Full title: Nonverbal imitation skills in children with specific language delay

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Abstract

Research in children with language problems has focussed on verbal deficits, and we have less understanding of children‟s deficits with nonverbal sociocognitive skills which have been proposed to be important for language acquisition. This study was designed to investigate elicited nonverbal imitation in children with specific language delay (SLD). It is argued that difficulties in nonverbal imitation, which do not involve the processing of structural aspects of language, may be indicative of sociocognitive deficits. Participants were German-speaking typically developing children (n=60) and children with SLD (n=45) aged 2-3½ years. A novel battery of tasks measured their ability to imitate a range of nonverbal target acts that to a greater or lesser extent involve sociocognitive skills (body movements, instrumental acts on objects, pretend acts). Significant group differences were found for all body movement and pretend act tasks, but not for the instrumental acts tasks. The poorer imitative performance of the SLD sample was not explained by motor or nonverbal cognitive skills. Thus, it appeared that the nature of the task affected children‟s imitation performance. It is argued that the ability to establish a sense of connectedness with the demonstrator was at the core of children‟s imitation difficulty in the SLD sample.

Key words

Specific language delay/impairment; nonverbal imitation; sociocognitive skills; body movements; actions on objects

1. Introduction

Specific language delay (SLD) is identified in young children who have slow language development that is substantially below expectations for their age level, with unknown aetiology (Whitehurst & Fischel, 1994). Some of these children outgrow their early language delays and move into the typical range of language acquisition as they get older, but others continue to struggle with persistent language problems. These can have far-reaching effects on educational achievement, social inclusion and employment opportunities (Conti-Ramsden, Durkin, Simkin, & Knox, 2009; Ellis & Thal, 2008; Snowling, Adams, Bishop, & Stothard, 2001). Children with specific deficits in language do not form a homogeneous group, but present with varied profiles (Leonard, 1998). Some children have primary problems with the forms and structures of language, some have problems with the meaning and social use of language and some have problems in both areas. It has been argued that specific deficits in language are the outcome of deficits in multiple underlying skills with different genetic and environmental origins (Bishop, 1998, 2006). Research in children with language problems has focussed on verbal deficits, particularly deficits in the acquisition of lexical forms and syntactic structures of language. This is exemplified by a wealth of research on verbal imitation such as word, nonword and sentence repetition as indicators of phonological and morphosyntactic constraints (Chiat & Roy, 2007; Conti-Ramsden, Botting, & Faragher, 2001; Gathercole, 2006; Graf Estes, Evans, & Else-Quest, 2007). In contrast, we have less understanding of the role of deficits in nonverbal sociocognitive skills which have been proposed to be important for the acquisition of language (Baldwin, 1995; Tomasello, 1995). Sociocognitive abilities have been hypothesised to be necessary for discovering the meaning of language (Chiat, 2001), and it has been found that some young children with specific deficits in language have sociocognitive difficulties (Chiat & Roy, 2008).

In this study, we focus on immediate elicited nonverbal imitation, which does not involve the processing of structural aspects of language but is assumed to rely significantly on sociocognitive abilities (Carpenter, Pennington, & Rogers, 2002; Tomasello & Carpenter, 2005). Given that some children with specific deficits in language have sociocognitive deficits, we argue that at a group level children with SLD will perform poorly on nonverbal imitation tasks that entail sociocognitive skills**.**

In line with this reasoning, it is now well established that children with autism spectrum disorder (ASD), who are known to have sociocognitive difficulties, show deficits in different types of nonverbal imitation (Rogers & Williams, 2006; Williams, Whiten, & Singh, 2004). In contrast, there has been little exploration of nonverbal imitation skills in children with specific deficits in language. Existing studies have predominantly involved school-age children and focussed on the imitation of body movements (Hill, 1998; Marton, 2009; Vukovic, Vukovic, & Stojanovik, 2010), and no investigation has targeted the ability to imitate actions on objects. To our knowledge, only two studies have elicited nonverbal imitation in preschool-age children with SLD (Dohmen, 2007 [2-3 years]; Thal & Bates, 1988 [18-32 months]). Dohmen found that these children in contrast to typically developing (TD) children performed poorly on body movement imitation tasks. Furthermore, both investigations revealed difficulties in imitating pretend acts with substitute objects (designated as symbolic gestures by Thal and Bates). Thus, outcomes suggest that children with SLD have difficulty imitating body movements and pretend acts on substitute objects, but no study yet

has systematically investigated a range of different types of nonverbal imitation including body movements, actions on objects and pretend acts.

1.1. Nonverbal imitation

In this paper, the term imitation is used to refer to any form of copying behaviour, „when one individual voluntarily reproduces behaviour observed in another who acts as the model for the form of a behaviour" (Butterworth, 1999, p. 65). It has been argued that elicited imitation is not simply a one-to-one mimicking but rather an interpretation of an event which depends on children"s abilities to perceive, map, recode and reproduce demonstrated stimuli. Hence, elicited imitation taps children"s cognitive processing (Gleissner, Meltzoff, & Bekkering, 2000; Wagner, Yocom, & Greene-Havas, 2008), and children"s errors in replicating target acts provide a window onto how they process demonstrated information. A range of competencies are thought to be involved in imitation behaviour, e.g. perceptual and attentional skills, memory, motor planning and execution, and the ability to read the demonstrator"s intentions behind her/his actions (Decety, 2006; Hepburn & Stone, 2006; Williams, Whiten, Waiter, Pechey, & Perrett, 2007). Since imitation behaviour is multifaceted and the nature of different imitation acts varies substantially, not all competencies are necessarily involved in the same way for all types of imitation.

