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Clinical Studies with Oticon Play PX: Exploring New Domains in Paediatric Amplification

ABSTRACT

Exploratory research studies were completed in the areas of paediatric hearing aid selection, supporting best practices in hearing aid fitting for infants and young children, and voice emotion recognition for children and teens wearing hearing aid technology. Findings add new evidence to the existing body of research that highlights the benefit of using Oticon Play PX hearing aids for infants, children, and teens.

EDITORS OF ISSUE

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Background

Play PX is the latest addition to the Oticon paediatric hearing aid portfolio. Designed with our best research, and embracing the Oticon BrainHearing™ philosophy, Play PX is a hearing aid well-suited for infants, children, and teens. Play PX includes a first of its kind, rechargeable, mini behind-the-ear (BTE) hearing aid that complements our current paediatric hearing aid products of Opn Play and Xceed Play. With our first wave of research on Play PX, we documented benefits for children and teens with hearing loss in the areas of word recall and word recognition in complex listening environments, opportunities for families to develop their self-determination with Oticon RemoteCare, and learning about parents' perspectives on using rechargeable hearing aids with their young children.

For this whitepaper, we are looking at new domains in paediatric amplification and different aspects of clinical practice such as auditory acclimatisation, accuracy of first fit, and voice emotion recognition. With little or no evidence available on these topics and restricted access to participants, exploratory research was designed and constructed to inform the development of future, larger scale, experimental design studies.

These studies and their results are described in the sections below.

How difficult is it for children and teens with hearing loss to change hearing aid manufacturers? Considerations for auditory acclimatisation

What is auditory acclimatisation?

Arlinger et al. (1996) described auditory acclimatisation as the adjustment time related to learning to accommodate new auditory inputs through hearing technology. In studies with adult hearing aid users, researchers found that the introduction of new or different sound required listeners some time to adjust. Because children's auditory skills are in development and changing, they may not require the same auditory adjustment time as adults (Wright & Zhang, 2009).

How easy is it for children and teens to change hearing aid brands?

Although research (e.g., Glista et al.,2012) has explored auditory acclimatisation when moving from traditional hearing processing to frequency lowering, there is little research on children changing to a different hearing aid manufacturer. Anecdotal reports from clinical audiologists suggest that when selecting new hearing aids for children, they are reluctant to use a different hearing aid manufacturer as they anticipate the auditory acclimatisation may be more difficult. Audiologists have also expressed uncertainty on how to counsel for this change in hearing aid technology. Many describe a trial-and-error approach by simply asking: "How does this sound?" In addition, audiologists have reported that some children and teens were nervous about changing their hearing technology because it may have a negative impact on their communication abilities. When their hearing aid technology did not work well, it affected their self-confidence and desire to participate (Gordey, 2020).

In this study, we asked two questions:

1. According to teens with hearing loss, how should audiologists approach the introduction of new hearing aid technology from a different manufacturer?
   a. With the sub-question: Are there facilitators for successful auditory acclimatisation that support children and teens' "readiness" to try a different hearing aid manufacturer?
2. What is the auditory experience of teens who were fitted with a different hearing aid manufacturer within a typical clinic appointment time?

Qualitative methodology using exploratory case studies was utilised as they are well-suited to examine this unfamiliar phenomenon of auditory acclimatisation (Yin, 2015). The small sample size was useful in investigating these real-life clinical contexts and scenarios, and learning about the "how" and "why" (Mills et al., 2010).

Case study description

Participants were recruited from the patient database of a paediatric audiology clinical practice, in a large urban setting, in western Canada. Two teens (who identified as female, ages 15 and 17) with mild to moderate-severe sensorineural hearing loss, wearing a competitor's paediatric hearing aids that were less than five years old, were invited to participate. They took part in an interview with a researcher from Oticon, discussing the concept of auditory acclimatisation and participated in an "in clinic" trial with Oticon Play PX miniBTE rechargeable.

