Being deaf at the playground: the effects of hearing loss on children's social participation

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Chapter 3

Being Deaf in Mainstream Schools

The effect of a hearing loss in children's playground behaviours

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ABSTRACT

Naturalistic playground observations are a rich source of information when studying the social interactions of preschool children. On the playground, children can interact with their peers, explore different places and activities, and engage in different types of play. For deaf and hard of hearing (DHH) children, interactions at a playground can be more difficult because of the large number of auditory stimuli surrounding them. Constraints in the access to the social world on the playground might hamper DHH children's interactions with their typically hearing (TH) peers, activities, and play. This pilot study aimed to examine the playground behaviours of preschool DHH children across three aspects: social levels, type of activities, and play choices. For this purpose, 12 preschool DHH children were observed during recess time, and their behaviours were coded and compared to their 85 TH peers. The preliminary findings indicate that DHH children spend less time in social interactions compared to their TH peers and that they still face difficulties when socially engaging with their TH peers. These findings suggest that interventions should focus on three aspects: the physical environment awareness of TH peers about communicating with DHH children, and the use of exercise play to facilitate social interactions between DHH children and their TH peers.

INTRODUCTION

A rich way to understand preschool aged children's skills and social interactions is through observing their play, and peer interactions on playgrounds. Through the observation of naturalistic interactions – without adult interference – one can understand each child's particular interest while playing, the dynamics between peers, their positioning in the social group, and their skills to enter and maintain interactions (Heravi et al., 2018; Veiga et al., 2016, 2017). However, playgrounds are often neglected as a mean to study children's development (Pellegrini & Bohn, 2005), and this kind of research is especially scarce regarding preschool Deaf and Hard of Hearing (DHH) children. Most research in this field dates from 20 to 40 years ago (see Antia et al., 2012, for a review), and reports that DHH children show different behaviours on playgrounds compared to their typically hearing (TH) peers, suggesting that the constraints in access to the social world affects their social interactions with peers (Antia et al., 2012). However, recently, many developments took place in terms of rehabilitation and technology (e.g., cochlear im-plants), and in terms of education. Currently, most DHH preschool children attend mainstream setting, which implies that they are mainly surrounded by TH peers (DeLuzio & Girolametto, 2011; Minnett et al., 1994; Stinson & Kluwin, 2012). In this pilot study, we focus on describing the playground behaviours of DHH preschool children on three categories: social levels, types of activities, and types of play.

School playgrounds usually offer many opportunities for children to engage in various forms of social behaviours, which have been related to higher levels of social competence, and lower levels of internalizing symptoms and peer problems (Coplan et al., 2014; Veiga et al., 2016). On playgrounds, children can play games (e.g., football, hide and seek), rest, communicate with peers, explore, and most importantly they can play. Play, defined as 'a spontaneous, pleasurable, and self-guided activity' provides children with a unique opportunity for their overall development (Pellegrini, 2009; Piaget, 1952). Yet, communication seems a key aspect for playing with peers (Levine & Antia, 1997; Quintas et al., 2009). Thus, children who have hindered communication – like DHH children – might face more challenges while playing. In fact, social play in itself, especially in the preschool years, is already difficult for these children to follow, as the interactions and rules keep changing, which might be more difficult for DHH children to follow (Rieffe et al., 2015). Moreover, social play can become even more difficult when

it occurs in the playground setting, with all the different auditory and kinetic stimuli (Veiga et al., 2022). In this chaotic setting, DHH children might miss out on information that is necessary to engage and maintain play with their peers, thus impacting their play choices (Antia et al., 2012; Bat-Chava et al., 2005).

While on the playground, children can broadly show three types of behaviours: non-social (i.e., solitary and reticent), parallel, and/or social (Coplan et al., 2014; Coplan & Ooi, 2014; Parten, 1933; Rubin et al., 1978). Social behaviours are those in which the child is communicating, and/or playing with their peers without any specific organization, or in a cooperative way (Antia & Dittillo, 1998; Parten, 1933; Rubin et al., 1978).

Nonsocial behaviours are those in which children do not try to initiate or engage in interactions with their peers, even though peers are available (Coplan & Ooi, 2014). Some children choose to play solitarily, however, the most frequent form of non-social behaviours are reticent (Hart et al., 2000; Nelson et al., 2008). Reticent behaviours can be split into onlooking behaviours, when children observe their peers without attempting to join them; or unoccupied behaviours, when children wander around the playground with no specific focus or purpose (Chen et al., 2006; Hart et al., 2000; Nelson et al., 2008). Although there is no consensus regarding the adaptive function of solitary behaviour, reticent behaviour has been related to less emotion understanding, internalizing symptoms, lack of social skills, and peer rejection (Choo et al., 2012; Coplan et al., 2008; Rubin, 1982; Veiga et al., 2017).

Parallel behaviours are those in which the child plays alone but is in close proximity with the peers, sometimes observing others and imitating them (Antia & Dittillo, 1998; Parten, 1933; Stinson & Antia, 1999). Parallel behaviours seem to mark the transition between non-social – solitary – behaviours and social – group – behaviours (Bakeman & Brownlee, 1980; Parten, 1933). That is, children are interested – and also learning – about their peers, including their play preferences, their interests, how they respond to situations and how they engage (Brown et al., 2008; Robinson et al., 2003). Therefore, parallel behaviours provide children with a unique opportunity to learn about their peers, and to understand how to initiate interactions with them and maintain them (Brown et al., 2008).

