Research in Developmental Disabilities 105 (2020) 103714

Contents lists available at ScienceDirect

Research in Developmental Disabilities

journal homepage: www.elsevier.com/locate/redevdis

Characteristics of peer play in children with visual impairments

Suzanne H. Verver*, Mathijs P.J. Vervloed, Bert Steenbergen

Behavioural Science Institute, Radboud University, Montessorilaan 3, 6525 HR, Nijmegen, the Netherlands

ARTICLE INFO

Keywords:
Children with vision impairments
Social play
Cognitive play
Individual variability
Augmented toys

ABSTRACT

Background: Although many studies report children with vision impairments (VIs) experience play difficulties compared to sighted peers, large variation is present within the population of children with VIs.
Aims: The present study investigated peer play variation in 70 elementary school-aged children with VIs (*M* age = 8;11 years, *SD* = 2.25) and associations with specific child characteristics in sub-groups of participants. Also, it was examined how play materials with supportive auditory cues affected social play in children with varying cooperative play skills.
Methods and Procedures: Play behavior was coded while participants used play materials with and without auditory cues and parents filled in questionnaires about child characteristics. Data were analyzed using binomial logistic regression analyses.
Outcomes and Results: Although the profoundness of the VI was not associated to cooperative or symbolic play, age, language ability and gender did predict the demonstration of these play behaviors. Furthermore, auditory cues were particularly facilitative of social play in children with VIs with low cooperative play capabilities.
Conclusions and implications: In sum, this emphasizes that child characteristics other than the VI can play a significant role during peer play and interaction, and that individual variation should be considered when providing peer play support.

What this paper adds?

Previous studies have reported that children with vision impairments (VIs) are often challenged to play and interact with peers as a result of vision-related difficulties, which emphasizes the need for adequate support. However, this assumption is primarily based on studies that compared play and social communicative behaviors of children with VIs with sighted peers, consequently ignoring potential variation within the population of children with VIs. In addition, recent research on peer play and interaction in elementary school-aged children with VIs is scarce. The present study provides additional insights in the nature of peer play variation in a substantial group of 4- to 12-year-old children with VIs. It also offers possible explanations of play variability by examining associations with the profoundness of the VI and individual characteristics, such as age, language ability, or social competence. Finally, this study reconsiders the potential of sound-augmented toys (i.e., play materials embedded with technology that enables auditory output) to facilitate peer play by taking within-group variation of peer play abilities into account.

1. Introduction

The majority of studies that examined the developmental trajectory of play behavior in children with vision impairments (VIs)

* Corresponding author at: Behavioural Science Institute, Radboud University Nijmegen, PO Box 9104, 6525 HE, Nijmegen, the Netherlands.
E-mail addresses: s.verver@pwo.ru.nl (S.H. Verver), m.vervloed@pwo.ru.nl (M.P.J. Vervloed), b.steenbergen@pwo.ru.nl (B. Steenbergen).

https://doi.org/10.1016/j.ridd.2020.103714
Received 17 September 2019; Received in revised form 7 May 2020; Accepted 6 June 2020

reported considerable differences compared to sighted children of similar ages (Celeste, 2006; Ferguson & Buultjens, 1995; Hestenes & Carroll, 2000; Hughes, Dote-Kwan, & Dolendo, 1998; Lewis, Norgate, Collis, & Reynolds, 2000; Preisler, 1993; Roe & Webster, 2002; Rogers & Puchalski, 1984; Troster & Brambring, 1994; Warren, 1994). Findings indicate that children with VIs spend more time in solitary play and less time in cooperative or group play than sighted peers and that they tend to direct their interactions to adults instead of peers (Celeste, 2006; Crocker & Orr, 1996; Roe, 2008). Furthermore, children with VIs were found to demonstrate less frequent and less complex functional play (i.e., using toys according to their functions) and symbolic or pretend play than sighted peers (Hughes et al., 1998; Lewis et al., 2000). Previous studies reported observations of children with blindness who did not engage in any form of play, or who showed repetitive play and stereotypical behaviors (Brambring & Tröster, 1992; Brown, Hobson, Lee, & Stevenson, 1997; Hestenes & Carroll, 2000; Hughes et al., 1998; Roe, 2008). This is assumed to have serious consequences for children's social-emotional development, friendship formation and social participation in mainstream settings (de Verdier, 2016; Hestenes & Carroll, 2000; Recchia, 1997).

However, some children with VIs appear to have considerably fewer difficulties with social communication and play than others (Bishop, Hobson, & Lee, 2005; Greenaway & Dale, 2017; Verver, Vervloed, & Steenbergen, 2019). For example, Lewis et al. (2000) revealed that, as a group, preschoolers with VIs showed less complex functional and symbolic play than would be expected from sighted children of similar ages. But when four participants who met the diagnostic criteria for autism and who did not enage in play were excluded from the analyses, the mean levels of symbolic play of the remaining participants actually were age-appropriate. Furthermore, Bishop et al. (2005) found that 5- to 9-year-old children with blindness demonstrated less complex symbolic play than sighted peers, but only if they had poor social skills. Owing to its heterogeneous nature regarding visual functioning, etiologies, and co-occurring disabilities, it is evident that individual variation is substantial in this population (Hatton, Bailey, Burchinaland, & Ferrell, 1997; Roe & Webster, 2002; Tadić, Pring, & Dale, 2010; Greenaway & Dale, 2017). Comparing behaviors of children with VIs to that of sighted peers to gain insight in developmental trajectories has several drawbacks. First, developmental variability within the population of children with VIs is neglected (Warren, 1994). The generalizability of findings of comparative studies on development, which often involve small samples, is therefore debatable (Hatton et al., 1997). Second, the comparative approach implicitly assumes a "blindness as deficit" model: deviations from the 'normal' development of sighted children are believed to be caused primarily by the absence of vision (Warren, 1994). Additionally, it indirectly presupposes that altered developmental pathways in children with VIs are a sign of problematic or abnormal development, whereas in fact, they might represent adequate adaptations to function optimally without vision (Perez-Pereira & Conti-Ramsden, 2013; Roe & Webster, 2002). This emphasizes the importance of studies examining both developmental variation within the population of children with VIs as well as the potential causes for this variation. The current study aims to clarify which child characteristics affect peer play in school-aged children with VIs.

A more detailed understanding of within-group differences allows for a more adequate adaptation of treatment or support to the individual needs of children with VIs (Sacks, Kekelis, & Gaylord-Ross, 1992; Warren, 1994). When the effectiveness of interventions is only investigated in children with VIs as a group, without taking individual variation into account, conclusions might not be representative of children with specific needs for support. In two recent studies, Verver et al. (2019a); Verver, Vervloed, & Steenbergen, 2019) examined whether sound-augmented toys (i.e., play materials enriched with auditory cues) could facilitate peer play in dyads of 4- to 12-year-old children with VIs and playmates. Results of both studies indicated that, compared to a session with non-augmented (i.e., 'regular') toys, children demonstrated less cooperative play while using sound-augmented toys, as the sounds drew their attention to play figures and actions of the playmate. However, as a group, children already played cooperatively most of the time with non-augmented toys, which made the authors question whether a ceiling effect occurred. At the same time, the authors stated that significant individual variation regarding peer play was present within the participant group, suggesting that some children demonstrated less adequate play behaviors than the average group. For these children it might be incorrect to conclude that sound-augmentation of play materials does not facilitate peer play. In the present study we therefore examined how peer play behavior varied within school-aged children with VIs, whether specific child characteristics could explain this variation, and whether this affected previous conclusions about the effectiveness of sound-augmented play materials to facilitate peer play.

