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**Effects of intensive vocabulary intervention (nouns) for preschool  
children with global developmental delay**

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## **Abstract**

Children with global developmental delay (GDD) are delayed in several areas of intellectual functioning and, among other areas; they often present substantial delay in language development. Due to a wide heterogeneity, intervention studies are scarce; yet, necessary in developing clinical language treatment for the group. The purpose was to explore the effects of intensive vocabulary intervention set in a preschool environment. Four participants, three boys and one girl between ages 3:9 and 4:4, diagnosed with GDD, received training of an individual set of target words (nouns). The training was carried out by their preschool teacher, supervised by an SLP. A single-subject multiple baseline design across subjects, with additional control across items was used. An improved success rate of word naming was seen in three out of four participants; however, at follow-up 3-4 months later, the rate had decreased in two of the participants. All participants showed proof of generalization of target words to the home setting. This study highlights the importance of further research in language acquisition in children with GDD.

## Introduction

Global developmental delay (GDD) is a term describing children under the age of five who are delayed in several areas of intellectual functioning (1), with at least two of the following domains affected: gross and fine motor, speech and language, cognition, social and personal development, and activities of daily living (2). Usually, the delay is quite significant, with performance two to three standard deviations below the age mean (3) and affects an estimated 1%-3% of children, similar to children with intellectual disability (ID; 4). The GDD term is used to describe children who have not received an underlying etiologic diagnosis and the chance of receiving an etiological diagnosis later on range from 10 to 80% (2). There is some controversy in the GDD diagnosis, as it relies on a summation of several clinical findings, gathering widely heterogeneous children under one term (5). Features in GDD are reportedly shared with a number of other conditions, such as autism spectrum disorder (ASD) (6) and other diagnoses such as cerebral palsy and certain neuromuscular disorders (7), proving the wide range of symptoms. In most cases, a psychological assessment is completed before school start and often the children with GDD receive a clinical diagnosis of ID (5). Miclea et al. (8) even argue that, for children under age of five years, it is more adequate to talk about a developmental coefficient rather than an intellectual coefficient, leading to a diagnosis of GDD rather than a diagnosis of ID.

Since this particular group of individuals may not receive an etiological or more specific clinical diagnosis throughout the preschool years, and since it is an extremely heterogeneous group, there are apparent difficulties in conducting research on this group in order to establish evidence-based guidelines for standardized clinical assessments (9), and consequently also to establish effective, evidence-based treatments. Perhaps that could explain why there are very few studies exploring the language development of and language intervention effects for children with GDD. Two recent studies do however suggest that children with GDD exhibit both receptive and expressive language difficulties (10; 11). In the first study, by Nair et al. (11), 84 children with GDD, including language problems, participated in a language intervention program. Assessment before intervention start showed low and similar performance in both receptive and expressive language on a group level. In the second study, by Kim et al. (10), the language function of children with GDD was compared to children with specific language impairment (SLI). They found that the children with GDD had a slightly lower, yet not significantly different, performance. Both groups in the study performed lower on expressive language than on receptive. Although there is a substantial difference between these two diagnoses, the language function thus seems to be comparable. In addition, from

clinical experience, we know that the language development of children with GDD most often advances at a slow rate and the children exhibit gaps regarding both word comprehension and production. Regarding language intervention effects in children with GDD, only one study has been found. In particular, Nair et al. (11) observed a significant increase in both receptive and expressive language quotient over a period of six months during which the children were exposed to an early language intervention program, focusing on responsive language strategies. In summary, this suggests that the language function of children with GDD is comparable to the one of children with SLI and they also appear to improve from language treatment.

Vocabulary is fundamental in language development (12) and since vocabulary size is proven smaller for the SLI population (13), it might be suggested to be the same for the GDD population. Regarding vocabulary intervention, plenty of studies have proven it to be effective on children with delayed language development (14). Additionally, gains have been reported in cases of focused stimulation, an approach in which a limited number of targeted words are highlighted and emphasized in a learning situation (15). In modelling the optimal intervention, there are several variables to take into account. Intensity has been brought up as a possible important component in optimizing intervention effect (16), e.g., in training of short-term memory (17) and expressive language (18). In 2009, Gallagher et al. (19) evaluated an intensive language intervention for children with SLI, in comparison with nursery-based or no intervention. They found that intensive direct specialist (SLP) group intervention was the more effective model. In their study, the intervention was given during four-hour sessions, once a week over a period of 24 weeks. The nursery-based intervention had better effect than no intervention and was set up with one-hour sessions once a week over 12 weeks divided into two blocks separated over time. As argued by Warren et al. (16), the definition of intensity is different for almost every new study, generating difficulties in comparing them, and Zeng et al. (20) suggest that the quality of method is just as important as the intensity. Marulis et al. (14) instead proposed a division into the following characteristics: duration, frequency and intensity; thus describing the length of the intervention, the amount of sessions and the length of each session. However, in their meta-analysis, there was a broad range between interventions regarding each of the three characteristics, proving the great complexity in modelling an intervention.

