The Importance of Sound for Access to Social and Educational Context - An Observational and Interview Study with Students with Blindness

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ABSTRACT

This study investigates auditory access and participation for students with blindness in everyday school situations. Data consist of auditory observations of different school environments, made by students and the researcher, along with qualitative interviews. Five students with blindness, age 8-18 years, from five Swedish schools participated. By Grounded theory a theoretical model has been generated which describes auditory identification and cognitive processes for access to social and educational context in activities, which is also the main concern of the study. The results show that sound often is the most important and the only source of information to get access to both social and educational settings and crucial for students' possibilities to participate. However, in areas designed for social interaction (cantina, after school center, corridors) the study shows that it is seldom possible to discriminate peers' voices due to noise, many people and parallel activities. This makes the auditory information anonymous. Also, too quiet environments, with no verbal communication become anonymous. In well-functioning sound environments, however, students' ability to identify settings, events and context is very good. Cognitive processes, such as experience and inference, are important to identify the auditory information in an ever-changing soundscape. The study discusses implications for organization, teaching plans and design of premises, which may enhance students' possibilities for access and participation.

1. INTRODUCTION

Both earlier and recent research on social participation for students with visual impairment show a rather problematic picture (Janson, 1996; Svensson, 1988; SPSM 2012; Söderqvist Dunker, 2006, 2011; Brown, Packer & Passmore, 2013; McGaha & Farran 2001; Vik, 2010; Warren, 1984, 1994; Webster & Roe, 1998).

In meetings between sighted and non-sighted students in school, access to context in the social arena differs, and the conditions are not alike. To regard the problem as interaction-related rather than dependent on individual personal qualities, has great importance for how inclusive settings must be assessed and addressed (Janson, 1996). Previous research shows that it is largely the activity and situation that determines the degree of participation, and that there is often a lack of information and a lack of access to context for students with visual impairment. Altogether, this raises a number of interesting questions:

What information can be received from sounds in different school situations and how can students with blindness use sounds for access to context? What is a useful sound environment for a student with blindness?

In what situations in school is it possible for the students to use their auditive capacity?

What could encourage participation both socially and in education through a more accessible auditory environment?

1.1 Sound environment

Poor sound environment is an overall environmental problem that has attracted more attention in society in general and in schools and preschools specifically.

Groups identified as particularly dependent on a good acoustic environment are children developing a language, people with hearing loss, people with different mother tongues, and people with neuropsychiatric disorders (Dellve et al., 2013, Gustafsson, 2009; HRF, 2010; Sahlgrenska Academy at University of Gothenburg, 2011). Remarkably, people with visual impairment are not mentioned anywhere in these reports. It is my hope that this study will serve as a contribution to emphasize the significance of the sound environment for students with blindness.

School and pre-school sound environment is greatly affected by the number of children / students per room and the activity going on, along with acoustics and room size (Dellve et al., 2013, Lewin & Nyman, 2011; Sahlgrenska Academy at University of Gothenburg, 2011). Other factors cited include teaching methods, awareness of noise problems, and noise from other

sources such as traffic noise and ventilation (Dellve et al., 2013).

Light and sound are two different physical phenomena with different qualities. It is not possible to limit, or to differentiate the direction of sound in the same way as visual stimuli, as sounds overlap and mask each other (Gibson, 1969).

Recent research in environmental psychology also shows that the conditions of the acoustic environment such as background noise and reverberation have impact on how auditory information is processed and stored in the brain (Ljung, 2010). Hearing and processing strain the working memory capacity, and if this is too demanding it will hamper memory functions. This suggests that even if a student in a noisy environment can hear what is said, it is considerably more difficult to absorb and remember information compared to a better listening environment (Gustafsson, 2009: Ljung, 2010).

1.2 Soundscape

A relatively new and increasingly explored research field is "Soundscape ecology" (Papadopoulos, Papadimitriou, Koutsoklenis (2012); Pijanowski, Farina, Gage, Dumyahn & Krause, 2011; Schafer, 1994, 1996). The term soundscape was coined by Schafer (1977) and focuses on the listener's experience of a surrounding sound environment at a given time, which often includes a complex mix of sounds at the same time. The common objective is to describe the soundscape with all of its elements like human and biological sound sources, acoustic landscape impacts, identification of cognitive processes and changes in the soundscape in time and space.