1.1. Play variability and the level of VI

Many studies have considered the role of the profoundness of the VI as potential explanation for play variability, since the level of VI can vary substantially within the population. To illustrate, a vision impairment can be classified as blindness (visual acuity < 3/60), severe (visual acuity < 6/60), moderate (visual acuity < 6/18) or mild (visual acuity < 6/12; ICD-11, 2019). Although findings are inconsistent across studies, the profoundness of the VI appears to affect play behavior only marginally. Children with blindness seem to spend more time manipulating and exploring objects than those with some residual vision (Hughes et al., 1998). They most likely need more time to explore object-characteristics than children with some residual vision, because they need to rely on consecutive tactile and auditory cues. Results also indicate they demonstrate less functional play (i.e., using objects according to their common functions) compared to peers with low vision (Hughes et al., 1998; Verver et al., 2019a), which suggests children with blindness have more difficulties to perceive object-functions and to play with them accordingly. However, this was not confirmed by a study of Lewis et al. (2000). Furthermore, evidence suggests that the level of the VI does not explain within-group variation regarding the quantity or quality of both early and more advanced symbolic (i.e., pretend) play (Celeste & Grum, 2010; Ferguson & Buultjens, 1995; Hughes et al., 1998; Lewis et al., 2000; Rogers & Puchalski, 1984; Verver et al., 2019a; 2019b). Only one study found that children with some residual vision showed more pretend play than children with blindness (Skellenger & Hill, 1997). This suggests that the observed symbolic play variability within the population is most likely the result of other individual or environmental characteristics (Bishop et al., 2005; Lewis et al., 2000; Rogers & Puchalski, 1984; Verver et al., 2019a). Since symbolic play is

considered to be a marker of cognitive functioning and language ability and has many social elements that promote peer interaction (Bishop et al., 2005; Lifter, Foster-Sanda, Arzamarski, Briesch, & McClure, 2011; Nielsen, 2015; Uren & Stagnitti, 2009), it is important to better understand causes of symbolic play variability.

Furthermore, several studies indicated that children with VIs engage in more solitary and less cooperative peer play than sighted children, but few studies focused on individual variation of peer play within the population of children with VIs (Celeste, 2006; Hestenes & Carroll, 2000). A recent study of Verver et al. (2019a) on peer play variability in school-aged children with VIs failed to find a relationship between the level of VI and social aspects of play. This indicates child characteristics other than the VI likely play a role during play. Previous studies focused on associations with language ability, cognitive development, social competence and age (Bishop et al., 2005; Lewis et al., 2000; Rogers & Puchalski, 1984; Skellenger et al., 1997; Verver et al., 2019b). Findings regarding these characteristics will be discussed briefly.

1.2. Play variability and associated child characteristics

1.2.1. Language ability

Positive associations between symbolic play and both expressive and receptive language abilities have been described in children with VIs (Ferguson & Buultjens, 1995; Hughes et al., 1998; Lewis et al., 2000; Pizzo & Bruce, 2010; Rettig, 1994; Rogers & Puchalski, 1984). Symbolic play complexity and time spent in symbolic play were positively correlated to verbal comprehension and expressive language use in children with VIs aged between 1.5 and 6 years old, also after controlling for age (Ferguson & Buultjens, 1995; Lewis et al., 2000). Finally, Hughes et al. (1998) reported a negative correlation between non-play and receptive language and a positive correlation between total demonstrated cognitive play and expressive language in children with VIs.

1.2.2. Social competence

A study of 13 children with congenital blindness (M age = 7.5 years) compared symbolic play complexity between children with high social competence (HS group) and those with low social competence (LS group; Bishop et al., 2005). Children were matched on age and verbal ability. Results indicated the LS group showed significantly less adequate attribution of symbolic meaning and personal roles to play objects than the HS group. Additionally, a case-study of free play reported that a 4-year-old girl with congenital blindness demonstrated solitary play most of the time and she often failed to respond to communicative behaviors of peers or to maintain interactions with them (Celeste, 2006). In typically developing children, results regarding the relationship between social pretend play and social competence are mixed (Li, Hestenes, & Wang, 2016; Lillard et al., 2013), with some studies describing a positive correlation between the two (Connolly & Doyle, 1984; Howes, Unger, & Matheson, 1992; Rubin, Maioni, & Hornung, 1976; Uren & Stagnitti, 2009) and others failing to find a correlation (Galyer & Evans, 2001). Also, some studies reported group play involving both boys and girls predicted social competence in girls but not boys (Colwell & Lindsey, 2005; Lindsey & Colwell, 2003).

1.2.3. Age

Previous studies in children with VIs show discrepancies regarding the influence of age on social and cognitive aspects of play. As for social play, Ferguson and Buultjens (1995) reported a positive association between collaborative play and age in preschoolers with VIs and Verver et al. (2019b) found a positive relationship between cooperative play and age in elementary school-aged children with VIs who attended mainstream education. In contrast, Hestenes and Carroll (2000) described a negative association between social play and age in preschoolers with disabilities (including VIs) in mainstream daycare settings and Verver et al. (2019a) did not find a relationship between cooperative play and age in elementary school-aged children with VIs attending special education. With regard to cognitive play, a negative relationship between age and explorative play has been described in preschoolers and elementary school-aged children with VIs in special education (Ferguson & Buultjens, 1995; Verver et al., 2019a). In children with VIs attending mainstream education, a negative relation between age and functional play was reported (Verver et al., 2019b), but no relation with explorative- or symbolic play was found.

1.2.4. Temperament and sex

Although not yet investigated in children with VIs, findings of previous studies in typically developing children suggest temperament and sex are associated with play. Studies of temperament and peer interaction during free play reported that typically developing children with easy temperament displayed more socially competent behaviors than those with 'less' easy temperament, whereas aggression towards peers occurred more frequently in children with difficult temperament (Billman & McDevitt, 1980; Farver & Branstetter, 1994; Kochanska, 1997; Youngblade & Mulvihill, 1998). Thus far, the only studies that examined temperament in children with VIs focused on infants and toddlers (Dote-Kwan & Chen, 2010; Plastonuva, 2002). Findings indicated that infants with VIs often showed negative emotions, were difficult to distract and had little interest in toys (Plastunova, 2002). In addition, toddlers with more profound VIs showed more withdrawal, negative mood and less persistence than those with some residual vision (Dote-Kwan & Chen, 2010). With regard to sex, sighted girls were found to demonstrate more pretend play than boys, whereas both showed comparable levels of cooperative play (Benenson, Apostoleris, & Parnass, 1997; Jones & Glenn, 1991; Lindsey & Colwell, 2013). It is most likely that the effect of such biological characteristics is similar in most children, suggesting that sex and temperament presumably are relevant predictors of play in children with VIs too.

1.3. Present study

The aim of the present study was to investigate whether the level of VI and the aforementioned child characteristics could account for the within-group variation of play behavior in 4- to 12-year-old children with VIs. The first objective was to obtain a more detailed understanding of the actual influence of the VI on social and cognitive play. Based on previous studies we hypothesized that children with blindness would demonstrate less functional play than children with some residual vision. The level of VI was expected to be unrelated to symbolic play and to social aspects of play. The second objective was to examine the role of child characteristics other than the VI on children's symbolic and cooperative play. These are two of the most complex forms of cognitive and social play and can be challenging for children with VIs (Bishop et al., 2005; Celeste, 2006; Howes et al., 1992; Lillard et al., 2013; Hughes et al., 1998). We hypothesized that language ability would be the main predictor of symbolic play based on previous studies in children with VIs and the compelling evidence in typically developing children (Ferguson & Buultjens, 1995; Hughes et al., 1998; Lewis et al., 2000; Lillard et al., 2013; Pizzo & Bruce, 2010; Rettig, 1994; Rogers & Puchalski, 1984). Language ability was also expected to be the most important predictor of cooperative play. Cooperative play involves joint planning, negotiation and conflict solving, which requires sufficient language ability (Hoff, 2006; Roe, 2008). Furthermore, we hypothesized social competence would be positively associated with both symbolic and cooperative play. As participants' ages ranged from 4 to 12, age was also expected to be positively associated with both play behaviors. We hypothesized that girls would show more symbolic play than boys, but just as much cooperative play (Benenson et al., 1997; Jones & Glenn, 1991). Finally, children with 'slow-to-warm-up' or difficult temperament styles were expected to demonstrate less cooperative play than those with easy temperament. Since participants of the present study did not have cognitive impairments, we did not focus on associations between cognitive development and play.