Access to their peers and joining in social play might be more challenging for DHH children. Studies show that DHH children are less successful in initiating and maintaining social interactions with their peers (DeLuzio & Girolametto, 2011; Levine & Antia, 1997; Weisel et al., 2005). DHH children thus spend more time alone at playgrounds compared to their TH peers (Guralnick et al., 2006), whilst showing more onlooking behaviours (Vandell & George, 1981). Moreover, when they interact, their interactions are shorter compared to their TH peers, which makes their social networks more fragile (PBrown et al., 2008; Wauters & Knoors, 2008). Note that their TH peers might form a barrier here, as DHH children are less often invited or allowed to join in play (DeLuzio & Girolametto, 2011; Guralnick et al., 2006; Levine & Antia, 1997) and TH peers are overall less willing to initiate interactions with DHH children (Weisel et al., 2005).

Regarding play, there are two major forms: physical and pretend play (Pellegrini, 2009; Pellegrini & Smith, 1998). Physical play can be characterized by a moderate to vigorous physical activity, that can be split into: exercise play (e.g., running, climbing), and rough-and-tumble play (e.g., chasing, play-fighting, etc.) (Pellegrini & Smith, 1998). Pretend play can be characterized by a symbolic – and playful – conversion of something into something else, that can be split into: role play (i.e., when an object is converted into something else), and fantasy play (i.e., impersonates someone else) (Fein, 1981; Lillard et al., 2013; Lindsey & Colwell, 2013). Research focused on play behaviours of DHH children show that DHH children seem to avoid pretend play (e.g., Brown et al., 2001; Brown et al., 2013; Levine & Antia, 1997). In fact, recent studies have shown that DHH children engage more in physical play, rather than pretend play (da Silva et al., 2021; Mira et al., 2019).

Using playground naturalistic observations, the aim of this pilot study is to describe spontaneous playground behaviours of DHH preschoolers integrated in mainstream education, and compare them to their TH peers. Within the umbrella of playground behaviours, we focus on social levels, type of activities, and type of play that these children engage in during recess time. Past studies looked into play choices, and social levels of preschool DHH children (see (Antia et al., 2012) for a review), however – to the best of our knowledge – no previous studies have also looked into the engagement in different types of activities. Focusing on these three aspects in a single study (i.e., social levels, type of activities, and play choices) allows us to get a more in-depth understanding

of how preschool DHH children behave on playgrounds. Regarding the social levels and based on previous research (Vandell & George, 1981), we expect that DHH children show more non-social behaviours, - in particular onlooking ones and less social behaviours – than their TH peers. Regarding the type of activities, due to lack of previous research, no assumptions are made. Regarding the play choices, based on previous research (da Silva et al., 2021; Mira et al., 2019) we expect that DHH children engage more frequently in physical play than any other type of play. These preliminary findings might provide a more comprehensive view on how hearing loss can influence social participation and play preferences of DHH children in mainstream education.

MATERIALS AND METHODS

Participants and Procedures

A total of 12 DHH children (Mage = 59.67 months, SD = 8.60 months; 58% boys), participated in this study. Six DHH children had profound loss and bilateral cochlear implants; four had severe loss and conventional hearing aids (HA); and two children had severe loss and HA in the left ear, and profound loss and CI on the right ear. All DHH children in our study used spoken language as their primary mode of communication. Similarly to previous studies (Nunes & Pretzlik, 2001; Wauters & Knoors, 2008), classmates of our DHH participants were recruited as control group. A total of 85 TH children (Mage = 61.98 months, SD =11.42 months; 45% boys). DHH children and their parents were recruited in two hospitals in Lisbon and asked to participate in this study during their hospital visit. DHH children's parents were asked for the name of the preschool that their child attended, and only when parents gave permission, the preschool was contacted at a later stage to participate. Preschools were first asked for their participation, and when they agreed, parents of all children in the group or class with the DHH child were also asked to participate. Participants were recruited in two hospitals in the area of Lisbon, and in preschools in the centre and south of Portugal. Parents, preschools, and hospitals were informed about the goals and procedures of the study, how data would be handled and stored to guarantee participants privacy, and about the voluntary nature of their participation. Parents gave written consent. Children were informed about the purpose of the study, and gave verbal consent on their own

participation. Approval for the study was obtained from the ethics committees of all institutions involved.

Materials

Playground Observations

A total of 548 videos were collected and randomly distributed between two trained observers. To test inter-observer reliability 24% of the videos were double-coded. Each child's behaviour at outdoor recess was randomly video recorded during 3 days. Each 3 minute video was split into 12 segments (15 seconds each), in which the observer identified the prevalent type of behaviour (social level; type of activity; type of play). A frequency score for each type of behaviour was obtained, through the division of the total number of segments in which the child was involved in each specific type of behaviour, by the segments in which the child was observed. If children were not seen during any segment, their behaviours were coded as "not observed".

Social level (k=.91) was coded based on social levels categories suggested by Rubin (et al., 1978), that is unoccupied, onlooking, solitary, parallel, social. A non-social category was obtained through the sum of unoccupied, onlooking, and solitary behaviours.

