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How Do Acoustic Stimuli Influence Preschool Children's Behaviour and Concentration?

Jak bodźce akustyczne wpływają na zachowanie i koncentrację dzieci w wieku przedszkolnym?

KEYWORDS

children, children's development, sounds, noise, acoustic stimuli, psychoacoustics

ABSTRACT

The research aimed to find the positive and negative effects of acoustic stimuli on preschool children. It was divided into three parts: conducting surveys among parents and teachers on children's behaviour and their daily acoustic conditions; measuring the sound pressure level in kindergartens; children-performed tasks in the presence of various sounds. The study showed that the sounds produced by the peers were the most distracting acoustic stimuli. It was observed that in the kindergartens where children tend to behave calmer and quieter, the results of tasks were much better, i. e. children are more willing to perform exercises, they do them quicker and focus on them for a much longer time. Sounds made by other children (especially sudden noises) often delayed the task's completion or prevented it. It was also observed that if a sound was neither particularly interesting nor distracting for children, it had very little impact on the task performance. Attractive sounds caused delays, errors and, in some cases, they forced the children to completely ignore the instructions and focus on the appealing stimulus. Interestingly, road or domestic noise was almost imperceptible to children and had little impact on the tasks. Music, which children do not mind, proved to be a good masker of other distracting sounds.

SŁOWA KLUCZE

dzieci, rozwój, dźwięki, hałas, bodźce akustyczne, psychoakustyka

ABSTRAKT

Celem badań było znalezienie pozytywnego i negatywnego wpływu bodźców akustycznych na dzieci w wieku przedszkolnym. Badania podzielono na trzy części (przeprowadzenie ankiet wśród rodziców i nauczycieli dotyczących zachowania dzieci oraz warunków akustycznych, w jakich na co dzień przebywają; pomiary poziomu ciśnienia akustycznego w przedszkolach; wykonywanie przez dzieci zadań w obecności różnych dźwięków). Z przeprowadzonych badań wynika, że najbardziej rozpraszającymi dźwiękami są odgłosy pochodzące od innych dzieci. Zaobserwowano ogólną tendencję, że w przedszkolach, gdzie dzieci zachowują się spokojniej i ciszej, wyniki uzyskiwane podczas wykonywania zadań są dużo lepsze, dzieci chętniej i szybciej wykonują zadania oraz znacznie dłużej się na nich skupiają. Dźwięki wydawane przez inne dzieci (szczególnie nagle) często opóźniają lub całkowicie uniemożliwiają wykonanie zadania. Zaobserwowano również, że jeśli dla dzieci jakieś dźwięki nie są ani szczególnie interesujące, ani rozpraszające, to dzieci nie zwracają na nie uwagi i mają one znikomy wpływ na wykonywane zadania. Dźwięki szczególnie atrakcyjne dla dzieci powodują opóźnienie w rozpoczęciu prac, błędy, a czasami dzieci całkowicie ignorują polecenia i skupiają się na ciekawym bodźcu. Co ciekawe, hałas drogowy czy domowy są dla dzieci prawie niezauważalne i mają znikomy wpływ na wykonywane zadanie. Muzyka, do której mają neutralny stosunek, okazała się dobrym maskerem innych rozpraszających dźwięków.

Introduction

Sounds are undoubtedly an integral part of our lives. They reach us almost incessantly from many different sources and we often even fail to realize how many different sounds accompany us in a given situation. Some of these sounds, such as the sound of rain falling outside, cars passing by or neighbours carrying out repairs, are out of our control. However, we are able to control many of the sounds in our lives: we decide what music we listen to, what time we listen to it, how loud we talk, or whether TV sounds accompany us all day long. The presence of these sound stimuli is not meaningless for humans, as each of them can improve or reduce our concentration, the quality of our body language or mood, as well as increase or decrease our stress levels (Jabłońska, 2014).