In Swedish habilitation services, the parents and/or the preschool and kindergarten teachers generally carry out language training for children with GDD, with a continuous but sparse guidance from the speech-language pathologist (SLP). It is concluded that children at an early language level benefit from early and intensive intervention (21; 22); however, most of these

studies have been conducted on children with ASD or children who are at an extremely early language and communication level. In Swedish habilitation services, a few parent education programs focusing on the early stages of language are available, such as the ‘Hanen Parent Program: It takes two to talk’ (23) and the Swedish AKKtiv – KomIgång (24). The latter program additionally focuses on implementation of augmentative and Alternative Communication (AAC). These programs apply to children with GDD, but when the children reach a level of combining words into phrases, the intervention options lessen, exposing a clinical need of investigating what interventions are effective for these children.

Consequently, few studies investigate language intervention for preschool-aged children with GDD and the need for establishing effective evidence-based language treatments for this group is evident. For children with GDD, all elements of language function, both receptive and expressive, are in need of further investigation; however, expansion of vocabulary is fundamental in the overall language development. In terms of vocabulary treatment for other groups of children with language impairments, the method focused stimulation has proven effective and in several other areas of language related treatment, intensity has been identified as an important component in intervention. Investigating the effects of intensive vocabulary treatment for this group of children using a focused stimulation inspired approach thus seems warranted.

### *Aims*

The first aim of this study was to explore the effects on expressive vocabulary regarding nouns after intensive vocabulary treatment using a focused stimulation inspired approach on children with GDD. A secondary aim was to investigate whether these words also generalized to the children’s active vocabulary at home.

## Methods

### *Participants*

Participants were recruited from the Stockholm habilitation organization, Habilitering & Hälsa. Inclusion criteria were a diagnosis of GDD, including a history of slow language development, established by a neuropsychiatrist. Participants should be between 3 and 5 years of age. Further, the children should be able to combine words into sentences of two to three words and should be able to sit down and collaborate in an arranged situation at a table. Based on these criteria, possible participants were selected by the first author. All four children, three boys and one girl, age 3:9 to 4:4, fulfilled the inclusion criteria (see Table 1).

Table 1

*Participant description including SECDI scores, at study inclusion. Maximum SECDI word production score was 711.*

Participant	Gender	Age (years:months)	SECDI word production score pre-intervention (home/preschool)	Percent of maximum SECDI score (home/preschool)
Musa	M	3:9	245/155	34.5/21.8
Linus	M	3:10	93/30	13.1/4.2
Amina	F	4:4	179/152	25.2/21.4
Edvin	M	4:0	261/140	36.7/19.7

Before school start, all participants underwent a psychological assessment, separate from this study (Table 2). Three out of four participants in this study received a diagnosis of ID and one participant received a diagnosis of ASD diagnosis with no ID.

Table 2

*Age and diagnoses received at psychological assessment before school start for each participant*

Musa	5:6	ASD, no ID, but below mean
Linus	4:11	ID, mild to moderate
Amina	6:6	ID, mild
Edvin	6:4	ID, mild; Atypical autism; ADHD

### *Design*

This quasi-experimental study used a single-subject multiple baseline design across subjects with additional control across items. The study was conducted over two periods (spring and autumn of 2012), repeating the design with two participants each period. In Table 3, the planned procedure of each pair of participants is displayed, illustrating the multiple baselines across subjects.

Table 3

*Procedure for each pair of participants (Y & Z represents the two participants)*

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	~	28
Pre-intervention baseline	YZ	YZ	YZ	Z	Z	Z	Z											
Intervention				Y	Y	Y	Y	Z	Z	Z	Z							
Post-intervention baseline								Y	Y	Y	Y	YZ	YZ			YZ		
Follow-up																		YZ
Generalization measure								Y				Z						YZ

### *Material*

The Swedish version of MacArthur-Bates Communicative Development Inventories, Swedish Early Communicative Development Inventories (SECDI; 25), was used in studying the participants' vocabulary. Prior to intervention, parents and preschool teachers of all participants filled out SECDI forms of 'Words children use' for a word production score (see Table 1). From the SECDI forms, an individual set of 50 words was selected for each participant. In particular, 40 target words (nouns), which the child produced neither at home nor at the preschool, and 10 additional words (nouns), which the child did produce both at home and at preschool, were picked out from these forms. The set of 40 individual target words were used in the intervention as well as in the weekly probes. The 10 additional words that the child already produced were included in the weekly data collection with the purpose of keeping the participants interested and concentrated, since they otherwise initially only would be shown pictures of things they could not name. However, these 10 additional words were not included in the probe word count. Images depicting the 50 words in each individual set were mainly collected from an internet database of drawn pictures. In some cases, pictures were selected elsewhere, containing both drawn and photographed pictures, but all images contained an object of the target word with a clean white background. The same images were also included in the training material handed out to the preschool teachers.