1.3 Participation

Participation is a central concept in Convention on the rights of the child as well as the Convention on the rights of persons with disabilities included in the UN convention on human rights (Socialstyrelsen, 2009: UNICEF, 1989).

For a student with disabilities participation in school is largely dependent on the prerequisites and requirements of the activity (Janson, 1996; Söderqvist Dunker, 2011). A school day consists of many different situations and activities in different environments. These activities have different requirements for participation and the prerequisites are highly varied. Consequently, participation in this context is not considered as something static.

Jansson (2004, 2005) has developed a model for participation from a socio-cultural perspective, in which participation is seen as something that is created in social processes. Janson claims that it is not enough to ensure the participation of only one individual's commitment but also that there must be an objective, observable part of the concept. He breaks down the concept of participation in six aspects: affiliation, accessibility, co-activity, recognition, involvement and autonomy. This model of participation has been tested and developed with respect to use in everyday practice in both the preschool and school (Janson, 2005; Melin, 2013; SPSM, 2012). The first three aspects, affiliation, accessibility and co-activity is seen as objective, observable, while the latter three, recognition, involvement and autonomy are more subjective and self-perceived.

Both Janson (2005) and Söderqvist Dunker (2011) show the importance of accessibility for participation and its impact on other aspects. In the present study, the auditory accessibility for students with blindness in the school environment, is especially lifted out and analyzed, as this has not previously been studied.

2. METHOD

Since research on sound environments in school for people with blindness is largely missing, Grounded Theory (Glaser & Strauss, 1967; Glaser, 1978, 1998) was chosen as a methodological approach to, as far as possible, achieve the purpose of the present study. The study does not claim to meet all the requirements in GT regarding theoretical saturation but should be considered as a modified version of GT. But as a whole the method and analysis process follows Grounded Theory.

Both observations and interviews were used as data collection methods. To answer the questions regarding how students with blindness may be involved, requires both a subjective part (what the students themselves experience) and an objective observable part of participation (Janson, 2004, 2005) to be studied. The observations consisted of auditory observations made by the researcher, and auditory observations made by the students themselves. Also visual observations have been made by a sighted supplied, but these have been separated from the auditory observations to keep the latter as just auditory.

Unstructured observations were carried out, in accordance with grounded theory, as there were no predetermined categories (Bryman, 2011; Charmaz, 2006). Student observations have been initiated by asking the students to describe what they hear in the moment in various situations. All student observations and interviews were recorded and transcribed in full. Qualitative, semi-structured interviews have been carried out separately to capture a deeper, more comprehensive picture of students' experience of sound and sound environments in school and how they use sound as information (Kvale & Brinkmann, 2009).

2.1 Target group and selection

In accordance with Grounded Theory the selection was made strategically (Charmaz, 2000). Purpose of this study was to highlight the usefulness of different sound environments for students with blindness. Children and young people with blindness, with or without light perception i.e. categories 4 and 5 according to the WHO definition 1 (Socialstyrelsen, 2011) were selected for the study. At the time of the study these students participated in primary and secondary school. In pursuit of theoretical saturation students of different ages and at different stages of schooling have been selected (Thornberg & Frykedal Forslund, 2009). The selection was made based

on those in the past decade that has been in contact with the National agency for special needs education and schools. The study group consisted of 5 students with blindness between the ages of 8-18 years. Three of the students have a congenital blindness, and two acquired blindness at the age of 4-6 years. This may imply differences in the perception of sound environments regarding conceptual and spatial perception, which has been considered in the analysis process.

The environments and situations selected are lessons in classrooms, breaks in the corridor, lunch in the cantina and spare time at the after-school center. The environments and situations have been selected to capture various types of sound environments that students stay in, and to look at common situations and activities during the school day. Students have generally had a resource teacher or an assistive person for support.

All participants were in written and oral informed about the purpose and design of the study, and how data were to be used. Participation was voluntary and written consent was given by the participants' guardians. All personal names, locations and school names are fictitious and sensitive data and information which would disclose the identity were left out.

2.2 Processing and analysis

In the analysis process, starting with the open substantive coding (Glaser, 1978, 1998) a number of categories emerged. When the researcher repeatedly returned to raw data for constant comparison using the principles of grounded theory, it became clear that the participants' main concern (Glaser, 1998; Guvå & Hylander, 2003; Hartman, 2001) was to get access to meaning and context to be able to interact and participate. All categories could be grouped under a common category: Access to context. This category is referred to as the core variable in grounded theory.

