruptive background noise.

Accordingly, we see that the structure of this activity is directly related to the opportunity to identify the content of the information and thus the opportunity to participate (see Figure 2).

The activity is thus completely decisive in terms of the pupil’s requirement for auditory information. Everyone works independently during many of Jacob’s lessons. Jacob has written materials on paper and on the computer. On these occasions, there is no greater requirement for verbal information from the teacher. His degree of participation is high in these situations. Well-functioning forms of teaching based on verbal communication, for example traditional question and answer teaching, are also used on several occasions in Jacob’s class. On these occasions, the teachers are careful to verbalise as much as possible, making it easy to keep up. For example, they consistently say the name of the person who gets to speak.

In addition to talking about the importance of the teacher verbalising in lessons, the pupils also say that it is easier when the teachers tells them when they are coming and going, and when they say the name of the person they have allowed to speak.

5.4.2 Form, framework and structure of lessons and activities

Verbal communication has an important role for the pupils in terms of gaining access to what is happening in the room and what everyone is doing – now everyone has sat down, now they are starting to pack up, now everyone picks up their fruit, now they have put down their hands, etc. This information is often only visual. Sighted people see what others are doing and “follow along”. When staff verbalise such events, it becomes much easier for pupils to keep up with and be part of the group. The pupils also avoid having to expend energy on attempting to listen to and guess what is happening, and worrying about “doing things wrong”. Verbal information can help to give existence structure and form, providing the pupils with the opportunity to plan and prepare for activities. For example, when the teacher says "there are now five minutes left", the pupil is able to finish their work, save documents, and shut down and put away their computer, making it easier for them to get out for a break at the same time as the others. In several observations, the teachers also go over in the morning what is going to happen during the day, who is there and who is ill, which creates form and security for the pupils and makes it easier for them to access the social and educational context. Being made aware that others sometimes take breaks can also be important. One example is from Hilda’s woodwork lesson when Hilda’s hand gets tired from chiselling. The sighted observer notes that the rest of the class take short breaks, yet this is not evident aurally.

Thus we see a relationship between verbal information, identification of activity and tempo and access to the social and educational context.
Experience also has an impact on the need for verbal information. A familiar structure, an activity that recurs and which the pupil knows, reduces the need for verbal instructions to some extent. One example is the verb relay described above. There are not many verbal instructions prior to the start, but Kim knows exactly how it works and she finds it easy to participate. Accordingly, we can add the two factors activity structure and experience (see Figure 2) to the above model.

During an observation of a PE lesson with Daniel, several positive factors that benefited his participation were present in the verbal information from the teacher. This activity, physical group training outdoors, required a high level of verbal expression to become accessible to the pupil as it involved understanding and copying various movements. Some positive factors were that the teacher was very verbal and clear, she described the activities and movements in a well-thought-out way for the entire group, provided extra instructions to those who needed them when needed. The teacher also verbalised the form and tempo of the activity. She counted in and counted down, gave information about the time in seconds. The teacher also provided verbal confirmation to the group; "Come on! Wow, you’re really good!" Her voice sounded dedicated and encouraging. The pupil could participate without support from the assistant and he was part of a group. He also said himself that he felt the teacher’s verbal expression worked really well. The relationship between the teacher’s verbal information during the activity and several of the categories in the identification processes become visible here.

5.4.3 Knowing something about others

It is important to get to know the group and the people around you, to be given the opportunity to understand your social surroundings and relate to it in order to gain access to the social and educational context. Atmospheres, feelings and expressions can be interpreted based on voices and intonation and what is said. But much of what is communicated between people happens only visually. Teachers can help in various ways to verbalise things that are otherwise only seen, such as body language, reactions, facial expressions, clothes, the atmosphere in groups, etc. During a couple of observations in the study, the teacher uses a morning meeting with the class to incite the pupils to tell the rest something about themselves, how they are today, about something they did at the weekend, etc. This provides the pupils with important information about their peers that can then be used in subsequent interaction. It is also important that the teacher says the name of the person who is talking so that the content can be tied to the right person. Teacher providing an audio description of what they can see for everyone is also good, and the pupils prefer this solution to having someone sit next to them and interpret to them in a whisper. Nevertheless, there are certain things they would like to have interpreted, which are not suited to being interpreted openly for everyone. This may be personal things about classmates, things that are visible to all, but which you do not really talk about openly. Kim describes how she has a special needs teacher who interprets things about classmates for her, which she appreciated knowing.
Kim, 15 years old: P and I talk quite a lot and she describes things that are happening and whatnot. In a way that not all adults do maybe. I appreciate this a lot. It’s like: "Now the boys are doing this" and yeah, and "That girl, who is in my class or whatever, has put on way too much makeup". Yeah, it’s a bit like that. And I actually think that’s fair. Everyone can see this, so why shouldn’t I know about it. [...] That she interprets things she sees that don’t relate to lessons. Like, to me, that’s invaluable.

A relatively common phenomenon in a classroom where insufficient information for pupils with blindness is concerned is that the teacher scans the group with the help of a show of hands or, as in the example below, that the pupils have to indicate with their thumbs. This can involve anything from how many have completed a task, how they feel about a certain subject and how things have been during break time, to who is part of which group or forthcoming activity. The point is to scan the group and that everyone, both teacher and pupils, see how the others respond. This is valuable information when it comes to understanding who you are in relation to the group – information that the pupil with blindness misses out on if the result is not verbalised. One example of this situation is described below in the chapter on auditory focus.

Accordingly, verbal communication is important to comprehend both your physical and social environment and the social and educational context. But this is not simply about comprehension. Voices and speech are also an important stimulus. This is something the pupils often come back to. Human beings have a great need for daily stimulation, and auditory stimulation accounts for a large part of this for those who cannot see. The pupils often talk about the character of voices and expressions, and this variation seems to be an infinite source of stimulation. One pupil states that it is easier to follow and remember what a teacher is saying if their voice sounds dedicated. The pupil says that a more indifferent voice has "no edges to grab hold of". Another pupil talks passionately about a classmate’s soft and beautiful voice that makes their entire body shiver.

5.4.4 Auditory acknowledgement

People those around them to acknowledge their actions. Much of this confirmation is visual, for example facial expressions, glances and smiles. Those who cannot see need such acknowledgement to be verbalised or described using some other form of auditory information. Saying or doing something in front of people who are completely silent is felt to be very uncomfortable – like a vacuum or like doing something in front of a wall. Daniel describes this vividly. He talks about when he had to make a presentation to the class.

Daniel, 18 years old: So, you know, to react it is good if you can hear it. As that way you capture the atmosphere. For example, when I give a presentation. Then I want people to react. And it’s the sound I hear and listen for. [...] And that makes it very difficult sometimes, to give a presentation without feeling totally outclassed, you know. [...] Yeah, because people have a tendency to [...] Of course they’ve been taught to listen. And sit quietly and watch, and smile and, and that sort of shit.

I: And then you don’t get any confirmation?

D: Exactly. Dammit, I really hate that! Totally. Sometimes it’s like standing and talking to a wall. And you understand how difficult that is. [...] Presumably they are listening, really well probably. And they’re following it and they’re interested. But you don’t get any confirmation of that. So you can stand there and: But damn! What do I have to say to get a reaction, you know? And then you begin to crack these jokes. Yeah. And they’re so bloody polite. So they giggle a little bit. And don’t laugh out loud. And then you feel like; Dammit! That’s it! That joke died. So [...] I mean sure, they are smiling. People do smile.

Verbal information thus plays an important role here, not just for receiving confirmation from those around you, but also for gaining any sort of access to people’s reactions to who you are and what you are doing. We can see a relationship between verbal information and identifying
atmosphere/emotion/character to gain access to the social and educational context and the opportunity to participate.

In the example above, experience and age possible play a role. Daniel knows that people sit quietly because they have been brought up to do so, and he knows that they are smiling and nodding. A younger child is perhaps unaware of this. But Daniel still finds the situation uncomfortable.

Verbal acknowledgment from teachers is important to the pupils. You become uncertain if there is no verbal reaction. In one of Kim’s French lessons the pupils are working in pairs with a dialogue that they will present to the teacher at the end of the lesson. The teacher is clear and verbalises what she is doing. In addition to providing verbal confirmation about the presentation, she also states clearly when she is coming and going, when she is just passing by to "eavesdrop" a little and when she comes to listen to the presentation. The classmate provides verbal confirmation to Kim that their presentation went well. The classmate also makes a sound to reinforce how nervous she was. This becomes very expressive and replaces facial expressions in their communication.

C (Classmate): That went really well Kim!
Kim, 15 years old: It totally did! Score!
C: I was super nervous. I just ugh! (makes a sound of breathlessness)

5.4.5 Verbal communication between peers

Verbal communication is a basis and a very important factor in blind pupils’ relationships with their peers. This partly relates to activity. Talking is a valued activity and it constitutes a significant aspect of relationships between peers. But it also relates to the fact that voices, laughter and other expressions account for a large proportion of the pupils’ daily stimulation. It is also through the voice that you interpret others and identify who is who. Another important function of verbal communication relates to contact, and knowing where peers are, how to find them and whether they are still near or if they have left.

All of the pupils in the study say that "talking" is an activity they like to do with friends. Kim and her classmate enjoy talking to one another and Kim appreciates her classmate’s verbal and lively expressiveness.

Kim, 15 years old: We eat quickly, but we talk for ages. (laughter)
C: We don’t talk while we are eating. But then we talk (more laughter)
Kim: We don’t talk before either, because then we’re hungry. (even more laughter)

They communicate really well. Her friend talks about what she normally does to let Kim know where she is.
C: But I usually try to come up with something to do too, like, when I’m coming. So that you’ll know when I’m coming. I maybe hum a little tune (both laugh)

Kim: Yes. Yeah, you do normally do that.

C: It’s just that it feels a little silly to go: Hello, now I’m here. Now I’m standing here.

Kim: Or you just start talking like a chatterbox.

Something Kim thinks her classmates should think about is to say something when they are coming and going.

Kim: Most of it is this thing with presence. Are you here? Are you not here? The most awkward thing ever – and I’m sure you’ve also experienced this – is when you’re talking with someone and the others come along and go: Er, she went to get milk. You know, that feeling … It’s not the greatest.

About it being difficult when her classmates do not say anything:

Kim: So, no, it’s not good. It’s also like: I have friends who are really quiet and I never know if they are there or not. […] It’s really difficult. That’s what’s so good about C. She talks all the time. […] we have a friend, the girl who was with us in English class. She doesn’t say much. And sometimes she’s with us and sometimes she isn’t. And because she doesn’t talk it’s a bit strange if we, you know … No I’ll say that too, I’ve asked C several times: "How often is she actually with us? Is she shadowing us the whole time or is she actually not here?"

I: Does it feel OK to ask: Are you here?

Kim: No (hesitant), what I’m saying is I think it feels a little silly.

Another pupil says that he would like to mix more with the quieter pupils, but that he cannot find them because it is only the pupils with the loudest voices who penetrate the carpet of sound in the corridor and dining hall. Here we can see how the sound environment plays a large role.

One further result that shows the value of verbal communication in relationships with peers is what Molly says she thinks her peers should think about.

Molly, 8 years old: And children should think about being clear and explaining. Because S (classmate) is the only one who is clear and explains and that’s why I can be her friend. But it is just her and me, and it’s like we’re invisible. But it’s because I can’t be with anyone else because she’s the only one who explains things.

This quote also suggests that there may be difficulties in choosing friends and that the choice is reduced simply to those few with whom it is possible, for various reasons, to communicate. No reasons are given for why she feels that they are invisible to others.

As stated, stimulation is an important aspect of verbal communication. It is notable that all pupils in the study list human voices and laughter as the most stimulating sounds in the school environment. To return to the model (Fig. 2) by means of summing up, it would appear that the most of the factors play a part with respect to verbal communication between peers.

5.5 Auditory focus

5.5.1 Dealing with several focuses at the same time in lessons

Pupils are often required to maintain several auditory focuses. Dealing with two or more auditory focuses at the same time in classroom situations is something the pupils struggle with and several of them state that this is a problem. Typical difficult situations that arise include:
- synthetic speech/computer navigation at the same time as group work or when the teacher is going over something,
- writing on a computer with synthetic speech support at the same time as having to listen to the teacher or others,
- working on something else when the teacher is going over something with the rest of the class, and
- verbal description, when voices clash.

The older pupils make conscious choices and have strategies to solve these conflicts involving double focuses. The younger pupils do not make conscious choices to the same extent; the youngest probably does not do it at all. It is clear that auditory focus is related to both activity structure and experience (Fig. 2). The activity structure deals with the requirements of the activity and how it is structured. The experience deals with whether the pupil is able to make conscious choices.

There is also an important temporal aspect here; having the time to complete your work, navigate on the computer to open documents, save documents, etc. Kim sometimes makes a conscious decision not to listen to the teacher so that she can concentrate on getting the computer up and running and navigate to the documents. For her, this is often better than needing to devote time to the computer when the others have started working, which would deprive her of work time and give her worse conditions.

Kim, 15 years old: You know, I can’t sit and listen to my computer and the teacher at the same time. So I just take off my headphones. […] But on the whole I don’t think it’s a problem. Cause in reality, the teacher should talk and then everyone else should be quiet […] The only time it’s a problem is when I have open my work. If the maths teacher is going over something. And I feel I’m behind in maths. Then I have to open my maths book. And I know how long it takes ’cause I have to jump and then there’s Textview and then it’s, yeah like that. […] Then it’s difficult. So sometimes I just go: Boring lecture. I’ll concentrate on the computer instead.