The concept of auditory acclimatisation was explained at the start of the appointment. For the interview on auditory acclimatisation, participants were asked to answer the following question:

How should the audiologist prepare you to try new hearing aids from another manufacturer?
After the participants addressed the question, they were fitted by a clinical audiologist with Oticon Play PX BTE hearing aids which had a similar form factor to their current BTEs. The fitting followed hearing aid best practices (AAA, 2013) and used an equivalent prescriptive method and real-ear measurement procedure as with their current hearing aids. Participants were advised they would be using the new hearing aids only during the clinic appointment. Participants engaged in a 15-minute conversation with the researcher about their school and recreational activities. They were then asked to answer the following question:

Tell me about the sound quality of my voice and your own voice with the Play PX hearing aids?
The Play PX was paired to their mobile phone. They streamed their favourite music and participated in a short phone call with the researcher. They were next asked to answer the following question:

Tell me about listening to music and talking on your mobile phone with the Play PX hearing aids?
Participant responses to the above questions were audio recorded and recordings were transcribed by a certified transcriptionist. Transcripts were coded and thematic analysis was completed.

Results

How should the audiologist prepare you to try new hearing aids?
Participants in this study described the relationship with their audiologist as one that was based on trust. They believed their audiologist was invested in providing them with technology to have the best hearing possible. The major themes that emerged as facilitators for auditory acclimatisation were the importance of setting expectations for the new hearing aids, providing information about the features of the hearing aid, and discussing new opportunities for communication and technology access with the hearing aids (Figure 1).

For participants in this study, having the audiologist set expectations for the hearing aid was crucial. Participants relied on their hearing aids for learning, social activities, and communication at home and in their community. They wanted to understand the impact these new hearing aids may have on these activities. The teens wanted the audiologist to use simple, concrete language that was easy to understand, describe how the hearing aids may sound when activated, and have expectations for adjustment time explained. Sharing examples of other children's experiences when getting new hearing aids from another manufacturer were described as very helpful. One teen described why these facilitators for auditory acclimatisation were so important:

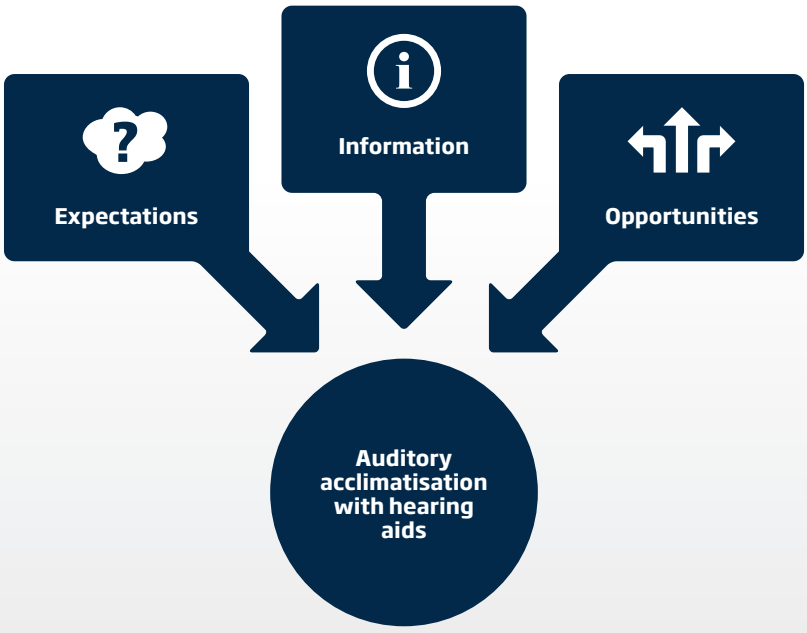

Figure 1. Facilitators for auditory acclimatisation with hearing aids

"It helps to feel prepared that sound will be different, so that I am not blind-sided. I really like to know what to expect, even if the sound may be weird."
Abby, 15 years old.