Data collection was filmed using a Sony Handycam DCR-DVD92E or Sony Handycam DCR-DBD404.

## *Measures*

*Probe measure.* The probe measure consisted of the 40 child individual target words. In addition, as described above, the 10 additional words in each child's individual word set, i.e., words that the child already could produce, was also included in the probe data collection sessions. The participants were instructed to name pictures of the target words presented to them one at a time by the study SLP (i.e., the first author) who asked: 'What is this'? Each probe session, the 50 pictures were presented in a randomized order; however, the first five pictures always showed images from the additional 10 words, with the intention of getting the participant started. The study SLP blindly presented the pictures to the child one at a time by holding them up in front of the child while only seeing the back of the thick-papered card. Each probe session was filmed. The study SLP, i.e., the first author, assessed the 40 target and 10 additional words weekly. Perceived utterances were noted simultaneously during assessment and then controlled via video within two days. To be considered correct, a word had to be sufficiently phonologically correct to the extent that the study SLP could recognize the word out of the child's individual set of 40 words. This proved to be difficult in two participants: the first had quite extensive phonological impairments, and the other had difficulties staying focused throughout the assessment, and talked fast and quite indistinctly. In these particular cases, the study SLP controlled utterances over time, comparing phonological patterns to determine whether they would be regarded as correct or not. By doing so, some utterances which at first were considered incorrect afterwards were found to be correct, e.g. [dədə'dədə] (ɛɛ'fantən). Also, throughout intervention, we were able to contrast utterances that changed over time, after introduction of new target words, thus deeming utterances as correct when they became more similar to the target words.

*Control measures.* By nature, the multiple-baseline design provided a control of intervention effects across participants. In addition, sub-sets of the intervention target words of each participant served as a control across items, since they were introduced sequentially in treatment, see below.

*Generalization measure.* During the study, parents were blind to what words their child was exposed to in treatment. Post-intervention and at follow-up, they filled out additional SECDI forms, allowing us to monitor whether the target words were generalized to the home setting.

*Overall word production measure.* At the time of follow-up, preschool teachers filled out a second SECDI form, enabling us to survey the overall word production development.

*Social validity.* At the time of follow-up, the preschool teachers were asked to fill out a questionnaire with closed-ended questions, but with an option of commenting, valuing their experience of the intervention. Questions included whether they liked the intervention, whether it was feasible and worth the effort of completing it, whether they felt comfortable in providing treatment and whether they would consider another intervention period in the future. In addition, parents were asked to fill out a similar questionnaire with mostly open-ended questions. Questions included how they experienced the intervention, whether it was worth the effort, whether they experienced any improvement in their child, how they experienced their participation in the intervention, whether there was anything they would want to change in aspect of intervention setup and whether they would consider another intervention period in the future. All but two respondents, parents of one participant and preschool teacher of another, submitted the questionnaire.

### *Intervention*

During intervention, the participants underwent daily treatment with their own preschool teachers, with the study SLP reachable via telephone, serving as support for the teachers. Pre-intervention, the teachers received structured verbal information of the intervention and procedure; although, target words were presented in sub-sets, right before beginning of training. The aim of intervention was to arrange sessions twice a day with a total of approximately 40 minutes a day (26) for four weeks and the teachers noted time and content of each session. However, the teachers struggled to reach the desired amount of time, even during this limited period, and consequently, total amount of time came to vary from 20 to 30 minutes and altered between one longer session and two shorter, differing from day to day.

Each child's individual set of 40 target words, which he/she did not produce at study start according to SECDI ratings, was divided into four sub-sets, containing ten words each. When possible, words from the same category (e.g. animals) would occur in the same sub-set. The four sub-sets were introduced sequentially, one sub-set per week, during the intervention phase, thus also serving as a control across items. In the treatment sessions, an approach inspired by the focused stimulation method (15) was used, which included frequent and highly concentrated presentations of the preselected target words in an environment structured by the preschool teacher. In training, the participants were not required to respond; however, since all of them were talking children, and each child was familiar with both the teacher and the learning environment, they were encouraged to try. The materials used in the training included pictures,

items and simple board games. The preschool teachers were given liberty to produce own ideas since they knew the children best, but focus during the sessions were to be the ten new words of the week. Some activity suggestions were supplied by the study SLP (see Table 4) and some training material was handed out, in which the same images as in assessment were included.

While the first participant in the pair underwent intervention, the other participant in the pair was given the regular treatment, i.e. individual or group training once or twice a week and informal training in daily routines, with SLP and special educator visiting once every six to eight weeks, consulting the teachers.