At least two main functions of imitation for children"s development can be differentiated: instrumental and social (Carpenter & Call, 2007; Nadel, Guérini, Pezé, & Rivet, 1999; Uzgiris, 1981). The instrumental function of imitation primarily serves the purpose of learning about features and affordances of objects. Information is

transmitted within and across generations through imitation of more experienced humans using instruments. Here, imitation acts as an important learning tool for acquiring new skills which help to solve instrumental problems in the physical world. Instrumental acts (e.g. pressing a button of a toy police car to evoke a flashing light) focus on the observable outcome of an action on an object. The main reason for children to reproduce such actions is to achieve the observed outcome by extracting useful information from the demonstration. Accordingly, children‟s reactions are primarily guided by the physical outcomes of instrumental acts, and the need to connect with the demonstrator is less crucial. In contrast, the social function of imitation primarily serves the purpose of engaging socially with others in shared activities to experience connectedness, mutuality and understanding. Here, imitation is considered to facilitate children‟s ability to establish and maintain social relations and communication by experiencing socio-emotional engagement and practising social communicative strategies in interactions with others. Social acts (e.g. imitating funny faces) necessarily focus exclusively on the demonstrator as a person. The main reason for children to reproduce such otherwise rather purposeless actions is to receive positive social feedback and share a fun experience with the demonstrator. Taking these different functions into account, we argue that types of nonverbal imitation which serve a primarily social function rely more on sociocognitive abilities than types of nonverbal imitation which serve a primarily instrumental function. It follows from this that children with sociocognitive difficulties should perform poorly on imitation tasks with a primarily social function, whereas imitation tasks with a primarily instrumental function should be less challenging.

1.2. The current study

Based on these theoretical arguments and empirical findings, the current study set out to investigate nonverbal imitation in young children with SLD, as part of a larger longitudinal study of imitation and language in children with language problems. The key aim was to compare the performance of samples of TD children and children with SLD aged 2;0-3;5 years on a range of elicited immediate nonverbal imitation tasks in order to determine whether and which nonverbal imitation behaviours significantly differentiate samples. It was hypothesised that at a group level the SLD sample would perform significantly below the TD sample on imitation tasks categorised as „social", while imitation tasks categorised as „instrumental" would be no more challenging for the SLD sample than for the TD sample. To evaluate this hypothesis, a new assessment battery was designed which included a range of measures requiring the imitation of social and instrumental acts:

- *Social acts*. These included four different types of body movements. None of these acts involved objects and none produced an observable functional outcome. All involved self-other mappings and were therefore assumed to rely on sociocognitive capacities.

- *Instrumental acts*. These included common actions on familiar and unfamiliar objects. Both involved real objects, and in both cases, target acts resulted in observable unambiguous outcomes. All were therefore assumed to be relatively independent of sociocognitive capacities.

- *Hybrid acts*. These comprised pretend acts on substitute objects (e.g. pretending to use a pencil as toothbrush). Like instrumental acts they involve real objects, but like social acts, they do not lead to an observable outcome,

and the task was therefore categorised as hybrid. Since objects are used in decontextualised or even counterfunctional acts which do not produce an instrumental result, the imitator has to focus on the actions of a demonstrator to be able to reproduce an act. Children have to infer why a demonstrator intends to perform such an odd action, i.e. that it is fun to pretend to deal with objects as if they were something else. Therefore, it appears that pretend acts draw on sociocognitive abilities, but it is unclear whether these are crucial or merely helpful. Hybrid acts were included in the battery to explore whether children would have difficulty imitating target acts that can be seen as being on the cusp between serving an instrumental and social function.

Further, this study aimed to compare nonverbal imitation errors occurring in the TD and SLD samples, to determine whether the types of errors of children with SLD resemble those of TD children or whether they are qualitatively different, and whether the rates of errors of older children with SLD resemble those of younger TD children.

2. Methods

2.1. Procedures

Approval for the study was given by the City University School of Community and Health Sciences Research Ethics Committee. Each participant was seen individually

for two to three sessions lasting 30-45 minutes at the child‟s home, nursery or clinic. Assessments were administered in a fixed order for each age range. Data collection was video recorded for the purpose of reliability check if parents gave permission (Panasonic digital video camera NV-GS 120 3CCD 1.7 mega pixel). A questionnaire containing questions relating to the child‟s general developmental history was given to parents and returned to the researcher or a nursery teacher.

2.2. Participants

Participants in this study were TD children and children with SLD. Criteria for participation were:

- age between 2;0-3;5 years
- German as main language
- no significant history of general developmental delay or disorder, including physical, neurological, sensory and nonverbal cognitive development (see „nonverbal cognitive ability‟ 2.2.1)
- children in the clinical sample additionally had to meet the criteria of delayed language development (see „language‟ 2.2.2).

Children were referred to the study by paediatricians, speech and language therapists, phoniatricians and nursery teachers from clinical institutions and nurseries in the areas of Bonn and Magdeburg in Germany who were all provided with detailed information sheets about the study and agreed to participate. Parents of potential participants were approached in person by nursery staff and clinicians. Parents who had expressed an interest in participating in the study were given an information sheet and consent form to be completed and returned prior to the

assessments. Six children referred as TD children and 10 children referred as children with SLD were excluded due to violation of the above criteria.

The final TD sample comprised 60 children (45% girls and 55% boys), and the SLD sample 45 children (35.5% girls and 64.5% boys), reflecting the well-established ratio of boys to girls typically observed in children with specific deficits in language. Since children"s language and imitation profiles were expected to be age related, both samples were divided into three 6-months age groups: 2;0-2;5, 2;6-2;11 and 3;0-3;5. There were no significant differences in the age composition of the TD and SLD groups (see Table 1).

 # insert Table 1 #

2.2.1. Nonverbal cognitive ability

Nonverbal cognitive ability in the two older age groups was measured using a German translation of the Special-Nonverbal Composite of the British Ability Scales II (BAS II) (Elliott, Smith, & McCulloch, 1996), a validated scale of nonverbal intelligence, that has been standardised on English-speaking children for the age range 2;6-3;5 years. All children fulfilled the inclusion criterion of a score within one standard deviation (SD) of the mean (≥85) on the BAS II (see Table 1). Hence, children with language delay qualified as having SLD, with nonverbal skills in the average range. The TD and SLD groups in the middle age group (2;6-2;11) did not differ with respect to nonverbal cognitive skills. However, in the oldest age group

(3;0-3;5), the TD group performed significantly better than the SLD group on the nonverbal BAS II (see Table 1).

Since there was no suitable standardised measure for children under 2;6 years, children‟s nonverbal cognitive development within the youngest age group was checked through parental questionnaires and questioning health professionals and nursery teachers who had referred participants. The parental questionnaire included a question about potential concerns regarding the child‟s development in the preventive screenings U7 (around 24th month), routinely carried out in Germany by paediatricians, which focus on children‟s body functions, cognitive development, motor skills, social behaviour, language, hearing and vision. According to parents, no concerns regarding a child‟s cognitive development were expressed. Each parental report was confirmed by the referring health professional in the SLD group and the judgement of a nursery teacher in the TD group.