The next theme was information. Participants felt it was important to understand how the new hearing aids might help them hear better. Explanations of benefits of hearing in noisy environments, hearing sound more clearly, and having loud sounds be more comfortable were identified as important elements to encourage them to try new hearing aids. On the theme of information, one teen said:

"If you tell me I can hear more with new hearing aids, without having everything magnified all at once, this is very good." Amy, 17 years old.

The final theme was opportunities. Participants in this study felt a willingness and excitement to try new hearing aids from another manufacturer if there were opportunities to experience improvements over their current hearing device. Opportunities for smaller, more cosmetically discreet hearing aids, improved wearing comfort, and new options for connectivity to smart phones and other consumer devices were described as very motivating and helpful in managing their auditory acclimatisation. Participants stated that live demonstrations with the new hearing aids were essential:

"I thought I wasn't going to like getting new hearing aids until I realized it's better than the last ones. It is really cool to see the new ways I can connect to phones and computers." Amy, 17 years old.

Tell me about the sound quality of my voice and your own voice with the Play PX hearing aid?
When the Play PX hearing aids were activated, participants described the sound quality as different. They reported that knowing it would be different was very helpful and provided them with the context and openness to experience what they were hearing. Comments were positive, and participants acknowledged that it would take some time to fully adjust, and they were prepared to await that adjustment. One participant initially described the sound quality with uncertainty, and then transitioned into expressions of optimism for the new Play PX hearing aid:

"I just do not know how to feel about them. I have used these hearing aids (a competitor's paediatric hearing aid) for most of my life and now we are just switching it out to something completely different. But, it is refreshing to hear something different. I like it. I like it very much." Abby, 15 years old.

Amy had a similar experience and commented:

"I am slowly adjusting to it. It sounds a bit weird, but I like the features of the hearing aids. I really like the way it feels." Amy, 17 years old.

Tell me about listening to music and talking on your mobile phone with the Play PX hearing aid?
Participants in this study indicated that the opportunity for improvements in sound quality for streamed music and phone calls was a facilitator to managing their auditory acclimatisation experience. In this study, participants reported that the phone and music sounded better with the Play PX hearing aids. Amy stated,

"I like the way it connects to my phone and how clear the music comes through. I really like it." Amy, 17 years old.

"I can hear much better on the phone, it sounds really clear, I like that." Abby, 15 years old.

In addition, improvements in sound quality for the phone and for music were very important to the participants as they stated these new benefits motivated them to work through the auditory acclimatisation process.

Conclusions
This exploratory case study provided some interesting insights into the participants' experience with auditory acclimatisation. Successful auditory acclimatisation is possible, and in this work, it is supported by several facilitators. First, audiologist counseling. The audiologist has a very important role to prepare teens for their hearing technology change. Setting expectations for initial hearing aid activation is important, and this can be supported by sharing experiences of other children and teens who have also switched hearing aid manufacturers. Second, explaining new hearing aid features and how they may help their hearing and communication was essential. Lastly demonstrations on how the new hearing aids may offer opportunities to connect to smart

phones and other electronics used by their hearing peers was helpful in getting through the auditory acclimatisation process. In this study, the participants wore a competitor's paediatric hearing aids and were successfully fitted with Oticon Play PX hearing aids. Within the one-hour clinical study appointment, the participants had a positive auditory acclimatisation experience with the new hearing aids. Both participants expressed a preference in continuing to wear the Play PX hearing aids.

Matching hearing aids to DSL targets on first fit: A comparison of two paediatric hearing aids

Best practice for fitting hearing aids to infants, children, and teens includes the matching of hearing aid output levels to prescribed Desired Sensation Level (DSL) targets for different levels of speech, and targets for maximum power output (MPO) (Bagatto, 2019; AAA, 2013). Fitting to DSL targets provides the audiologist with an objective clinical tool to ensure hearing aids are providing safe, comfortable, and appropriate levels of sound required for infants and children to make use of auditory inputs (Bagatto, 2019). For infants and young children, hearing aid fitting guidelines support the use of coupler measurements in the hearing aid test box for electroacoustic verification of the hearing aid (Bagatto, 2019). Fit-to-target measures with hearing aids are completed using verification systems such as the Audioscan® Verifit and Interacoustics Affinity.