Table 4  
*Examples of intervention activities suggested to the preschool teachers*

<b>Material</b>	<b>Activity suggestions</b>
<b>Items</b>	Sorting into categories
	Play with items
	Doll play
	Kim's game and other memory games
<b>Pictures</b>	Sorting into categories
	Memory
	Board games
	Book reading
	Drawing and painting

Since Musa and Linus went to the same preschool department, the teachers were instructed not to discuss intervention strategies between each other. Purpose was to ensure no change in activity for the participant not undergoing intervention. All preschool teachers were instructed not to inform the parents of the target words.

In case of illness up to one week of time, the intention was to extend the training period with an extra week; however, due to the timespan of the preschool semesters, it was not possible to extend the periods enough to fit every sub-set of words for all participants.

### *Procedure*

Data on the 40 intervention target words was collected once a week throughout the whole period, so long as the participants were healthy enough to attend preschool. In the beginning of each period, pre-intervention baseline measurement data was collected over at least three weeks, verifying that no spontaneous development occurred in any participant. As the first participant in each pair started the intervention phase, baseline measurements were continued for the other participant in the pair for a few more weeks, serving as a control across subjects. Post-intervention, data collection continued as post-intervention baseline measurement. Four to

five months post-intervention, a follow-up data collection was conducted, investigating the long-term effects of the treatment.

### *Data analysis*

From recordings, amount of correct target words was assembled for each week, both in words total and per sub-set, and presented in visual graphs. For each phase, mean success rate was determined, both in amount of words and in percent, providing possibility of statistical analysis. In between phases, mean rate of increase was calculated in percent.

From SECDI forms, data was used to study development of target words in the home setting for each participant and also to survey the overall development of word production from pre-intervention to follow-up in both home setting and in preschool setting. This data was presented descriptively, in tables and graphs.

Statistical analysis of effect size was performed on all participants' data using a variation of Cohen's *d*, as proposed by Beeson et al. (27). The difference between means of pre-intervention baseline and post-intervention baseline was divided by the standard deviation of pre-intervention baseline.

### *Inter- and intrarater reliability*

From all participants, there was a total of 40 videotaped probe measurement sessions. Of the collected data, 25%, i.e., 10 videos, was randomly selected; however, containing at least two videos from each participant. The videos were evaluated by an independent SLP as well as reevaluated by the study SLP to determine point-by-point inter- and intrarater reliability respectively. The interrater comparison was made from the results of independent SLP's data and the study SLP's probe measurement data. In beforehand, the independent SLP and the study SLP practiced together on two samples, creating a consensus in evaluation. Still, both independent SLP and study SLP were unable to strictly replicate probe measurement, since it was partly performed in a live setting. The degree of interrater agreement was 90.2% and the degree of intrarater agreement was 91.4%, which was deemed acceptable (28).

### *Ethical considerations*

This study was performed within Stockholm Habilitation Services, providing research in developing treatment strategies for children with GDD. Since intervention was of the same treatment as the preschool teachers already practiced, only more intensive, it was considered sufficient obtaining approval from the head of the unit from which the participants were

selected. The parents of the participants filled out a consent form prior to the study and the preschool directors gave a verbal consent based on structured verbal information from the study SLP. Both parents and preschool teachers and directors were informed of the option to discontinue participation without repercussions. The parents of the participants also filled out a separate consent form allowing us to look into the medical journals of each participants, and thus retrieving information on diagnoses.

## Results

Due to illness, both Musa and Linus had reduced days of training and thus a reduced amount of sub-sets of words introduced. Musa was introduced to the first two sub-sets, over a period of five weeks. Linus was introduced to three sub-sets over a period of four weeks. Consequently, both participants' intervention was interrupted by illness. In the second pair of participants, both participants completed all sub-sets of words.

Fig. 1 shows data for Musa and Linus. During the pre-intervention baseline phase, the mean success rate for Musa was 2.0 out of 40 words (5%). During the intervention phase, the mean success rate increased to 13.0 words (32.5%), i.e., a mean increase rate of 27.5% (see Table 5). During the post-intervention baseline phase, the mean success rate was 17.7 words (44.3%), showing a steady increase of word naming success rate through the intervention phase into post-intervention baseline, as confirmed by a mean difference increase of 39.3% in naming rate. However, at follow-up three months later, the success rate decreased to 12.0 words (30.0%), presenting an overall mean increase rate of 25.0%. When calculated on the two trained sub-sets only, Musa had a post-intervention baseline target word naming success rate of a whole 88.5%, while the sub-sets not introduced remained at the same low level throughout the whole period. The corresponding rate at follow-up was 60 %, indicating an overall mean increase rate of 50% for the words actually trained.