Type of activity (k=.88) was coded based on the different activities that children engaged in on the playground, that is play; games with rules; talking; exploratory behaviours; transitioning between activities; personal care; aggressive behaviours; and other behaviours. If children were not engaged in any activity, their behaviour was coded as reticent.

Play behaviours (k=.89) were coded according to the observation scheme developed by Veiga (et al., 2016). The prevalent type of play in which the child was engaging during each segment was coded (i.e., exercise play; rough-and-tumble; fantasy play, role play; constructive play; playing with the equipments; or other play).

STATISTICAL ANALYSES

First, descriptive data was gathered for both groups. Second group differences were assessed for each variable. Due to non-normality of the data, we used the Mann-Whitney U test to assess group differences. Third, within group differences were assessed through Friedman's rank test, and post hoc comparison between social levels, type of activities, and types of play of each group were accessed through pairwise Wilcoxon sum rank tests. Within group differences of social levels were assessed considering the 'non-social', 'parallel', and 'social' categories. While assessing in-group differences, the frequency of "Not observed" episodes was not considered for the analysis, as they do not represent behaviours.

RESULTS

As reported in Table 1, differences between groups appeared regarding the social levels of interaction at the playground during recess time. Compared to their TH peers, DHH children showed fewer social interactions ($U = 230.50$, $p = .002$), but more non-social behaviours ($U = 242$, $p = .003$). Within the domain of non-social behaviours DHH children showed more onlooking behaviours ($U = 265$, $p = .007$), and solitary behaviours ($U = 281$, $p = .012$), than their TH peers. Parallel interactions were almost absent for children in both groups.

Within group comparison of the level of social interactions showed no difference within the DHH group between social and non-social play ($Z = -1.26$, $p = .209$), whereas TH children engaged most in social play ($Z = -7.68$, $p < .001$). Furthermore, both groups engaged less in parallel interactions, in comparison to social (DHH: $Z = -3.06$, $p = .002$; TH: $Z = -7.85$, $p < .001$), and non-social interactions (DHH: $Z = -2.93$, $p = .003$; TH: -8.01, $p < .001$).

Table 1. Mean scores (SD), mean rank and results of Friedman's Rank Text for children's engagement in different social levels, activity, and types of play by group.

	DHH Group	**TH Group**
	Mean (SD)	**Mean (SD)**
Social Level		
Social**	.57 (.19)	.75 (.16)
Parallel	.00 (.01)	.01 (.03)
Nonsocial**	.42 (.18)	.24 (.16)
- *Unoccupied*	*.11 (.08)*	*.09 (.08)*
- *Onlooking***	*.11 (.07)*	*.06 (.07)*
- *Solitary**	*.20 (.15)*	*.09 (.09)*
Not Observed	.01 (.02)	.00 (.01)
	$\chi^2(2)= 18.67^1$ **	$\chi^2(2)= 152.83^1$ **
Activity		
Play	.44 (.17)	.42 (.19)
Games with rules	.02 (.05)	.08 (.15)
Communication	.23 (.17)	.28 (.17)
Exploratory Behavior	.02 (.04)	.03 (.06)
Transition	.02 (.02)	.02 (.03)
Personal Care	.02 (.04)	.01 (.02)
Aggressive Behavior	.00 (.01)	.00 (.01)
Other Activities	.02 (.03)	.01 (.02)
Reticent	.22 (.11)	.15 (.12)
Not Observed	.01 (.03)	.00 (.01)
	$\chi^2(8)= 77.40^2$**	$\chi^2(8)= 429.33^2$**
Type of Play		
Exercise*	.52 (.29)	.32 (.28)
Rough-and-Tumble	.13 (.18)	.15 (.22)
Fantasy Play	.02 (.06)	.12 (.22)
Role Play	.08 (.17)	.15 (.21)
Constructive Play	.05 (.14)	.06 (.15)
Equipment	.19 (.15)	.17 (.25)
Other	.01 (.03)	.03 (12)
	$\chi^2(6)= 31.71$**	$\chi^2(6)= 89.10$**

[1]Including the Nonsocial, Parallel, and Social categories; [2]Excluding the "Not Observed" category;

** $p < .05$; ** $p < .01$; *** $p < .001$;

No differences were found between groups regarding the engagement in different types of activities (Table 1). Within group comparisons of the type of activity (Table 2), showed that DHH children equally preferred to play, and communicate over the remaining activities, whereas TH children preferred play over all the remaining activities. For TH children, communication was the second preferred activity (Table 2). Furthermore, reticent behaviours were the third most prevalent activity for both groups (Table 2).