2.2.2. *Language*

Language ability was measured using three general language tests standardised on German-speaking children at different age ranges. All tests are validated, reliable measures of language ability in young children and are widely used in clinical practice in Germany. Children in the two younger groups (2;0-2;11) were assessed on all four subtests of the „Sprachentwicklungstest für zweijährige Kinder‟ (Grimm, Aktas, & Frevert, 2000). This test measures receptive and expressive language competencies at word and sentence level in 2-year-old children. For the oldest group (3;0-3;5), two subtests of the „Sprachentwicklungstest für dreijährige Kinder‟ (Grimm & Akta, 2001), and three subtests of the „Patholinguistische Diagnostik bei

Sprachentwicklungsstörungen" (Kauschke & Siegmüller, 2009) were chosen to test language ability since these assess a range of receptive and expressive language competencies in semantics, syntax and morphology at this age range. Participants were defined as having SLD when they performed at least 1.5 SD below average on one subtest and 1.25 SD below average on another subtest out of four (2-year-old-children) and five (3-year-old-children) language subtests. All children in the SLD sample met these criteria.

2.2.3. *Motor skills*

Since motor skills might influence children"s nonverbal imitation performance, children"s gross and fine motor skills were assessed using the Entwicklungstest 6-6 (ET 6-6) (Petermann, Stein, & Macha, 2005), a general developmental test standardised on German-speaking children for the age range 6 months to 6 years. The subtest gross motor skills measures children"s body control and locomotion in everyday actions like climbing, jumping or balancing; the subtest fine motor skills measures children"s ability to manipulate objects of different sizes and with different functions. Two-thirds of the items are directly administered by the investigator while playing with the child, and one third of the items are obtained using a parental questionnaire. All children attained scores above the 10th percentile on the gross and fine motor development subtests and no significant differences were found between the performance of TD and SLD groups on any of the subtests at any age (see Table 1). Thus, any between group differences observed in nonverbal imitation in this study cannot be attributed to children"s motor abilities.

2.3. Battery of imitation tasks

2.3.1. General procedure

The novel imitation battery consisted of four body movement tasks and three action on object tasks (see Table 2). Nonverbal tasks were administered as part of a larger imitation battery that included different verbal imitation tasks (word, nonword and sentence repetition) which will be reported in a subsequent paper. The imitation battery alternated between body movement, actions on objects and verbal tasks and was presented in two counterbalanced orders to control for fatigue and practice effects. All imitation tasks were embedded in game-like contexts that were specifically designed to keep children at this young age engaged, and to elicit immediate responses with a minimum of verbal instructions. In each task, instructor and child were seated opposite each other on the floor. After the investigator was sure she had the child"s full attention, she modelled each target item twice and then invited the child to act by saying: “Now you (do it)!”. If the child did not show any reaction within five seconds the investigator modelled the item again, followed by a second invitation. Since each item was demonstrated twice and the procedure allowed for two trials per test item children observed items up to four times.

 # insert Table 2 #

2.3.2. Body movement tasks (social acts)

Tasks were based on research by Beadle-Brown and Whiten (2004), Hill (1998), Smith and Bryson (2007), and Vivanti, Nadig, Ozonoff, & Rogers (2008). All target postures, gestures and expressions required the imitation of body movements. They did not involve objects and did not produce observable functional outcomes (see Table 2 for items included). Manual postures did not convey conventional or symbolic meaning and comprised hand-only and hand-to-body postures with an

increasing level of difficulty. Movements involved one or both hands, and were directed towards ipsilateral and contralateral body parts, and the middle of the body. In contrast, gestures conveyed meaning. The conventional gesture task comprised gestures which carry a culturally defined social-communicative function. The object-related gesture task involved pretend actions which symbolise characteristic features of the referent object and its use in the absence of the object. Hands are used as pretend objects (e.g. hands as cushion) or as if employing an object (e.g. as if eating with spoon). All body movement items were mixed and presented in two blocks, which were separated by other tasks. The instructor told the child: “I know a really funny game. Look!”. Then she presented each item following the general procedure described above.

Facial postures and expressions were scored with a simple pass-fail coding scale for attempt (1) or refusal (0) to imitate, since piloting revealed that it was not possible to reliably score these in a more graduated way. Manual postures and representational gestures have clearer components allowing for reliable differentiation of attempts to imitate and were scored using a more graduated coding scale for accurate (2), partial (1), and unrelated (0) imitation responses and refusal to imitate (0). To enable reliable application of scoring, full scoring criteria were drawn up describing each individual posture and gesture in detail and specifying which features of a target act needed to be produced by the child to achieve accurate performance (Dohmen, 2012). Allowances were made for some developmental processes based on research investigating imitation skills in TD children at this age (Erjavec & Horne,

2008; Gleissner et al., 2000). For example, children were allowed to carry out the posture „pull one ear" either with the ipsilateral or the contralateral ear. Refusals were scored as zero and included in the dataset in this study because the exclusion would risk losing important information about children"s imitation performance (see Table 2 for full scoring criteria).

2.3.3. Common actions on objects (instrumental acts)

Tasks were based on methodology developed by Hobson and Hobson (2008) and Meltzoff (1988). Each item led to an unambiguous observable outcome in an event similar to those that children had most likely experienced before in their everyday life. To achieve an outcome, an object and its properties had to be manipulated according to a particular strategy (see Table 2 for items included).

Actions on familiar objects involved simple everyday actions. This task was carried out in the „present game", in which the investigator showed the child a box wrapped in gift paper that contained the objects that were invisible to the child. For each item, the investigator took one object out of the box, carried out the target action, handed the object over to the child and instructed the child following the general procedure. Children were awarded 1 point if they achieved the outcome and 0 points if they did not achieve the outcome or refused to imitate the act.

Actions on unfamiliar objects demonstrated the manipulation of a novel object with a hidden outcome. Children had never seen or played with the objects before and were unaware of their function. Objects were stored in a toy-bag and were invisible to the child. To ensure that target acts were not part of children"s spontaneous repertoire, the investigator handed each object to the child with the instruction: ”Use

this!". If the child did not perform an act similar to that about to be demonstrated (and no child did), the investigator retrieved the object from the child, performed the act with the object, handed the object over to the child and instructed the child following the general procedure. The imitation of the means and the causation of the outcome were scored separately using pass-fail coding scales: means correct / incorrect (1/0) and outcome achieved / not achieved (1/0) (see Table 2 for full scoring criteria).