Linus had a mean success rate of 7.0 out of 40 words (17.5%) during the pre-intervention baseline, showing that he already on beforehand knew quite a few words not registered in the home or preschool pre-intervention SECDI forms. During the intervention phase, the mean success rate increased to 14.0 words (35%), i.e., a mean increase rate of 17.5%. During the post-intervention baseline, Linus had a success rate of 21.0 words (52.5%), presenting a mean increase rate of 35% from pre-intervention baseline to post-intervention baseline. At follow-up, he maintained the level of success with a rate of 19.0 words (47.5%), presenting an overall mean increase rate of 30.0%. When calculated on the three trained sub-sets only, Linus had a post-intervention baseline target word naming success rate of 56.7%. The corresponding rate at

follow-up was 50%, indicating an overall mean increase rate of 40% for the words actually trained.

Control across subjects confirms that the increase of success rate was linked to the intervention phase, as the pre-intervention baseline of Linus remained stable throughout the intervention of Musa, and alike, the post-intervention baseline of Musa remained stable throughout the intervention of Linus. For Musa, the additional control across items clearly showed that the trained sub-sets were the ones showing results while the non-trained sub-sets remained at a low rate. For Linus, the trend was not as clear, with just a slight increase of the trained first, second and third sub-sets. Moreover, the increase in naming rate of the words in the second sub-set was delayed and took place when the third sub-set had been introduced in the intervention. The naming rate of the words in the fourth sub-set was elevated already in the pre-intervention baseline phase, and continued to be so throughout the probe sessions even though it was never trained.

For Musa, the post-intervention parent SECDI rating revealed that 8 of the 20 actually trained target words (i.e., 40%, 20% of total target words) had generalized to the home setting. From the remaining 20 target words, which had not been trained, one word (i.e., 2.5% of total target words) was registered. At follow-up, the parent SECDI rate of trained target words had increased to 14 (i.e., 70%, 35% of total target words) and additionally, the amount of non-trained target words had also increased to 14 (35% of total target words). Musa's total score in the parent SECDI rating increased with 42 words during the intervention phase and had increased with another 78 words at follow-up. Post-intervention, Linus' parent SECDI rating revealed that 6 of the 30 actually trained words (i.e., 20%, 15% of total target words) had generalized to the home setting. From the remaining 10 target words, which had not been trained, three words (i.e., 7.5% of total target words) were registered. Unfortunately, we did not receive a follow-up score, but his overall parent SECDI rating score increased by 46 words from pre-intervention to post-intervention.

Table 5  
*Mean difference in target word naming rate between phases, displayed in percent*

	Musa	Linus	Amina	Edvin
Pre-intervention to intervention	27.5	17.5	6.7	33.8
Pre-intervention to post-intervention	39.3	35.0	11.2	57.5
Pre-intervention to follow-up	25.0	30.0	4.2	35.0
Post-intervention to follow-up	-14.3	-5.0	-7.0	-22.5