It is harder for the younger pupils to make such conscious choices. A similar situation arose for Jacob, 10 years old, during a presentation in the class council in the classroom, when he was supposed to be the secretary and taking notes on the computer while simultaneously following and understanding what was said. This made him very stressed, but despite nearly breaking down in tears he still did his best to keep up.

The pupils’ usual strategy is to use headphones together with the braille screen when they are writing and reading longer documents on the computer, and to put down the headphones on the desk when the teacher is talking. But sometimes they are required to write at the same time as listening to what others are saying. This requires them to write using the keyboard without synthetic speech support. One strategy for the pupils who are still not completely secure in using the keyboard is to listen to the sound from their headphones lying on the desk, as a form of quiet verbal feedback. Another strategy, when having to simultaneously write and listen to a teacher or classmates, is to write without verbal feedback and accept that there will be errors in the text, choosing to correct them in peace later on. Jacob uses this strategy during the class council. However, his partner is standing beside him and points out all the spelling errors, which makes Jacob stressed. The classmate is only trying to help, but is not aware of Jacob’s strategy.

Kim, who is in Year 9, has a digital note-taking assistant for braille. It is easy to use without verbal feedback. The note-taking assistant is a very important tool in lessons where you have to listen, as it eliminates the problem of double focuses in the form of a synthetic speech voice clashing with what the teacher or classmates are saying. This is clear in one example from Kim’s school. The pupils are
to work in groups of two or three. The teacher says to Kim that she doesn’t need the computer as there are only ten minutes left. Her friend is asked to read the questions that are to be answered out loud and they have a group discussion. Kim has the textbook in braille and searches for answers to the questions in it. The group of three talk and work together. Kim writes in the note-taking assistant for the group and C reads the questions. Kim communicates freely while she works and she is quick. She finds the note-taking assistant easy to use and navigate without synthetic speech. Kim is able to make a big contribution because she has the entire text in braille in her book and she can search for answers to the questions. She can also write for the group and communicate at the same time without any double auditory focus. Kim talks about the note-taking assistant:

Kim: You see, I think the point is that you write very little. You write … most often I take notes and then I have to hear what others are saying. You can’t have headphones on. But it’s really easy to deal with, you know […] And often it’s really short texts and whatnot.

Another problematic situation involving double auditory focus that can arise in the classroom is when the pupil is not expected to participate when the whole class is going through something together. In the following example from a maths lesson in Year 1, Molly is to work on her own exercise while the teacher goes through something with the rest of the class. Molly has a different maths book to the others and on this day, she is supposed to work on writing plus, minus and equals signs in rows. My colleague and I both observe that Molly finds it difficult to concentrate on her exercise and that she is constantly listening to what the teacher and the other pupils are talking about. Throughout large parts of the lesson Molly has double and sometimes several auditory focuses, which makes her work slower. A little later, when everyone is working independently, she speeds up dramatically. In an observation interview, Molly says that she is good at doing several things at once, indicating that she has thought about these double focuses she has to deal with. If Molly had participated in what the rest of the class were doing, there would have been no problem, indicating a clear link between activity structure and double auditory focus. The excerpt below can be considered rather fragmentary and incoherent, but it is important to stress that it is precisely this soundscape Molly is dealing with in this situation, and actually the only information available.

From an observation from a maths lesson, Molly, 8 years old.

Teacher: (to the rest of the class) Now everyone turn to page 96. Page 96.

(Rustling of paper and books and someone talking. Otherwise quiet in the classroom.)

Molly: (Reads from her paper that sits in the Perkins brailler) I don’t understand anything. There’s a load of weird signs.

T (temporary teaching assistant): Perhaps you have to go a bit further down the page.

Molly: Maybe.

Teacher: Now what have we here.

T: Well? You have to trace it says. So maybe you just have to follow the line with your fingers?

Teacher: This chapter we’re starting on now … there’s not very much left before we are done (sound dramatically full of expectation).

Molly: But this paper isn’t actually supposed to be put in the braille machine.

Teacher: (to the class) And now I wonder; if you look at the picture. Is there something you can do with maths in this picture? Yes, what do you think E?

E: The buns.

Teacher: What do you mean?

E: I mean 1 + 2.
Teacher: OK. And what do you say N?
N: 3 in the accordion.
Teacher: Yes!
(Molly has stopped working.)
T: You can go down a few rows so we can see what’s on the paper.
(Molly jumps down a few rows with the Perkins brailler. The teacher continues going through other work with the rest of the class.)
Teacher: Now I’ll tell you what we will be practising in this chapter … That way you’ll feel confident using tables and bar charts …
T: (whispering) I think that you have to practice writing the signs.
Teacher: And then you will also become really confident with the half hours on the clock. And we’ll do a little survey with all of our thumbs. Thumbs up if you feel confident about the clock? Or in the middle or a little unsure. Or down for I hate the clock. The clock is really hard.
T: I see you’re holding up your thumb M? You feel it’s a little so so.
Molly: I’m a little bit unsure.
T: If you’re unsure you have your thumb like this and confident like this. And you had it like this M. (T shows both M and me)
Teacher: Now we’ll turn the page … (more instructions)

As the teacher conducts a little survey with thumbs in the class, M is immediately involved, even though she was actually expected to be doing her own work. This suggests she constantly has one ear on the class and the teacher and what is happening there. She wants to participate and be part of the group.

Additional difficult situations that can arise in the classroom with respect to auditory focus involve verbal description of what can be seen when voices clash. This can apply to audio description of a film or different teaching elements. Taking in, understanding and remembering a message conveyed verbally requires you to focus on it. But here it appears to be difficult, if not impossible, to process verbal information from two sources at the same time. But this study also indicates that verbal description is something that is often entirely necessary and a really helpful for gaining access to the social and educational context. Here we again see the connection between activity structure and auditory focus.

Figure 8 Mini Model 6

The pupils state that these clashes with verbal description are a problem and they also have their own ideas about how this can be resolved.

Daniel, 18 years old: Sometimes it’s impossible, I mean, come on! […] with films, for example. Watching films. […] The assistant explains a picture and then the people in the documentary, or the information continues. So you miss it. That’s how it is. Or when the teacher shows a picture and doesn’t actually explain what it is, and then the assistant is forced to do it. And then you miss a bit […] Yeah. Jesus Christ! That’s a real problem.
When I ask Daniel to propose a solution he says:

Daniel: "Well, mainly for the teacher themselves to do it. What I’m saying is that I reckon it wouldn’t harm the others to have this explained to them."

Kim also says that the teacher providing an open verbal description to everyone directly is a much better solution than having someone sit beside you and do it.

Kim, 15 years old: "Sure, of course I’d prefer that. Because, like, then you become part of the whole."

Accordingly, when the teacher is going through things and there is a visual element, the pupils think it’s easier if the teacher interprets what can be seen for everyone. They indicate two reasons why. The first is to avoid being subjected to double auditory focus. The information then becomes purer and does not overlap. The second reason relates to communal activities and participation in the group – being part of the whole. Having a person beside you whispering to you can in the long run be perceived as isolating and discriminatory. In addition, as pointed out by Daniel, open verbal description for the whole class can be of benefit to everyone.

With respect to the verbal description of films, it is significantly more difficult for the person who is to provide the description as they have to interject during the gaps in the film’s dialogue. The pupils are aware that it can be difficult for the describer, but the problem of double focuses is still stressful and frustrating for them as they want to take in the information in the film. This is a situation where they can get stuck in a conflict of loyalties.

Kim: And there’s a film and someone sits and interprets. In the end you don’t know whether to concentrate on what they are saying in the film or on the interpreter. So sometimes I, like, think that it’s a shame for the interpreter who’s made such an effort. And then you don’t even listen.

However, the pupils say that verbal description of films is something that is important and positive when it is done correctly. One simple solution suggested by a couple of the pupils is for the films used in lessons to have a pre-recorded audio description. In that case, the films are produced so that the audio description does not clash with the talking in them.

### 5.5.2 Auditory focus for understanding surroundings

The pupils generally do not find it difficult or disruptive to have sound all around them. The pupils do not want their surroundings to be completely silent. "I hate it when it’s quiet", says Hilda, 12 years old. Sound provides information that is both necessary and simulating. Every one of the pupils in the study thinks that chatter in the classroom is usually only a good thing. It provides important information about the group and it creates a sense of contact and affinity. You hear your classmates and know they are there. The pupils often listen to the class with one ear while they are working and this gives them greater opportunity to participate.

Kim, 15 years old: "You see, most of the time I think it’s good, 'cause I feel like then I’m involved in what’s happening."

This applies to all pupils in the study, regardless of their age. Even Molly, who is only 8 years old, often catches the topics of conversation and activities going on in the classroom, which gives her the opportunity to participate. In such classroom situations, the pupils seem able to easily switch focus, catch important sounds when necessary and focus on their work when required to do so. What is difficult is when the sound sources become too loud or there is a need to concentrate on important information supplied verbally. Difficult situations, such as those in the various examples above where there are obvious clashes, are impossible to deal with for all unsighted people, regardless of their age.
or maturity. However, something that appears to be related to age and experience involves an awareness of the problem and the development of strategies for choosing what to focus on. The older pupils list several strategies they have for choosing what they want to concentrate on. It is possible that Molly also does this in certain situations, despite not yet being able to talk about it.

Several of the pupils sometimes choose to put on their headphones to avoid having more than one focus. They usually only do this when the classroom activity is independent work, when everyone is working alone. They sometimes miss out on social interaction that takes place in the classroom – it is easy to become a little isolated when wearing headphones. On the other hand, they are then able to focus properly on their work. As has been stated, the pupils prefer to listen to the class, and it seems that they have to strike a balance in order to both gain access to what is happening in the class and focus on their work. But they do not bring this up as a problem; instead they appear to be well capable of dealing with it. Kim, for example, perceives a lot of the quieter sounds when she is listening intently. But when she is working, she concentrates and does not think about them. She has developed a well-functioning way to use quiet sounds when needed. Like hearing when the teacher comes into the classroom and when people come and go and are talking.

Jacob also appears to have a good ability to focus on what he is working on, which helps him greatly. Jacob, 10 years old: "And often, when I’m working, I don’t think about noises, because I’m concentrating so hard on what I’m doing."

Sometimes he likes to use headphones to shut out sound when he is working.

Jacob: "It feels good. Then I can avoid, then I don’t need to … But, you know, when someone is talking to me, then I usually take them off."

One factor that, to some extent, governs what the pupils focus on is motivation and stimulus. If you are absorbed in what you are doing, or the exercise is important to you, it is easier to block out other sounds around you. And stimulating and exciting sounds and conversation attracts attention and can be difficult to block out. In the maths lesson, Molly actually wants to be involved in the presentation with the class. Buns, accordions, diagrams, birthdays, it is easy to understand why she is unable to block out this focus. Kim and Daniel, the two oldest pupils, say that their motivation for the exercise they are doing has an impact on how much they listen to the chatter in the class.

Kim, 15 years old: "It depends a bit on how much you concentrate and how interesting you find the thing you’re doing. […] And how important it is for our grades, you know."

But sometimes the two focuses are so strong that it is impossible for the pupils to choose between them. Then motivation is not enough. Examples of this are the verbal description situations that the pupils talk about. They really want to keep up with things but they find it impossible. Similarly, the computer voice in combination with other verbal information is very difficult. However, classroom conversation appears simply to benefit participation, rather than being any great problem. They can also choose focus in this respect.

5.5.3 Uncertainty regarding auditory focus when interacting

Something that appears very clearly in the study is that all of the pupils with visual impairment worry about being too loud in the classroom and about disturbing their classmates. Molly types really softly on the Perkins brailler so as not to disturb others, Kim thinks that the keys on her computer and Pronto are too loud when she types, Jacob is also worried about this and Hilda uses the chisel really carefully in the woodwork class as she thinks it is a disturbing noise. What this boils down to is that they
themselves have an auditory focus and that they do not really know how their classmates will react to
the sound they are making. Do sighted people think about this or is their focus more visual? This is a
question that several of the pupils think about. Kim is very worried that she is making too much noise
in the classroom when she is writing on the computer and Pronto, and when she opens the Velcro
fastening on the Pronto case. He sighted friend says that no one thinks about it, but Kim is still
uncertain about whether this is the case. This fear of causing disruption in the classroom is felt by all
of the pupils in the study. It may be connected to the fact that they themselves are so focused on
sound. But there also appears to be a lack of information; they do not know how their peers react. Kim
asks both her friend and her mother about this, but she remains uncertain. She talks about having also
been criticised because she causes disruption in the classroom with her computer, despite always using
headphones.

I: Really! You think that about the computer as well?

Kim, 15 years old: Yes! Yes, I do. But I’ve had complaints. So I know that it can be disruptive. And,
for example, I’m almost never allowed to sit and write tests together with the others as it’s disruptive
 […] yeah, sometimes it annoys me that I’m annoying. Simply because I would prefer to do the test
with all the others …

Something else that appeared clearly in the data is an uncertainty among the pupils involving their
auditory focus in relation to their surroundings. What focus am I allowed to have and what focus do
others have? On several occasions they talk in terms of "eavesdropping" when they hear what others
around them are talking about, as if this was a bit naughty and forbidden, and as if they should not
have the auditory focus they have. It would seem that there is some sort of misunderstanding here.
The causes of this have not been investigated in this study, but one reasonable interpretation is a lack
of information about the reactions of those around them and what is regarded as socially acceptable.