Once the core variable was established the sampling and coding became more selective, which represents the second stage in coding process of grounded theory (Glaser, 1978, 1998). The third stage was theoretical coding. By return to data and comparing the codes, categories, and analyzes in memos, different connections and relationships between categories emerged. Various processes have become clear. Data generated an overall theoretical model describing auditory accessibility and enabling of participation, which are presented in the results chapter (Figure 1). Throughout the analysis, the researcher referred to the transcripts of the interviews to check that the derived concepts and categories kept close to the data. This was done to ensure the reliability of the analysis.

3. RESULTS

The model describes the variety of auditory factors and processes that affect students' access to context and possibility for participation in the school environment (Figure 1). The model can be seen as a process map with the physical sound sources at the top (the sound environment), and below, the soundscape that students

are offered to interpret (individual cognitive and identification processes) in order to access context and participation in school situations. The factors and the processes, environmental and individual, affect each other in different directions. The upper part of the model mainly consists of the components that form the sound environment, while the lower part describes the individual processes to audibly identify what is happening in school situations.
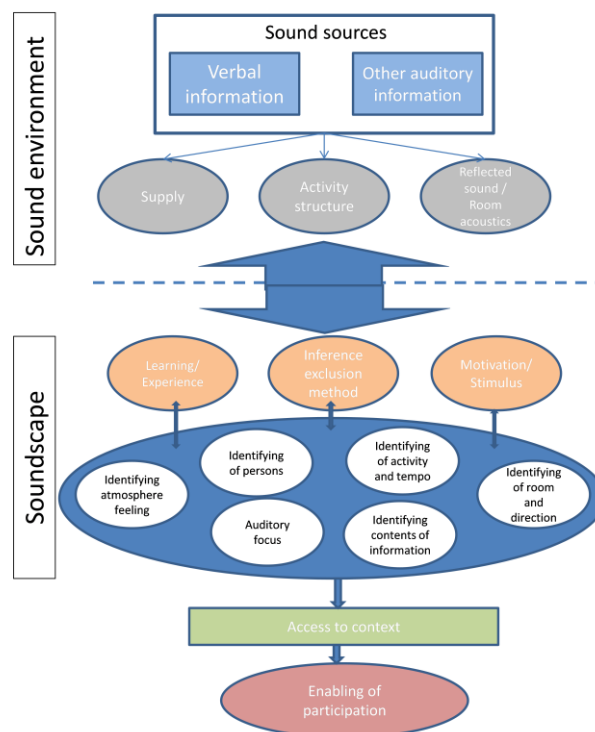

Figure 1 Auditory accessibility enabling participation. Theoretical model.

3.1 Factors that form a sound environment

Getting access to meaningful context is a prerequisite for participation in the common activities and to entry in social interaction. The question is what auditory information the school provides in various sound environments, what can be identified and used in various situations. The sound environment is made up of a variety of factors interacting, which are possible to control.

3.1.1 Sound Sources

A sound environment consists of various sound sources which gives us information through our perceptual system. Verbal information conveys content and message through the spoken language. Other auditory information is the sound that comes from other sources. It may be a matter of sound from an activity that someone or some perform or sound from the everyday environment, such

as fans, machinery, traffic, etc. Usually sounds from an activity consist of both these sources, i.e. both verbal information and other auditory information simultaneously. Based on previous experiences, this information taken together enables the blind student to understand and figure out what is happening.

But there are additional factors that have a great impact on the sound environment. These have in the model been divided into three categories: supply, activity structure and reflected sound/room acoustics.

3.1.2 Supply

One aspect of the supply is about the number of sound sources in the environment or in a situation, for example the number of people in a room. The supply also refers to various kinds of audio sources, which will be crucial in order to discriminate sounds in a variety of sounds. One example is that it is much easier for the students in the study to discriminate teachers' voices in the classroom than the peers' voices, in part because there are only one or two adult voices in the environment and the situation.

3.1.3 Activity structure

The type of activity and how it is designed is also crucial for the sound environment that is created in the room. In the sports hall, running games with many students moving in an unstructured form gives a different sound than an assembly on the floor with more fixed positions. Private, quiet work in the classroom gives a different sound than working in pairs or groups in the classroom. The design and requirements of the event are also crucial for any needs of auditory information in the student's situation. If the activity for instance is independent work in the classroom and the student has lesson materials in Braille, on paper or in the computer, the need for auditory information is not so big. At the after school center, however, the situation is quite different. There, students are totally dependent on sound information to get access to context and meaning.