Appropriate sounds can have a positive impact on both our emotional and physical state. The music we like can support the work of our nervous system, brain, and metabolism, and it can stabilise our breathing rhythm and heart rate (Topor, 2009). In turn, overexposure to noise can cause an increase in the level of the hormone

stress (Babisch,2003), an increase in blood pressure (van Kempen et al., 2006), problems with sleep and its quality (Öhrström et al., 2006), and hyperactivity (Tiesler et al.,2013). In addition, chronic noise exposure is associated with problems in some areas of learning, for example, poorer performance in reading comprehension, later mastery of reading skills and poorer long-term memory (Haines et al., 2001; Clark et al., 2006). Furthermore, excessive environmental noise (caused, for example, by transport or the behaviour of neighbours) causes irritability in children, problems with concentration and tiredness, although to a lesser degree than in the case of adults. Some of the problems related to irritability, attention or fatigue are further reinforced by sleep problems, meaning that the negative effects of living with noise reinforce one another (Stansfeld and Clark, 2015). Unfortunately, children often cope with noise much worse than adults, and are unable to control, reduce or isolate themselves from it. Fortunately, noise that surrounds us does not usually reach levels that can lead to permanent hearing loss or damage, but it negatively affects people both physically and psychologically, even at sound levels much lower than those that cause hearing damage (Stansfeld and Clark, 2015).

This is particularly important for young children who learn new things all the time and for whom sleep is very important, because good quality rest not only helps them regenerate physically, but also enhances their growth, strengthens their immune system and helps their brain to develop (Jiang, 2020). In addition, early childhood is a time of intensive cognitive development during which the nervous system is already being shaped. That is why, it is important to provide appropriate acoustic and emotional conditions to children not only when they are learning, but also while they are playing or just watching everyday situations.

Studies with the participation of children are extremely important because children often experience sounds in a way that is different than among adults. Unfortunately, most psychoacoustic research involves adults, possibly teenagers, while children, especially younger ones, are often overlooked in such studies. And although some information on the effects of sounds on children can already be found in books, there is still much that has not been explored. That is why, I decided to try to find some correlations between sounds that surround children and their behaviour as well as their pace and effectiveness of learning.

Method

The research involved 233 children from various kindergartens, four of which are located in Kraków and four in Jasło. The children were four years old when the research began. The research consisted of three stages. The first stage was a detailed

survey of parents and teachers in the kindergartens, and it provided information on the acoustic conditions in which children spend their daily lives (both at home and in the kindergartens) and on children's habits and preferences related to sounds. In addition, teachers and parents evaluated the children's behaviour and temperament. The next stage of the research was to measure the level of sound intensity in the different kindergartens during different forms of spending time (e.g. during study, during rest and play). The last stage of the research included carrying out tests among the children: they were to do three types of tasks in the presence of different background noises and in silence. The most common types of everyday noise (typical house and street sounds), human speech and five kinds of music (classical music, jazz, contemporary songs, contemporary instrumental music, and rock) were selected for this study. The limitation of the research to this number of sound stimuli was mainly due to the fact that the research participants were four-year-old children who quickly become tired, who are only able to concentrate for a short period of time and, above all, get bored quickly. Therefore, extending the tests to other stimuli could result in children refusing to do the task, doing it quickly, without much thought, or even randomly, in order to shorten the time to complete the task, as a result of which the tests would become less reliable and their results could have little practical use.

It should also be taken into account that psychophysical examinations should not take too long, because if the participant becomes too tired or bored, he/she will not be able to give a reliable answer. This is particularly important in the case of (young) children who get tired very quickly and become bored very quickly. Therefore, the activity to be performed by the children was designed to last no longer than 30-40 minutes, including the organisational part. If necessary (because of the children's fatigue or boredom), there was a short break or the activities were resumed the next day, which ensured that the children did not get tired of the activities and they did not give up on them because of being tired.

During the tests the children were doing simple tasks in arithmetic, memorizing and listening comprehension. The choice of these areas was motivated by the fact that these tasks are most often carried out in kindergarten and (in future) at school. And although, in the literature of the subject, some information can be found on the influence of various sounds on memorizing, there are still not many studies which check the influence of distracting sounds on doing particular types of tasks.