2.3.4. Pretend acts on substitute objects (hybrid acts)

The task was based on methodology developed by Chiat and Roy (2008) and Smith and Bryson (2007). Real objects with clear instrumental functions were used to represent a different object with a different function. All substitute objects conveyed symbolic meaning and shared visual similarities with the real objects (see Table 2 for items included). The objects were hidden in a bag. For each item, the instructor took an object out of the bag, presented the act, handed the object over to the child, and instructed the child following the general procedure. Afterwards, she encouraged the child to throw the object in a foldable tower that the instructor displayed between the child and herself. Like manual postures and gestures, pretend acts were scored using a 3-point scoring scale, based on a specified description of each target act (see Table 2 for full scoring criteria).

2.3.5. *Gesture composite*

Descriptive statistics showed similar patterns of distribution for raw scores of both gesture tasks in the TD (conventional: mean = 7.38, SD = 1.53; object related: mean = 6.80, SD = 1.59) and SLD (conventional: mean = 3.24, SD = 3.52; object related:

mean = 2.91, SD = 3.24) samples. Furthermore, scores for both gesture tasks were significantly correlated in the TD ($r = .94$, $p \leq .001$) and SLD ($r = .73$, $p \leq .001$) samples controlling for children‟s age, validating the construction of a gesture composite. Accordingly scores from the two tasks were combined.

2.3.6. *Inter-rater reliability*

An experienced speech and language therapist, blind to the status of the children and trained in the scoring system, watched video-recordings of the administration of the imitation battery and independently rescored six TD children and five children with SLD (10.47% of the collected data). Inter-rater agreement was calculated using Cronbach‟s Alpha (Cronbach, 1951), with alpha values ranging from .82-1.0 for the individual tasks. This is considered to be a good to excellent level of agreement (George & Mallery, 2011) and demonstrated the reliability of scoring criteria developed for the imitation battery.

3. Results

3.1. Analysis of group differences

The first aim of this study was to compare the performance of samples of TD children and children with SLD on a range of novel nonverbal imitation tasks across three age ranges. Data was analysed using SPSS version 19. Due to violations of the underlying assumptions of normality and homogeneity in most data-sets, planned analyses of variance could not be calculated. Instead, two-tailed Mann-Whitney-U tests were used for significance testing. To calculate effect sizes, z-scores were converted into the effect size estimate r using the following equation (Field, 2005):

¯_. Based on Cohen"s (1992) widely accepted suggestions, correlation coefficients were interpreted as small (.10), medium (.30) or large (.50) effect. Table 3 provides the descriptive and inferential statistics for imitation raw scores according to task, sample, and age group.

 # insert Table 3 #

3.1.1. Social acts: Body movements

As predicted, significant differences between TD and SLD groups were found on all body movement tasks for almost all age ranges. The only exception was the gesture composite, which showed no difference in the 3-year-old groups. Patterns of results were similar across tasks, with large effect sizes for group differences in the two younger groups and medium for the oldest group (see Table 3). The majority of children in the TD sample completed body movement tasks with little difficulty and scored towards or at ceiling, with the exception of a tenth of children in the youngest TD group who emerged as extreme outliers. In contrast, the majority of children in the two younger SLD groups scored substantially below their TD peers, revealing difficulty with the imitation of body movements as can be seen in Table 3. Most children in the oldest SLD group performed substantially better than children in the two younger SLD groups, but a fifth of children emerged as outliers. Accordingly, scores of the two older SLD groups differed significantly from each other on all body movement tasks (facial postures/expressions: $z = -2.98$, $p<.05$; manual postures: $z = -2.85$, $p<.01$; gestures: $z = -2.72$, $p<.01$), whereas no significant differences were found between the two younger SLD groups. The distinction between manual

postures which do not convey meaning and gestures which convey meaning was not found to affect either group.

3.1.2. Instrumental acts: Common actions on objects

The majority of children at all ages in the TD and SLD samples scored towards or at ceiling on the instrumental acts on familiar objects task and scores in both samples were similarly distributed (TD sample 2;0-2;5: median = 4.0, SD = 0.36; 2;6-2;11 and 3;0-3;5: median = 4.0, SD = 0.00 / SLD sample 2;0-2;5: median = 3.0, SD = 0.60; 2;6-2;11: median = 4.0, SD = 0.50; 3;0-3;5: median = 4.0, SD = 0.41). However, contrary to the prediction, results revealed significant differences between the TD and SLD samples at all ages (2;0-2;5: $z = -2.49$, $p < .05$; 2;6-2;11: $z = -2.84$, $p < .01$; 3;0-3;5: $z = -2.06$, $p < .05$). Since it was observed during the administration of the imitation battery that a number of children in the SLD sample had particular difficulties with the item „stroking dolphin" but not with any other items of this task, it was of interest whether group differences were due to this specific item. Therefore performance in the TD and SLD samples was compared separately item by item. Analyses revealed significant differences at all ages for the item „stroking dolphin" (2;0-2;5: $z = -2.46$, $p < .05$, $r = -.40$; 2;6-2;11: $z = -2.84$, $p < .01$, $r = -.51$; 3;0-3;5: $z = -2.48$, $p < .05$, $r = -.42$), but differences for all other items were not significant. Qualitative analysis of children"s imitation errors revealed that, in contrast to the other items, the act „stroking dolphin" was not associated with one inherent instrumental function that is intrinsically linked to one outcome. Instead, children with SLD associated the soft-toy with different play actions (e.g. let dolphin swim, eat, or explore). Since the task was intended to investigate performance on instrumental acts which lead to an unambiguous observable outcome, this item was removed from the data-set. With this item removed, differences between the TD and SLD

samples were no longer significant for any age group (see Table 3).

In the instrumental acts on unfamiliar objects task, the TD and SLD groups did not differ significantly at any age, and effect sizes were small (see Table 3). Patterns of scores were similar in the TD and SLD sample, with the majority of children scoring towards or at ceiling.

Thus, as predicted, TD children and children with SLD had almost no difficulty imitating common instrumental acts, with the exception of the item „stroking dolphin", to which TD and SLD groups responded significantly differently. The familiarity versus unfamiliarity of objects did not influence the imitation performance of either group.