Table 2. Wilcoxon pairwise comparisons regarding types of activity DHH/TH children

	Play	**Games w. Rules**	**Communication**	**Exploratory**	**Transition**	**Personal C.**	**Aggressive**	**Other**
Games with rules	-3.06**/ -7.09***	-	-	-	-	-	-	-
Communication	-1.96/ -3.84***	-3.06**/ -5.87***	-	-	-	-	-	-
Exploratory	-3.06**/ -7.82***	-.51/ -1.65	-3.06**/ -7.90***	-	-	-	-	-
Transition	-3.06**/ -7.94***	-.87/ -1.93	-3.06**/ -7.77***	-.12/ -.59	-	-	-	-
Personal C.	-3.06**/ -7.91***	-.54/ -3.84***	-3.06**/ -7.93***	-.32/ -2.9**	-.92/ -3.86***	-	-	-
Aggressive	-3.06**/ -7.91***	-1.07/ -4.17***	-3.06**/ -7.96***	-.94/ -4.03***	-2.38*/ -4.48***	-.73/ -2.02*	-	-
Other	-3.06**/ -7.91***	0/ -3.71***	-3.06**/ -7.97***	-.42/ -3.08**	-.41/ -4.34***	-.32/ -.55	-1.84/ -.82	-
Reticent	-2.75**/ -6.81***	-3.06**/ -3.66***	-.55**/ -4.42***	-3.06**/ -6.79***	-3.06**/ -6.87***	-3.06**/ -7.43***	-3.06** / -7.62***	-3.06**/ -7.43***

* p < .05; ** p < .01; *** p < .001;

Regarding play, differences between groups were found for exercise play. Compared to their TH peers, DHH children engaged more in exercise play (U = 299, p = .026) (Table 1). Within group comparisons showed that both groups preferred exercise play over all the remaining types of play (Table 3). Furthermore, DHH children preferred to engage in constructive play with equipment rather than fantasy play (Z = -2.50, p = .012), whilst TH children preferred both forms of pretend play over constructive play (Table 3).

Table 3. Wilcoxon pairwise comparisons regarding types of play of DHH/TH children

	Exercise	**RTP**	**Fantasy**	**Role**	**Constructive**	**Equipment**
Rough-and Tumble	-2.67** / - 4.05***	-	-	-	-	-
Fantasy Play	-2.98** / -4.18***	1.68 / -.83	-	-	-	-
Role Play	-2.51* / -3.71***	-.98 / -.30	.85 / -1.31	-	-	-
Constructive	-2.75** / -5.58***	-1.26 / -2.77**	-1 / -2.03*	-.68 / -3.41**	-	-
Equipment	-2.35** / -3.42**	-1.25 / -.55	-2.50* / -1.15	-1.58 / -.19	-1.8 / -3.15**	-
Other	-2.98** / -6.56***	-1.72 / -4.51***	-.73 / -3.47**	-1.99*/ -4.75***	-.73 / -1.27	-2.81** / -4.32***

* p < .05; ** p < .01; *** p < .001;

DISCUSSION

The main purpose of our pilot study was to describe the spontaneous playground behaviours (i.e., social levels, type of activities, and play choices) of preschool DHH children who attend mainstream preschools, and compare them to their TH peers. As previously mentioned, past studies have focused on certain aspects of playground behaviours of preschool DHH children. However, these studies were mostly focused on children with conventional hearing aids, or who were implanted later, whereas neonatal hearing screening at national level, the development of new technologies, and early interventions now provide much better opportunities for DHH children to improve their hearing compared to 20 years ago (see Antia et al., 2012 for a review). Thus, understanding the differences – or similarities – between the current and past results might allow us to reflect on how the progress in the rehabilitation of DHH children has influenced their behaviours and abilities to participate within the peer group. Contrary to previous studies, the DHH children did not spend most of their recess time at the school's playground in non-social behaviours, but the prevalence of these non-social behaviours is still significantly higher than for their TH peers. Unfortunately, preliminary findings of the present study also suggest that DHH children still face difficulties in engaging in social interactions with their TH peers, and that they maintain similar patterns of interaction as found in studies from more than 2 decades ago (Antia et al., 2012).

In line with previous studies (Guralnick et al., 2006; Vandell & George, 1981) the DHH children in our study engaged less frequently in social interactions, and more frequently in non-social behaviours compared to their TH peers. Within the TH group, children preferred to engage in social interactions rather than non-social behaviours, however for DHH children this preference was not confirmed. DHH children seemed to be equally engaged in both types of behaviours (social versus non-social). Moreover, DHH children spent more time in onlooking behaviours, compared to their TH peers (Guralnick et al., 2006; Vandell & George, 1981). That is, DHH children spent time in proximity with their peers, observing them, without attempting to join them. These findings are often interpreted with regard to problems in the socio-emotional development of DHH preschoolers, such as a lack of emotion understanding (Wiefferink et al., 2013) and emotion regulation (Wiefferink et al., 2012), which may hinder them to freely participate in social interactions with their TH peers.

In our study all DHH children used spoken language as their primary mode of communication, similarly to their TH peers. To date, this is the case for most DHH children who have no additional diagnoses because most early intervention programs are focused on spoken language acquisition (NCHAM, 2019). Although technological advances in hearing devices allow DHH children to receive better auditory input, their hearing is still not comparable to that of their TH peers, and many factors can influence their communication in a predominantly TH world. Recent studies show that despite sharing the same communication mode, good language skills, compatible socioemotional functioning and good social skills, DHH children are still more often ignored or excluded by their DHH peers (Rieffe et al., 2018). Various factors may cause this lack of social inclusion. For example, poor acoustics of the play-ground might hinder full participation or any participation at all. Yet, this lack of social inclusion might also be partially caused by a lack of awareness in TH children to understand what it takes to include a DHH child in a noisy environment like playgrounds, in play. For example, the DHH child has to see where sounds are coming from; who is talking; and additionally, the face of the speaker should be facing the light. Furthermore, TH children should wait until one is finished talking, before starting to talk. In sum, TH children have to be aware that DHH children rely on visual cues to facilitate their access to social information. However, all these tasks are not easy for young children at playgrounds. Moreover, poor acoustics of the playground might further hinder full participation or any participation at all. But besides the access to sound, children can also easily exclude that one child who is perceived as "different", i.e., purposely ignoring or excluding a DHH child. All these facets might further contribute to difficulties for DHH children to develop their socio-emotional skills in ways that TH children do: in naturalistic, spontaneous settings with their peers.