Why is first fit DSL target accuracy important to clinical audiologists?

Clinical audiologists have reported that completing coupler measures for infants and young children is a feasible method for programming hearing aids and it can be completed within their busy clinic schedules (Moodie et al., 2016). Anecdotal reports from clinical audiologists suggest that paediatric hearing aids that meet prescriptive DSL targets on the first fit following programming are very desirable, as it further supports their clinical efficiency.

The aim of this study was to investigate the accuracy of first fit to DSL prescriptive targets for average speech and MPO of two paediatric hearing aids. Oticon Play PX and a competitor's paediatric hearing aid, both miniBTE rechargeable hearing aids with similar specifications for gain and output were utilised. Hearing aids were programmed with the manufacturer's hearing aid fitting software using the DSL prescriptive method and the manufacturer default settings (i.e. pinna omni and NR off) for a six-month-old child. Each hearing aid was programmed to three different configurations of sensorineural hearing loss: 1) mild to moderate, sloping 2) moderate, sloping, and 3) mild to moderate, reverse slope (Figure 2).

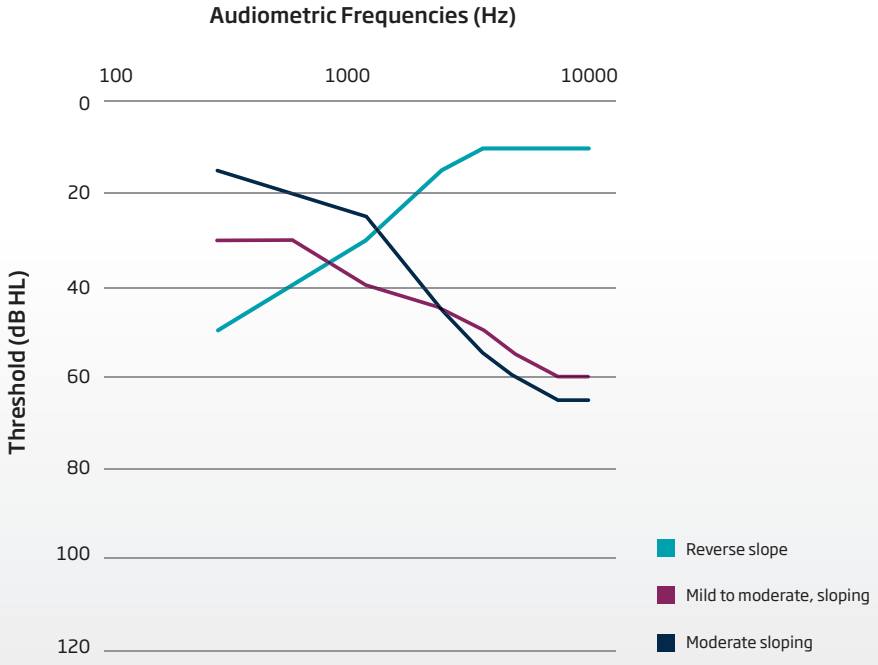

Figure 2. Configuration of hearing losses utilized for programming hearing aids

These configurations were selected as they represent audiograms that are familiar to paediatric audiology clinical practice.

Coupler verification measures for a six-month-old child were completed on the Audioscan Verifit2 with Play PX and the competitor's paediatric hearing aid. To represent the parameters for an infant hearing aid fitting, insert earphones were selected as the transducer, and the ear mold acoustics were set to "closed mold". The "first fit" accuracy of the match to DSL Child targets for average conversational speech and MPO for each configuration of hearing loss was analysed.

Accuracy or goodness of first fit to DSL Child targets was represented using the following descriptors:

- Match = met the DSL target within the +/- 3 dB
- Below = output fell below the intended target, by more than 3 dB
- Above = output was above the intended target, by more than 3 dB

Output from the Verifit2 coupler measures indicated that Play PX and the competitor's paediatric hearing aid matched DSL Child targets for MPO when programmed as first fit. Measurements for both hearing aids did not exceed the limit ranges for uncomfortable loudness levels. Accuracy of the first fit with the six-month-old child for the three hearing loss configurations at a 65 dB SPL speech input across frequencies is in Table 1. Results indicated that Play PX matched to DSL Child targets with first fit across all frequencies more often than the competitor's paediatric hearing aid (Table 1).