3.1.4 Reflected sound / room acoustics

The sound produced by sound sources bounces off the various surfaces and objects in the surrounding environment. The sound is reflected in the room and creates echo and reverberation. The reflected sound sounds differently, depending on the surfaces, shape and position of the material. In a room with a long reverberation, it is often difficult to understand, for example, speech, because the reverb partially masks or drowns subsequent sound. But also reflected sound is largely used by the students with blindness for spatial awareness and orientation in the environment.

3.2 Processes for access to context

What then are the processes, based on the sound environment, that occur to a person with blindness, getting access to what happens in different situations at school? These processes are shown in the lower half of the model. Somewhat simplified it could be said that one

needs to know the following to understand the plot of a situation: What is going on? What are people doing? Who are they? Where are they? How is it performed and why? Emotions, atmosphere? Time and pace? What content is conveyed?

There is thus a range of identification processes continuously running as shown in the larger blue oval in the model. But crucial for these processes are also different, pure cognitive and emotional processes. It is about learning/experience, inference/exclusion and motivation/stimulus. In order to identify a sound one must know what is sounding and be able to link the sound to the source and its concepts. One must have heard it before, perhaps many times, to understand the whole character of the sound. Therefore, one must get the opportunity to learn sounds and voices in different sound environments. Motivation and incentives are also factors shown to affect identification processes. A process that has emerged clearly in the study and proved to be very important in understanding what is happening is the process of inference. Based on what you hear and what you know you calculate what is happening in the situation. The inference/exclusion process becomes relatively strong for the non-sighted as the information is often brief and sometimes messy due to problems with focus direction in the auditory medium - who is talking to whom?

This process is in turn related to experience - you know how people tend to behave or how activities usually occur. The design of the activity has also proved crucial to the ability of drawing inferences. This is easier in a clearly structured and recurrent activity. The supply is also crucial. When there is only a handful of things with a specific sound, it is easier to draw conclusions. Both identification and learning processes correlate strongly to the factors mentioned earlier, creating different sound environments. For instance, activity structure and supply relate closely to the ability of learning to recognize voices and sounds of people. Below some examples from observations and student interviews showing the importance of the interplay between identification and cognitive processes for the student to be able to understand the meaning of the context.

3.2.1 Identifying of activity and tempo

Activity and tempo identification is about the audio information that is anonymous. There is a difference between the sounds that reveals what someone is doing, but not who is doing it, and the sounds that are related to specific persons. Students constantly use sounds that are everything from strong to very weak and detailed, that in total provide a picture of what is happening and what people are doing. It is a very important source of information for the students. Jacob, 10 years:

I: Can you hear what is happening right now?

Jacob: Yea, they bring forward their books, like. Opening boxes and unbuttoning backpacks.

I: So, what do you think that sounds like?

Jacob: They are picking up pencils.

But whether this information gets across and is heard depends on how the sound environment in the situation is constituted. In too loud environments important details will not be heard, and in silent environments there will be no auditive information at all. Too quiet environments are often perceived as a vacuum where there is no contact.

There is a clear relationship between structures of activity, for example the type of teaching that goes on in the classroom, and what auditive information the student receives. Many of the classroom sounds that students experience during quiet, independent work in the classroom are anonymous activity sounds, that is, you do not know who is rustling, creaking, writing etc. Jacob says that "it's when they talk that I know who it is."

All activities have a tempo, a stream and a shape, and the students use sound to identify, for example, start and finish of different activities. Much of this identification of activities is difficult to perceive auditorily.

3.2.2 Identifying of persons

Knowing who are around, where they are, and thus being able to relate to them and initiate contact is the most complicated in many of the school environments. People are mainly identified by their voices, but also by other personal sounds, such as footsteps, breath and a bunch of keys. But it has proved difficult to learn to identify voices and above all to be able to spot them in the crowd in many of the school's large and complex environments. The largest amount of audio information in school environments are sounds that are not possible for students with blindness to link to any individual. Environments can thus become anonymous. Jacob, 10, talks about his after school centre:

Jacob: You know, the hardest thing is that I keep losing people. Like, it feels that I can't find anybody. And... well, yea. And you can't talk to each other, because it is so noisy. / .../ Well, I don't know. I usually go ask someone of the staff. But there is this other thing too, you know, I don't know what everybody is actually doing.