Play behaviors and associations with the level of VI and other child characteristics were studied in two play settings: one where dyads of children used a preselected set of Playmobil® toys that produced play-related sounds (i.e., sound-augmented toys) and one in which dyads used a similar toy set that did not produce any sounds (i.e., non-augmented toys). Previous studies showed sounds interfered with cooperative play for children with VIs as a group, but that significant variability was present (Verver et al., 2019a, 2019b). After examining this variation and associated child characteristics more closely, the final objective of this study was to examine whether sound-augmented toys have a different effect on social play when individual characteristics are considered. It was hypothesized that the effect of sound-augmented toys on social play differed as a function of the amount of cooperative play that children demonstrated with regular toys. In other words, sound-augmentation of toys was expected to be less effective in children who already showed much cooperative play with regular toys than in those who did not.

2. Method

2.1. Participants

Seventy-two children aged 4- to 12-years with a vision impairment participated in this study (*M* age = 8;11 years, *SD* = 2.25; 69.4 % boys). All children were registered with either Royal Dutch Visio or Bartimeus, two national organizations for people with a vision impairment. Staff of Royal Dutch Visio and Bartimeus ascertained that children met the following inclusion criteria before they were approached for participation: a) IQ-score > 70, b) Dutch as the first language, c) no hearing impairment, d) able to play on the floor with small objects. Thereafter, parents received information letters and provided written informed consent. During data collection, participants were informed they could withdraw from the study at any given moment. The Social Sciences Ethics Committee of Radboud University gave ethical approval for the present study, which is part of a larger research project investigating the effect of sound-augmented toys on play.

Participants were then appointed to dyads using semi-random sampling based on school type (special or mainstream), school location and age (special education: maximum age difference of 2.5 years; mainstream education: maximum age difference of 1.5 years). Due to the small population of children with VIs without co-occurring disabilities that attend special education in the Netherlands, we were unable to match children based on their developmental level. We therefore employed an age-range of 2.5 years. Participants in special education played together with another child with a VI, whereas participants in mainstream education played with a sighted peer. For this purpose, 92 sighted classmates (at least four sighted children per child with a VI) were approached with informed consent letters by their teachers, and 46 % agreed to participate. If multiple sighted classmates per child with a VI could participate, the researcher randomly assigned one of these sighted children to the dyad. This led to 18 dyads in mainstream education (*M* age = 7.51 years, *SD* = 2.11) and 27 dyads in special education (*M* age = 9.37, *SD* = 2.09). Because the current study focused on the examination of play variation within the population of children with VIs, data of sighted children are not discussed any further (see Verver et al., 2019b for more information on play of children with VIs and sighted peers).

Parents of 42 participants (response rate of 60 %) completed all questionnaires assessing language ability and temperament (*M* age = 8.78 years, *SD* = 2.42; 76.2 % boys). Of these children, 73.8 % attended special education. The mean visual acuity of this group was 0.19 (*SD* = 0.17), including 8 children with blindness, 9 with severe VIs, 12 with moderate VIs and 13 with mild VIs.

2.2. Materials

2.2.1. Augmented knight's castle

Children used a play set that consisted of a Playmobil® Knight's Castle on a plywood base in which Radio Frequency Identification (RFID) readers were integrated at five different locations. The play set came with 13 different play figures that were tagged so that the

readers could pick up their signals and generate 75 different sounds. Sound effects involved theme sounds (e.g., animal sounds or music), play figure identification sounds (e.g., '*I am the King*') and play proposals ('*The dragon is attacking the castle*'). Sounds differed as a function of play figure and location. The sound-augmentation could be switched off for children to use the play set without additional features (for a more detailed description, see: Verver et al., 2019a, 2019b).

2.2.2. Social- and cognitive aspects of play

Play behaviors were coded using two mutually exclusive observation schemes based on Farr, Yuill, and Hinske (2012)); Wolfberg and Schuler (1999) and van den Broek, Moleman, and Hellendoorn (2005)). A distinction was made between cognitive aspects of play (i.e., how a child uses play materials) and social aspects of play (i.e., the extent to which a child involves others in play). Cognitive aspects of play consisted of manipulative play, functional play, functional pretend play and symbolic play. Social aspects of play involved solitary play, parallel play and cooperative play (for a more detailed description, see Verver et al., 2019a, 2019b). To code social play, a 15 min fragment of each video recording was randomly selected, and the first 10 min of this fragment were also coded for cognitive play. Prior to data collection, two coders (who were blind for this study's research objectives) received intensive training. Time sampling was used as observational method. For each consecutive 10 s segment of the videotape, the predominant types of social- and cognitive play were coded. Inter-rater reliability for double-coding of 20 % of the videos equalled an agreement Kappa of 0.82 for social play and 0.79 for cognitive play.

2.2.3. Language ability

Language ability was measured with the Dutch version of the Children's Communication Checklist-2 (CCC-2-NL) by Geurts (2007). The CCC-2-NL is a questionnaire for parents assessing communicative skills in children aged 4- to 15-years. It measures language structure and pragmatic aspects of communication and is used as a screening method for further assessment of autism or specific language impairments (SLI). Parents answered questions regarding their child's communicative skills (e.g., *'He/she does not recognize when others are upset or angry'*) on a 4-point Likert scale (less than once a week to more than twice a day). Answers can be transformed to norm-referenced standard scores in order to compare a child's performance to that of other children of similar ages. The General Communication Composite (GCC) is used for identifying communication problems. GCC scores range between 44 and 122, with higher scores indicating more communicative problems (score $\geq$ 104 indicates significant communication problems). The Pragmatic Composite (PC) is used to identify pragmatic language problems and ranges from 19 to 63, with scores $\geq$ 53 indicating significant pragmatic problems. The Social Interaction Deviance Composite (SIDC) helps identify children whose pragmatic language ability deviates significantly from their structural language. Reliability of the GCC, PC and SIDC is good, but construct and criterion validity are insufficient in the Dutch norm group (Egberink, de Leng, & Vermeulen, 2007).

In addition, the Vocabulary subtest of the Wechsler Intelligence Scale for Children–III (WISC-III) in the case of 6- to 12-year-olds or the Wechsler Preschool and Primary Scale of Intelligence-III (WPPSI-III) in the case of 4- to 6-year-olds was administered. The WISC-III and WPPSI-III are intelligence tests and the Vocabulary subtest assesses word knowledge, verbal fluency and concept formation (Hendriksen & Hurks, 2009; Kort et al., 2005). Standard scores range from 1 to 19 with a score of 10 (SD = 3.00) representing an average score in the Dutch norm population. Both intelligence tests have good to sufficient reliability and construct validity, yet criterion validity is insufficient (Egberink, de Leng, & Vermeulen, 2005). Note that at the onset of this study, the WISC-V was not yet available in Dutch and that the WISC-IV was never translated and standardized for Dutch children.

2.2.4. Social competence

In order to assess social competence, a shortened version of the Social Cognitive Skills Test was used (SCST; Van Manen, Prins, & Emmelkamp, 2009). The SCST administers social cognitive skills in 4- to 12-year-old children. Children were presented with cartoons displaying short stories of social situations in which a problem occurs. Children were then asked eight questions that refer to several social competence skills (e.g., '*How does the boy feel when his brother takes away his toy?*'). A standardized score of 10 (SD = 3.00) represents average social competence in the Dutch norm population of children with similar ages and gender. Reliability and construct validity of the total test are sufficient. Criterion validity has not been tested (Egberink, de Leng, & Vermeulen, 2009). This test could only be administered in children that had some residual vision (n = 57), because children needed to be able to look at cartoons. Given the availability of this norm-referenced test we decided to prioritize psychometric quality over accessability to all participants.