Interview with Daniel, 18 years old:

I: What could make things easier? Is there something to do with sound? Or what could make it easier
to make contact with people?

D: Well … I don’t know. I mean, if you’re standing outside a classroom, waiting to go in, and talk to
people. Well, it’s like this; they usually stand around and talk in groups. And then it’s that whole
thing about listening to others, you know. It’s considered pretty bad (chuckle). So I’d rather not do it.

I: But surely you’re allowed to do that. Listen to what others …

D: Yeah, but definitely not show that you are, maybe. Yeah, that’s probably it. And so, no, it’s
generally hard to get a hold of anyone. In my opinion. If you don’t ask, that is. What I’m saying is
that if you want social contact then, no, it’s actually best to have a friend around, you know. Find
one, you know, like from before.

The pupils’ auditory focus is constantly turned on, which is completely natural for them. But this focus
is not necessarily shared by those around them.

Kim: … or when I was with G (former special needs teacher) on the bus, I’ve said something like:
Yeah, this radio station is good. Then she hasn’t even thought about the radio being on, like. Yeah,
but things like that.

Kim is slightly uncertain about what focus those around her have.

Kim: And we discussed this quite a lot at home; if mum says something, like something that you
don’t really want everyone to hear. It doesn’t have to be anything extremely private, but like just
something that isn’t meant for other people’s ears. […] And I’m like: But mum! They can hear! And
then I can get really angry with her because for me it’s like everyone is sitting there listening to what
we’re saying. But she just goes: No, but people don’t care. And I’ve always wondered whose version
is the most accurate. And it’s probably hers. But for me it’s really strange because I would have
thought … If I had stood close by and she had talked as loud as that, I would have thought about it and heard it and registered it.

5.5.4 Auditory direction and shared focus

It has become clear over the course of the study that, under certain circumstances, it can be difficult for the pupils with blindness to work out the direction of verbal communication. Sighted people use eye contact and direction of gaze to help them establish shared focus and as a directional indicator in communication. Vision also works in loud and confusing environments, but if you only have auditory information to go on, the sound environment plays a significantly greater roll. In these situations, verbal communication appears to be completely vital, and most often it governs and establishes the shared focus. But sound and body movements, head directions and body positions help to indicate the direction of communication – who is talking with whom. If several conversations are taking place at the same time, it can be difficult for the pupils to concentrate and understand who is talking with whom. Turning off the surrounding aural impressions can also be very difficult as they have and must have an auditory focus all the time. Consequently, the sound environment is completely vital to the chances of focusing and identifying the direction of verbal communication. Here, all the factors contributing to the sound environment are important – supply, activity structure and room acoustics.

Figure 9 Mini Model 7

The activity structure can, for example, involve two conversations happening at once across a table, or when two or more people are ordering or paying at a counter. Confusion can easily arise in these situations. Below is an account of a situation that arose at the table in the dining hall during my observation interview with Hilda.

Excerpt from observation:

I: Is it more difficult here than in other rooms?
Hilda, 12 years old: Mm.
Special needs teacher: Oh dear, you dropped some food. Hold onto your plate (the voice turns out towards the aisle).
Hilda: What?
I: Do you need to concentrate more here than in other rooms?
Hilda: Who dropped food?
I: What did you say?
Hilda: Who dropped food and hold onto your plate?
Special needs teacher: There was a little girl who held her plate so that the food fell off. And then I said to her that she should hold onto her plate. So that wasn’t directed at you.

In the above situation I was focused on the conversation I was having with Hilda and unconsciously heard that the special needs teacher had turned their head out towards the aisle. I did not interpret this
as having been directed at us; instead I concluded that it was for someone passing by in the aisle with their plate. However, H was uncertain. This may be related to experience, age and maturity. But it may also relate to the fact that Hilda is often together with, and assisted by her special needs teacher, and that she is attentive to and focused on her voice in a way that I am not.

Distance is also of great significance with respect to understanding the direction of communication. It is easy if the speaker stands beside you and turns their voice away, but it is not as easy to determine the direction in which a teacher right at the front of the classroom is facing. Distance and placement are thus decisive in terms of the ability to use this finesse. However, in difficult situations verbal information is needed to clarify the direction of communication, for example the teacher saying the name of the person who is being given permission to speak. The pupils also stated it’s important for the teacher to specify who they are asking to do something or telling to be quiet. In the interview, Molly says:

Molly, 8 years old: "Not just if they’re angry with me, but whoever they’re angry with, they should say who it is before or I get scared. I think adults should think about that.”

This is particularly important, not just because the pupils should know if it applies to them, but also because it provides valuable information about the group and what the teacher thinks and says to different pupils – information that all the sighted classmates actually receive.

In a familiar and manageable sound environment with a limited supply, it is easy to hear head directions and to work out who is talking to whom. But this becomes difficult in large, confusing environments and at a distance.

5.6 Identifying people

5.6.1 Voice recognition

The study shows that in school situations, people are identified primarily through their voices. Voice recognition is therefore very important for pupils with blindness. If the voices are not familiar and linked to the right person, it usually becomes difficult to understand the social context and participation thus becomes difficult. Successful voice recognition is dependent on many different factors.

It appears clearly in this study that it is difficult for pupils with blindness to find people and know who is who in many school environments. The vast majority of the sound information the pupils receive during the day is not, to them, of a person-specific character, i.e. they do not have the opportunity to determine who they can hear. This is mainly due to the impossibility to distinguish familiar voices in many of the school sound environments as so many people can be heard at the same
time. Another reason is that quiet individual work in the classroom provides a low level of person-specific sounds, and it is possible that the pupil’s do not actually know everyone’s voices. Several of the pupils in the study know the voices of everyone in their class, but still have difficulty distinguishing them in many environments.

The study also indicates that learning voices is a process that takes place over time, and on which many factors in the surrounding environment have an impact. The pupils know some voices well. These are the ones they hear a lot and the ones they have personal contact with. The pupils say that it is only when they come into direct contact with people, "when they talk to me", that they know who it is, and that is also when they begin to recognise the voice.

Every one of the pupils in the study says that it is easier to distinguish and recognise voices in the classroom than in the dining hall and corridor, or other spaces with longer echoes. The classroom is smaller and often has significantly softer acoustics, with plastic or wood flooring and acoustic tiles in the ceiling. But the main reason why the classroom is easier is that there are fewer people in the room and the activity structure is often collective and organised.

It is interesting that all the pupils say that their loudest classmates are the easiest to hear when they are somewhere in the corridor. Only their voices penetrate the carpet of sound that often dominates loud environments. They often do not know where the quieter people are. One pupil states that this is a problem because he would like to socialise with those who are a little quieter, but that he cannot find them.

The motivation for wanting to know who is who varies somewhat between the pupils from situation to situation. Sometimes they "don’t care" and sometimes they really want to know.

Kim, 15 years old: Sometimes you get really curious. It’s a little egotistical, sure, but … if you sit in a lesson and someone comes in and is like 20 minutes late. It doesn’t concern you, but you want to know who it was that came so late.

5.6.2 Learning voices

Learning to recognise people in the school environment is a process that takes place over time. This is a process of connecting what is said with the person that said it, and having something to attach the voice to. The voice then takes on more and more character and represents a personality.

Kim: No, but I remember when I started Year 7 and there were loads of new people. It was mainly the boys who were difficult. Because I knew all the girls already. And I thought they sounded a little like this (imitates a voice that’s breaking) (collective laughter). But you know, you learn after a while. You just have to ask.

By asking her special needs teacher, Kim got help to connect what was said with the person that said it.
It is thought to be difficult to generalise with regard to how long it takes to learn voices. The pupils in the study who, based on observations and their own assessment, found it easiest to recognise all of their classmates voices says that it took between a couple of weeks and a few month to learn the voices in their class. The pupils point out that it differs greatly and that it is not possible to say how long it takes. Two of the pupils do not know everyone’s voices after one and 2 and a half years, respectively, in the same class.

Factors that have been shown to affect learning are activity structure, degree of exposure, supply, character of the voice, sound environmental conditions and whether the teacher says the name of the person who has been given permission to speak in the classroom. Everyone saying their own names when they say hello also makes things easier.

Based on the selection in this study it is not thought that age is decisive in terms of learning voices. It appears that the most decisive factor is the degree of close contact in the form of conversation. This is mentioned by all of the pupils as being the most important factor.

Daniel, 18 years old: Do you know, it’s down to how much contact you have with a person. There are some people I’ve talked to and heard a lot. And I recognise them immediately. And there is, I think one or two here in the class who I’ve never even talked to actually. And I’ve been here for a year now. And I don’t know who they are. What I mean is when they talk. […] You know, the teachers for example, I learned them, well, really quickly. You know, not even a few days. I think that I could work out who they were as early as the first day. In fact. That was totally due to, what’s it called, exposure.

Jacob, 10 years old: "I remember, among the boys; It was impossible to hear who it was."

Jacob talks about two boys who used to sound exactly the same, but now sound completely different. He says that ”we didn’t talk so much in the beginning” and it was difficult to learn the voices.

Jacob: "But after a few weeks it came together And then I heard the difference much better."

Kim says that it is good to get to know something about the person in order to recognise the voice. And people with a particular character, both in terms of personality and voice, are easier to remember. When you do not have appearance to attach the memory to, personality and things the person tells you become much more important.

Kim: In any case, if you have had, you know direct contact. If you have had sort of friend interviews or something. And sat and talked with this person. Then it can be easier to remember. But, you know, some people, they just melt into the background. But it’s the same there. Those who I found difficult to distinguish before, I now can’t understand how I found it so difficult.

Several of the pupils mention that friend interviews, work in pairs and work in small groups are good ways to learn to recognise peers voices and connect the voice to the person.

The supply is also important for learning voices and identifying people, with consideration given to the method of deduction (Fig. 2). If there are many voices in a situation it can be more difficult to guess which one it is. The teachers’ voices are easy to identify in the classroom, partly due to the fact that there are only one or two adult voices in that environment. But it is also because they talk a lot without disruptive background noise.

An interesting result from this study is that the pupils who know many of their classmates’ voices have teachers who consistently say the name of the person who is given permission to speak in the
classroom. A good juncture at which to learn peers voices is when they are answering questions in the classroom. This is addressed by several pupils in the interviews. Molly, 8 years old, says: "It’s when they’re talking with me that I know who it is. And when they answer questions." The classroom environment is beneficial with respect to understanding spoken language when the voices are heard one at a time. A high degree of verbal communication and different verbal teaching forms generally appears, based on this study, to be beneficial for learning voices. But one prerequisite for learning is that you know who is talking. If you are not made aware of who the person is, then the anonymity can continue for a long time.

5.6.3 Other auditory ways to recognise people – personal soundscapes

People are also identified with the help of sounds other than the voice. This mainly concerns footsteps and style of walking, but breathing, other body movements and bunches of keys are also mentioned. One pupil says that it is as if every person has their own personal soundscape.

Daniel, 18 years old: But the main thing is that a person has a, er, I want to call it a soundscape. Strangely enough. Well, what I’m saying is that it’s down to … you know, it’s mainly the steps. That’s the most important. But then you can really hear if the person in question has certain keys. If they have lots of keys and whatnot. Or how they move about and things like that. […] Then you also hear how people breathe all the time.

I: Yes, exactly. Can you recognise breathing? Is that a part of someone’s soundscape?

Daniel: Yes, of course. Then it’s down to how close they are. I think breathing takes much longer to learn. In fact. Er, I don’t know if R (the assistant) is around, but … R, he has a … er … he is overweight so to speak (chuckle). He breaths a little more heavily. So then it’s easy …

Kim also identifies people with the help of personal soundscapes. She recognises the caretaker because he always sings in a specific way when he walks round and picks up rubbish in the dining hall with tongs. The welfare officer often walks around whistling, and the special needs teacher T drags her feet in a typical way. However, the French teacher lifts her feet so she can’t be heard quite as well.

Kim, 15 years old: "And then my last teacher, who we had in Year 6. She could be detected a long way off. As she was known for her enormous bunch of keys."

Often, the subtle details are registered and this is only possible in good sound environmental conditions. The exclusion method also becomes important here as you link people to certain environments and situations. For example, a pupil works out whose bunch of keys it is as no one else has a similar bunch of keys in that specific environment. Daniel reflects on what is important with respect to auditory details:

Daniel: "Well, it’s the small things, you know. It’s all in the details. In fact. Strangely enough. It’s the details that make us so independent. Not the big things …."
Kim: T (the teacher) is kind of special in that she never lifts her feet. (with tongue in cheek)
I: And so you recognise her footsteps?
K: Yes, but I always know when T is coming.

Another teacher has quieter footsteps, but this is compensated for by the fact that she always says when she is coming and going. Kim also says that she can feel when someone is standing close by her and that sound is reflected differently when this happens.

It may feel embarrassing to call for the teacher when the teacher is not in the room. To avoid this, Kim uses voice, other personal sounds and smell in order to try and locate her teacher.