Conclusion

Simulated coupler measurements with a six month old child showed Oticon Play PX had a better "first fit" DSL target matching accuracy than the competitor's paediatric hearing aid on a variety of hearing loss configurations. Play PX and its ability to achieve an accurate first fit to DSL targets supports a clinical paediatric hearing aid fitting efficiency many audiologists' desire.

Voice emotion recognition in children and teens

Why is voice emotion recognition important for children and teens with hearing loss?

Tweens and teens with hearing loss, like their hearing peers, wish to learn, have friends, understand who they are, and feel as though they belong in their school (Antia, et al., 2011). While developed speech and language, and well-fitted hearing technology have been facilitators for a successful transition into their neighborhood school, they do not guarantee successful social integration, wellness, and belonging (Warner-Czyz et al., 2015). Research has shown that social competency is correlated to an individual's communication skills and the understanding of the nuances of spoken language (Semrud-Clikeman, 2007). When there are difficulties in the perception of emotion, studies have shown that it may

Configuration of Hearing Loss	Hearing aid	Speech Input Level	250Hz	500Hz	750Hz	1000Hz	2000Hz	3000Hz	4000Hz	6000Hz
Mild To Moderate Flat SN HL	Play PX	65 dB SPL	✓	✓	✓	✓	✓	✓	✓	✓
	Competitor	65 dB SPL	✓	✓	✓	X	✓	X	X	✓
Moderate Sloping SN HL	Play PX	65 dB SPL	✓	✓	✓	✓	✓	✓	✓	X
	Competitor	65 dB SPL	✓	✓	✓	X	✓	X	X	X
Reverse Slope SN HL	Play PX	65 dB SPL	✓	✓	✓	✓	✓	✓	✓	✓
	Competitor	65 dB SPL	✓	✓	✓	✓	✓	X	X	✓

Match to target = ✓ Below target = X

Table 1. Accuracy of first fit to DSL targets for average speech (65 dB SPL) for different hearing losses

compromise communication and impact social competency (Shaffer et al, 2009). The ability for an individual to identify an emotion appears to be much stronger when observing a person's face (Ebner et al., 2010). However, children may not always be facing the speaker when engaged in communication (Ricketts & Galster, 2008).

In noisy environments, do children and teens with hearing loss have the same access to voice emotion as their peers with normal hearing?

Access to voice emotion for children and teens who wear hearing aids has not been investigated in complex, noisy listening environments. The purpose of this study was to investigate the voice emotion recognition abilities of tweens and teens with hearing loss and compare them to their age-matched, normal hearing peers. The aim was to answer the research question: Is voice emotion recognition in noisy environments an area of concern for children and teens who wear hearing aids?

Ten english speaking children between the ages of 8 and 18 years with mild to moderately severe, permanent, bilateral hearing loss, and 10 children with normal hearing (defined as hearing thresholds <20 dB HL at audiometric test frequencies) were recruited to attend a clinical study appointment at a paediatric audiology clinic in Saskatoon, Canada.

Participants with hearing loss were fitted with Oticon More receiver-in-the-ear (RITE) hearing aids that utilised MoreSound Intelligence (also found in Play PX). Hearing aids were programmed and fitted using the DSL Child prescriptive method and verified through on-ear probe microphone measures.

Participants with normal hearing and those fit with Oticon hearing aids completed the Toronto Emotional Speech Set (TESS) (Dupuis & Pichora-Fuller, 2010). The TESS was modelled on the NU-6-word list with a speaker (audio only) saying words that portray different emotions. TESS word lists were presented at 70 dB SPL at 60 degrees azimuth with multi-talker babble presented at 180 and 270 degrees azimuth. Participants completed a list of 25 words and were asked to identify whether the words were being portrayed with anger, sadness, happiness, or fear.