2.2.5. Temperament

Temperament was measured with Dutch versions of the Behavioral Style Questionnaire (BSQ; McDevitt & Carey, 1978) and the Middle Childhood Temperament Questionnaire (MCTQ; Hegvik, McDevitt, & Carey, 1982), both part of the Carey Temperament Scales (Carey & McDevitt, 1995). The BSQ is developed for 3- to 7-year-olds and the MCTQ for 8- to 12-year-olds. These parental questionnaires assess nine different temperamental characteristics that appertain to three temperament dimensions (easy, slow-to-warm-up, difficult) based on Thomas and Chess (1977). Parents rate how frequent their child demonstrates certain behaviors (e.g., *'Loses interest in a toy the same day he/she gets it'*) on a 6-point Likert scale (almost never to almost always). Parent responses can be transformed to norm-referenced standard scores using a scoring form. The questionnaires have a moderate validity and moderate to good reliability (Carey & McDevitt, 1995).

2.3. Procedure

2.3.1. Play sessions

The data regarding social and cognitive aspects of play analyzed in the current study were part of a larger research project investigating the effect of sound-augmented toys on play in 44 dyads of children with VIs and peers. Data collection took place at children's schools. A counterbalanced cross-over repeated measures design was used, with all dyads playing with an augmented toy (augmented condition or AC) and a non-augmented toy (non-augmented condition or NC). In order to control for possible order effects, starting condition was counterbalanced across participants, with 47.2 % of the participants starting in the AC and 52.8 % in the NC. For practical reasons total Play sessions lasted 30 min (special education) or 20 min each (mainstream education) and were videotaped. Observation duration was equal in both groups since of each video recording, a 15 min fragment was randomly selected for offline observation of play behavior (as described in Section 2.2.2). Children received no instructions other than to play with the toys the way they wanted to. The AC was preceded by a brief demonstration of how to elicit sounds on five different locations within the augmented Playmobil® castle.

2.3.2. Child characteristics

After parents gave informed consent for participation, they received questionnaires about their child's language abilities, temperament, and background. These questionnaires were filled in at home. Both vocabulary and social competence were assessed by a researcher with each child individually at the school of the participants.

2.4. Statistical analyses

First, preliminary analyses were performed to examine within-group variation for social- and cognitive play behaviors. Second, the effect of the level of VI on social and cognitive play was examined in the total sample using binomial logistic regression analyses as part of Generalized Linear Models (GLM). These models are suitable for modelling proportional data or mutually exclusive count data that consist of nonnegative integer values with a maximum number of trials (Cameron & Trivedi, 2013; White & Bennetts, 1996). In our study, social play behaviors could not exceed a count of 90 and cognitive play could not exceed 60. GLM does not make assumptions regarding normality, linearity or homogeneity of variances (Hoffmann, 2004). Third, relationships between age, gender, language ability, social competence, temperament and both symbolic and cooperative play were investigated in subgroups of participants that had available data. In order to identify which predictors to include in the multivariate regression models, univariate analyses were performed. All factors that had a (marginally) significant relationship with the dependent variables were included in multivariate binomial logistic regression models thereafter. Since children in our sample were aged between 4 and 12 years, this likely had an effect on their play behavior. Age was entered as a factor in each of the multivariate models to take this into account. As the *N* varied significantly across predictors (from 40 to 72), we used a ratio of one predictor per 10 participants as a rule of thumb for the multivariate model (Babyak, 2004). Finally, the effect of sound-augmented toys on peer play was investigated for children that demonstrated low (< 33 % of time, $n = 18$), moderate (66 % - 33 % of time, $n = 21$) or high (> 66 % of time, $n = 31$) levels of cooperative play with regular toys by means of Generalized Estimating Equations (GEE), with the autoregressive correlation structure to correct for autocorrelation due to the repeated measurements. A Sidak correction for multiple comparisons was applied.

3. Results

The aim of the present study was to examine the nature of play variability within a group of school-aged children with VIs, by investigating whether this variability could be explained by specific child characteristics. Descriptive information about characteristics of our sample is presented in Table 1. Both social and cognitive aspects of play were observed when dyads of children played with two different toy-sets: a knight's castle that produced play-related sounds (augmented condition or AC) and a normal knight's castle without sounds (non-augmented condition or NC). First, preliminary analyses were performed to explore the data structure and the presence of potential outliers, as described in Section 3.1. Second, we examined whether social and cognitive aspects of play differed between children with varying levels of vision impairment (blind, severe, moderate, or mild), see Section 3.2. Third, we investigated the role of other child characteristics (age, sex, language ability, temperament and social competence) during cooperative play (i.e., active peer play) and symbolic (i.e., pretend) play in Section 3.3. Finally, we examined the effect of sound-augmented toys on peer play in children with VIs that demonstrated varying cooperative play abilities in Section 3.4.

3.1. Preliminary data analysis

Two participants (one dyad of two girls with total blindness) could not participate in the NC because of illness. Because only a few children with blindness were part of this study, their data remained part of further analyses of play in the AC. Data distributions and the potential influence of outliers were examined for all play behaviors. Since the play variables consisted of count data (maximum of 60 or 90 observations per video recording), most had negative binomial distributions, which justified the use of binomial logistic regression analyses for hypothesis testing. Boxplots of play variables indicated the presence of two extreme outliers for Disengagement in the AC and one for solitary play in the NC. These were two children (one with blindness and one with a mild VI) that interacted with the researcher frequently and one child with blindness who actively refused interaction with his playmate because he wanted to "play inside his head", while tapping a play figure to his hands and spinning in circles. Examination of

Table 1
Descriptive statistics of child characteristics per level of vision impairment (VI).

		Total group	Blind	Severe VI	Moderate VI	Mild VI
Age (years)	*N*	72	12	13	24	23
	M (*SD*)	8.91 (2.25)	9.88 (1.78)	8.46 (2.60)	8.89 (2.23)	8.67 (2.28)
	Min – Max	4.58 – 12.98	6.75 – 12.54	4.58 – 12.57	5.09 – 12.98	4.67 – 12.65
Visual acuity	*N*	72	12	13	24	23
	M (*SD*)	.20 (2.25)	.00 (0.01)	.06 (0.01)	.19 (0.05)	.38 (0.09)
Social competence†	*N*	57	0	12	22	23
	M (*SD*)	10.32 (3.03)	–	9.43 (1.72)	12.20 (2.93)	11.54 (2.88)
Language ability						
Vocabulary	*N*	72	12	13	24	23
	M (*SD*)	10.28 (3.32)	11.00 (3.13)	10.08 (3.20)	9.96 (3.03)	10.35 (3.56)
GCC	*N*	42	8	9	12	13
	M (*SD*)	88.26 (18.47)	87.25 (14.57)	84.33 (15.27)	97.75 (16.45)	84.92 (22.35)
Pragmatics	*N*	42	8	9	12	13
	M (*SD*)	46.45 (9.31)	46.64 (9.93)	43.56 (9.62)	50.25 (8.20)	44.85 (9.58)
Sex						
Boys	*N* (%)	50 (69.4)	7 (14.0)	8 (16.0)	16 (32.0)	19 (38.0)
Girls	*N* (%)	22 (30.6)	5 (22.7)	5 (22.7)	8 (36.4)	4 (18.2)
Education type						
Special	*N* (%)	54 (75.0)	12 (22.0)	8 (14.8)	18 (33.3)	16 (29.6)
Mainstream	*N* (%)	18 (25.0)	0	5 (27.8)	6 (33.3)	7 (38.9)
Temperament						
Easy	*N* (%)	19 (45.2)	7 (36.8)	2 (10.5)	3 (15.8)	7 (36.8)
Slow-to-warm-up	*N* (%)	10 (23.8)	2 (20.0)	3 (30.0)	3 (30.0)	2 (20.0)
Difficult	*N* (%)	13 (31.0)	0	4 (30.8)	5 (38.4)	4 (30.8)

Note. † Social competence could not be administered in children with blindness. GCC = general communication composite, a measure of structural language ability. Normal visual acuity is referred to as 1.00 (6/6): a visual acuity of 0.10 (6/60) would indicate the ability to see objects at a distance of 6 m, which a person with normal visual acuity would be able to see at a distance of 60 m. Social competence and Vocabulary: standard scores have a mean of 10 (SD = 3.00) in the Dutch norm population. GCC: a standard score ≥ 104 indicates structural language problems. Pragmatics: a standard score ≥ 53 indicates pragmatic language problems.

standardized residuals revealed that only the latter case had a significant influence on results of group mean analyses of solitary play, Since this was the only participant displaying this kind of repetitive play behavior, we decided to delete this case from further analyses of solitary play in the NC.