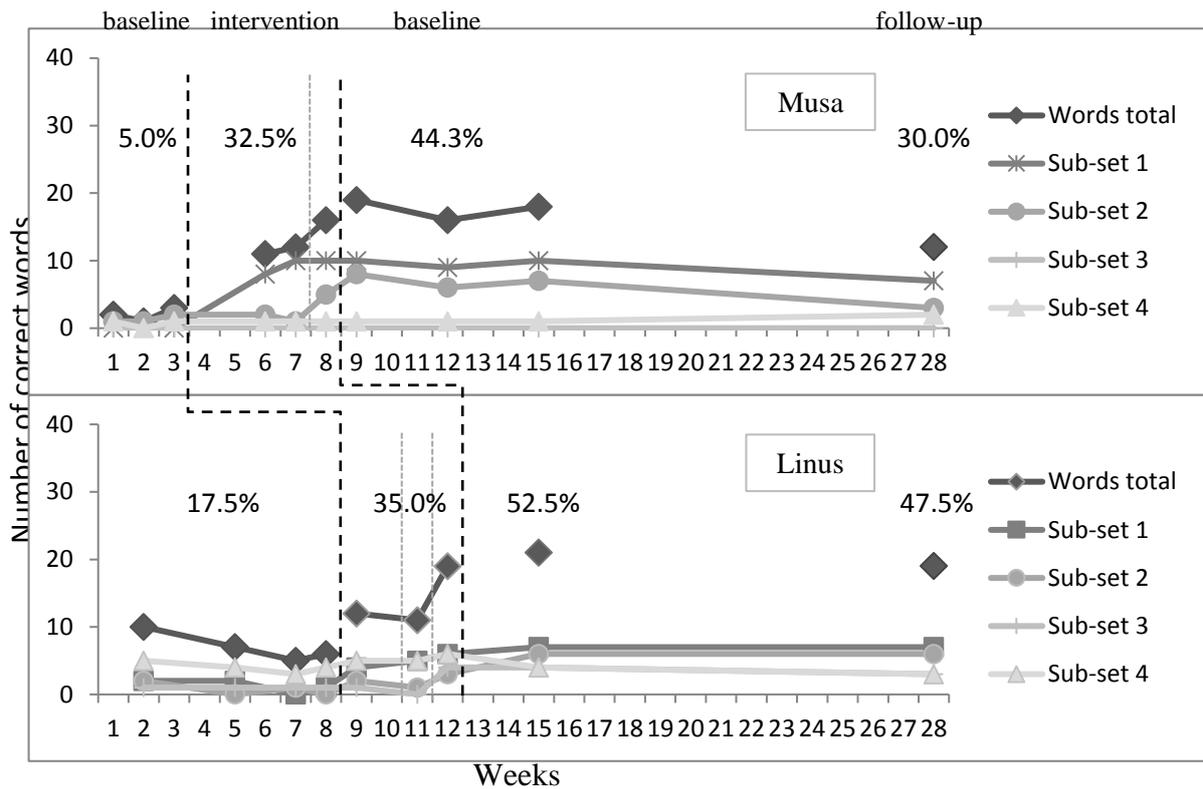


Figure 1  
 Number of correctly named words out of 40 target probe words for Musa and Linus. Musa's pre-intervention baseline week 1-3, intervention week 4-8, post-intervention baseline week 9-15 and follow-up week 28. Linus' pre-intervention baseline week 2-8, intervention week 9-12, post-intervention baseline week 15 and follow-up week 28. Thin lines during intervention indicate introduction of a new target word sub-set. Mean success rate in total target words of each phase, are presented in percent.

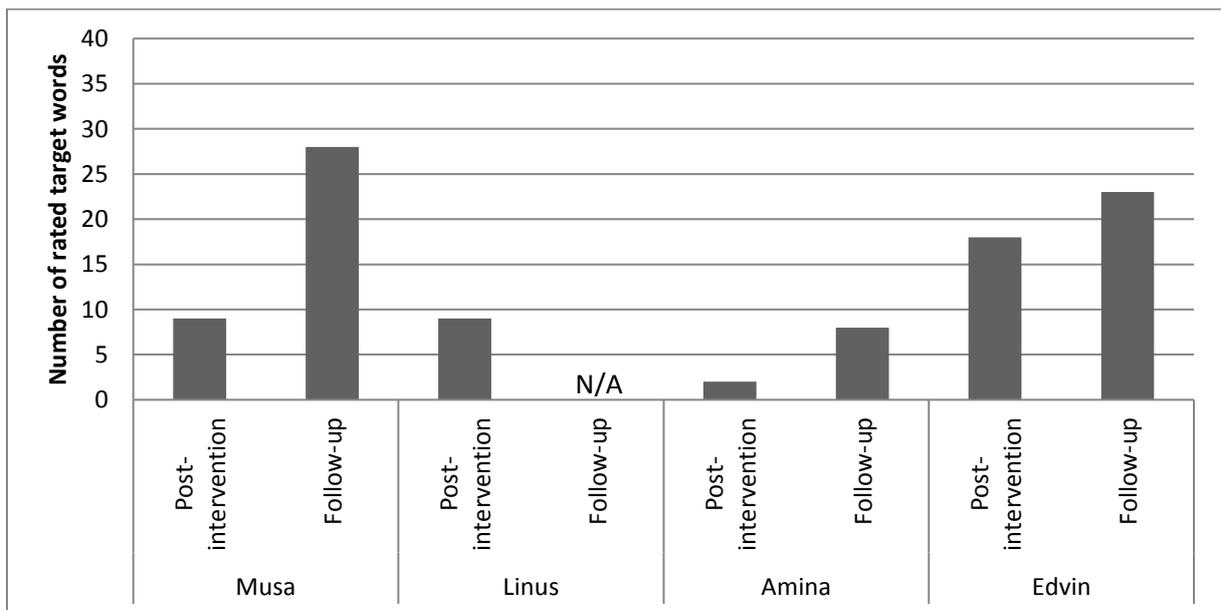


Figure 2  
 Production of the 40 intervention target words in the home setting, according to SECDI parent ratings post-intervention and at follow-up. Follow-up from Linus was not received.

Table 6

*Overall SECDI word production score, filled out by parents and preschool teachers*

	Musa		Linus		Amina		Edvin	
	Home	Preschool	Home	Preschool	Home	Preschool	Home	Preschool
Pre-intervention	245	155	93	30	179	152	261	140
Post-intervention	287		139		159		347	
Follow-up	365	-	-	135	207	147	404	515

Fig. 2 shows data for Amina and Edvin. During pre-intervention baseline, mean success rate for Amina was 1.33 out of 40 words (3.3%). During intervention, mean success rate increased to 4 words (10%), i.e., a mean increase rate of 6.7% (see Table 5), ranging from three to five words each week. During post-intervention baseline, mean success rate was 5.7 words (14.5%), and at follow-up, it had decreased to three words (7.5%), presenting an overall mean increase rate of 4.2%. During word naming in the probe data collection sessions, Amina used body language to display the words she did not know, and a few of the words were expressed solely with manual signs; however, these words were scored as incorrect based on the scoring criteria used in the study.