Kim: Today, when I called for A (teacher), for example, I listened first: Is she talking to someone? No, she’s not talking to someone. It was quite, it was a bit interesting. And then, no but I check, I listen first if she goes and talks to someone. No, she isn’t doing that. Then I listen to work out whether she is outside. No, she isn’t. Because A has a very dark voice (imitates a dark voice). So I can usually hear her. Yeah. And then: Nah, she wasn’t there. So then it’s the teacher’s desk. Is anyone sitting there? Is there someone leafing through a book? Is the office chair rolling about and that sort of thing? No. I don’t hear anyone there, but she should be there. So, then I go (sniffs with her nose). Yeah, it smells like A. She is here. So that’s what I do.

5.7 Hearing what is happening

Consequently, sound is a resource that provides constant guidance in the pupils’ daily lives at school. They are in the middle of the soundscape and it provides a comprehensive impression of what is happening. Their focus is not limited to the direction in which they are looking, rather is extends all around them. Their sound perception is constantly turned on and they benefit from all the sounds offered to them by their everyday surroundings.

Kim, 15 years old: "Because it’s like your own way of seeing. So for me it’s just as natural as, you know, it is for those who glance around the room and see what people are doing."

The focus in this chapter will be on the sounds that indicate which activities are taking place, but which do not necessarily indicate who is involved.

5.7.1 Activity sounds

The non-person-specific auditory information about activity appears relatively similar in all the pupils’ observations in both classroom and dining hall. The corridor observations differ a little more because the environments differ more between each of the pupils. Typical activity sounds that all pupils hear and register in the classroom are talking, shuffling papers, books opening and closing, the sound of pencil on paper, pens being tapped, creaking chairs, the opening and closing of zips on bags/rucksacks, teachers’ footsteps, the classroom door being opened and closed and people coming in and going out.

Conversation with Jacob, 10 years old:

I: Can you hear what’s happening now?
Jacob: Yes, they are taking out their books like. Opening drawers and … opening rucksacks.
I: What is that sound then?
Jacob: They are getting pencils.
There is a clear relationship between activity structure, for example the type of teaching taking place in the classroom, and the sound information the pupil receives. Many of the sounds in the classroom the pupils perceive during quiet, independent work in the classroom are anonymous activity sounds, i.e. they do not know who is rustling, creaking, writing, etc. Jacob says that "it’s only when they talk that I know who it is". But even if the sound is anonymous, it provides important information about what classmates are doing. The sound of pencils writing indicates that everyone is working when they are sitting quietly at their desks. The sound of rubbing out with an eraser, clearing crumbs from the paper and an eraser dropped onto the desk indicates that someone else has made a mistake and has had to rub it out – so I am not the only one who makes mistakes on my Perkins brailler or computer. The two youngest pupils in the study do not hear the rubbing out, while the older three do. The reason for this is unknown at this juncture, but it is reasonable to postulate that it is related to experience and conceptual understanding. I have myself heard all of the rubbing-out sounds mentioned in each of the classroom observations.

Although there is little opportunity to recognise people during individual, silent work, it is at the same time easy to hear details and distinguish many quiet activity sounds. The supply of sound is not so great in the environment and there are not so many things that can be heard at the same time.

Aside from sound from various objects, sound from body movements is also important for identifying activity. Footsteps, breathing and head direction are others that are mentioned.

Daniel, 18 years old: Because, you know, really the thing is that you hear how they are moving and waving their hands and walking about and bending down and standing up and holding their heads high or low. Er, if they nod, etc. In fact, all of that can be heard. Strangely enough.

Daniel hears that a group of girls is coming into the classroom through the door. I ask him what is happening:

Daniel: They are waving their hands a little, I think. They are gesticulating. Now they’ve sat down.
I: Yes, exactly. You heard them sitting down?
Daniel: Sure, yeah. No, that’s not so hard to hear. They pulled back the chairs. And their voices also came down.

In the corridor it is often more difficult for the pupils to discriminate between sounds due to the carpet of sound that is formed by everyone’s voices. Important quiet sounds are not heard and it is usually difficult to identify what is happening and who is there. This became clear in a situation in Molly’s corridor where we stood observing and recording. Neither Molly nor I had noticed that a group of children were standing beside us looking and listening. It was only when my colleague started talking to them that we noticed. In quieter environments, the pupils generally notice when people are standing beside them, even if they are not talking – sound from body movements, breathing, suppressed echo due to people standing beside them. This demonstrates the importance of these quiet sounds for understanding what is happening around us. In this case it was only piercing, loud sounds, for example voices, that got through.

In many situations, perception has become so automated that they are not even really aware of having registered something. On a quieter occasion in Kim’s corridor, she notices that some boys from her class are fooling around over by their lockers. She hears someone hitting someone else on the head with a folder. She is herself surprised that she knew it was a folder.

Kim: "But think about the fact that I know it C. That they used a folder. I was almost a little impressed."
The pupils identify objects based on how different materials sound, for example wood, glass, metal, plastic, paper, etc. "It was someone banging a glass down on the table." "It was someone dropping a metal pencil case." "It’s the sound of nylon from a quilted jacket and salopettes when they are getting dressed." Size, weight and shape also affect how objects sound. But in order to identify objects and activities, you have to know what is making the sound and perhaps have heard it many times. The pupils say that it is when they have done something themselves that they know what it sounds like.

Kim: A lot of it is down to, like, how you do it yourself, if you have done it yourself or not. For example, these guys who hit someone on the head with the folder. I mean (takes her folder and hits her head with it) like that. I have a folder here. So I know what it sounds like. […] And I write on the computer all the time so, then you think about it.

Kim also uses her sense of smell to identify what is happening, for example when the overhead projector screen is rolled down.

Kim: Yeah, you can hear that they are rolling something down. And usually you are able to tell quite clearly from the smell too. Cause you use your sense of smell. I think that you use the sense of smell quite a lot too.

The sound of different objects is often linked to the environments in which they belong, and conclusions are drawn based on experience (Fig. 2). One example is from an observation from a woodworking lesson when some classmates were using round poles. The pupil hear the sound when they are hit against one another and dropped on the floor and identify this as drumsticks. The sound is exactly the same, and the pupil has no experience of round poles, but does have experience of drumsticks.

Using sound all the time is very natural for all of the pupils in the study. Much is registered automatically and is simply there. The sensation is not usually that they hear, but rather that they experience. But it has become clear in the study that the ability to talk about and verbalise sound impressions differs depending on age. The older pupils have a high level of awareness of sound and find it easier to talk about it. They can specify many ways in which they use sound. The younger pupils find it harder to talk about this and have a lower level of awareness. Accordingly, it can be concluded that awareness is something which develops over the years and potentially in line with the need for sound becoming greater the more independent they become.

5.7.2 Identifying tempo and flow

Several of the pupils talk about sound information that helps them to understand tempo and flow in activities, when things happen and when it is time to do something. For the pupils, this information is important to following the timing of activities – information that sighted people usually get via sight.

In her locker area, Kim hears when people open and close lockers, put things in them and take them out. She also hears a difference between lockers being locked and unlocked. The click when the padlock is closed is distinctive. It provides information that people are finished and on their way somewhere else. Kim, 15 years old, also perceives tempo and flow by hearing that people are walking up and down the stairs, to and from the classroom. She also hears when people go out as she hears when people press the open button.
Daniel, 18 years old, also draws conclusions about tempo based on auditory information, for example that everyone has finished reading, as it starts being louder in the classroom again following quiet reading. In this case, the teacher did not provide any verbal information about what was happening but Daniel could take advantage of his classmates talking.

5.7.3 The inference process

In this study, it has become clear that there are several auditory factors that combine to provide information about what is happening: the verbal communication, the other auditory information such as footsteps and sound from objects, the familiar structure, the supply and the inference and elimination process. You work out what is happening based on the information you have. Common to all of the pupils and all the situations and environments in this study is that inference is used to a great extent to identify what is happening because sometimes there is very little information. The inference process is dependent on experience and supply, for example that you know people usually behave in a specific way, or that you know which people or objects are normally in that specific environment. One example is Jacob, who locates one of his teachers when he hears the specific sound of her iPhone being plugged in to charge in the group room.

Jacob, 10 years old: It was G (teacher) who put her phone in the charger.
I: OK, how did you know it was G then?
Jacob: Because she has an iPhone. And she is usually in there.

6. Discussion and Conclusions

6.1 Method discussion

Using grounded theory as the methodology has been time-consuming and demanding, but also a very exciting process. Allow me to start with an initial reflection on my own visual impairment: I think that GT is a particularly time-consuming method when using braille and synthetic speech as a reading and writing medium, considering the difficulties of gaining an overview of the extensive data produced using this method and the time it takes to find, sort and structure the different codes and categories in the several analytical stages involved in this method.

There is a limited supply of research concerning auditory accessibility in the school environment for pupils with blindness linked to social processes and participation. Grounded theory as a methodology has proved appropriate as categories and terms have been built up based on the data collected. This method has also made it possible to generate the theoretical model (Fig. 2).
What disadvantages are there in the choice of grounded theory as a methodology? One problem is the question of theoretical saturation and the potential need to collect further data. In the context of this study, conducting a theoretical sampling would be very time consuming as it was unwieldy due to administrative circumstances. Nevertheless, a large number of situations have been observed and the vast majority of the collected data has been analysed in several stages which, according to Guvå and Hylander (2003) can replace further data collection. The analysis has also taken place in parallel with the data collection, which means that categories and terms have been saturated step by step in the process. However, the results cannot be generalised to the group of pupils with blindness in Sweden, rather they must be regarded as only applicable to the studied group. It is important to point out that this study only involves five schools and that the situation can look completely different at other schools with other circumstances, for example in terms of sound environments and number of pupils. The schools included in the study are medium-sized to large schools, with about 400–800 pupils. They are located in or outside of medium-sized to large cities. In a small school in the countryside, for example, the sound environment in the dining hall is perhaps significantly more accessible.

Further reflection on the selection is that the group investigated are heterogeneous in terms of many aspects. The pupils have different experiences partly in terms of their varying ages, but also with respect to their visual circumstances. Two of the pupils could see until they were about 4–6 years old, which may have affected the results. For example, it is difficult to know what the significance of the category experience is for those pupils who could see for a period and their understanding of the social and educational context. On the other hand, it is what the pupils hear and understand "here and now" that has been investigated, but what underlies their interpretation is partly unknown. The large age range was a conscious and, I believe, correct choice in order to get a large variation in the ambition to reach theoretical saturation.

One further aspect to reflect on with respect to the choice of methodology is Glaser’s (2010) statement that the researcher is not to have too much prior knowledge of the field. Considering that I am blind myself, and that I work at the SPSM, it is natural that I have prior knowledge of this field. However, the ambition during the study has been to have as open a data collection as possible in order to then, based on the data, search for patterns and theories about how sound is used by pupils with blindness to gain access to social and educational processes and contexts. I have attempted to be vigilant not to allow my own prior understanding to get the upper hand and affect the interpretation of the results. At the same time, I believe that I have been able, in the analytical stage, to benefit from my own knowledge and experience, allowing me to achieve a deeper understanding of correlations and relationships. Guvå and Hylander (2003) write:

In grounded theory, prior understanding is not presented from the beginning. But when theories or previous experience come into play and prove relevant to the study, they are used in the same way as other data that have been collected. The assumption is that theoretical and practical knowledge acquired previously may contribute to an increased theoretical sensitivity, facilitating the emergence of new theory. (Guvå & Hylander, 2003, p. 15)

It is necessary to reflect on the significance of the researcher to the results in a qualitative study. Grounded theory is largely based on the theory from symbolic interactionism that reality is constructed and changed through interaction between people. "Both the researcher and the researcher’s experience and basic premise are regarded as important parts of this construction, which means that the researcher must constantly analyse their own relationship to their data” (Freyne Lindhagen, cited in Guvå & Hylander, 2003, p. 11). According to the authors, the researcher’s own experience can thus be both an advantage and a disadvantage in research based on grounded theory.
In this case, the method of combining pupil interviews with my own observations has been a way to use the pupils’ perspective as a starting point. Soundsapes are complex and constantly changing, built up from many quiet sounds and loud sounds in various directions and at various distances. The aim has been to capture the pupils’ perception of the soundscape in a "here-and-now situation" in order to include information that is as detailed as possible. At an early stage of the preparations for this study I had planned to make sound recordings in school environments with very advanced recording equipment, in order to subsequently listen to and analyse the soundscapes together with the pupils. However, I chose not to proceed with this method as it is almost impossible to capture the full complexity of a soundscape on a recording in terms of room acoustics, directions, reflected sound and small details. I chose instead to allow the pupils to observe and describe on site what they heard and perceived in the study, which has been recorded and transcribed. Over the course of the study was ongoing, this proved to be the correct choice as it is important to capture the pupils perceptions in real time.

In the auditory researcher observations it may have been an asset for the researcher not to see, as this permits a focus and perspective that is similar to that of the pupils. In the analytical process, I have also used my experiences to interpret links between different factors. Here, the experience and knowledge I have gained through my work in the SPSM has been of significance as I have met and conversed with many pupils with visual impairment, their teachers and parents over the years.

Because of administrative circumstances the same sighted observer has not been used in all of the observations, which could mean the data is skewed to some extent. But because these observations have only been highlighted when they have differed on significant points, I have not assessed this to be a problem. The focus is constantly strongly placed on the auditory observations.

As early as in the interview stage, the researcher is involved and has an impact, which involves several factors that can have an impact on the result. One aspect is that the interviewer/researcher is an adult and the interviewees are children, meaning that the relationship is not equal (Ek, personal communication, November 7, 2012). My day-to-day professional role may also have affected the children’s responses in the interviews, despite the fact that I was careful to explain to them that the investigation was taking place within the scope of my own studies and that their responses were confidential.