3.1.3. *Hybrid acts: Pretend acts*

The differences between the TD and SLD samples on the pretend acts task were significant for the two younger but not for the oldest groups (see Table 3). Patterns of results were similar, though not identical, to those for body movement tasks. TD children had little or no difficulty imitating pretend acts and scored towards ceiling, apart from a tenth of children in the youngest TD group who emerged as extreme outliers, whereas some children in the SLD groups had problems with this task. However, more children were likely to attempt the pretend acts than the body movement acts (see „error patterns" below). The oldest SLD group performed significantly better than the middle SLD group, but no significant difference was found between the two younger SLD groups.

3.2. Error patterns

A distinction was made between „incorrect" responses, where a child attempted to imitate the demonstrator but failed to accurately reproduce the target act, and „refusal", where a child made no response. Both types of error occurred in both samples. Figures 1 and 2 show the percentage of the total numbers of items in the body movement (Figure 1) and pretend acts (Figure 2) tasks that were either performed incorrectly or refused in the TD and SLD sample, according to age group (total number of items = the number of items in each task multiplied by the number of children in each age group). Since children were scored only for „attempt to imitate" in the facial postures/expressions tasks, these tasks are not included in these figures.

3.2.1. Selective refusal

Refusal occurred only in the youngest group in the TD sample, but at all ages in the SLD sample, though it reduced with age (see Figures 1 and 2). Importantly, no child refused all tasks. Rather, consistent refusal to comply occurred in the body movement and pretend acts tasks, but not in the instrumental acts tasks. Within the SLD sample, refusal occurred most frequently in the body movement tasks, less frequently in the pretend act tasks and only occasionally in the instrumental act tasks. Thus, children in the SLD sample showed a pattern of *selective* refusal affecting those imitation tasks that were expected to be difficult for the SLD sample, rather than *general* non-compliance affecting the whole imitation battery. It may be inferred that refusal reflected difficulty with certain tasks rather than general uncooperativeness.

3.2.2. Error patterns according to tasks

Different percentages of incorrect responses and refusals emerged for different

tasks. In the **body movement tasks**, a higher percentage of refusals occurred in the SLD sample compared to the TD sample, whereas the percentage of incorrect responses in the SLD sample was similar and in some cases lower than in the TD sample (see Figure 1). Hence, the significantly poorer performance of the SLD sample stemmed from higher refusal rates. Group differences between the oldest TD and SLD groups were reduced or non-significant due to lower refusal rates. Thus, it appears that once children in the SLD sample attempted to reproduce postures and gestures, they were as competent as TD peers.

 # insert Figure 1 #

In the **pretend acts tasks**, in the two younger SLD groups, percentages of incorrect responses and refusals were higher compared with the two younger TD groups (see Figure 2). Hence, differences between groups stemmed from higher rates of refusals *and* incorrect responses. It appears that more children in the 2-year-old SLD groups attempted to reproduce pretend acts than body movements, but reproduced these incorrectly. Closer inspection of children‟s incorrect errors revealed that children in the SLD groups were proportionally more likely than TD children to use an object in its conventional way (e.g. „eat with spoon‟ for „pretend to brush hair with spoon‟), rather than imitating the counterfunctional action inaccurately (e.g. „brush in front of the face‟ for „pretend to brush hair with spoon‟). In the SLD sample approximately two-thirds of the 52 partial errors were categorised as conventional (65.4%) and one-third as inaccurate (34.6%), whereas in the TD sample one-third of the 36 partial errors were categorised as conventional (33.3%) and two-thirds as inaccurate

(66.6%). In the oldest TD and SLD groups, percentages of incorrect responses and refusals were similar, manifesting in a non-significant difference.

 # insert Figure 2 #

In the **instrumental tasks**, percentages of incorrect responses and refusals were very similar in the TD and SLD groups at all ages, manifesting in non-significant differences in all comparisons. As can be seen in Table 3, the error rate was very low.

3.2.3. Delay versus deviance

A comparison of types and rates of errors revealed that error patterns in the oldest SLD group broadly resembled those in the youngest TD group across tasks. In both groups, refusal rates were low and levels of incorrect responses according to task were similar as described above (see Figures 1 and 2). The majority of incorrect responses in both samples were partial errors, i.e. responses that shared some but not all features with the target act, and almost all partial errors in the SLD sample resembled those of the TD sample (a list of individual errors is available on request from the first author). The exception was the item „stroking dolphin", which elicited different and unexpected responses in the SLD sample (see results 3. and discussion 4.). Unrelated errors, i.e. responses that shared no features with the target act, occurred only in the SLD sample, but were very rare. Overall, this suggests a delayed rather than deviant pattern of response on these imitation tasks.

4. Discussion

This study compared samples of 2;0-3;5-year-old TD children and children with SLD

on a range of nonverbal imitation abilities. Significant group differences were found on all body movement imitation tasks and the pretend acts on substitute objects task. In contrast, no significant group differences emerged for the common instrumental act tasks, apart from the item „stroking dolphin". Thus, it appears that at least some children in the SLD sample had difficulty with nonverbal imitation, but this depended on the task. Children in the SLD sample did not show a general difficulty with nonverbal imitation, but a specific difficulty with target acts categorised as „social acts" on the grounds that they rely on sociocognitive abilities. Different patterns of errors were associated with tasks categorised as social, hybrid and instrumental, also suggesting that children"s difficulties varied according to task.

4.1. Social versus common instrumental acts

What is it about social acts that makes them so challenging for the SLD sample while the ability to reproduce instrumental acts is relatively intact? First, as pointed out above, social acts focus on actions of persons, in contrast to instrumental acts which focus on functions of objects. One challenge in reproducing social acts might be the need to connect socio-emotionally with the demonstrator as a person as a prerequisite for mapping the demonstrator"s actions onto one"s own. In contrast, the involvement of real objects in instrumental acts reduces the need to engage with the demonstrator, especially when the acts to be imitated have an inherent function that is intrinsically biased towards a certain outcome. Second, the purpose of an instrumental act is to achieve a perceivable outcome, whereas a social act, lacking

such an outcome, has only the purpose of social connection and receiving positive social feedback. In the former, the purpose is obvious since the outcome as physical state is observable. In the latter, the purpose is less obvious since the intention behind the demonstrator‟s actions as mental state is only inferable. Gattis (2002) emphasised that physical outcomes of actions tend to be unambiguous for the observer, whereas mental reasons behind actions can be multitudinous and therefore less clear. Thus, another challenge to reproduce social acts might be the need to infer the demonstrator‟s intention behind her/his actions as guidance for one‟s own actions. In contrast, imitation of instrumental acts might be sufficiently guided by their physical outcomes. Crucially, connecting socio-emotionally with the demonstrator as well as inferring the demonstrator‟s intention require the child to establish a sense of connectedness with the demonstrator as a basis for sharing emotional and mental states.