During pre-intervention baseline, Edvin had a mean success rate of 5 out of 40 words (12.5%). During intervention, mean success rate increased to 18.5 words (46.3%), i.e., a mean increase rate of 33.8% (see Table 5), and during post-intervention baseline, the success rate had increased to 28 words (70%). Visual inspection of Edvin's graph (Figure 3), revealed a direct increase of target word success rate at onset of the first target word sub-set. In the second week of intervention, there was a disruption in progress of unknown origin. However, in the succeeding weeks, he gained approximately five new words each week, increasing in three out of four sub-sets of words, thus presenting a 57.5% mean difference rate between pre-intervention baseline and post-intervention baseline. At follow-up, success rate decreased to 19 words (47.5%), almost matching mean rate of the intervention phase and presenting an overall mean increase rate of 35.0%.

Control across participants was not as evident between Amina and Edvin, since Amina did not improve during intervention and Edvin's pre-intervention baseline was quite irregular and ended in an upward movement (Fig. 3). However, there is a notable success rate increase for Edvin in the intervention probe measurements, while Amina's post-intervention baseline

remains stable. For Amina, the additional control across items presented a marginal increase in naming rate of the first sub-set, during the first week of intervention, while none of the remaining three sub-sets improved at all. During the remaining weeks of intervention, no other sub-set improved while the first sub-set maintained its marginal increase. For Edwin, there was a distinct increase of naming rate of the words in the first sub-set, during the first week, while the remaining sub-sets were unaffected. The increase in naming rate of words in the second sub-set was delayed and took place over several weeks and for the third sub-set, the increase took place when the fourth sub-set had been introduced in the intervention. Finally, the fourth sub-set did not show any increase of naming rate and was, as indicated in pre-intervention baseline, irregular throughout the intervention phase.

For Amina, the post-intervention parent SECDI rating revealed that 2 of the 40 trained words (i.e., 5.0%) had generalized to the home setting, which is a lower percentage than documented in the post-intervention baseline word naming probe (mean rate 14.5%). At follow-up, the parent SECDI rates of target words had increased to 8 words (20.0%), exceeding the follow-up word naming probe (7.5%). Amina's total score in the parent SECDI decreased by 20 words during intervention, but then increased by 48 words at follow-up compared to pre-intervention baseline. Noteworthy, the preschool SECDI overall rating instead decreased by 5 words from pre-intervention baseline to follow-up. At post-intervention baseline, Edwin's parent SECDI rating revealed that 18 of the 40 trained words (i.e., 45%) had generalized to the home setting. During follow-up, this score had increased to 23 (57.5%). Edwin's total score in the parent SECDI rating increased with 86 words during the intervention period and had increased with another 57 words at follow-up. In preschool SECDI, total rates increased with 375 from pre-intervention baseline to follow-up.