3.2. The effect of vision impairment on social- and cognitive play

In order to examine whether social and cognitive aspects of play differed between children with varying levels of VI, binomial logistics were performed with each play category as dependent variable and Level of VI as independent dummy variable (with blindness as reference category). Mean proportions and standard deviations of demonstrated play in both the NC and AC are presented in Fig. 1 for social play and Fig. 2 for cognitive play. Fig. 1 shows that children with severe and mild VIs demonstrated more solitary play than children with blindness while using the normal knight's castle, $Wald\ \chi^2\,(1, N = 70) = 8.57, p = 0.036$. None of the other social aspects of play differed between children as a function of the level of VI. From Fig. 2 it can be observed that with normal toys, children with blindness spent less time in functional pretend play than children with some residual vision, $Wald\ \chi^2\,(1, N = 70) = 8.06, p = 0.045$. This was also the case when children used sound-augmented toys, $Wald\ \chi^2\,(1, N = 72) = 13.14, p = 0.004$. In addition, children with blindness showed significantly less functional play in the AC than those with some residual vision, $Wald\ \chi^2\,(1, N = 72) = 12.88, p = 0.005$. Instead, children with blindness demonstrated significantly more manipulative play that focused on sound exploration ($M = 0.34$, $SD = 0.20$) than children with a severe VI ($M = 0.13$, $SD = .13$, $p = .002$), $Wald\ \chi^2\,(1, N = 72) = 9.37, p = 0.025$. Symbolic play did not differ between children as a function of their level of VI.

3.3. Associations between child characteristics and peer play

Figs. 1 and 2 show that within-group variation was particularly high for cooperative play and symbolic play, but that this could not be explained by differences in the profoundness of the VI. Hence, associations with child characteristics were further investigated for these particular play behaviors.

To gain insight in relationships between play, the level of VI and other child characteristics, Pearson correlation coefficients were calculated (see Table 2). Cooperative play showed small to moderate correlations with age and two of the three measures of language ability, namely vocabulary and structural language ability (i.e., the General Communication Composite or GCC). Pragmatic language ability (i.e., social aspects of language use) was unrelated to cooperative play and it was strongly correlated to the GCC ($r > 0.70$). This factor was excluded from further data analysis to avoid multicollinearity. None of the child characteristics were significantly correlated to symbolic play. Table 2 also shows visual acuity was not related to play, language ability or social competence (although

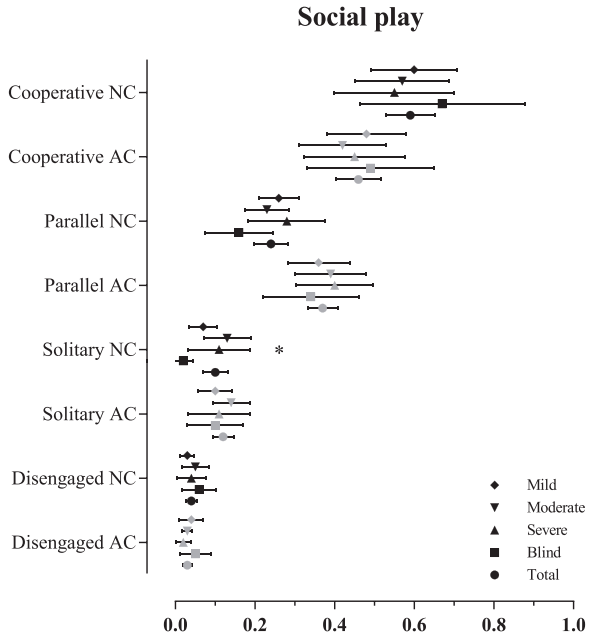

Fig. 1. Means and 95 % confidence intervals of proportions of demonstrated social play behaviors during the non-augmented condition (NC) and the augmented condition (AC) for children with different levels of visual impairment and the total group. * $p < 0.05$.

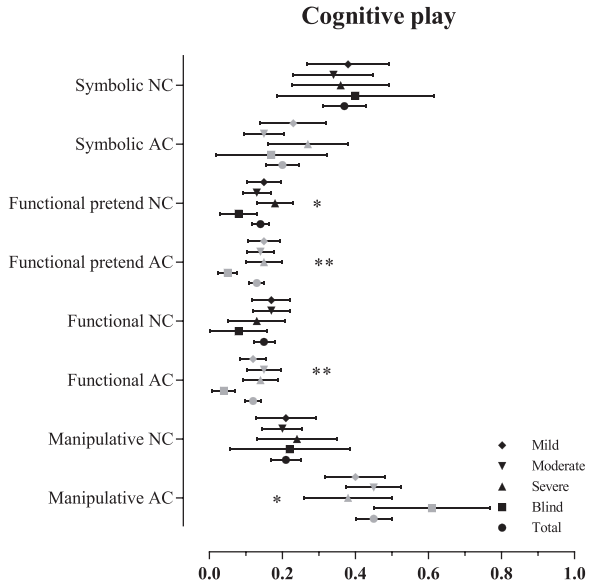

Fig. 2. Means and 95 % confidence intervals of proportions of demonstrated cognitive play behaviors during the non-augmented condition (NC) and the augmented condition (AC) for children with different levels of visual impairment and the total group. * $p < 0.05$; ** $p < 0.01$.

social competence was only assessed in children with severe, mild, or moderate VIs).

Potential associations between child characteristics and both cooperative and symbolic play were further examined using Binomial logistics, with Age, Vocabulary, GCC (i.e., structural language ability) and Social competence as continuous predictors and Temperament (easy, slow-to-warm-up, or difficult), Sex (boy or girl) and Education (special or mainstream) as categorical predictors. In order to decide which of these child characteristics needed to be entered in a multivariate model, the first step was to perform univariate analyses. All child characteristics that were (marginally) significantly associated with cooperative play or symbolic play were entered in a multivariate model. Table 3 displays results of both univariate and multivariate analyses of child characteristics predicting cooperative play and symbolic play in the NC. Table 4 presents results of similar analyses focusing on play in the AC.

First, findings of play with the normal knight's castle will be discussed (NC). Results of univariate analyses presented in Table 3 indicated that Age, Vocabulary and Temperament were (marginally) significant predictors of cooperative play in the NC. These

Table 2
Descriptive statistics and Pearson correlation coefficients (*r*) for child characteristics and proportions of symbolic and cooperative play.