Results

For the children and teens who wore the Oticon hearing aids, results indicated a mean score of 94% correct on the TESS when presented in background noise. This suggested that participants had the emotion nuances of spoken language available to them without the support of facial expressions. In addition, participants wearing the Oticon hearing aids had similar performance in their voice emotion recognition as their age-matched peers with normal hearing (Figure 3).

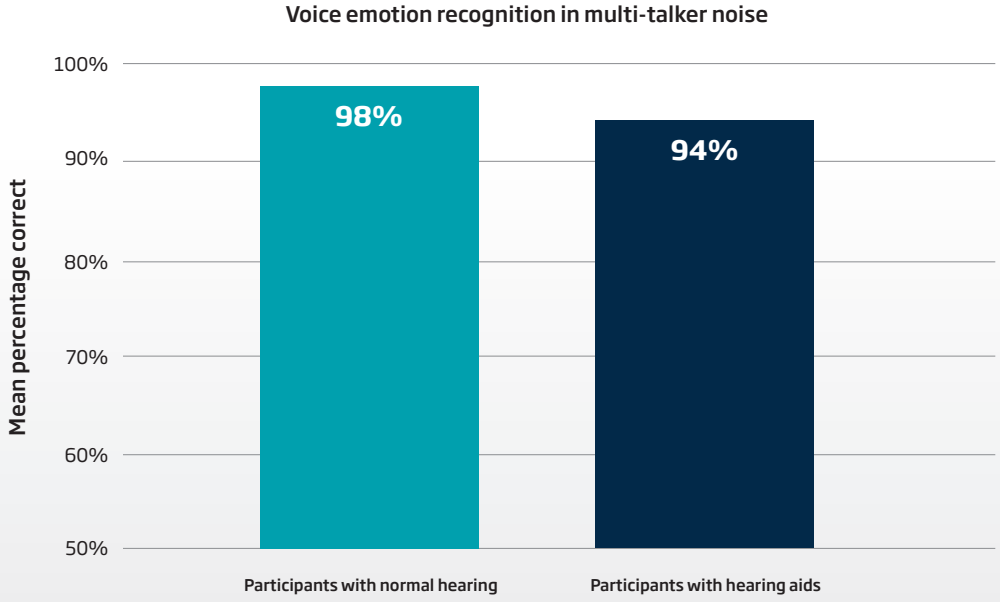

Figure 3. Voice emotion recognition abilities of children with normal hearing and children using Oticon hearing aids

Conclusions

Findings of this study suggest that Oticon hearing aids support voice emotion recognition in noisy environments for tweens and teens, with similar performance to their age-matched peers with normal hearing. These findings further support that Oticon hearing aids provide the communication access required for the development of social competency.

Summary

The exploratory research studies involving Oticon Play PX and those hearing aids with equivalent features to Play PX provided new evidence for auditory acclimatisation, supporting best practices in hearing aid fitting for infants and young children, and voice emotion recognition for children and teens wearing hearing aids. The role of the audiologist is important for the success of teens who change hearing aid manufacturers. They are able to set appropriate expectations, provide accurate information about the new hearing aids, and describe opportunities for using the hearing aids.

These were cited from the teens as facilitating the success of their acclimatisation to the new hearing aids. When fitting Oticon Play PX hearing aids to infants, the results presented indicate that applying the first fit in the software achieves a good match to DSL Child targets when verified in the coupler of the Audioscan Verifit2. This supports the execution of best practice paediatric hearing aid fitting protocols (AAA, 2013). Finally, when wearing Oticon hearing aids, tweens and teens demonstrated similar voice emotion recognition skills as their age-matched normal hearing peers. This important social skill will be supported through the use of Oticon hearing aids. The information determined from these exploratory studies will inform the development of future larger scale studies related to infants, children, and teens who wear hearing aids. In particular, Oticon Play PX has the potential to provide the access necessary for important developmental components of young hearing aid users.

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