In our study, the engagement of children from both groups in parallel play was almost absent. Although parallel play seems to play an important role in the transition from solitary play to social – group – play, previous studies have referred that this stage is not obligatory, and that they only arise if/when children need them to facilitate interactions, which might explain our results (Bakeman & Brownlee, 1980; Smith, 1978).

When on the playground, DHH and TH preschoolers show similar activities engagement: they spent most of their time playing, and communicating. Previous studies have suggested that because of their communication difficulties, DHH children might avoid communication with their peers in playground settings, which can also hinder their

engagement in play (see Antia et al., 2012, for a review). Our current findings suggest that the progresses in technology and rehabilitation might have positively contributed to their opportunities for communication in the mainstream setting. There are different types of hearing aids, but as a whole, all of these devices have been improved over the years. Furthermore, nowadays cochlear implants are a commonly used device for people who have severe to profound hearing loss, which allow them to have access to a wider range of auditory information compared to the conventional hearing aids (Rich et al., 2013). Also in our study, two thirds of the DHH children had CI's, which might explain the positive results regarding communication. When comparing a DHH child with a CI with a child with a conventional hearing aid, or no hearing aid at all, within the same range of hearing loss, the CI child will be able to access more auditory information, and therefore their communication abilities will be closer to TH children (Rich et al., 2013). In fact, after implantation, these children can achieve better communication skills, and therefore interact more and take more advantage of the auditory clues provided by the social environment (Bat-Chava et al., 2005), which might explain our results.

Regarding the engagement in play, our results are in line with recent literature (da Silva et al., 2021; Mira et al., 2019), that shows that DHH children prefer exercise play over any other type of play. Our hypothesis that DHH children would prefer physical play over pretend play was also confirmed. When comparing between the two types of play – physical and pretend – pretend play requires more complex language abilities, better communication and social skills (Casby & Mccormack, 1985; Mathieson & Banerjee, 2010). Therefore, our results are in line with previous studies, that shows that DHH children tend to avoid this type of play because it is more demanding in terms of language and socio-emotional skills (Brown & Watson, 2017; Casby & Mccormack, 1985). In comparison, exercise play might be less demanding in terms of language, and emotional skills, making it more attractive for DHH children (Veiga et al., 2022). Exercise play allows DHH children to use their bodies and movements (rather than words) to communicate, to be in synchrony, and to cooperate with their peers, promoting more frequent and more positive interactions (Veiga et al., 2022). Physical play, especially exercise play, has been suggested to provide DHH children with a more suitable alternative to engage in play with their peers (Veiga et al., 2022). Furthermore, contrary to their TH peers, DHH children preferred constructive play over pretend – fantasy – play. The reasoning for this preference seems to be in line with the pretend versus physical play

preference. Previous studies that compared the engagement of DHH preschool children in both types of play, showed that these children spend more time in constructive play rather than in pretend play (Higginbotham & Baker, 1981; Levine & Antia, 1997). Similarly, to physical play, constructive play is less dependent on verbal communication, in comparison to pretend play. Furthermore, constructive play does not require children to have a play partner, and can be easily engaged alone. Indeed, previous studies report that DHH children prefer to engage solitarily in constructive play, rather than engage in cooperative/social types of play (Higginbotham & Baker, 1981).

As a final note, we want to address four limitations that might be addressed in future studies. First, this is a pilot study with a small sample size. Future studies should replicate our study with a larger sample, to confirm if our results are maintained with a more representative sample of the population. Furthermore, a larger sample size would allow comparisons between DHH children who use conventional hearing aids versus cochlear implants. Comparisons between both types of hearing devices can further inform us about the benefits types of different hearing devices, and how each device singularly impacts social participation and inclusions of DHH children within the peer group. Second, in the present study all participating DHH children were in different classes or schools, and consequently, only had TH peers available for them at school. DHH children in main-stream schools, still prefer to engage in interactions with similar peers (Stinson & Kluwin, 2012), which might have influenced the high prevalence of non-social behaviours. It will be worthwhile that future studies focus schools where DHH child have other DHH children, as well as TH peers. The presence of DHH peers on the playground, might allow these children to feel more welcomed into engaging in group interactions with other DHH children. Third, all the DHH children in our study used spoken language as their primary mode of communication. However, this is not true for all DHH children mainly because spoken language is not accessible to them (e.g., they have irreversible deafness; they do not have criteria to benefit from hearing devices), or because they rely on a more visual – or bilingual - mode of communication (e.g., sign supported language) [48]. DHH children who do not use spoken language, might have a different social experience – and engagement – than the DHH children included in our study. Therefore, future studies could also include DHH children who primarily use sign language, or sign supported language, to understand how different communication modes influence social participation of DHH children within the peer group. Fourth, it is important to highlight

the importance of naturalistic observations, as a method to obtain information regarding children's interactions. Observations allow us to specifically understand what children are doing, and with whom, during the period of observation. However, this method is very time consuming, and it only allows us to capture limited fragments of children' interactions. New studies including new methodologies – such as sensor data – are also important to study playground behaviours, as they enable to capture spontaneous behaviour through intense and continuous data (Veiga et al., 2016, 2017). Future studies should combine observation data with these new technologies to better understand the social functioning of preschool DHH children on playground settings. Additionally, future studies should also include sociometric measures (e.g., likeability, friendship ratings, popularity), as these peer reports can further inform us about the social participation, and social positioning of DHH children within the peer group.