According to Glaser, the terms reproducibility and generalisability do not have any place in theories created with grounded theory. Nevertheless, he describes four criteria that may be used to assess a grounded theory, and which answer questions regarding validity and reliability. These are: fit, relevance, function and modifiability (Glaser, 2010). Fit relates to whether the concept that has been generated fits the data that have been gathered. It has to be possible to follow the path from the data to the concept and onwards to the final theory. Glaser (1998) argues that fit is a form of validity. Relevance involves the theory being relevant to those whom it concerns. Accordingly, the theory has to be functional in a way that allows it to identify and explain the main problem in a comprehensible way, but also sufficiently complex to explain the most important processes within the field. Finally, the theory has to be modifiable, i.e. possible to change if new data are added.

I have attempted to provide a general description of the theory generated based on the categories and concepts that appeared during coding and analysis. My hope is that the reader will be able to follow the path from data to theory, which demonstrates the study’s fit. The study also contains plentiful quotes in order to verify and demonstrate the theory’s close connection to the data, supporting the study’s validity and fit. Consequently, my assessment is that the theory is relevant and describes
processes relating to auditory accessibility that are central and important to these pupils. I also hope that the theory is functional and that the model described in both words and pictures can be understood as a process chart illustrating the factors, various identification processes and cognitive processes of the sound environment. The smaller models can help to clarify different relationships and correlations that have emerged, which reinforces the theory’s function. I also regard the theory as modifiable and hope that it will be useable in further studies, where it can be reshaped and developed.

However, one weakness of the theory may be that it is complex and therefore possibly difficult to use in practice. The complexity can be explained by the large number of identification processes and factors that constantly interact on several levels, but a simplified model would perhaps have been appropriate with respect to its use in practice. One further reflection is that the theoretical model does not describe a comprehensive picture of the pupils’ access to the social and educational context and opportunity to participate. Participation encompasses many more processes and only auditory accessibility is highlighted in this study. In certain cases in the analytical process it has been difficult to isolate the sound environment as an individual factor of the pupils’ opportunities for social interaction.

But finally, Glaser (1967) emphasises that a generated theory makes no claim to be fact, instead it is a collection of hypotheses based on arguments with a higher or lower degree of probability. He states that these hypotheses can be used in day-to-day practice or can be tested in traditional deductive research. My hope is that with this theoretical model, I have still been able to highlight the subject of auditory accessibility for pupils with visual impairment and relate this to access to the social and educational context and opportunity to participate. I have attempted to tease out the processes that are taking place and that are necessary in order to understand and identify various components that together provide a comprehensive picture. Accordingly, my hope is that the model can be used as a basis for further studies within this subject, and that it is thus developed, altered and kept alive.

6.2 What constitutes a usable sound environment?

The overall aim of the study is to look at the usability of sound environments in terms of enabling participation in the daily life of schools. What auditory information is offered in different situations and how can the pupils use it? In an attempt to illustrate this, a theoretical model (Fig. 2) has been put together on the basis of categories that emerged in the analysis. The model has been used as a tool with which to understand processes and in that way come closer to the pupils’ descriptions, experiences and circumstances. The model, described in detail in the results chapter, is complex; consequently, not all of its parts are discussed here. The focus is on the processes that are judged to be most important for the pupils’ opportunity to participate.

Understanding social processes and the social and educational context necessitates being able to distinguish who is who and who is doing what. It becomes clear in this study that pupils with blindness mainly use sound to gain access to processes, and to the social and educational contexts of various activities at school. In addition, sound is most often the only source of information the pupils have when it comes to accessing social processes. The same is also applicable in certain educational situations where there is no tactile material for the pupil. In many respects, the pupils have a well-developed auditory capacity and an auditory focus that is constantly switched on, and they perceive much of what is happening in beneficial sound environments via the soundscape that surrounds them.
But the study also indicates that many sound environments in school obstruct the pupils’ opportunities to utilise their capabilities, making it very difficult for them to perceive aurally what is happening and who is who in these environments. If it is far too loud and confusing, the sense of hearing is essentially knocked out and the primary sense becomes next to useless. Difficult sound environments are a barrier to the pupil’s opportunity to participate (Janson, 2004; SPSM, 2012).

It is important to point out that it is possible to change and have an impact on the factors contributing to these difficult sound environments. This relates to the number of people in the space, the activity structure as well as the size and soundproofing of the space.

One interesting result is that the spaces and situations in schools that are intended for socialising and social interaction are the most difficult for the pupils with blindness in terms of sound. Previous research (Svensson, 1988; Söderqvist Dunkers, 2011; Warren, 1994; Webster & Roe, 1998) has shown that participation in social contexts in school is problematic for pupils with visual impairment. This research points to loneliness, exclusion and marginalisation. The results of this study indicate that the sound environment can be a contributory cause of this exclusion.

In this study a situational perspective has been adopted in which the focus is on activity and situation, rather than individual characteristics and attitudes. This does not involve denying the individual’s motivation and experience is of significance, but it is more interesting, not least for educational purposes, to ask the question of how environments and activities should be structured in order to enable pupils with varying circumstances to participate. Educational research has shown that participation is strongly related to activity (Janson, 1996). The same pupil can participate fully in one situation, for example in the classroom, only to then become excluded a moment later, for example during break time. In a study looking at social participation for pupils with visual impairment, Janson (1996) demonstrates that activities, which on the one hand have a limited number of participants, and on the other are also relatively easy to control with reduced visual function, are regularly characterised by integrated participant patterns. These results are further supported in this study, which shows that the usability of the sound environment for these pupils is directly linked to number of people and the activity structure.

It is possible to influence a sound environment and there is much to do with respect to the structure of sound environments in schools. At this juncture, it can be helpful to compare the sound environment to a mixing desk with parameters that can be altered (Fig. 2). If one of the parameters (supply, activity structure and room acoustics) is changed, the result, i.e. the soundscape surrounding the pupil, becomes different. When planning and organising it can be valuable to think about issues such as: What impact do the room acoustics have on this space? What difference will it make to the soundscape if the number of people involved in the activity is reduced? How can we structure the activity in order to make the soundscape manageable? Having this perspective when planning activities in school would benefit not only pupils with blindness, but other groups of pupils as well.

More recent investigations show that the acoustics in Swedish school premises are generally poor, and the problems relating to sound environment in schools and preschools should be prioritised (Dellve et al. 2013; Gustafsson, 2009; HRF, 2010; Sahlgrenska Academy at the University of Gothenburg, 2011). At this juncture it is of the utmost importance to also take pupils with visual impairment into consideration as they are not mentioned anywhere in these documents. Bearing in mind that the sound environment is so important and central to these pupils’ opportunities to participate in school, it is astonishing that they are not included in the discourse concerning the design of sound environments in
schools and preschools. In this respect, I hope that this study can make a contribution and spark an interest in a subject that needs to be highlighted and studied further.

It sometimes happens that pupils with blindness are separated from the collective context in a desire to create a better sound environment for them; this does not promote participation. For example, placing the pupil in a special dining hall, separated from the class, or with an assistant in a group room in order for the pupil to have a quieter environment may increase the risk of marginalisation and exclusion in the long run. Co-activity is an aspect of participation that has proven to be very important, and which has an impact on several other participation aspects such as recognition and involvement (SPSM, 2012; Söderqvist Dunkers, 2011). Separate solutions and lack of co-activity in particular has been shown to have negative consequences for recognition in the peer-group culture. It sends out negative signals to the rest of the class that the pupil is special and not part of the group. This is also something the pupils are aware of themselves, and they talk about this in interviews, both in this study and in the aforementioned R&D report *Där man söker får man svar* [Answers are found where you are looking] (SPSM, 2012). The pupils state that being allowed to be and feel part of the group is very important and something that schools should aim for. Consequently, the challenge with respect to the design of sound environments lies in creating good conditions that work for everyone. Research and experience indicate that comprehensive solutions that are beneficial to pupils with blindness would also benefit many other groups of pupils, such as pupils with impaired hearing, neuropsychiatric functional impairments and those for whom Swedish is a second language (Gustafsson, 2009; Lewin & Nyman, 2011; Sahlgrenska Academy at the University of Gothenburg, 2011). This applies to organisational structure and educational solutions, as well as the design of premises.

Dellve et al. (2013) demonstrate the connection between how comprehensible and manageable sound environments are to preschool children and their level of stress. This a qualitative study conducted on sighted children in Swedish preschools. Aside from measures in the physical environment, they propose that one way to reduce children’s frustration could be to clarify in a simple way the origin and occurrence of sound sources, as well as strategies for alleviating everyday sound. This would also increase awareness of the sound environment and make it more manageable for both children and staff in preschools. Such measures would also benefit children with visual impairment, partly to create a greater focus among the sighted people around them, thus creating a shared focus (Janson, 2001), but also to help children with blindness connect sounds to their source and function (Fraiberg, 1977).

In this study it has also become clear that an environment that is too quiet is not a usable environment either. Each of the pupils highlights the importance of having sound around them and how difficult it can become when it is completely silent. Silence is perceived as a vacuum in which there is no information, for example about who is there, how they are reacting, where they are or what is happening. Thus we can see that a usable sound environment should not have background noise that is too loud and forms an obstructive carpet of sound. But neither should it be too quiet so that there is no information at all. The louder the background noise is, the harder it is to experience the room. Perhaps it is only possible to distinguish important sounds that are less than a metre away. If the carpet of sound is very loud, spatial perception and the judgement of distance can be difficult as echoes from walls and objects cannot be heard.
6.3 What information does the pupil receive in the classroom?

One phenomenon worth considering, which is of value in special needs education, is the question of what information the pupil actually receives in a situation and how this differs from that given to sighted people around them. What can actually be distinguished aurally right now? If I close my eyes, what information do I receive and how can I use it? What information in this situation is only visual? These may be important educational questions. A clear lack of information for the pupil with blindness appears in several teaching situations in the study, at the same time as there is a certain general lack of awareness on the part of the educator about what the situation is actually like for the pupil.

One example is the observation excerpt (p. 31) from a lesson in Year 1, in which the teacher draws on the board and communicates with the class. Aside from the prevailing lack of verbal information from the teacher, the entire teaching situation is exclusionary as the teacher talks about what the pupils see. The presentation on the board was to function as a go-through for the group exercise they would be doing immediately after, but the information was not accessible to the pupil. Even if the ambition is to say what is written on the board or what is shown in pictures, it seems to be difficult for the sighted teacher or presenter to separate their impressions and the verbalised information is therefore not equivalent to that received by the sighted pupils. The auditory information often becomes fragmentary and out of context. This does not reflect unwillingness on the part of the educator, rather it appears, quite simply, to be very difficult to conceptualise what the situation is like when reduced to only the auditory aspects. One possible explanation is that vision is so dominant a sense for those who see, which means that visual impression constantly take over and get prioritised. All the information the visual impressions provide comes so natural to the sighted, and it is difficult to reflect on exactly what it conveys as a whole. Many parts of this information are forgotten in the verbalisation. Aside from what is shown in text and images on the board, this may involve the structure and format of what is being conveyed and emotional and aesthetic expressions. The exposure time of that which is conveyed and the opportunity to gain an overview are also important factors to reflect on, which is discussed below. What is remarkable here are the results indicating that teachers change the verbal information they provide when no visual information exists, for example on the board, as everyone is dependent on verbal information. Shared focus is then placed on what is said and the information does not become fragmentary. In certain situations in this study, it can also be presumed that the teaching element is not well thought-out in advance on the basis of there being a pupil with blindness in the class. If the pupil in the example mentioned above had been given tactile images, the conditions would have been more equal.

This observation is only a small episode on one school day, but it can still be valuable to look more closely at it as the situation is fairly common and possible recurs on a daily basis for many pupils with blindness. What does this lack of information do to the pupil and what are the potential consequences? Here, the pupil’s "main concern" is to listen and attempt to understand based on the auditory information available. The pupil wants to perform well in school and she listens actively. She also wants to work with others and be part of the group like the other classmates, which she mentions several times in the interview. In addition to the pupil in this case missing out on the message the teacher wants to convey, she is also excluded from the social interaction taking place in the classroom. The pupil has an auditory focus, while the focus of the teacher and the rest of the class is visual. They communicate regarding what they see on the board, comment on and react to what is drawn, but the social and educational context is not accessible to the pupil with blindness. The lack of information
makes her passive, incapable of performing as she wants to by proving her capability to herself, the class and the teacher. They are gathered around a common piece of informational content that the pupil does not have access to, which can be detrimental to recognition in the group. If similar situations occur frequently, it may be relevant to ask how this affects her self-image. As has been mentioned, research shows that discrimination and a low level of co-activity has consequences in the peer-group culture and increases the risk of marginalisation (SPSM, 2012; Söderqvist Dunkers, 2011). The pupil also say in the interview that the situation was difficult because she cannot see, i.e. she lays the blame on her disability.