In line with this argument, it was observed that many children in the SLD sample had difficulty establishing a sense of connectedness with the demonstrator in the social acts. Children who happily engaged in instrumental acts clearly and decidedly refused to imitate body movements. Rather than ignoring the demonstrator and her action in an indifferent or unmotivated manner, children not only refused to reproduce the body movement, but disengaged from the demonstrator, e.g. by terminating eye contact or shaking the head. These observations are supported by the finding that the significantly poorer performance of the SLD sample on the social tasks stemmed from higher non-response rates and not from incorrect responses, implying that once children in the SLD sample attempted to reproduce postures and gestures, they were as competent as TD peers. Thus, the ability to establish a sense of connectedness with the demonstrator appeared to be at the core of children‟s

difficulty with social tasks in the SLD sample. In contrast, the majority of children in the TD sample had no difficulty in attempting the reproduction of body movements. Rogers, Young, Cook, Giolzetti, and Ozonoff (2010) beautifully describe an imitation interaction as „a reciprocal frame [that] has been set up in a call-response format, in which the adult‟s behaviour invites a child‟s response‟ (p. 82), and „believe that children without autism feel this invitation and respond accordingly, reciprocally and imitatively‟. In keeping with this description, we believe that at least some children with SLD felt the invitation, but lacked the sociocognitive skills to respond appropriately. Whether these difficulties were due to problems with inferring the relevant purpose behind the presentation, or to problems with engaging socio-emotionally with the demonstrator, or with both, remains speculative within the context of this paper.

4.2. Hybrid acts: fuzzy boundaries between social and instrumental acts

Performance of children in the TD and SLD samples was also compared on the imitation of pretend acts, a task on the cusp between serving an instrumental and social function that was categorised as hybrid. Results were in line with this hybrid status, since pretend acts were less problematic than the social acts, but more problematic than the instrumental acts. The analysis of errors was particularly informative about the nature of children‟s difficulty with this type of task: non-responses were lower and incorrect response were higher than for body movements, and children in the SLD sample were proportionally more likely to use an object in its conventional way, rather than to imitate the counterfunctional action. Children used

the objects according to their instrumental function, although they did not observe the adult using them in this way. Hence, they responded to the affordance of the object instead of imitating the demonstrator, suggesting that they were guided by the inherent instrumental function of the object, rather than by the demonstrator‟s specific intention behind her action. Fewer children with SLD refused the hybrid compared to the social measures, suggesting that the possibility of focussing on the object rather than the demonstrator reduced difficulty in complying with an imitation task, possibly by reducing the need to establish a sense of connectedness with the demonstrator. Children‟s performance on this task illustrates that not every form of imitation involving real objects can as a matter of course be categorised as „purely‟ instrumental, and relatively independent of sociocognitive abilities. In line with this observation, TD and SLD groups responded significantly differently to the item „stroking dolphin‟. In contrast to other instrumental acts a soft toy has no inherent instrumental function that is biased towards one possible result and not all children perceived „stroking‟ as the only possible outcome, suggesting that correct imitation of „stroking dolphin‟ required children to be in tune with the intentions of the demonstrator. Others have also pointed out that the instrumental salience of instrumental acts varies from subtle, functional object affordance to strong sensory experience, and that the motivating effects of sensory feedback might influence the imitation performance of children (Ingersoll, Schreibman, & Tran, 2003; Rogers et al., 2010). Likewise findings in this study support the view that not every action that involves an object is „purely‟ instrumental, and furthermore that the difference between social and instrumental is not clear-cut.

4.3. Nonverbal imitation errors

The majority of errors occurring in the SLD sample resembled those in the TD sample rather than being qualitatively different, and the nonverbal imitation skills of the children with SLD improved with age. However, the largest gain was observed between the middle and oldest SLD groups, indicating that a much larger proportion of 2-year-old than 3-year-old children with SLD had difficulty with the imitation of body movements and pretend acts. A comparison of types and rates of nonverbal imitation errors revealed that error patterns in the oldest SLD group appeared to resemble those in the youngest TD group across tasks, suggesting a delay rather than deviance in the elicited imitation of body movements and pretend acts within the SLD sample. Findings are in line with previous research investigating the nature and rate of nonverbal imitation errors in children with ASD (Beadle-Brown, 2004) and children with specific language impairment (Hill, Bishop, & Nimmo-Smith, 1998; Marton, 2009): authors have consistently found the same types of nonverbal imitation errors in typical and clinical samples, though there were differences in the frequency with which these occurred.

In analysing error patterns, selective non-compliance was considered to reflect difficulty rather than uncooperativeness, since children in the SLD sample showed a pattern of selective non-responses affecting those nonverbal imitation tasks that were predicted to be difficult for the SLD sample. This is also in line with previous research that has reported non-compliance in imitation performance in preschool-age TD and SLD/ASD, since authors have reported higher non-response rates on body movement tasks in the ASD/SLD groups, but similar non-compliance rates on instrumental acts tasks in all groups (Charman, Baron-Cohen, Swettenham, Baird,

Drew, & Cox, 2003; Dohmen, 2007; Rogers et al., 2010). However, the majority of papers give no information on non-responses and few studies have looked in depth at children‟s error patterns.

4.4. Motor skills and nonverbal cognitive abilities

Studies have demonstrated a close link, or co-morbidity, between specific language impairment and poor motor skills (Hill, 2001). Since the reproduction of body movements as well as the handling of objects requires basic motor and praxis skills, insufficient motor skills might influence children‟s imitation performance. To consider the possible impact of difficulties at the motor planning and execution level on nonverbal imitation performance, participants‟ fine and gross motor skills were assessed using standardised subtests in this study. No evidence of differential motor performance was found in the TD and SLD samples at any age range. Thus, the differences observed in nonverbal imitation tasks in this study cannot be attributed to children‟s motor abilities.