CONCLUSIONS

The outcomes of our study provide a current – and extensive – picture of the playground behaviours of DHH children. Our results might increase awareness to the positive impact that progress in technology, rehabilitation and educational policies have brought to these children. DHH children currently seem more prone to interact and communicate with their TH peers than DHH children 20 to 40 years ago. However, certain playground behaviours (i.e., high prevalence of onlooking behaviours; avoidance of pretend play) reflect that they still face some of the same difficulties in terms of socio-emotional development. This suggests that problems in interactions, are not solely related to DHH children hearing capacity, but are a consequence of multiple factors, such as the context in which interactions occur, the type of peers available, and the sensitivity/awareness of TH peers towards the DHH child. In this sense, environmental changes (e.g., changes in the playground setting), should accompany the progress of technology in providing these children better hearing, as to increase their social participation. Nowadays, most DHH children are integrated in mainstream education, interventions in this setting are needed to promote closeness, and positive social interactions with their TH peers. Interventions should increase the awareness of TH children on what is needed to communicate with a DHH child (i.e., the child has to see your face for example, in order to also use lip reading, or to see where the sound is coming from), promoting more, and better quality of

interactions. Furthermore, exercise play seems a promising tool to promote interactions between TH and DHH children, therefore interventions through play within the peer group (e.g., psychomotor therapy) can play an important role on DHH children's inclusion. Future research should address the impact of exercise play in the social inclusion of DHH children.

REFERENCES

Antia, S. D., & Dittillo, D. A. (1998). A Comparison of the Peer Social Behavior of Children Who are Deaf/Hard of Hearing and Hearing. *Journal of Children's Communication Development*, *19*(2), 1–10.

Antia, S. D., Kreimeyer, K. H., Metz, K. K., & Spolsky, S. C. (2012). Peer Interactions of Deaf and Hard-of-Hearing Children. *The Oxford Handbook of Deaf Studies, Language, and Education: Second Edition*, *1*(July 2018), 1–26. https://doi.org/10.1093/oxfordhb/9780199750986.013.0013

Bakeman, R., & Brownlee, J. R. (1980). The Strategic Use of Parallel Play : A Sequential Analysis. *Child Development*, *51*(3), 873–878.

Bat-Chava, Y., Martin, D., & Kosciw, J. G. (2005). Longitudinal improvements in communication and socialization of deaf children with cochlear implants and hearing aids: evidence from parental reports. *Journal of Child Psychology and Psychiatry*, *46*(12), 1287–1296. https://doi.org/10.1111/j.1469-7610.2005.01426.x

Brown, M., Rickards, F. W., & Bortoli, A. (2001). Structures Underpinning Pretend Play and Word Production in Young Hearing Children and Children With Hearing Loss. *Oxford University Press*.

Brown, P. M., Bortoli, A., Remine, M. D., & Othman, B. (2008). Social engagement, attention and competence of preschoolers with hearing loss. *Journal of Research in Special Educational Needs*, *8*(1), 19–26. https://doi.org/10.1111/j.1471-3802.2008.00098.x

Brown, P. M., Prescott, S. J., Rickards, F. W., & Paterson, M. M. (2013). Communication about pretend play: A comparison of the utterances of 4- year-old normally hearing. *Volta Review. Winter97*, *99*(1).

Brown, P. M., & Watson, L. M. (2017). Language, play and early literacy for deaf children: the role of parent input. *Deafness and Education International*, *19*(3–4), 108–114. https://doi.org/10.1080/14643154.2018.1435444

Casby, M. W., & Mccormack, S. M. (1985). Symbolic Play and Early Communication Development in Hearing-Impaired Children. *J. Commun. Disord.*, *18*, 67–78.

Chen, X., Desouza, A. T., Chen, H., & Wang, L. (2006). Reticent behaviour and experiences in peer interactions in Chinese and Canadian children. *Developmental Psychology*, *42*(4), 656–665. https://doi.org/10.1037/0012-1649.42.4.656

Choo, M. S., Xu, Y., & Haron, P. F. (2012). Subtypes of Nonsocial Play and Psychosocial Adjustment in Malaysian Preschool Children. *Social Development*, *21*(2), 294–312. https://doi.org/10.1111/j.1467-9507.2011.00630.x

Coplan, R. J., Arbeau, K. A., & Armer, M. (2008). Don't fret, be supportive! Maternal characteristics linking child shyness to psychosocial and school adjustment in kindergarten. *Journal of Abnormal Child Psychology*, *36*(3), 359–371. https://doi.org/10.1007/s10802-007-9183-7

Coplan, R. J., & Ooi, L. (2014). The Causes and Consequences of " Playing Alone " in Childhood. In R. J. Coplan & J. C. Bowker (Eds.), *The Handbook of Solitude: Psychological Perspectives on Social Isolation, Social Withdrawal, and Being Alone* (1st ed., pp. 111–128). John Wiley & Sons, Ltd.