/ ... / If there wouldn't be, you know- Otherwise I'd hear it, if he went away. Like, if I hear him talk and then he says that, well, maybe he tells someone else that he is leaving. But I didn't hear it.

The study also shows that the learning of voices is a process over time, where many environmental factors affect the learning. It is a process of connecting what is said with the right individual and the correct name, and to get something to attach to the voice. By and by the voice gets more and more character and represents a personality. All the students in the study point out exposure and direct contact in conversations as key factors for the opportunity to learn to identify a voice. It has become clear that it is of great importance that the teacher addresses the student who is next to speak by name. If you do not know who is talking, anonymity can continue for a long time.

3.2.3 Identifying of mood/feeling

The feeling or the mood that prevails in a situation or in that which is communicated is crucial for understanding the meaning of the context. This information is primarily accessed through verbal communication and tone of voices. But even sounds from body movements are mentioned. Daniel, 18 years:

Well, you know, if you want to react it is important to hear. That is how you pick up the atmosphere. For example if I do a presentation of my work, I want the people to react. And that is the sound that I hear and listen in on. / ... That makes it very difficult at times, to do a presentation without a feeling of total failure/ you know. Because people out there have a tendency to well ... One has learned how to listen, you know, to sit quiet and like, smile or, well, stuff like that.

I: So there is no affirmation around?

D: Exactly. Damn, how I hate that! Totally! You know sometimes it's like standing in front of a wall and talk to it. They probably do listen, quite intense even. And they are hanging in there and they are interested. But no one confirms it to you. So, that's when you just stand there and... "Damn, what can I tell them to get a reaction ? That's where you start cracking jokes, you know. Yeah. And they are so damned well behaved, maybe the giggle a little. Never laugh out loud. That's when you feel like, Damned! Shit! That joke sucked. But they are smiling. People are smiling, you know.

3.2.4 Identifying of information content

Except for understanding what others are doing, you also need access to what is conveyed and communicated, that is the content of the information. It is, for example, not enough to hear that the teacher is writing on the whiteboard or that some are playing games on their mobiles. One must also be able to take part in what is being written or the meaning of the game to get access to the meaning the context. Observations and interviews in this study have shown that the information content is often conveyed visually, leading to a lack of information for the students if it is not verbalized or made available tactually.

A relatively frequent classroom situation that leads to a lack of information for the student with blindness is when the teacher conveys a message by drawing and writing on the whiteboard and the student does not have the same tactile information. The verbal information in these situations is often insufficient. Maybe the teacher forgets to describe verbally or descriptions are fragmentary, resulting in incomplete information that is not possible to fully understand. In such situations the student is often excluded from the interaction that takes place around what is done on the whiteboard, such as classmates laughing, reacting and making comments. This is also an emotional exclusion. From observation, Molly, 8years:

Teacher: What is this? (She draws on the white board) F, can you see it?

F: It is a sandwich.

T: It is a sandwich. Y, can you see what it is?

Y: Ehm, it is a square.

T: Different opinions in the room. F saw a sandwich, and Y saw a square. So, A, what can you see?

A: It's a ladder. A very tiny ladder.

T: Aha! You know what? This is actually one of these things: Dododooooo! (She draws something more and sings a little tune to it. The class mates start talking and commenting, and there is no making out what they say.

In several observations it becomes clear that in situations where teachers provide verbal information to all students, when the teaching is mainly verbal and there is no visual information available, the problems mentioned above do not occur. The teachers change the way of expressing themselves and the information does not become fragmentary.

In several observations it becomes evident that auditory information cannot be equated with visual or tactile in terms of access to information content. The media have different characteristics. Verbal information is transient while text, visual or tactile, is more constant. The text on board, screen or paper is there for the students to read, while the auditory information disappears immediately (if you do not have time to write it down). Several students mention that they have a good memory but conditions will still not be equal. In Hilda's class the teacher is verbal when she is working with the class at the whiteboard, but the details of what she writes, and the questions she asks the students to work with in pairs, pass so quickly that Hilda does not have time to take notes. Consequently, Hilda does not have access to the text on the whiteboard, but must memorize it. During the pair work is Hilda dependent on her classmate to read the words to her. She ends up at a disadvantage. If she had been given the questions in braille or if she had got them on the braille display in front of her, the conditions would have been more equal. The auditory medium is not sufficient, even though the teacher is very verbal.