To participate in this study, children had to satisfy the recruitment criteria of nonverbal cognitive development within typical limits. Since all children fulfilled this selection criterion, a deficit in nonverbal cognitive abilities could be ruled out in interpretation of performance on nonverbal imitation tasks. However, it has to be considered whether the significant difference on nonverbal cognitive abilities between the oldest TD and SLD groups might have affected imitation performance. Given that the difference was mainly due to higher scores in the TD group, and that differences in nonverbal imitation performance between the oldest TD and SLD groups were weaker or non-significant compared to the middle groups, there is no

evidence that the differences observed in nonverbal imitation were affected by the difference in nonverbal cognitive abilities.

5. Conclusion

To the best of our knowledge, no study has previously investigated a range of different types of nonverbal imitation in children with SLD. The most significant finding of this research is that a sample of children with SLD performed significantly below their TD peers on some, but importantly not all, nonverbal imitation tasks: the more closely target acts were related to a social function, the more challenging was the reproduction, and the more closely a target act was related to a common instrumental function, the less challenging was the reproduction. Patterns of errors also indicated different between tasks. Neither motor nor nonverbal cognitive skills could account for the group differences in nonverbal imitation ability, and it was argued that the ability to establish a sense of connectedness with the demonstrator is at the core of the imitation difficulties observed in the SLD sample.

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Figure 1

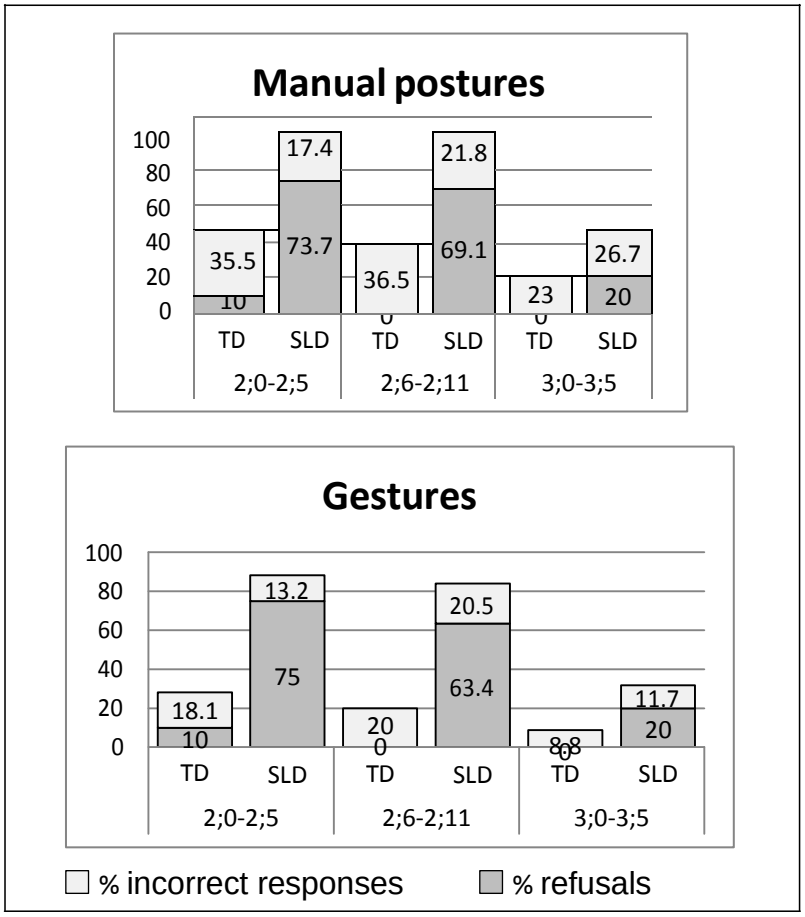

Figure 1: Percentage of the total number of items in the body movement tasks categorised as incorrect and refusal in the TD and SLD samples, according to task and age group

Figure 2

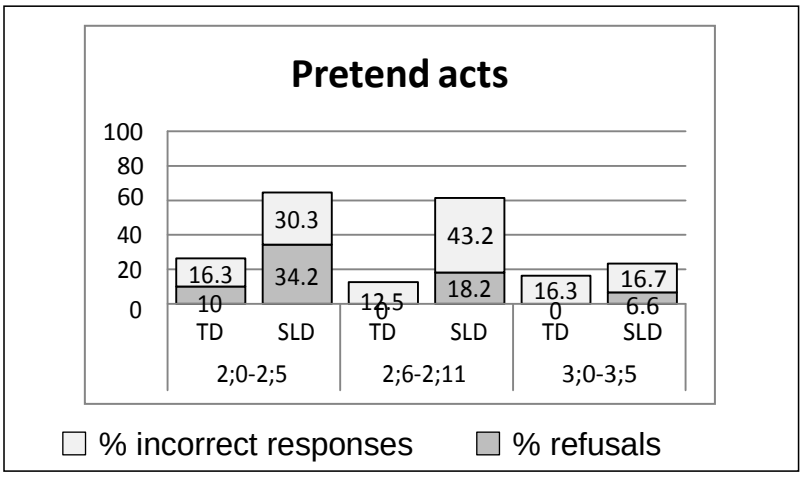

Figure 2: Percentage of the total number of items in the pretend acts task categorised as incorrect and refusal in the TD and SLD samples, according to age group

Table 1: Participant details according to sample and age group

	Age group	TD [1]	n	SLD [1]	n	z
Chronological age (in months)	2;0-2;5	26.6 (1.63 / 24-29)	20	26.1 (1.24 / 24-29)	19	z = -1.12 ns
	2;6-2;11	32.5 (1.88 / 30-35)	20	31.8 (1.40 / 30-34)	11	z = -1.03 ns
	3;0-3;5	38.3 (2.00 / 36-41)	20	38.4 (2.03 / 36-41)	15	z = -0.18 ns
Nonverbal cognitive ability (standard score)	2;6-2;11	103.3 (7.58 / 95-127)	20	97.8 (4.51/89-102)	11	z = -1.94 ns
	3;0-3;5	107.5 (8.40 / 97-129)	20	97.2 (4.78 / 90-106)	15	z = -3.53 ***
Gross motor skills (dimension-specific test value)	2;0-2;5	7.36 (1.16 / 5-9)	20	6.63 (1.30 / 4-9)	19	z = -1.73 ns
	2;6-2;11	6.46 (1.58 /4.44-8.88)	20	6.66 (1.38/4.44-8.88)	11	z = -.30 ns
	3;0-3;5	6.20 (1.11 / 4.16-7.5)	20	5.71 (1.25 / 4.16-7.5)	15	z = -1.09 ns
Fine motor skills (dimension-specific test value)	2;0-2;5	7.50 (1.86 / 5-10)	20	6.97 (1.78 / 5-10)	19	z = -.88 ns
	2;6-2;11	6.85 (1.43 / 3.33-10)	20	6.99 (1.05 / 6.66-10)	11	z = -.24 ns
	3;0-3;5	8.33 (2.06 / 3.33-10)	20	7.10 (1.72 / 3.33-10)	15	z = -1.88 ns