Variable	1	2	3	4	5	6	7	8	9	10
1 Symbolic AC	1									
2 Symbolic NC	.63**	1								
	72									
3 Coop AC	.49**	.42**	1							
	72	70								
4 Coop NC	.27*	.47**	.56**	1						
	72	70	70							
5 Visual acuity	.09	.03	.04	.02	1					
	72	70	72	70						
6 Age (years)	.06	.16	.23†	.41**	.02	1				
	72	70	72	70	72					
7 Vocabulary	.17	.18	.37**	.28*	−.08	−.16	1			
	72	70	72	70	72	72				
8 GCC	−.30†	−.22	−.32*	−.18	.04	.09	−.36*	1		
	42	40	42	40	42	42	42			
9 Pragmatics	−.22	−.09	−.15	−.10	.01	.14	−.25	.89**	1	
	42	40	42	40	42	42	42	42		
10 Social comp.	.07	.02	.08	.02	.24†	.00	.54**	−.15	.02	1
	57	57	57	57	57	57	57	31	31	

Note. † $p < 0.10$; * $p < 0.05$; ** $p < 0.001$. Each cell presents the Pearson correlation statistic followed by the number of participants (*N*). GCC = General Communication Composite, a measure of structural language ability.

predictors were subsequently entered in the multivariate model. This model showed that cooperative play instances significantly increased as participants' age and their vocabulary increased. Although univariate analysis indicated a trend for children with slow-to-warm-up temperament to show significantly less cooperative play (*M* proportion = .43, *SD* = .30) than children with easy temperament (*M* proportion = 0.61, *SD* = 0.27), this effect did not hold in the multivariate model. As for symbolic play in the NC, both Sex and Vocabulary could be entered in the multivariate model, together with Age as a covariate (see Table 3). Results indicated only Sex significantly predicted symbolic play, with girls spending a significantly higher proportion of time in symbolic play (*M* = 0.66, *SD* = 0.11) than boys (*M* = 0.27, *SD* = 0.22).

Next, we examined associations between play and child characteristics when children used sound-augmented toys instead of regular toys (see: Table 4). As for cooperative play, results of univariate analyses suggested Age, Vocabulary and the GCC (i.e., structural language ability) could be entered as predictors in the multivariate model. Because Vocabulary and GCC are both measures of language ability that might induce multicollinearity when entered in the same model, we only added Vocabulary as a predictor. Findings suggested that cooperative play in the AC was positively associated to both vocabulary and age, comparable to previously reported findings in the NC.

Finally, Table 4 displays that Sex, Education and the GCC could be entered in the multivariate model as predictors of symbolic play in the AC, with Age as covariate. Findings indicated that only Sex could significantly predict symbolic play. Similar to the condition with normal toys, girls spent significantly more time in symbolic play (*M* proportion = 0.31, *SD* = 0.22) than boys (*M* = 0.14, *SD* = 0.15) while using augmented toys. Furthermore, a trend suggested that symbolic play with sound-augmented toys was positively associated to children's vocabulary.

3.4. The effect of sound-augmented toys in children with varying cooperative play abilities

The final objective was to investigate whether sound-augmentation of toys had a different effect on social play in children with varying cooperative play abilities. Children were categorized as demonstrating low (< 33 % of time), moderate (33%–66 % of time), or high (> 66 % of time) levels of cooperative play while using the normal knight's castle, which will be referred to as Baseline cooperative play. Since participants were appointed to start playing in either the NC ($n = 38$) or the AC ($n = 32$), a Chi-squared test was performed to ascertain that counterbalancing did not affect Baseline cooperative play, χ^2 (1, $N = 70$) = .12, $p = 0.910$. GEE analyses were executed for the dependent variables Solitary, Parallel and Cooperative play, with Condition, Baseline cooperative play and the interaction term as factors. The analyses revealed a significant Condition*Baseline cooperative play interaction-effect for solitary play, *Wald* χ^2 (2, $N = 70$) = 32.93, $p < 0.001$; parallel play, *Wald* χ^2 (2, $N = 70$) = 19.62, $p < 0.001$; and cooperative play, *Wald* χ^2 (2, $N = 70$) = 43.10, $p < 0.001$. Fig. 3 depicts the findings for the three different groups regarding cooperative play abilities. Pairwise comparisons indicated that solitary play significantly decreased when children with low cooperative play abilities used sound-augmented toys compared to non-augmented toys. Instead, they spent significantly more time in parallel play and levels of cooperative play remained similar between conditions (see Fig. 3). In children with moderate cooperative play abilities, social play did not differ between the NC and AC, suggesting the sound-augmentation did not affect their peer-directed play behaviors. In children with high cooperative play abilities, solitary and parallel play significantly increased while using sound-augmented toys, whereas cooperative play decreased compared to non-augmented toys.

Table 3
Parameter estimates and model fit for univariate and multivariate models of cooperative and symbolic play with regular toys (NC).

		Cooperative NC									Symbolic NC							
		Univariate Model				Multivariate Model (N = 40)					Univariate Model				Multivariate Model (N = 70)			
Factor	N	B	χ^2	p	OR	B	χ^2	p	OR	N	B	χ^2	p	OR	B	χ^2	p	OR
Age	70	0.20	24.46	< .001	1.36	0.26	18.61	< .001	1.30	70	0.08	1.60	.206	1.08	0.06	0.99	.320	1.06
Vocabulary	70	0.09	3.88	.049	1.09	0.11	6.51	.011	1.11	70	0.07	2.85	.092	1.07	0.07	2.83	.093	1.07
GCC	40	−0.01	1.27	.260	0.99					40	−0.02	2.42	.120	0.98				
Soc comp. †	57	0.01	0.07	.790	1.00					57	0.02	0.16	.686	1.02				
Girls vs. boys	70	0.09	0.09	.769	1.09					70	1.11	16.5	< .001	3.03	1.09	14.0	< .001	2.83
Mainstream vs. Special	70	0.05	0.03	.857	1.06					70	0.09	0.07	.789	1.10				
Temperament	40	–	5.30	.071	–	–	3.98	.137	–	40	–	2.60	.628	–				
STWU - Easy		−0.71	3.22	.073	0.49	−0.55	2.52	.112	0.58									
Log Likelihood χ^2						31.33									20.12			
df						3									3			
p						< .001									< .001			

Note. All factors that significantly predicted cooperative or symbolic play in the univariate models were included in the multivariate models. † the predictor Social competence does not include participants with blindness. GCC = general communication composite, a measure for structural language ability. *STWU - Easy* = slow-to-warm-up temperament vs. easy temperament styles. OR = Odds ratio.

Table 4
Parameter estimates and model fit for univariate and multivariate models of cooperative and symbolic play with sound-augmented toys (AC).

	Cooperative AC								Symbolic AC							
	Univariate Model				Multivariate Model (N = 42)				Univariate Model					Multivariate Model (N = 42)			
	N	B	χ^2	p	OR	B	χ^2	p	OR	N	B	χ^2	p	OR	B	χ^2	p	OR
Age	72	0.10	3.78	.052	1.10	0.13	7.28	.007	1.14	72	0.04	0.45	.501	1.05	0.04	0.23	.635	1.05
Vocabulary	72	0.11	10.34	.001	1.12	0.13	13.77	< .001	1.14	72	0.07	2.41	.121	1.07				
GCC	42	−0.02	4.36	.037	0.99					42	−0.02	3.29	.070	0.98	−0.16	2.70	.101	0.99
Soc comp. †	57	0.03	0.34	.558	1.03					57	0.03	0.38	.537	1.03				
Girls vs. boys	72	0.08	0.11	.738	1.09					72	0.87	9.65	.002	2.38	0.96	5.97	.015	2.61
Mainstream vs. Special	72	0.17	0.42	.516	1.19					72	0.62	3.43	.064	1.86	0.68	2.64	.161	1.98
Temperament	42	–	3.02	.222	–					42		3.15	.533					
STWU - Easy		−0.64	2.82	.093	0.53													
Log Likelihood χ^2						18.99												
df						2												
p						. < .001									.010			

Note. All factors that significantly predicted cooperative or symbolic play in the univariate models were included in the multivariate models. † the predictor Social competence does not include participants with blindness. GCC = general communication composite, a measure of structural language ability. *STWU - Easy* = slow-to-warm-up temperament vs. easy temperament styles. OR = odds ratio.