The exercises for the children have been prepared in such a way that they seemed interesting to them. For this reason, in order to test how different sounds affect the children's counting ability, instead of asking them to count the pieces, I asked them to colour the proper number of pieces, which was more attractive to them as they perceived it as fun.

The study was carried out in kindergarten classrooms in order to reflect as closely as possible the natural conditions in which children live and study on a day-to-day basis. Although the research in an isolated room makes it possible to limit other distracting sounds, the conditions created in this way are not natural. On a daily basis, we are not exposed to just one isolated stimulus, but to a multitude of sounds which intermingle. Also, a new room might have greatly distracted the children and disturb the research much more than the usual everyday noises in the background. All the tasks were prepared in the form of play so that the children were willing to participate without getting bored too quickly. The last part of the study was repeated three times with each group to verify the results. The study was carried out over a two-year period.

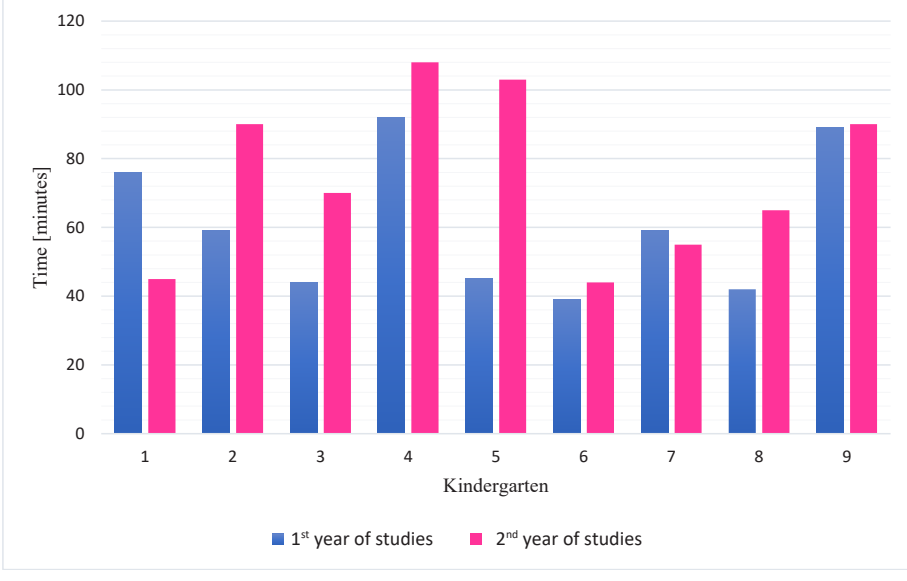
Observations and results

During my research, I found some interesting trends among the children. The first is that the most distracting and disruptive stimuli for them were sudden and unexpected noises from their friends (their conversations, accosting, shouting, sometimes crying). This is probably due to the fact that these sounds are very variable and often very loud. The children often find such sounds much more important than, for example, music in the background, because they can be a source of interesting information (e.g. suggestions for play) for the children. Such sounds are the reason why children usually stop doing their tasks and focus on what seems more interesting to them. It is interesting to note that it is not so much the level of intensity of a sound that is more important but whether the sound appears suddenly, whether it is unusual, whether it surprises children or whether they may expect it. It is worth pointing out that, depending on the circumstances, children may react and perceive sounds in a completely different way. Sounds that children may want to hear in some situations, e. g. those that are part of their playtime and that do not disturb them in any way, can be very disruptive and tiresome during the time for rest or while children are listening to the teacher.

Some sounds disturb children to such an extent that they start asking one another to be quiet. And although shouting or loud laughter or speech are a certain way of expressing oneself and one's emotions, it should not be forgotten that, when in a group, each child's behaviour can have a strong influence on others. Therefore, not only should the child's need to behave loudly be taken into account, but also, and perhaps even more importantly, we should bear in mind the perspective of other children who are exposed to different sounds in this situation. Of course, every child may respond to distracting or fatiguing sounds in a different manner, and some children will be more resistant or used to such sounds than others. However, most children

will react in a similar way: unexpected sounds from other children will be distracting or tiresome for them. It has been noticed that in kindergartens where children behave calmly and play without unnecessary noise, performance while doing tasks is significantly better, children are more willing to complete tasks faster, and they stay focused on their work for a longer time. This is shown in Chart 1.