3.2.5 Auditory focus

Focusing auditorily is difficult and cannot be compared to focusing visually. The hearing cannot define in the same way as sight does. Gaze has a direction and a boundary while auditory perception occurs all around. Hearing is not possible to disconnect in the same way that you can close your eyes. An environment with chatter and noise around is usually not difficult for the students with blindness in this study, it is rather promoting participation, as sound provides important information about who are there and what is happening. But some situations proved difficult when students are required to receive and process verbal information from multiple sources simultaneously or when a sound source takes over and masks another. One can partially develop strategies to deal with dual auditory focus, but when it becomes too obvious, it is difficult regardless of age and experience. Motivation and incentives are also factors which partly control the auditory focus. What seems to be most important is however the sound environment with factors such as activity structure, supply and spatial relationships. Kim, 15 years:

Well, there is no way I can listen to my computer and the teacher at the same time. So I just remove my earphones. /... / But I don't consider this to be a major problem. The case is that when the teacher speaks everyone else needs to be quiet. /.../ What I can feel is that I, myself, need time to get my work up. So if the math-teacher is going through some issue, and you feel you are way behind in math. So I need to get my math book up. And I know how long it takes to jump around, and there is Textview, and then there is... Yeah. Like that. /.../ That makes it

hard. So, sometimes I just go: "Boring going through this. I concentrate on the computer instead."

Students mention as a problem the demands on dual auditory focus during verbal descriptions, and they also have their own thoughts and ideas on how to solve this. Daniel, 18 years:

"It's completely impossible at times, ! / ... / for example, when we are watching movies / ... / my assistive person describes a picture and in the movie, speech continues, so you are missing out a lot. Or when the teacher is showing a picture, but does not describe it, then the assistive person has to do it, then you miss information again./ ... / Yes, it is really a problem. "

When I ask Daniel if he has a proposed solution, he says:

"That the teacher himself does the description. Because I think it is good for everybody".

Also Kim, 15, mentions that open verbal description for all, directly from the teacher in the front, is a much better solution than someone sitting next to her describing:

"Yeah, positively I would prefer that. Because then you become a part of the group".

3.2.6 Identifying of room and direction

Auditory information helps to understand one's physical surroundings. Through both direct and reflected sound information about objects' shape, size, position, and movement is provided, which helps to understand where we are and where other people and things are. Reflected sound is used by students to identify rooms, walls, stairs and doorways. But also direct sound of footsteps and voices is important for spatial orientation and perception of direction as reflected in interviews and observations.

4. DISCUSSION AND CONCLUSIONS

4.1 What is a useful sound environment?

It becomes clear in this study that students with blindness use mostly sound to get access to events and meaning of context in various activities in school. Sound is often the only source of information the students can use to get access to social events. The same also applies in some educational situations when no tactile material is available for the student. Students have, in many respects, a well-developed auditory capacity and an always active auditory focus, and in favorable acoustic environments the students perceive a lot of what goes on through the surrounding sounds. But the study also shows that many sound environments in school hinders students' possibility to utilize their capacities, leading to difficulties for them to auditorily perceive what is going on and who is who in these environments. If it is too loud and messy the hearing is basically extinguished and the primary sense becomes virtually unusable. Too quiet sound environments, on the other hand, provide no information at all. Silence is perceived as a vacuum where there is no information, neither of who are present, nor how they react or what is happening. Thus, we can see that a useful sound environment should not have too strong a background sound that creates a blocking sound

carpet. But it should not be too quiet so that no information at all is available. But fortunately challenging environments can be changed and influenced, regarding number of people in the room, activity design, size of premises and their acoustic softening.

The results of this study indicate that the acoustic environment may be a contributing cause of alienation. The usefulness of the sound environment for students with blindness is directly linked to the number of people and design of activity. One interesting result is that precisely those areas and situations in school that are designed for socializing and social interaction are the most difficult auditorily for the students. Special solutions are however not the solution to the problem. Lack of co-activity has been specifically shown to have a negative impact on recognition in the peer culture (Jansson, 2005; SPSM, 2012). It gives negative signals to the rest of the class that the student is different and not one of the group. This is something that students themselves are aware of and talk about in the interviews. The challenge in the design of sound environments lies consequently in creating good conditions that function for all together.