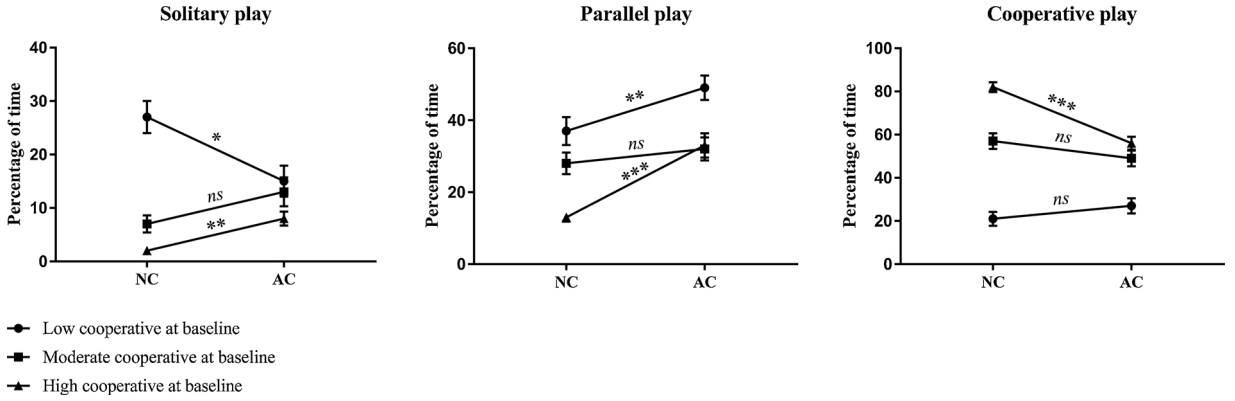

Fig. 3. Differences in demonstrated social play behaviors between a play session with non-augmented toys (NC) and sound-augmented toys (AC) for children with VIs that engage in low, moderate, or high levels of cooperative play at baseline. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

4. Discussion

The present study showed that social and cognitive aspects of peer play varied significantly between 4- to 12-year-old children with VIs, especially in the case of cooperative and symbolic play. First, we examined whether social and cognitive play behaviors differed as a function of the level of the VI in dyads of children. Second, we investigated whether variation in cooperative and symbolic play could be explained by specific child characteristics, namely language ability, social competence, age, gender and temperament. Finally, we explored whether these associations between play and child characteristics differed when dyads used regular Playmobil® toys or when they used sound-augmented toys, and whether sound-augmentation was more effective for children that showed little cooperative play with regular toys than for those who engaged in much cooperative play already.

4.1. Play and the level of VI

Social and cognitive play behaviors were highly comparable between children with different levels of VI, except for functional (i.e., using toys according to their functions) and functional pretend play. Findings indicated that children with blindness engaged in less functional pretend play than those who had some residual vision. In line with previous studies, this suggests that functional pretend play with objects (e.g., making walking movements with play figures or moving a dragon through the air as if it was flying) has important visual elements that are less accessible to children with blindness in particular (Hughes et al., 1998; Lewis et al., 2000). Audio feedback did not facilitate functional or functional pretend play (also see: Verver et al., 2019a, 2019b), as children with blindness also engaged in less functional play than children with moderate and mild VIs when sounds were available. As hypothesized, symbolic play (i.e., pretend play) did not differ as a function of the level of VI, which corresponds to findings in preschoolers with VIs (Ferguson & Buultjens, 1995; Hughes et al., 1998; Lewis et al., 2000). The only social aspect of play that was associated with the level of VI was solitary play, with children with blindness actually showing less solitary play than peers with severe or mild VIs. It could be that children with blindness needed more assistance to understand how to use toys than children with some remaining vision, or that they tried to be in proximity of their playmate in order or to initiate or maintain contact with peers. However, this is highly speculative and does not explain why their low levels of solitary play did not differ from children with moderate VIs.

4.2. Play and child characteristics

4.2.1. Language ability

The large variation of symbolic and cooperative play (i.e., actively playing together with peers) within our participant group could not be explained by children's level of VI, implying that other child characteristics likely played a role. We expected that language ability would be the most important predictor of both symbolic and cooperative play. Findings of the current study confirm that language ability, in this case children's vocabulary, positively predicted cooperative peer play, both when children used regular toys and sound-augmented toys. However, vocabulary was only marginally positively associated with symbolic play. This seems unexpected, since various studies describe associations between symbolic play and both expressive and receptive language ability in children with VIs (Ferguson & Buultjens, 1995; Hughes et al., 1998; Lewis et al., 2000; Pizzo & Bruce, 2010; Rettig, 1994; Rogers & Puchalski, 1984) and sighted children (Lillard et al., 2013). Notwithstanding, Doswell, Lewis, Sylva, and Boucher (1994)) reported these associations were particularly strong in children under 4 years of age. Indeed, most studies on language and play in children with VIs and typically developing children focused on preschoolers (Greenaway & Dale, 2017; Lillard et al., 2013; Quinn, Donnelly, & Kidd, 2018). Our findings seem to confirm that the association between symbolic play and language decreases after the age of 4, also in the case of children with VIs. The result that vocabulary was more strongly associated with cooperative play than with symbolic play might be due to the fact that symbolic play communications are mostly context-specific (for example, in our study children played with a knight's castle) or specific for pretend play schemes, whereas cooperative peer play interactions involve joint planning,

negotiation and conflict solving within and outside the pretend play context (Hoff, 2006; Roe, 2008). This is presumably more demanding of children's word knowledge and verbal fluency. Remarkably, participants had, on average, structural and pragmatic language abilities within the normal range (as compared to a sighted norm group of similar ages) and neither differed as a function of the level of VI. Former studies reported children with more profound VIs were more prone to social communication difficulties (Dale & Sonksen, 2002; Greenaway & Dale, 2017; Mukaddes, Kilincaslan, Kucukyazici, Sevketoglu, & Tuncer, 2007). Our results seem to confirm the notion that children with VIs can overcome early social communicative difficulties (Greenaway & Dale, 2017).

4.2.2. Age and sex

As opposed to language ability, participants' age was the main predictor of cooperative play with regular toys and sex of symbolic play. In line with other studies (Ferguson & Buultjens, 1995; Verver et al., 2019b), findings of this study showed older children with VIs spent more time playing cooperatively than younger ones. Even though participants' ages ranged from 4 to 12, age appeared to be unrelated to time spent in symbolic play. This implies that the ability to play cooperatively with peers is still developing in children with VIs in the elementary school-period, while symbolic play does not become more frequent once children have reached these ages. Sex did significantly predict symbolic play. Girls with VIs engaged in symbolic play more often than boys, whereas they demonstrated equal amounts of cooperative play. Our findings replicate those of previous research in typically developing dyads of school-aged children (Benenson et al., 1997; Jones & Glenn, 1991). A possible explanation is that pretend play materials might be more appealing to girls with VIs, whereas school-aged boys with VIs might prefer other types of free play (e.g., rough-and-tumble play or games-with-rules).

4.2.3. Temperament

Furthermore, temperament appeared to be associated with cooperative play. Results of univariate analyses revealed a trend for children with 'slow-to-warm-up' temperament to demonstrate less cooperative play than those with easy temperament. Children with 'slow-to-warm-up' temperament can be cautious in new situations and are slow to adjust to new experiences (Thomas & Chess, 1977). These children apparently needed more time than those with easy temperament to get used to the experimental setting and to their playmate, as children in our study were randomly appointed to dyads. Contrary to our expectations, children with a difficult temperament spent similar amounts of time playing cooperatively to participants with easy temperament. Former research in typically developing children described those with difficult temperament displayed more negative interactions towards peers than those with easy temperament (Billman & McDevitt, 1980; Farver & Branstetter, 1994; Kochanska, 1997; Youngblade & Mulvihill, 1998). Interestingly, our findings indicated 32.5 % of children with VIs had difficult temperament and 25 % had slow-to-warm-up temperament, as opposed to approximately 10 % (difficult) and 15 % (slow-to-warm-up) of typically developing children (Thomas & Chess, 1977). Difficult temperament has often been associated with behavioral problems in typically developing children and relations have been described between temperamental fearful inhibition and later anxiety, negative affectivity and depression (Caspi, Henry, McGee, Moffitt, & Silva, 1995; Guerin, Gottfried, Oliver, & Thomas, 1994; Posner & Rothbart, 2000; Rothbart, 2011). Since two previous studies in young children with VIs also suggested that difficult temperament might be more common in this population than in sighted children (Dote-Kwan & Chen, 2010; Plastonuva, 2002), additional research should examine whether these behavioral patterns are (partly) a result of the lack of vision, or a manifestation of personal traits, and how temperamental dispositions influence peer interaction, play and psychological functioning in children with VIs.