Chart 1. Children's maximum concentration time in particular kindergartens



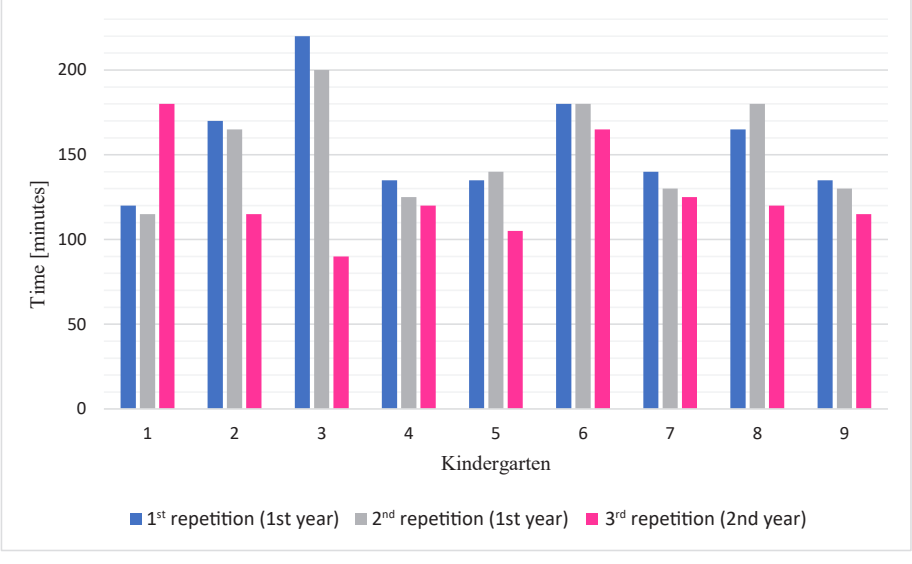
Source: the author's own work

In the first year of the study in kindergartens 1, 4 and 9, the children were able to stay focused on a given task for much longer (as compared to some kindergartens, this was even twice as long), they were more willing to carry out tasks and did not get tired so quickly. Those were the three kindergartens where the children behaved in a much calmer way, where it was quiet during classes, and where the teachers paid attention to ensuring that the children did not disturb one another during classes. In addition, these kindergartens made a clear distinction between the time when children could "blow off" and the time when they should be more quiet. In turn, in kindergartens 3, 5, 6 and 8, the children were always very loud, and they were not criticised for being too loud and disturbing others during the time for learning. The children in those kindergartens were often distracted very quickly, and they complained about being tired and about noise made by other children (the children often tried to tell each other to be quiet, but they were usually not very effective). As a result, children found

it difficult to hear the teacher's instructions or to concentrate on the story they were reading. This could also be the reason why they did not want to participate in the activities carried out as a part of the research. The children were very annoyed that they could not hear what had to be done for a task, and even if they managed to hear the instructions, they could not concentrate and fulfil the task anyway.

During the second year of the research, in kindergarten 1 the teacher changed, as a result of which the approach to silence and noise also changed. The new teacher was not attentive to children who disturbed others while learning, which resulted in the fact that the children became distracted more quickly and they felt much more tired. In turn, the children in preschools 2 and 5, who generated the most noise and frequently picked on other pupils, moved to other kindergartens. This made the group calmer, quieter, more cheerful and definitely more able to concentrate on their activities for a longer time. In the kindergartens where there is a high incidence of unexpected or unwanted noise from children, the studies took longer and were sometimes unsuccessful, which is shown in Chart 2.

Chart 2. Total time needed to perform the tasks



Source: the author's own work

In the first year of the study, children in preschools 3, 6 and 8, which are definitely the noisiest ones and in which unexpected and often undesired sounds are often present, took the longest time to complete the tasks during the tests. This is probably

due not only to the fact that it is more difficult for children to concentrate in noisy conditions, but also to the fact that a lot of time was spent repeating instructions and information needed to perform the activities. In turn, during the second year, the time spent on tasks in kindergarten 1 has increased significantly, which probably results from changes in the composition of the group.