Coplan, R. J., Ooi, L. L., & Rose-krasnor, L. (2014). Naturalistic Observations of Schoolyard Social Participation : Marker Variables for Socio-Emotional Functioning in Early Adolescence. *Journal of Early Adolescence*, *35*(5–6), 628–650. https://doi.org/10.1177/0272431614523134

Da Silva, B. M., Veiga, G., Rieffe, C., & Frijns, J. H. M. (2021). The play behaviours of Portuguese Children with Hearing Loss in mainstream and special schools a review study. *International Congress of Early Childhood Outdoor Practices Congress*.

DeLuzio, J., & Girolametto, L. (2011). Peer Interactions of Preschool Children With and Without Hearing Loss. *Journal of Speech Language and Hearing Research*, *54*, 1197–1210. https://doi.org/10.1044/1092-4388(2010/10-0099)

Fein, G. G. (1981). Pretend Play in Childhood : An Integrative Review. *Child Development*, *52*(4), 1095–1118.

Guralnick, M. J., Hammond, M. A., & Connor, R. T. (2006). Nonsocial play patterns of young children with communication disorders: Implications for behavioural adaptation. *Early*

Education and Development, *17*(2), 203–228. https://doi.org/10.1207/s15566935eed1702_1

Hart, C. H., Yang, C., Nelson, L. J., Robinson, C. C., Olsen, J. A., Nelson, D. A., Porter, C. L., Jin, S., Olsen, S. F., & Wu, P. (2000). Peer acceptance in early childhood and subtypes of socially withdrawn behaviour in China, Russia, and the United States. *International Journal of Behavioral Development*, *24*(1), 73–81. https://doi.org/10.1080/016502500383494

Heravi, B. M., Gibson, J. L., Hailes, S., & Skuse, D. (2018). Playground Social Interaction Analysis using Bespoke Wearable Sensors for Tracking and Motion Capture. *Proceedings of the 5th International Conference on Movement and Computing*, *21*. https://doi.org/10.1145/3212721.3212818

Higginbotham, D. J., & Baker, B. M. (1981). Social Participation and Cognitive Play Differences . in Hearing-Impaired and Normally Hearing Preschoolers -. *Volta Review*, 135–149.

Levine, L. M., & Antia, S. D. (1997). The effect of partner hearing status on social and cognitive play. *Journal of Early Intervention*. https://doi.org/10.1177/105381519702100104

Lillard, A. S., Lerner, M. D., Hopkins, E. J., Dore, R. A., Smith, E. D., & Palmquist, C. M. (2013). The impact of pretend play on children's development: A review of the evidence. *Psychological Bulletin*, *139*(1), 1–34. https://doi.org/10.1037/a0029321

Lindsey, E., & Colwell, M. (2013). Pretend and Physical Play: Links to Preschoolers' Affective Social Competence. *Merrill-Palmer Quarterly*, *59*(3), 330. https://doi.org/10.13110/merrpalmquar1982.59.3.0330

Mathieson, K., & Banerjee, R. (2010). Preschool peer play: The beginnings of social competence. *Educational & Child Psychology*, *27*, 9–20.

Minnett, A., Clark, K., & Wilson, G. (1994). Play Behavior and Communication Between Deaf and Hard of Hearing Children and Their Hearing Peers in an Integrated Preschool. *American Annals of the Deaf*, *139*(4), 420–429. https://doi.org/10.1353/aad.2012.0345

Mira, C., Veiga, G., da Silva, B. M., & Pereira, C. (2019). As crianças com perdas auditivas nas escolas de referência para a educação bilingue de alunos surdos: uma análise dos comportamentos de jogo. In K. O'Hara, B. Travassos, & C. Lourenço (Eds.), *Estudos em Desenvolvimento Motora da Criança XIV* (pp. 287–295). UBI Edições.

National Center fo Hearing Assessment and Management. (2019). *EHDI legislation: Overview.* National Center for Hearing Assessment and Management.

Nelson, L. J., Hart, C. H., & Evans, C. A. (2008). Solitary-functional play and solitary-pretend play: Another look at the construct of solitary-active behaviour using playground observations. *Social Development*, *17*(4), 812–831. https://doi.org/10.1111/j.1467-9507.2008.00470.x

Nunes, T., & Pretzlik, U. (2001). Deaf children's social relationships in mainstream schools. *Deafness and Education International*, *3*(3), 123–136.

Parten, M. B. (1933). Social play among preschool children. *Journal of Abnormal and Social Psychology*, *28*(2), 136–147. https://doi.org/10.1037/h0073939

Pellegrini, A. D. (2009). Research and policy on children's play. *Child Development Perspectives*, *3*(2), 131–136. https://doi.org/10.1111/j.1750-8606.2009.00092.x

Pellegrini, A. D., & Bohn, C. M. (2005). The Role of Recess in Children's Cognitive Performance and School Adjustment. *Educational Researcher*, *34*(1), 13–19. https://doi.org/10.3102/0013189X034001013

Pellegrini, A. D., & Smith, P. K. (1998). Physical Activity Play: The Nature and Function of a Neglected Aspect of Play. *Child Development*, *69*(3), 577–598.