4.2 Verbalization

In several teaching situations in the study there is clear lack of information for the students with blindness, while, at the same time, the educator seems to be unaware of how the situation really is for the student. Although the educator's ambition is to verbally describe what you write on the board or what appears on images it does not correspond to the information that sighted students get. The auditory information is often fragmented and isolated. This is not about reluctance from the teachers', but it turns out to be simply very difficult to understand how the situation is reduced to only auditory information. Remarkably, the results show that teachers change their verbal information when no visual information is available, for example on the board, when everybody is dependent on verbal information and the common focus is auditory.

Another phenomenon that has become evident in many teaching situations in the study is the "weaknesses" of the auditory medium compared to the visual and tactile, regarding access to information content. Although what is written or shown on the board or the screen is verbalized, the degree of information cannot be paralleled to seeing the text or image or having it under your fingers tactually. The auditory medium is transient and the information is here and now only in the moment if it is not stored in memory. Text and image, however, is usually present for a longer time, that is, the exposure time is longer for the recipient. It is possible to move backwards in the text and the senses can receive and process information in a different way. Verbal information is also linear, sequential, unlike visual text or image where a whole passage of information can be perceived in an instant. This provides completely different opportunities for

overview and structure. If the student gets the text in Braille or has it on the Braille display in front of her the terms are more equal.

4.3 About double auditory focus in the classroom

A specific problem in the learning described by the students is about being subjected to demands to perceive verbal messages from two directions simultaneously. In the analysis of empirical data this appeared to recur quite frequently, and it was experienced as stressful and hard to handle by all students. This became the reason for a category called double auditory focus. Difficult situations described are:

- Verbal description when voices clash.

- Synthetic speech/computer navigation and teacher's review or group work simultaneously.

- Typing on computer with synthetic speech support while listening to the teacher or others.

- To work with something else when teacher is reviewing with the rest of the class.

This can be compared to what in previous research is described as the cocktail party effect (Cherry 1953, Wood & Cowan, 1995). It refers to the ability to focus one's auditory attention on one conversation in a room where many conversations are going on in parallel. Studies of this phenomenon have shown that it is not possible for anyone to interpret and process two semantic messages at the same time. This may explain the students' frustration when they, for example, are dealing with the teacher's message up at the board while at the same time receiving, in the earpiece, information from the speech synthesizer, or the spoken lines in a film, and at the same time listening to someone who conveys verbal descriptions close by. Various studies of simultaneous processing further show that the brain cannot handle several cognitively demanding tasks at the same time (Klingberg, 2007). The brain switches attention between the tasks, which is time-consuming and reduces capacity. Students' frustration is also about losing educational information due to these parallel processes.

Conway, Cowan, and Bunting (2001) have made research on the cocktail party effect, and have found that the ability to consciously focus one's attention and to block irrelevant information is related to the working memory. People with strong working memory capacity can more easily block out irrelevant information while people with less working memory capacity get easily distracted. To check our attention thus requires working memory as we have to remember and retain what we should concentrate on (Klingberg, 2007). Interesting in this context is that our working memory is not fully developed until the age of 20 (ibid.).

Based on the above reasoning and findings in this study there is reason to believe that many learning situations require strong working memory capacity for students

with blindness to compensate for the vision loss. People with blindness often have better developed verbal working memory compared to sighted people (Withagen & Kappers, 2013). But this study shows that situations requiring significant dual auditory focus become impossible to handle regardless of age and ability.

Just listening to information requires more working memory compared to having the information on paper or on the board. The essential difference is that the written text and the pictures are still there and are easy to return to and repeat. You can choose to switch focus when needed. The auditory information must be stored in the working memory to be interpreted further and is more difficult to repeat. In many situations, such as conversations, films, lectures and other presentations vision probably helps to reinforce and maintain focus on the relevant message. Without vision it is more difficult to block out irrelevant auditory information as one is dependent on it in other ways than sighted people are. In other words, what may seem irrelevant can simply be highly relevant as environmental information for a person with blindness.

It may be important to make educators aware of the difficulties of dual auditory focus for these students, and that adaptation of materials, planning and structuring of teaching elements occur in such a way that situations requiring dual auditory focus, as far as possible, are avoided. The importance of Braille has been demonstrated in multiple previous research (Fellenius, 1999a; Rex, 1994) and also in this context it becomes clear how important Braille is to reduce the dual auditory focus for students with blindness.