That is why, it is very important to teach children from the very beginning to pay attention to sound hygiene, to respect others, and not to create situations in which other people feel uncomfortable. Of course, children need to have time and space to be loud, to express their emotions, "to be a bit noisy", but it is very important to organise children's time and space in such a way that they can both use their expressive energy and rest, eat or study in silence. The observations made during the study show that in kindergartens that have this kind of approach, children are calmer, less aggressive and can concentrate on their tasks for much longer.

It is also interesting to note that children are extremely sensitive to sounds that seem particularly interesting to them or that they like a lot. It is precisely the child's approach to particular kind of music and their musical preferences that have proved to be more important than the genre itself. For example, in the case of music that the child has a strong liking for, the task becomes less important, takes much longer than usual or is done with mistakes, or is even abandoned. The child, instead of concentrating on his/her activity, shifts attention to the melody that is attractive to him/her and starts singing, dancing, asking for the title of the song, etc. If, in turn, music or sound is not very interesting to the child, he/she will not pay too much attention to it, and the melody will not distract the child, which will have little effect on the child's ability to perform tasks. And this is not only about learning, but also about playing and everyday activities. Surprisingly, children are generally not attentive to unusual noises coming from the street (passing cars, trains, sounds of traffic lights, etc.) or to everyday sounds at home or conversations of others. In most of such cases children do not divert from their activities; they do not try to locate the source of the sound or ask what is going on.

This is probably due to the fact that the environment is getting louder every year: more and more cars are on the roads, more and more factories are being built, producing more and more industrial noise, and we are accompanied by electronic devices that make us listen to music, receive messages from numerous applications, etc. Silence or being in the presence of only quiet sounds is something that is less and less common, less natural or even hard to bear. More and more often, we do things to get rid of this silence, to drown it: we turn on the radio, spend time with the television switched on even though we don't watch anything, we talk more, etc. That is why children are getting used to noise which becomes natural for them. Moreover, the sounds we hear all the time do not change suddenly; they are much less variable than, e. g. sounds of

children playing in a kindergarten. Of course, it may turn out that such sounds will make children tired or that they will negatively influence their nervous system, but, in a short-term perspective, they are not distracting and they have no influence on children's temporary behaviour and actions.

What is more, such neutral sounds, to which the child does not pay much attention, can be a kind of masking element for other distracting sounds, such as conversations in the background, noises from neighbours behind the wall, or the sound of dogs barking outside. Therefore, it can be concluded that, if we were surrounded by total silence, any noise would not only be distracting but also frightening for us, and it would have a much greater negative impact on us than soft, gentle and indifferent sounds around us. This is especially true for children who live in increasingly noisy environments and for whom silence is a more and more unnatural, and often disturbing, phenomenon. However, we are not talking about being constantly surrounded with noise, but about non-isolation from any sounds.

Conclusion

The research results show how extremely important acoustic conditions are for children, not only in terms of their level of fatigue, but also in terms of their mood and behaviour. It can be concluded that the most disruptive and distracting acoustic stimuli for children were sudden, unexpected and unusual sounds (especially those coming from other children). It is, therefore, of the utmost importance to teach children respect for each other, which may be expressed in the attempt not to make unnecessary noise, and to organise children's time in such a way that they may enjoy both loud playtime and expression of emotions (which they undoubtedly need at this stage of their lives) and learning in silence. Studies have shown that in kindergartens where children behave more quietly and generate less unexpected noise, the group is less nervous, carries out tasks more quickly and correctly, and has significantly improved concentration. Of course, there is some noise in every kindergarten because there are lot of children each of whom generates sounds of play, speech and laughter that overlap each other, but children react to sounds (even loud ones) that are part of play or music in a different way than to unexpected loud noises, such as shouting. That is why, it is important that the acoustic environment in which children live is as stable as possible. Of course, we cannot eliminate all unexpected or sudden noises, such as the sound of a doorbell, a sudden cry of a child who has fallen over, or a dog barking outside, but we can teach children from a very young age to pay attention to the sounds that surround them.

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