Piaget, J. (1952). *Play, dreams and imitation in childhood.* W W Norton & Co.

Quintas, T., Curti, L. M., De Goulart, G., & Chiari, B. M. (2009). Caracterização do jogo simbólico em deficientes auditivos: estudo de casos e controles. *Pró-Fono Revista de Atualização Científica.*, *21*(4), 303–308.

Rich, S., Levinger, M., Werner, S., & Adelman, C. (2013). Being an adolescent with a cochlear implant in the world of hearing people: Coping in school, in society and with self identity.

International Journal of Pediatric Otorhinolaryngology, *77*(8), 1337–1344. https://doi.org/10.1016/j.ijporl.2013.05.029

Rieffe, C., Broekhof, E., Eichengreen, A., Kouwenberg, M., Veiga, G., da Silva, B. M. S., van der Laan, A., & Frijns, J. H. M. (2018). Friendship and emotion control in pre-adolescents with or without hearing loss. *Journal of Deaf Studies and Deaf Education*, *23*(3), 209–218. https://doi.org/10.1093/deafed/eny012

Rieffe, C., Netten, A. P., Broekhof, E., & Veiga, G. (2015). The Role of the Environment in Children's Emotion Socialization. In *Educating Deaf Learners* (pp. 369–388). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780190215194.003.0016

Robinson, C. C., Anderson, G. T., Porter, C. L., Hart, C. H., & Wouden-Miller, M. (2003). Sequential transition of patterns of preschoolers' social interaction during child-initiated play: Is parallel-aware play a bidirectional bridge to other play states? *Early Childhood Research Quarterly*, *18*(1), 3–21. https://doi.org/10.1016/S0885-2006(03)00003-6

Rubin, K. H. (1982). Nonsocial Play in Preschoolers: Necessarily Evil? *Child Development*, *53*(3), 651. https://doi.org/10.2307/1129376

Rubin, K. H., Watson, K. S., & Jambor, T. W. (1978). Free-Play Behaviors in Preschool and Kindergarten Children. *Child Development*, *49*(2), 534. https://doi.org/10.2307/1128725

Smith, P. K. (1978). A longitudinal study of social participation in preschool children: Solitary and parallel play reexamined. *Developmental Psychology*, *14*(5), 517–523. https://doi.org/10.1037//0012-1649.14.5.517

Stinson, M. S., & Antia, S. D. (1999). Considerations in educating deaf and hard-of-hearing students in inclusive settings. *Journal of Deaf Studies and Deaf Education*, *4*(3), 163–175. https://doi.org/10.1093/deafed/4.3.163

Stinson, M. S., & Kluwin, T. N. (2012). Educational Consequences of Alternative School Placements. *The Oxford Handbook of Deaf Studies, Language, and Education: Second Edition*, *1*(December 2018), 1–30. https://doi.org/10.1093/oxfordhb/9780199750986.013.0005

Vandell, D. L., & George, L. B. (1981). Social Interaction in Hearing and Deaf Preschoolers : Successes and Failures in Initiations. *Child Development*, *52*(2), 627–635. https://doi.org/10.1007/slll53-006-0010-9

Veiga, G., da Silva, B. M., Gibson, J., & Rieffe, C. (2022). Emotions in Play. In D. Dukes, A. C. Samson, & E. A. Walle (Eds.), *The Oxford Handbook of Emotional Development* (pp. 339–353). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780198855903.001.0001

Veiga, G., Ketelaar, L., De Leng, W., Cachucho, R., Kok, J. N., Knobbe, A., Neto, C., & Rieffe, C. (2017). Alone at the playground. *European Journal of Developmental Psychology*, *14*(1), 44–61. https://doi.org/10.1080/17405629.2016.1145111

Veiga, G., Leng, W. De, Cachucho, R., Ketelaar, L., Kok, J. N., Knobbe, A., Neto, C., & Rieffe, C. (2016). Social competence at the playground: preschoolers during recess. *Infant and Child Development*, *26*(1). https://doi.org/10.1002/icd.1957

Wauters, L. N., & Knoors, H. (2008). Social integration of deaf children in inclusive settings. *Journal of Deaf Studies and Deaf Education*, *13*(1), 21–36. https://doi.org/10.1093/deafed/enm028

Weisel, A., Most, T., & Efron, C. (2005). Initiations of social interactions by young hearing impaired preschoolers. *Journal of Deaf Studies and Deaf Education*, *10*(2), 161–170. https://doi.org/10.1093/deafed/eni016

Wiefferink, C. H., Rieffe, C., Ketelaar, L., De Raeve, L., & Frijns, J. H. M. (2013). Emotion understanding in deaf children with a cochlear implant. *Journal of Deaf Studies and Deaf Education*, *18*(2), 175–186. https://doi.org/10.1093/deafed/ens042

Wiefferink, C. H., Rieffe, C., Ketelaar, L., & Frijns, J. H. M. (2012). Predicting social functioning in children with a cochlear implant and in normal-hearing children: The role of emotion regulation. *International Journal of Pediatric Otorhinolaryngology*, *76*(6), 883–889. https://doi.org/10.1016/j.ijporl.2012.02.06