Another phenomenon that becomes clear in several teaching situations in the study is the auditory medium’s "weaknesses" compared with the visual and tactile media in terms of access to the informational content. Even if what is written or shown on the board/screen is verbalised, the degree of information cannot be compared with seeing the text or the image or having it under the fingers in a tactile format. The auditory medium is transient and the information only exists here and now in the moment if it is not stored in the memory. Text and images often remain for a longer time, i.e. the exposure time is longer for the recipient. There is the opportunity to go back to the text and the senses can take in and process the information in another way. Moreover, verbal information is linear and sequential as opposed to visual text or images, where a complete field of information can be taken in at the same time. This provides completely different prerequisites for overview and structure. This become clear in the excerpt of an observation from a lesson in Year 5 (p. 33) when the teacher writes important terms and questions on the board for the pupils to then discuss in pairs. The teacher reads what is there, but the pupil is not able to note it down and she does not have the terms and the questions in braille. The other pupils can read the terms and questions on the interactive whiteboard while the teacher is talking. They can read them over and over again, compare them, connect them and get an overview. In addition, they are confident because the information will remain on the board while they are working in pairs. During the work in pairs, the pupil with blindness becomes dependent on their classmate reading the terms and questions for her and she has not had any time to think about them in advance. Accordingly, the auditory medium is not sufficient in this situation, despite the teacher being verbal.

Here we can also see that the inadequate accessibility in the situation leads to a low degree of autonomy as the pupil is dependent on their classmate and does not have the same opportunities to control and influence the situation. The degree of recognition and involvement can also be lower because the lack of information makes it difficult for the pupil to contribute to the work in pairs. If the pupil had been given the text in braille or had it on the braille display in front of her, the conditions would have been more equal.

The phenomena described above can be summarised as follows:

- It is difficult to verbalise visual information in an equal way.
- The auditory medium differs from the visual and tactile media with respect to perception and processing.

On this basis, certain conclusions can be drawn concerning what can promote participation in teaching for pupils with blindness. One conclusion is that verbal information cannot replace text when others receive text. In certain situations, this may be the only possibility at the time, but there must then be an awareness of the differences and their consequences. Well-thought-out educational formats based on either verbal information for all or the pupil receiving braille and tactile materials when the others are presented with visual text and images appear to be most beneficial to the pupils’ participation. A
combination of both of these formats is used in many well-functioning teaching situations. This conclusion also supports previous research indicating the value of braille in teaching (Rex, 1994; Fellenius, 1999b; Vik, 2010).

6.4 Double auditory focus in the classroom

One specific problem in teaching that is made clear and described by the pupils involves instances when they are subjected to requirements to take in verbal information from two sources at the same time. As it appeared in the analysis of the empirical data that this is something that recurs relatively often, and it is a situation that all the pupils find stressful and difficult to manage, a category which I call double auditory focus was created. Difficult situations that are described are:

- verbal description when the voices clash.
- synthetic speech/computer navigation at the same time as group work or when the teacher is going over something.
- writing on a computer with synthetic speech support at the same time as having to listen to the teacher or others,
- working on something else when the teacher is going over something with the rest of the class.

This can be compared with studies describing what is known as the cocktail party effect (Cherry 1953, Wood & Cowan 1995). The cocktail party effect refers to the ability to focus your auditory attention on a conversation in a room in which many conversations are taking place at the same time. In clinical studies, experimental subjects have been subjected to different verbal messages in either ear at the same time. These studies all show that it is not possible for anyone to interpret and process two semantic messages at the same time. This may explain the pupils’ frustration when they, for example, have to deal with the teacher’s message at the front by the board at the same time as the message from synthetic speech in their headphones, or the speech on the film at the same time as someone beside them is providing a verbal description. Furthermore, various studies looking at the ability to multitask show that the brain cannot deal with several cognitively demanding tasks at the same time (Klingberg, 2007). The brain then shifts attention between tasks, which takes time and reduces the capacity. Here, the pupils’ frustration is also due to them missing out on important information in the lesson because of this.

Conway, Cowan and Bunting (2001) have conducted further research into the cocktail party effect and have found that the ability to consciously focus your attention and block out irrelevant information is connected to working memory. People with a good working memory capacity find it easier to block irrelevant information while those with poorer working memory are more easily distracted. Controlling our attention thus requires working memory, as we have to remember and retain that which we have to concentrate on (Klingberg, 2007). In this context it is also interesting that the working memory is not fully developed until people reach their twenties (ibid.).

Based on the above reasoning and the results of this study, there is reason to believe that a great deal of working memory is required by pupils with blindness in many teaching situations to compensate for their loss of sight. People with blindness often have a more developed verbal working memory that those who are sighted (Withagen & Kappers, 2013). But this study shows that situations involving obvious double auditory focus become impossible to manage, regardless of age and ability.
A study by Gisselgård, Petersson and Ingvar (2004) deals with the phenomenon of "the irrelevant speech effect", which describes how background noise in the form of irrelevant speech disrupts the ability to carry out tasks that place demand on the memory. They found that the serial, verbal/phonological working memory becomes worse when you are disturbed by spoken information specifically.

Simply listening for information also requires more working memory compared with having it on paper or the board. The essential difference is that written text and images remain, and it is relatively easy to go back and go over them again. You can choose yourself to change focus whenever you need to. Auditory information must be stored in the working memory in order to be interpreted and is more difficult to go over again. In many situations, such as conversations, film lectures or other types of presentation, view helps to maintain focus on the relevant message. Thus, it is harder for those who cannot see to turn off the irrelevant auditory information as they are dependent on it in a way that is different from those who are sighted. In other words, that which may be considered irrelevant can, quite simply, be extremely relevant to people with blindness as information about their surroundings.

It may be important to make educators aware of the difficulties of double auditory focus for these pupils, and that adapting material, planning and structure of teaching elements takes place in such a way that situations involving double auditory focus are avoided to the extent possible. The significance of braille has previously been demonstrated in a considerable body of research (Fellenius, 1999a; Rex, 1994). In this context the importance of reducing double auditory focus for pupils with blindness becomes even clearer. However, it should be noted that the spoken medium, for example computer synthetic speech, is often an important and essential complement in teaching (Vik, 2008).

In the observation example (p. 40) from a maths lesson in Year 1, it becomes clear that the pupil’s capability decreases when she is expected to work on her own exercise at the same time as the teacher is going through something on the board with the rest of the class. This is entirely understandable given the research into multitasking, working memory and verbal distraction mentioned previously. The pupil is 8 years old and the teacher and her classmates are talking about pictures of buns and birthdays, which naturally draws her attention. In addition to the problem of double auditory focus, such situations are also exclusionary given that the rest of the class are in one group involved in co-activity in which the pupils is not expected to participate. Again, we could ask ourselves what signals this, probably unconscious, discrimination sends to the classmates. That the pupil is different and the only one who does other things?

All of the pupils in the study want to hear sounds from the class, sit in with the class, be involved when the class is going through something and receive open verbal descriptions from the teacher directly in order to "be included" (co-activity). Accordingly, it is important in this context to point out that the pupils do not want to isolate themselves with headphones or in separate rooms, even though this may sometimes be necessary. The connection between activity structure and double auditory focus (Fig. 2) is clear, and it shows that, by arranging the activity correctly, it is possible to avoid subjecting the pupil to difficult situations involving double auditory focus. A format in which everyone goes through a problem together and then work independently or in small groups with support from the teacher is a solution that can be used to avoid double auditory focus. This requires reasonably good advance planning and the pupil being given material and other support in advance so that they are able to keep up when the class is going through the subject.

The educational implications of the above suggestion could be offering braille in each element in which the rest of the pupils are presented with text, for example text on the board, overhead
presentations, books or papers. One flexible solution here may be for the teacher/special needs teacher to have an extra keyboard for the pupil’s computer if it is not possible to adapt the materials in advance. The pupil will then instantly receive what is written on the board on the braille display.\(^2\)

Open verbal description, i.e. for the teacher or the person speaking to provide a verbal description themselves, openly to everyone instead of a person sitting and whispering beside the pupil, may also be a solution for avoiding auditory clashes and for increased participation and avoiding discriminatory solutions. One of the pupils in the study also wished for the films shown in lessons to have a pre-recorded audio description inserted into the film, which is done on some commercial motion pictures. The pupils are aware that it is very difficult for the teacher to provide a verbal description of a film as it involves interjecting important information into the gaps in the dialogue. One possible solution would be for pre-recorded audio descriptions to be regarded as an adaptation of teaching materials.

One reasonable consequence may also be for keyboard training to be prioritised as early as possible in order to make it easier for the pupil to write without synthetic speech support. Without the synthetic speech, the pupil becomes "more free" to communicate in situations where they have to write while listening to other people. This may involve situations where they are working in a group as well as making notes while the teacher is talking. The study also indicates that braille digital note-taking assistants are easier to use and navigate without synthetic speech than computers, which makes it easier in many teaching situations in the same way as described above. Knowing this makes it possible to understand the significance of providing an opportunity to use digital note-taking assistants as a complement to the computer. Finally, the pupil should be included when the teacher is going through something with the class and not be expected to work on something else while the teacher is presenting something to the rest of the class.

### 6.5 Recognising people and learning voices

It may be of great value to the field of special needs education to look more closely at the phenomenon of voice recognition. In this context, the field may be divided into two parts; the pupils’ opportunities to learn the voices of their peers, and their opportunities to then distinguish them in the various environments and activities in school. We know that the situation in terms of social participation for pupils with blindness in school has been, and remains, problematic. Research indicates that isolation and marginalisation are relatively widespread (Brown, Packer & Passmore, 2013; Janson, 1996; McGaha & Farran 2001; SPSM 2012; Svensson, 1988; Söderqvist Dunkers, 2006, 2011; Vik, 2010; Warren, 1984, 1994; Webster & Roe, 1998). Many pupils mention that it is difficult to find their friends and enter into interactions in schools and after-school recreation centres. There are many reasons for this, but recognising people may be an important piece of the puzzle in this context. People are identified mainly by their voices. In familiar company and smaller groups it is considered to be less problematic for the pupils, but it has nonetheless proven difficult to both learn voices and, above all, distinguish them from a crowd in many of the large and complex environments in school.

Knowing who you have around you is a self-evident basis for social interaction and when this becomes problematic in various situations, there are of course consequences. Therefore, voice recognition should be something that educators and staff in school should pay attention to and become aware of.

One aspect is that the pupils can feel "awkward" when they do not recognise people and thus prefer not to ask. There is some form of expectation in those around us that we should be able to recognise

\(^2\) A braille display can be used to read the information shown on the computer screen in braille.
them, particularly after a long period. Sighted people probably believe this is easier than it actually is. This is a quick process visually and it is often enough to have seen a person once or twice in order to recognise them. However, a voice often has to be heard many times before it can be recognised and distinguished from a large number of voices. This may involve subtle differences in tone and intonation and the full character of the voice only appears after some time. It is clear that it is much harder to learn some voices than others. This can be a sensitive subject to discuss as it may be perceived a personal insult. The pupils have taken several months to learn to recognise some voices, while others become distinctive immediately. But they prefer not to talk about this. The voice is an aspect of someone’s personality and potentially more intimate than their appearance.

Based on this study, it appears that age is not decisive in the ability to recognise voices. One possible explanation may be that the ability itself is so fundamental and is something that develops early in childhood. Research indicates that by the age of one month, children with blindness can already discriminate between their parents’ voices and those of other family members or acquaintances (Warren, 1994). The parent-child relationship is based on close contact and the child hears their voices a lot. These studies have probably also been conducted in a quiet home environment with a small number of people in the room, which are the most beneficial circumstances possible for discrimination. The situation in school is completely different, and it becomes clear how important context is to the opportunity for both learning voices and discriminating between them. All of the pupils appear to have this ability, but each of them talk about how it is the degree of personal contact and direct conversation that is decisive when it comes to learning voices well. They are all also dependent on a good sound environment and a comprehensible structure.

What then can be done practically to assist the learning of voices in schools? Pupils in the study state that work in pairs and friend interviews are good ways to learn to recognise voices and connect the voice to the person. This may make it easier for a pupil with visual impairment in a new class or group to become involved socially and get to know their peers. The sooner the pupil is able to distinguish and recognise voices and feel confident in their ability to do this, the less risk there is of exclusion and marginalisation. These results can be compared with the results from a study (SPSM, 2009) in which teachers rated work in pairs as the form of work in the classroom that pupils who read braille were felt to participate most in.

In general, it seems that educational formats and forms of teaching in which the pupil with visual impairment is exposed to the voices of their peers under accessible, structured conditions and in small groups is beneficial to the learning of voices.

In this study, it is possible to see a connection between pupils’ knowledge of their classmates and the teachers’ consistency in terms of naming. In other words, it is beneficial to say the name of the person who is being given permission to speak in the classroom or who is included in the group or the activity.

It can also be an important step to increase the awareness of educators and staff that this takes time, and that they need to be consistent in terms of saying the names of pupils in order to reinforce the process of connecting the right person to the voice. It is also important to ensure that the pupils in the class are allowed to have their say and introduce themselves, and in return get to know something about their classmates, making it easier to put a person to the voice. Knowing something about each other is also important to the opportunity to create further contact, for example at break time (Söderqvist Dunkers, 2011). One pupil in the study also talks about the value of having had someone provide verbal descriptions of their classmates that is not directly linked to the lesson – things that
everyone can see, but that are not talked about. When in a new context, this can be very valuable in helping to more quickly connect personalities to names and voices.

Different forms of teaching provide different soundscapes for the pupil and thus different types of information. At this juncture it can be important to differentiate between sound that provides information about activity in general in the group and sound that also provides information about who is doing something and where. Many of the classroom sounds the pupils perceive during quiet, independent work in the classroom are unspecific activity sounds, i.e. they do not know who is rustling, creaking, writing, etc. One pupil says that "it's only when they talk that I know who it is".