4.2.4. Social competence

Finally, we hypothesized that social competence would be positively associated with both cooperative and symbolic play, but this did not appear to be the case. Bishop et al. (2005) described teacher-reported social competence was positively associated with symbolic play in children with congenital blindness. The assessment of social competence used in our study was not suitable for children with blindness, meaning that findings of the present study represent social competence in children with low vision only. It might be the case that social competence is associated with peer play in children with blindness in particular, as the majority of these children experience social difficulties related to their blindness (e.g., mannerisms and a lack of facial expressions; Galati, Miceli, & Sini, 2001; Roch-Levecq, 2006; Roe & Webster, 2002). Notwithstanding, Bishop et al. (2005) examined symbolic play in a solitary setting instead of a peer play setting and focused on play complexity as opposed to play frequency. Research in typically developing children also suggested a positive association between teacher-reported social competence and solitary pretend play (McAloney & Stagnitti, 2009; Uren & Stagnitti, 2009), but not when social competence was reported by parents (Swindells & Stagnitti, 2006). As suggested by Lillard et al. (2013), the measurement paradigm of both social competence and symbolic play most likely has an important influence on the association between the two and further research should take this into account.

4.3. The effect of sound-augmented toys in children with varying cooperative play abilities

Dyads played with both a common Playmobil® knight's castle as well as one with additional auditory cues, because the sounds were expected to facilitate social and cognitive play with peers. Previous studies indicated that the auditory cues interfered with social play in the average group of children with VIs, whilst significant individual variability was present (2019b, Verver et al., 2019a). Based on this result, we hypothesized that the effect of sound-augmented toys on social play would differ as a function of cooperative play variability with regular toys. In other words, the availability of supportive auditory cues during play was expected to be particularly facilitative of social play in children who demonstrated low levels of cooperative play (i.e., < 33 % of time) whilst using regular toys. In children who already engaged in moderate (i.e., 33 %–66 %) or high (i.e., > 66 %) levels of cooperative play

with regular toys, auditory cues were expected to be less facilitative of social play than in children who showed low instances of social peer play. Results of the present study mostly confirmed this hypothesis. When children were already engaged in high levels of cooperative play with regular toys, the intensified focus on auditory cues led to a decline of cooperative play and an increase of solitary and parallel play. In contrast, children who showed low levels of cooperative play with regular toys demonstrated significantly less solitary play, more parallel play and similar levels of cooperative play when they used sound-augmented toys. This play pattern is indicative of a shift towards more socially inclined play, with an increasing focus on the playmate and his/her play actions. As focusing on peers and sharing attention are both precursors of social interaction (Mundy & Sigman, 2006; Robinson, Anderson, Porter, Hart, & Wouden-Miller, 2003), facilitating these behaviors will likely create more opportunities for interaction and play between children with peer play difficulties and other children. Our findings suggest that children who were less capable of engaging in peer play were significantly younger and had weaker language abilities than children who already showed high levels of cooperative play with regular toys. The social play behaviors of children who displayed moderate levels of cooperative play with regular toys did not differ when auditory cues were available. These findings confirm that a ceiling effect occurred for social play in the majority of children with VIs in our sample (2019b, Verver et al., 2019a). In conclusion, enriching play materials with auditory cues appears particularly facilitative of social play in those children with VIs who are less capable of peer play.

4.4. Limitations

The present study focused on multiple child characteristics to get a better understanding of possible associations with play behavior in children with VIs. We believe this study provides a thorough picture of peer play variation in school-aged children with VIs and more detailed insight in the potential of sound-augmented toys to facilitate social play with peers. Unfortunately, about 33 % of the parental questionnaires were incomplete or missing, reducing the sample size and therefore also statistical power. Also, convenience sampling had to be used to include a sufficient number of children. Children were recruited when they received outpatient treatment and met the inclusion criteria for participation in the present study, without taking the level of VI into account. Most participants had a moderate VI (visual acuity between 6/60 and 6/18) or mild VI (visual acuity $< 6/12$) as a result, and only 12 children with blindness participated. As we have no data on the distribution of level of VI in the population, it remains unclear how representative our study sample is of the general population of children with VIs. Although we were unable to match groups with differing levels of VI based on other individual characteristics, our results indicated that children's visual acuity was not related to most of the assessed child characteristics. However, the selected measure of social competence could not be administered in children with blindness, suggesting more research is necessary to provide a complete picture of the impact of individual differences on play in children with blindness. At the time, the SCST was the most appropriate test to use because of the availability of standardized norms for Dutch children, but this was not the case for children with blindness. It might have been more appropriate to use a teacher-report in order to assess social competence in children with blindness. Furthermore, it was not possible to take the nesting of participants within dyads into account in the analysis of the effects of sound-augmented toys for groups with varying cooperative play skills. Not all children in this study's sample were part of a dyad, since the participants in mainstream education played with sighted peers who were not included in the analyses. Because this led to a violation of the independence assumption of GEE, the results should be interpreted with some caution (Ballinger, 2004; Wang, Kong, Li, & Zhang, 2016).

4.5. Future directions

The current study sheds light on individual characteristics that explain differences in peer play behavior between children with VIs in the elementary school-ages. However, we only focused on the frequency with which play behaviors were demonstrated. Future studies could point out how the complexity of peer play is related to individual characteristics of children with VIs. For example, our findings indicated symbolic play did not become more frequent as age increased, but a study of Howes et al. (1992) showed symbolic play did become more complex in 4- to 8-year-old typically developing children. Furthermore, this study was performed in a semi-structured play context with preselected toys that children used in dyads. Playmobil® toys are mainly designed to encourage pretend play, so it is likely that results of the present study are representative for such play contexts only. In more challenging play contexts, such as free play in large open spaces or with peer groups, it appears to be more difficult to compensate for the lack of vision (Khadka et al., 2012; Roe, 2008), which could be more demanding of children's social or language abilities or for children with certain personality traits. Future research should examine whether these contexts have different or stronger effects on play and related child characteristics in children with VIs.

From a practical perspective, this study emphasizes the importance of adapting support or treatment plans for children with VIs to their individual needs. It appears to be insufficient to offer play intervention or social skills training that only focuses on the fact that children have a vision impairment. Our findings indicate that play interventions should rather be adapted to children's language ability, age, sex, or temperament in order to be more efficient and effective. More research is necessary to investigate what effect these kinds of adaptations would have on the effectiveness of existing interventions.

4.6. Conclusions

Peer play behavior of 4- to 12-year-old children with VIs can vary significantly as a result of specific child characteristics. Age and language ability were positively associated with time spent in cooperative play. Also, a trend indicated children with slow-to-warm-up temperament engaged in fewer cooperative play instances than those with easy temperament. Girls demonstrated more symbolic

play than boys and a trend indicated a positive association with language ability. Conversely, cooperative and symbolic play did not differ as a function of the level of the VI. Embedding play materials with technology that enables children to elicit supportive auditory cues during play seems to be particularly facilitative of social play in children with VIs who have peer play difficulties. These findings underline that individual characteristics should be considered when examining and supporting developmental trajectories of children with VIs.

Author statement

The first author recruited participants, collected and analyzed the data and wrote the article. The second and third authors initiated the project and edited the manuscript.

Funding roles

This work was supported by the Dutch Organization for Health Research and Development (ZonMW) [grant number: 60-00635-98-140]. The funding source had no involvement in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the article for publication.

Acknowledgements

Our gratitude goes out to Stichting Inzicht and the Dutch Organization for Health Research and Development (ZonMW) for funding this research project. We would like to thank the staff of Royal Dutch Visio and Bartiméus for collaborating. Special thanks go to the children and parents that participated in this study and to Laurie Buitenhuis and Alysha Merkx, the research assistants who supported our project.

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