Note. [1] mean (SD / range). n = number of participants. *** $p < .001$. ns = nonsignificant

Table 2

Table 2: Nonverbal imitation battery

Body movement tasks (social acts)	**Scoring**
Facial postures & expressions: 5 items (5)[1] • Open and close mouth • Protrude tongue • Close and open eyes • Anger • Happiness	1 (attempt) = attempt to move relevant parts of the face 0 (refusal) = no facial movement
Manual postures: 10 items (20)[1] • Pat top of head with hand • Grab nose • Pat tights with hands • Pull ear with one hand • Pull ears with both hands • Touch shoulder • Pat elbow • Lift one finger • Form and open fist • Form T-sign	2 (accurate) = entire body movement reproduced as specified 1 (partial) = response showed some but not all features of the target act in terms of • chosen body parts and/or plane and direction of movement • a visible attempt to represent a specific communicative function or to establish a reference to the use of a target object 0 (unrelated) = response shared no features with target act 0 (refusal) = no body movement
Conventional gestures: 4 items (8)[1] • Waving for greeting • Shake head for no • Shrug shoulders for uncertainty • Fingers to lips for quiet	
Object related gestures: 4 items (8)[1] Pretend to • sleep (hands shaping cushion) • eat with a spoon • drink from a bottle • throw a ball	

Common actions on objects tasks (instrumental acts)	**Scoring**
Familiar objects [2]: 4 items (4) [1] • Play xylophone (music) • Start police car (car moves) • Stroke soft-toy-dolphin (dolphin touched) • Play music box (music)	1 = outcome achieved 0 = outcome not achieved 0 = no response (refusal)
Unfamiliar objects [2]: 4 items (8) [1] • Shaking dumbbell (giggly noise) • Pulling both sides of a bone apart (obtain sticker) • Taking out a piece of foam and moving the leaver of a light-box (flashing light) • Holding a present on its handle and pushing it upside down on the floor (squeaking noise)	Means: 1 (correct) = accurate manipulation of the object 0 (incorrect) = inaccurate manipulation of the object 0 (refusal) = no response Outcome: 1 = outcome achieved 0 = outcome not achieved
Pretend acts on substitute objects (hybrid tasks): 4 items (8)[1]	**Scoring**
Pretend to • brush hair with spoon • drink from miniature hat • phone with banana • brush teeth with pencil	2 (accurate) = entire action reproduced as specified 1 (partial) = inaccuracies in the use of the substitute object OR real object used in its conventional way 0 (unrelated / refusal) = see body movements

Note. [1] number of items per task with max. raw score in parentheses. [2] outcome of action on object in parentheses.

Table 3

Table 3: Descriptive and inferential statistics of imitation raw scores according to task, sample, and age group

Imitation task	Age group	TD [1]	SLD [1]	z	r
Facial postures and expressions (max=5)	2;0-2;5	5.0 (1.71 / 0-5)	0.0 (1.54 / 0-5)	-4.54***	-.72
	2;6-2;11	5.0 (0.00 / 5-5)	0.0 (1.53 / 0-4)	-5.33***	-.95
	3;0-3;5	5.0 (0.00 / 5-5)	5.0 (2.08 / 0-5)	-2.74**	-.46
Manual postures (max=20)	2;0-2;5	16.0 (5.20 / 0-19)	0.0 (5.08 / 0-14)	-4.45***	-.71
	2;6-2;11	16.0 (1.42 / 14-18)	1.0 (5.92 / 0-14)	-4.52***	-.81
	3;0-3;5	18.0 (1.31 / 14-19)	16.0 (7.07 / 0-19)	-2.35*	-.39
Gestures (max=16)	2;0-2;5	14.0 (4.63 / 0-16)	0.0 (4.73 / 0-13)	-4.50***	-.72
	2;6-2;11	14.5 (1.09 / 12-16)	2.0 (5.16 / 0-14)	-4.20***	-.75
	3;0-3;5	15.5 (0.86 / 13-16)	15.0 (6.27 / 0-16)	-1.79 ns	-.30
Instrumental acts (familiar objects without dolphin max=3)	2;0-2;5	3.0 (0.00 / 3-3)	3.0 (0.16 / 2-3)	-1.02 ns	-.23
	2;6-2;11	3.0 (0.00 / 3-3)	3.0 (0.00 / 3-3)	0.00 ns	-
	3;0-3;5	3.0 (0.00 / 3-3)	3.0 (0.00 / 3-3)	0.00 ns	-
Instrumental acts (unfamiliar objects max=8)	2;0-2;5	7.0 (1.30 / 4-8)	6.0 (1.11 / 5-8)	-1.29 ns	-.20
	2;6-2;11	7.5 (0.75 / 6-8)	7.0 (1.27 / 4-8)	-1.37 ns	-.24
	3;0-3;5	8.0 (0.41 / 7-8)	8.0 (1.12 / 4-8)	-0.64 ns	-.20
Pretend acts (max=8)	2;0-2;5	7.5 (2.28 / 0-8)	4.0 (3.07 / 0-8)	-2.91**	-.46
	2;6-2;11	8.0 (0.60 / 6-8)	6.0 (2.48 / 0-7)	-3.88***	-.69
	3;0-3;5	7.0 (0.66 / 6-8)	7.0 (2.01 / 0-8)	-0.51 ns	-.08

Note. [1] median (SD / range). Number of participants per group: see Table 1. * $p < .05$, ** $p < .01$, *** $p < .001$, ns = nonsignificant