A couple of the pupils do not recognise all of their classmates’ voices and do not really know who is sitting where in the classroom. A contributory cause of this may be that a common method of working in these classes is independent work in silence. This situation does not provide any information about people, voices, personalities or mood, and thus reduces the chances of connecting voice to person and personality. It may be the case that a lot of independent work in the classroom makes the process of learning to recognise classmates and discriminate between their voices and character traits more difficult. A higher proportion of group work, in which pupils are divided into groups by adults, so that everyone has the opportunity to work with all of their classmates, probably makes this process easier (SPSM, 2009, 2012).

If we now turn to the ability to distinguish the voices of peers in various activities throughout the school day, the situations is different. In many observations in the study it appears that regardless of how well the pupil knows their peers’ voices, it is still not possible to distinguish them in many of school environments, except at close quarters, because of the high sound levels. These difficult environments are, as has been mentioned, also the ones specifically intended for social interaction. This mainly concerns dining halls, after-school recreation centres and corridors; places where there are a lot of people. Of course, the problem distinguishing voices becomes a barrier to the opportunity for interaction and participation in these environments. Aside from the high sound levels, the problem here is also the supply of voices that makes it more difficult to know who is who. The exclusion method is used to recognise voices, particularly when there is a little uncertainty. In a restricted environment such as the classroom, working out who is talking may be easy because perhaps there are no similar voices in the room. But in a dining hall or corridor, for example, the large supply means that many voices may appear similar. A third aggravating circumstance during break time and play situations is that the activity is often relatively unstructured, creating a confusing soundscape for those who do not see.

The data indicates that a surprisingly large proportion of the sounds offered to pupils with blindness over the course of a school day is categorised as non-person-specific activity. A large proportion of what is happening can usually be heard – all the different activities have characteristic sounds that are easy for the pupils to recognise. The problem lies in hearing who is doing the activity. Writing sounds, bags being opened and closed, people walking and pulling chairs and sitting, etc. are easy to identify. But, compared to the sighted, this information is significantly more anonymous. The people involved become like a mass of indeterminate people. Many younger children I have talked with often refer to their preschool peers/classmates as “the children”. This is understandable given that such a large proportion of the sound environment is made up of only non-person-specific information.

The process of learning voices itself also becomes difficult in environments that are too loud and "confusing". It appears in this study that the after-school recreation centre situations are consistently inaccessible with respect to the sound environment. The pupils think it is hard to hear and to know
where people are and what they are doing. They do not feel they are participating much and you can see in the observations made that the degree of co-activity is low or non-existent, which also makes the pupil’s level of involvement low. They do not think that after-school recreation centres are particularly fun. In these environments, it is possible to imagine that the process of learning voices, and even understanding and connecting sounds with their source, has not even begun. If there has been a constant carpet of sound from which not much can be distinguished, this process is not possible. The situation then continues to be relatively incomprehensible and anonymous. The pupils are in danger of getting ending up passive, excluded and dependent on adult support. One interesting question that may be a subject for further study is how this anonymity in preschool and school environments affects the children’s emotional development and opportunities to understand and learn social interaction.

The sound environment in the dining hall is also perceived by the majority of the pupils in the study to be very difficult. It is a great obstacle in terms of accessing the social and educational context and the opportunity to participate. High sound levels in school dining halls are a widespread problem affecting many people. A recently published report from the Swedish Association of Local Authorities and Regions (SALAR), in which 560 compulsory schools in 156 municipalities participated in an investigation of the dining hall environment, described how 41% of the schools feel the sound environment is a problem (Lewin & Nyman, 2011). In its report Kakafonien [The Cacophony] (2010), the Swedish Association for Hard of Hearing People (HRF) writes that school dining halls are known for having "something approaching infernal sound environments” (HRF, 2010, p. 62) and that the sound levels in dining halls and common rooms can exceed 80 decibels, i.e. the level at which there is a legal obligation to make hearing protection available (Swedish National Board of Health and Welfare, 2009). The HRF specifically highlights the difficulties this entails for pupils with hearing impairment and this study also shows that pupils with visual impairment are seriously affected by the inaccessible sound environment.

Knowing this, it is not particularly difficult to understand why the pupils in the study have problems finding people and initiating contact in school. What opportunities are we actually offering to the pupils? What chances are given to be active and instigate contact? What could be done in school to improve the pupils’ opportunities to recognise people in these difficult environments?

- In this study, assigned seating in the dining hall has proven to be helpful in creating opportunities to get in contact with and talk to peers, which in turn may also lead to further play at break times. The two youngest pupils in the study have assigned seating, while the older ones do not. A lack of assigned seating increases the risk of exclusion if they do not have a friend or a group they usually socialise with. If you do not have a friend, you have to turn to staff as you cannot take the initiative yourself due to a lack of information in the environment. Assigned seating at lower and upper secondary school would make things easier, provided that it applied to all, not just the pupil’s class. A separate solution for some would presumably create irritation among the pupil’s peers and be detrimental to the pupil’s chances of being admitted to the peer-group culture.

- Screening off areas of the dining hall with sound-absorbing screens in order to create smaller spaces within the hall (Lewin & Nyman, 2011) in order to reduce the sound level and create smaller groups in which the supply of voices is lower would make voice recognition easier. This is also something the pupils themselves talk about in this study. A logical system of sound-absorbing screens would potentially make it easier for the pupils to orient themselves and find their seat. Smaller spaces and screened-off areas would also make social interaction easier in the after-school recreation centre environment.
Organising activities in a way that offers accessible, guided activities in small groups would make the auditory environment at after-school recreation centres and during break times easier.

Increasing awareness of the significance of sound and sound environments among staff and pupils is something that is also emphasised by Dellve et al. (2013), as well as in the reports from the SALAR and the HRF mentioned previously.

Setting up meeting points in schools at which pupils with the same interests can meet would make things easier, considering that it has proven difficult to find people and actively choose friends in a school environment.

6.6 Shared focus

In order for interaction between people to come about, there needs to be some degree of shared focus for their actions (Janson, 2001). It appears in this study that there is sometimes a concern and an uncertainty among pupils with blindness about which focus applies; auditory or visual. What focus am I allowed to have and what focus do others have? How much am I allowed to hear and how much do others hear? Does everyone hear what I hear now or do the sighted people around me not even think about it? Is the sound I’m making now disruptive? These are questions the pupils ask themselves. The pupils have an auditory focus that is constantly turned on, which is natural for them and also necessary in order to keep up and participate. They hear and register a great deal aurally. Even small details that others do or say. But knowing in what way sighted people perceive situations and what is socially acceptable in the peer-group culture is difficult. This uncertainty about the reactions of those around you is largely based on a lack of socio-communicative accessibility (Janson, 2005). Much of what takes place in interactions between sighted people is based on visual communication such as body language and facial expressions. Without sight it can be difficult to learn about what other people like or dislike or if someone is listening or not (Söderqvist Dunkers, 2011), as well as how much you are allowed to listen to others. On several occasions in this study, the pupils mention that they feel they are "eavesdropping" when they hear what other people are talking about. In the quote (p. 43) about a corridor situation it becomes clear how this uncertainty about what focus you are allowed to have creates problems in terms of access to social interaction. The pupil in this example thinks it is bad to listen to what others are talking about in the corridor and that when this happens it should be done furtively. What do the sighted classmates do? You stand at a reasonable distance and acquire a perception of what is happening before joining in and making a contribution (Garvey, 1984). Consequently, at this juncture, it is possible to imagine that this is some form of misunderstanding about what is regarded as acceptable in the peer-group culture.

Another aspect is that sighted peers may also be uncertain about what focus unsighted people have. It is not possible to see where someone is directing their hearing as it is with their gaze. And sometimes the body language of the unsighted is perhaps misinterpreted or difficult to interpret. Sighted peers possibly believe that that the pupil with blindness is not interested in joining the interaction.

The pupils in the study want both to understand the focus of those around them and for those around them to understand their focus and how much they actually hear.

Given this desire, it may be important to increase awareness of the pupils’ auditory focus and attempt to get an idea of what this can involve in various situations. On the other hand, it is also important to
try and describe the focus of the surrounding sighted people to those who cannot see, and provide verbal description of activities and the reactions of those around them.

Language and experiences are central to children’s conceptual learning and abstract thinking (Klingenberg, 2008; Valberg, 2008). Swedish has plenty of words to describe visual concepts but significantly fewer words and expressions to describe auditory phenomena. This may be linked to the fact that vision is, and has been, so dominant for human beings and our language often relates to what we see. This can reinforce the blind pupils’ feelings of having an alternative focus. One pupil’s comment – "If you say that you hear the walls, people don’t understand at all" – illustrates this precisely. In reality, it is possible also for sighted people to hear when they get close to a wall (Rosenblum, Gordon & Jarguin, 2000), but as it is not necessary their hearing is not used for this purpose. They can see the walls. Everyday life may contain plenty of examples such as this and an increase awareness of the pupils’ auditory focus and capability may also be very valuable here. It has also not generally been easy for the pupils to describe their perceptions of sound. This is especially true of the younger pupils. The lack of auditory expression in Swedish may partly explain this.

Understanding focus in activities also involves perceiving the direction of communication. Sounds have a tendency to merge together. It is appreciably easier to specify and delineate visual impressions than auditory impressions (Gibson, 1969). Vision helps to both provide information and maintain focus. But for those who do not see, direction and delineation of everything communicates at the same time in the room is difficult, which can make maintaining focus and understanding the social and educational context difficult. In, for example, an after-school recreation centre or preschool that consists of one room in which many children are playing and many activities are taking place at the same time in different parts of the room, it is difficult to work out what belongs to what and who is talking to whom with only hearing. Small children sometimes learn through imitation (Fraiberg, 1977; Webster & Roe, 1998) and children without sight will imitate much of what they hear. They respond to their surroundings just as sighted children do. But sometimes the child perhaps responds to something they hear in another part of the room or behind their back – communication that is not directed towards the child. If there are too many parallel activities taking place in one room it can be difficult for the child to understand and structure the social contexts, which can have various consequences, for example that the child becomes a passive listener, shuts down and turns introverted, develops an excessive need for control or displays stereotypical behaviours or acts out (Warren, 1994). There is also a danger here that those around the child misunderstand the causes of these behaviours and interprets them as signs of autism or other neuropsychiatric functional impairments, when the problem can be the result of the social and educational context not being comprehensible due to a confusing sound environment. Taking the research into the cocktail party effect, working memory and distraction mentioned previously into account, together with the results of this study, it may be important to discuss how the environments and situations intended for play and interactions offered to children with blindness at school and preschool are structured.

It is also very important that people who meet children with visual impairment as part of their work have a knowledge and an understanding of the significance sound has to how they experience and take in the world. Hearing what the children hear and sharing this experience is one way to establish shared focus.
6.7 Proposals for further research

There are several examples in this study of how the sound environment can make social interaction more difficult for pupils with blindness because of, for example, problems identifying people and activities. The information children gain from their surroundings has been shown to be significantly more anonymous for pupils with blindness than for sighted children. Preschool is an important arena in which social interaction is established. Consequently, it would be interesting to study how this anonymity affects preschool children’s emotional development and opportunities to understand and learn social interaction in these sound environments. This is where the theoretical model (Fig. 2) may be of assistance to understanding auditory accessibility and the various identification processes that are required to gain access to the social and educational context.

Furthermore, there is a need for longitudinal studies of children’s learning of sounds, voices and sound environments, as well as how these learning processes function with respect to, for example, recognising people, conceptual learning, automated perception, etc. The theoretical model (Fig. 2) may also be helpful here in order to understand how children’s recognition of people works and is developed in the sound environments they encounter.

Another theme that needs to be studied involves looking specifically at teachers’ verbalisation in lessons. This is where it is particularly interesting to compare the information the pupil with visual impairment receives in different teaching elements with that received by their sighted peers, as well as studying how educational format and assistive technology can affect teaching situations given the difficulties of double auditory focus.

It would also be interesting to look into how environments and spaces can be structured and designed in order to achieve a more aurally accessible preschool and school environment for children with visual impairment.

The format of these proposed studies will have to be left as a challenge for further research.
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sound environment in preschools and schools: noise reduction requirements on rooms and construction and furnishing materials]. Gothenburg: Occupational and Environmental Medicine Unit, Department of Public Health and Community Medicine, Sahlgrenska Academy, University of Gothenburg


SFS 2010:800 Swedish Education Act.


**Electronic sources**

[http://www.socialstyrelsen.se/funktionshinder/fn](http://www.socialstyrelsen.se/funktionshinder/fn) (checked 02/05/2014)

[http://unicef.se/barnkonventionen](http://unicef.se/barnkonventionen) (checked 02/05/2014)
Appendices

Appendix 1 – Descriptions of Images

**Figure 1 Conditions for participation are created in social processes**
In the middle there is a box with the text "activity". To its left there is the text "Individual prerequisites" with an arrow pointing to the activity box. To the right of the box is the text "Surroundings factors/activity requirements" with an arrow pointing into the activity box. An arrow goes from the activity box down to the text "Participation or marginalisation". Below the text "Individual prerequisites" is the text "Individual qualities" with a bidirectional arrow between them. Below the text "Surroundings factors/the activity’s requirements" is the text "barriers" with a bidirectional arrow between them.

**Figure 2 Auditory accessibility for opportunities to participate (the main model)**
The upper part of the image consists of the field "Sound environment". The upper row contains the field "Sound sources" with two light-blue boxes beside one another: "verbal information" and "other auditory information".