The link between the activity structure and double auditory focus is clear, and it shows that by organizing the activity difficult situations with dual focus can be avoided. All students in the study want to hear sounds from the class, sit in class, participate in teachers' reviews, get open verbal description directly from the teacher; all this in order to "be a part of" the whole class (co-activity). Students do not want to isolate themselves with headphones or to sit in a private room, although it may occasionally be a necessary solution. An approach where everyone participates in joint briefings and then work independently or in small groups with the support from teachers is a solution to avoid double auditory focus. This requires good forward planning so that students can obtain materials and other assistance in advance to be able to keep up in joint briefings.

4.4 Identifying of persons and learning of voices

We know that the situation in terms of social inclusion for students with blindness in school has been, and still is, problematic. Many students mention that it is difficult to find peers and enter in interaction situations in school and in recreation centers. The reasons are many but the recognition of individuals by hearing can be an important part of this context. It is mainly through the voice that a person is identified. In familiar and calm situations there seems to be no problem for students, but in many of the

schools' large and complex environments it has proved difficult to learn new voices and above all to be able to distinguish them from the crowd. To know who are there, all around you, is a natural basis for social interaction and if this becomes problematic in different situations, there are of course consequences. Therefore voice recognition should be observed and teachers and other staff in school should work to raise awareness about it.

Visually, one can quickly recognize a person. It is often enough to have seen a person once or twice to recognize him or her. A voice, on the other hand, you must often have heard many times to be able to recognize and distinguish it from a variety of voices. There may be subtle differences in timbre and tone of voice and only after a while the whole character of the voice appears. It is clear that it is much harder to learn some voices than others. Some voices have taken the students several months to learn to recognize while others are distinguished directly. Based on this study age does not seem to be crucial for the ability to recognize voices. One possible explanation may be that the ability is so basic and something that develops very early in the child. Research shows that already at 1 month of age children with blindness discriminate a parent's voice from the voices of other family members (Warren, 1994). All participants in the study note that it is the degree of personal contact and direct conversation that is crucial for learning voices efficiently. They are all dependent on sound environment of good quality and comprehensible structure.

What can conceivably promote opportunities for voice learning in school? Students in the study mention the pair work and peer interviews as good ways to learn to recognize voices and connect the voice to the person. This can make it easier for a student with visual impairment in a new class or group to enter socially and get to know their friends. The sooner the student can distinguish and recognize voices and feel safe, the less is the risk of exclusion and marginalization. On the whole, teaching plans and teaching methods where students with visual impairments are exposed to peers' voices in accessible and structured activities in small groups seem to promote the learning of voices. In this study, one can see a correlation between students' knowledge of classmates and teachers' consistency in naming. In other words, there is a great value in naming the person talking in the classroom, or naming students in different groups or activities. It is also important to ensure that students in the class get to speak and tell something about themselves, so that one may know something about the others, which makes it easier to perceive a person behind the voice.

To know something about each other is also important for further peer connecting, for example during breaks (Söderqvist Dunker, 2011). It may be that much independent work in the classroom impedes the process of getting to know classmates and discriminating among their voices and character traits. A higher degree of pair working, where the groups have been divided by an adult,

giving everyone the opportunity to work with all classmates, would possibly facilitate this process (SPSM, 2009: 2012).

In many observations in the study it appears that how well the student knows the peers' voices, these can still not be distinguished in several of the school environments except for nearby due to the high sound level. These complex environments are precisely those that are designed for social interaction. It is mainly dining halls, after school centers and corridors where a lot of people spend time. The problems of discriminating become obviously an obstacle for interaction and participation in these environments. The exclusion method is used to recognize voices, and especially when you are a little unsure of some of the voices. In a wide range of voices, many sound alike. One hears usually very much of what is happening - all different activities have distinctive sounds, easy for the students to recognize. The problem is to hear who is performing the activity, the sounds are not individualized. Sounds from writing, bags that are opened and closed, people walking, pulling chairs and sitting down etcetera are easy to identify. But compared to seeing this auditory information is much more anonymous, since it is not possible to identify who is performing the activity. An interesting question that could be a topic for further research is how this anonymity in pre-school and school environments affect children's emotional development and opportunity to understand and learn social interaction.

Considering the aforementioned research on the cocktail party effect, working memory and distraction together with the results from this study, it may be important to discuss how the environments, situations and activities designed for play, learning and interaction offered to children with blindness in schools and preschools are designed.

It is very important that people who encounter children with visual impairment in their work have knowledge and understanding of the importance of sound for experiencing and embracing the world. To hear and understand what children hear and share their experience is a way to establish joint attention.

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