Below this, in the field "Sound environment", there are three grey round circles/buttons: "supply", "activity structure" and "room acoustics/reflected sound".

Below this field is a horizontal, dashed line right across the page. This acts as a dividing line between the upper, environmental part of the model and the lower part containing the individual’s cognitive processes and various identification processes.

Below the line there is the field "Soundscape" with orange circles containing the cognitive processes "experience", "inference" and "stimulus/motivation". Below them is a large blue oval containing six small ovals with the identification processes: "Identifying activity and tempo", "Identifying people", "Identifying room and direction", "Auditory focus", "Identifying atmosphere/feeling" and "Identifying informational content".

Below the field "Soundscape" is a light-green box containing the text: "Access to the social and educational context".

At the very bottom is a pink oval containing the text: "Opportunity to participate".

Between the various fields are bidirectional arrows showing that the factors and processes affect one another in both directions.

**Image descriptions for the mini models**
The mini models are made up of the same boxes and circles as the large model, Figure 2. They are arranged in a row from left to right with arrows pointing right in between. The first box leads to the next and so forth. The figure can be thought of as like a pearl necklace.

**Figure 3**
Mini model 1: 1 Sound sources Verbal information + other auditory information – 2 sound environment with activity structure/supply/room acoustics – 3 the identification processes – 4 access to the social and educational context

**Figure 4**
Mini model 2: 1 Other auditory information – 2 experience – 3 identifying room and direction – 4 access to the social and educational context

**Figure 5**

Mini model 3: 1 verbal information – 2 identifying informational content – 3 access to the social and educational context

**Figure 6**

Mini model 4: 1 verbal information – 2 identifying activity and tempo – 3 access to the social and educational context

**Figure 7**

Mini model 5: 1 verbal information – 2 identifying atmosphere/feeling – 3 access to the social and educational context

**Figure 8**

Mini model 6: 1 Verbal information – 2 activity structure – 3 auditory focus – 4 identifying informational content – access to the social and educational context

**Figure 9**

Mini model 7: 1 Sound sources Verbal information + other auditory information – 2 sound environment with activity structure + supply + room acoustics – 3 auditory focus + identifying room and direction – 4 Access to the social and educational context

**Figure 10**

Mini model 8: 1 Sound environment factors Supply + activity structure + room acoustics – 2 experience + exclusion/inference – 3 identifying direction – 4 access to the social and educational context

**Figure 11**

Mini model 9: 1 Sound environment with supply + activity structure + room acoustics – 2 identifying people – 3 access to the social and educational context –

**Figure 12**

Mini model 10: 1 Other auditory information – 2 supply – 3 exclusion/inference – 4 identifying people – 5 access to the social and educational context

**Figure 13**

Mini model 11: 1 other auditory information – 2 identifying tempo – 3 access to the social and educational context
Appendix 2 – Letters

Stockholm, 15 Feb 2013

Information for parents

My name is Sara Backström Lindeberg. I’m currently attending the Master’s Programme in Special Needs Education at Stockholm University. I also work as a music teacher at Resurscenter syn, at the SPSM in Stockholm. Over the course of 2013, my studies will involve an investigation of how visually impaired children experience and use sound during school activities. The aim of the study is to reveal how usable different sound environments are for severely visually impaired/pupils with blindness during school activities. I also want to investigate how sound functions as a source of information for these pupils, allowing them to access and understand what is happening in both social and educational situations.

Because I myself am visually impaired, I constantly use the sounds around me to get a handle on what is happening. Therefore, I’m curious about what visually impaired children and young people do and how they experience different sound environments in school. I think that the children’s experiences can contribute to new and important knowledge in this area. Being part of the investigation involves absolutely no preparations or effort on the part of the children and young people.

I will be visiting the child/young person in school and be with them for a portion of their school day or an entire day. A sighted colleague from Rc syn will accompany me on the visit. On a few short occasions during the day I, together with the child/young person, will stop and listen to the sounds around us and then talk about what we hear. I also want to conduct a longer interview with the child/young person (30–45 min.) following the end of the school day, or at another suitable time, in order to talk a little more about sound and sound impressions. I will be recording the interviews on a sound recorder.

Naturally, the children/young people will be completely anonymous in the study. All names, names of schools, names of places, etc. will be changed. The recordings will be stored so that no one other myself will be able to listen to them and they will be erased following the end of the study. I want to emphasise that participation is completely voluntary and that you or the children/young people may withdraw at any time. When the paper is ready it will probably be available to read on the SPSM and Stockholm University websites for those who are interested.

I would be very grateful if your child wants to participate in the study. This requires your written consent as guardian. You can either email this to sara.backstrom-lindeberg@spsm.se or send the counterfoil in the enclosed return envelope. Please let me know if you have any questions.

I have also written a separate letter to the children/young people themselves. I hope that you will read this together with the child/young person.

Yours sincerely,

Sara Backström Lindeberg

Sara Backström Lindeberg
Phone: 0730 711 668
Email: sara.backstrom-lindeberg@spsm.se
Address
Sara Backström Lindeberg
Swedish National Agency for Special Needs Education and Schools
Resurscenter syn
Box 121 61
102 26 Stockholm

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Counterfoil

I consent to my child participating in Sara Backström Lindeberg’s sound study.

Child’s name:

Guardian’s signature
Hi!

My name is Sara Backström Lindeberg and I work as a music teacher at Resurscenter syn. I want to conduct a little investigation about sound and I wonder if you would like to join me?

Because I can’t see myself, I use the sounds around me all the time to get a handle on what is happening. I’m curious to know about what you and other visually impaired children and young people do and what the sound environments are like in your school. I think that there are a lot of exciting things we can talk about. Joining the investigation is voluntary and you don’t need to prepare or be good at anything in particular.

If you choose to take part, this is what will happen:
The investigation will take place during a half or a full day at your school. A sighted colleague of mine from Rc syn will also be there. For a few short periods during the day you and I will stop and listen together and then talk about what we hear. I also want to interview you for a bit longer (30–45 min.) at the end of school (or some other time) to talk more about sound and sound impressions. I will be recording our conversations on a sound recorder.

You will be completely anonymous. This means that no one will know who has said what in the essay I will write. All names, names of schools, names of places, etc. will be changed. The recordings will be stored so that no one other than me (and you, if you want) can listen to them and they will be erased when the essay is finished.

I would be really great if you were involved. If you have any questions please ring me or send an email.

All the best, Sara.

Phone: 0730 711 668
sara.backstrom-lindeberg@spsm.se
Stockholm, 6 March 2013

Information and request for assistance in a study concerning sound

Hi!

My name is Sara Backström Lindeberg. I’m studying at the Master’s Programme in Special Needs Education at Stockholm University and am also a music teacher at Resurscenter syn at SPSM in Stockholm. Over the course of 2013, my studies will involve conducting an investigation into how visually impaired children and young people experience and use sound during school activities. The aim of the study is to reveal how usable different sound environments are for severely visually impaired/pupils with blindness during school activities. The aim is also to reveal sound as being a source of information and to understand what happens both socially and educationally.

Because I myself am blind, I use the sounds around me all the time to get a handle on what is happening. I’m now curious to know what you and other visually impaired children/young people do and what the sound environments are like in your school. I think that there are a lot of exciting things we can talk about and I believe that your experiences can contribute much important knowledge in this area. Being part of the investigation involves absolutely no preparations or effort on your part.

If you choose to take part, this is what will happen:
I will come to your school and spend a half or a full day there with you. A sighted colleague of mine from Rc syn will also be there. For a few short periods during the day you and I will stop and listen together and then talk about what we hear. I also want to interview you for a bit longer (30–45 min.) at the end of school (or some other time) to talk more about sound and sound impressions. I will be recording our conversations on a sound recorder.
Naturally, you will be completely anonymous in the paper I will be writing. All names, names of schools, names of places, etc. will be changed. The recordings will be stored so that no one other than me (and you, if you want) can listen to them and they will be erased when the study is finished. I want to emphasise that participation is completely voluntary and that you may withdraw at any time. When the paper is finished it will probably be available to read on the SPSM and Stockholm University websites for those who are interested.

I would be very grateful if you wanted to take part in this investigation. If you do, I require your written consent. You can either email this to sara.backstrom-lindeberg@spsm.se or send me the counterfoil below in the return envelope.
Please let me know if you have any questions.

All the best,
Sara

Sara Backström Lindeberg
Phone: 0730 711 668
Email: sara.backstrom-lindeberg@spsm.se

Address
Sara Backström Lindeberg
Swedish National Agency for Special Needs Education and Schools
Resurscenter syn
Box 121 61
102 26 Stockholm
Counterfoil

I consent to my child participating in Sara Backström Lindeberg’s sound study.

Child’s name:

Guardian’s signature:
Appendix 3 – Interview guide

Longer, individual interview at the end of the school day

General areas:
- Name age
- Facts the school the environment
- General
- The classroom
- The corridor
- The dining hall
- The schoolyard
- Threat stress
- Stimulus
- Voices, communication
- Independent activity
- Sound learning experience

1 Begin with why I am there and what’s going to happen. Time, confidentiality, the recordings will be erased, etc.

2 name age
- What’s your name?
- How old are you?
- Possibly talk about shared experience from the day’s observations in order to find something in common

3 Facts the school the environment
- How long have you been at this school?
- How long have you been in this class?
- How many pupils are there in your class?
- How long have you had this teacher?
- How long have you had this classroom?
- Have you had the same classmates the whole time?

4 General about sound in the school
- Do the rooms in school sound different?
- Describe them.
- When you come into a room, how do you know which room it is?
- Do you have any tricks for working out the room using sound / which room? how big is it? furniture etc.?
- Can you hear how many people are in it?
- Do you have any tricks for hearing where someone you know is?
- Where do you think has the school’s most difficult/toughest sound environment?
- What sounds are tough there?
- How does it feel?
- Where in your body do you feel the sound?
- What do you do then?
- Where do you think has the school’s nicest/easiest sound environment?
- How does it feel?
- What do you do then?
- Is the class sometimes divided?
- Is it easier/harder to hear then?
- What’s it like during PE? easy difficult to hear what is happening?
- Is there something in school that you would like to change?
- Sometimes I become tired of sound. Do you recognise that feeling?
- What do you want to do then?

5 The classroom
- Imagine that you’re sitting in the classroom. Describe what you usually hear.
How is the sound environment in the classroom? Your experience of the sound?
Is it usually easy/difficult to follow what the teacher is teaching?
What do you do to understand what is happening in the classroom?
Is it easy to hear who is saying what?
(Potentially ask more about what happened during the observation in the classroom.)
How did you know that?
Can you hear what others are doing?
Do you have any sonic orientation points in the classroom? Are there any specific sounds that allow you to work out what direction things are, e.g. doors?
If you want to get in contact with/talk to/find someone in the classroom, what do you do then?
How would you like the sound in the classroom to be?

6 The corridor
Imagine that you’re standing in the corridor outside the classroom. What do you usually hear then?
How is the sound environment in the corridor? Your overall feeling?
Is it easy to work out what is happening there?
Can you hear where your friends are?
Can you hear who is who?
Can you hear what they are talking about?
Can you hear what they are doing?
How many people are usually in the corridor at the same time?
How would you like it to be there?
Do you have any sonic orientation points in the corridor?
If you want to get in contact with someone, what do you do then?
Ask about a situation that happened today during the observation: How did you perceive this situation? How did you know that?

7 The dining hall
Imagine that you’re in the dining hall. Describe what you usually hear?
Can you hear what’s happening there?
Can you hear where people are?
Is there something that makes a specific sound?
Can you hear where you get food, drinks, dishes, etc. from?
Do you have any sonic orientation points in the dining hall?
If you want to get in contact with someone, what do you do then?
How would you like the sound in the dining hall to be?

8 The schoolyard
Imagine that you’re in the schoolyard. Can you describe what you usually hear?
Can you hear what’s happening there?
What do you do then?
What do you do to work out what is happening there?
Do you have any sonic orientation points in the schoolyard?
If you want to get in contact with someone, what do you do then?

9 Threat stress
Do you ever become stressed by the sounds around you in school?
What do you do when you feel stressed by the sound environment?
Are there sounds in school that you’re afraid of?
What do you do then?
Are there sounds that you don’t know the source of?
What do you do then?
Can you turn off the sound sometimes?
What situations do you do this in?

10 Stimulus
Describe some sounds you think are funny?
What do you feel then?
Are there any funny sounds in school?
Which sounds would you like there to be more of in school?
11 Voices, communication
What do the voices of your teachers sound like?
What do the voices of your classmates sound like?
Can you hear if they are happy angry sad, etc.?
Can you hear if they are joking/if something is in jest?
What voices do you like?
Dislike?

12 Independent activity
When/in which situations is it easy to do something in school?
When it is difficult to do something?
When is it easy to get by on your own? What do you do then?
When is it difficult to get by on your own? What do you do then?
What do you think is the most fun thing you do in school? Most boring?

13 Learning sound environments, experience
Compared to when you first started at this school: Have you become used to hearing things here in school?
How was it when you first started?
How long did it take to learn to recognise the voices? The rooms? What different things sound like? What everyone is doing and what is happening?
Is it easy/difficult to sort out the sounds now?

14 Finally: is there something you want to say to us adults, teachers, staff, parents that you think we should think about with regard to sound in school?
Is there something other children/young people in the class/school should think about?
Do you have any questions for me?

Thank you!