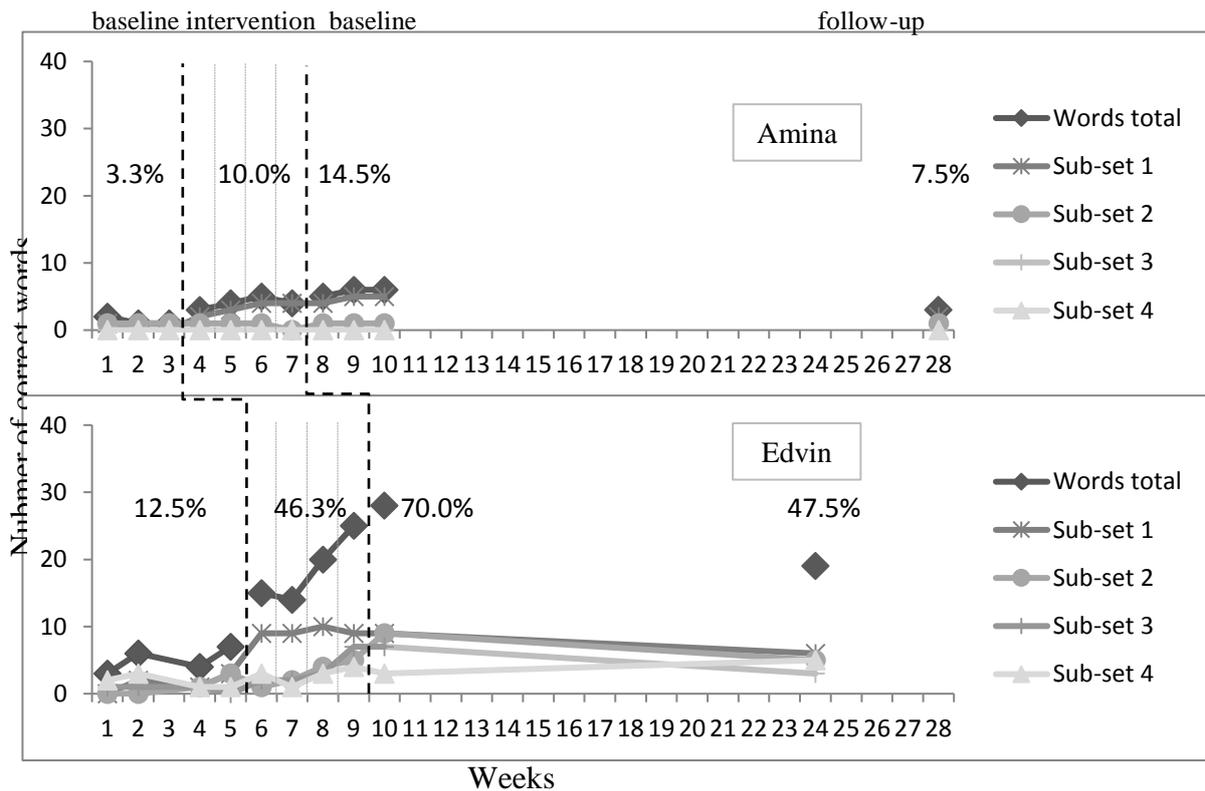


Figure 3

Number of correctly named words out of 40 target probe words for Amina and Edvin. Amina's pre-intervention baseline week 1-3, intervention week 4-7, post-intervention baseline week 8-10 and follow-up week 28. Edvin's pre-intervention baseline week 1-5, intervention week 6-9, post-intervention baseline week 10 and follow-up week 24. Thin lines during intervention indicate change of word. Mean success rate in total target words of each phase, are presented in percent.

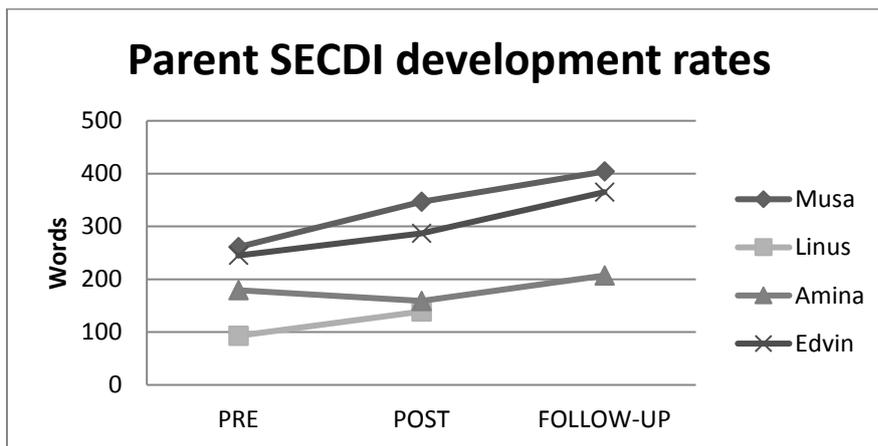


Figure 4

Development of vocabulary for each participant, assembled from parent SECDI rates.

#### Statistical results

Statistical analysis is presented in Table 7. Due to the rare focus of this study, it is difficult to interpret the *d*-values using criteria such as small, medium and large. Vannest et al. (29)

recommend a meta-analysis of a body of literature to determine these benchmarks, which is not available for this patient group. It is apparent that the benchmarks set by Cohen (30), where 0.8 is considered a large effect, would give an extremely large effect size for all participants, and therefore is not relevant. Studies conducted on preschool children in phonological treatment estimated benchmarks as 1.4, 3.6 and 10.1 for small, medium and large effect respectively (31), which might be more of a relevant approximation for children with GDD. If using these benchmarks, the effect size results of Linus and Amina would be valued as above medium and for Musa and Edvin as above large.

Table 7  
*Analysis of effect size, using a variation of Cohen's d (17).*

	Musa	Linus	Amina	Edvin
M Pre-intervention	2	7	1.33	5
M Post-intervention	17.67	22	5.67	28
SD Pre-intervention	1	2.52	1.53	0.58
<i>d</i>	15.67	5.56	7.51	15.06

### *Social validity*

All but two respondents, i.e., the preschool teacher of one participant and the parents of another, submitted the questionnaire addressing their experience of the intervention. In the preschool teacher questionnaire, two respondents answered positively (i.e., 'yes' or 'to a high degree') on all closed-ended questions and the third respondent answered positively regarding feasibility of intervention and feeling comfortable in providing treatment. However, the third respondent was 'doubtful' regarding liking the intervention and whether it was worth the effort. Further, third respondent would 'absolutely not' consider another intervention period in the future. In the comment section, the third respondent questioned the effects of intervention for the current participant. The fourth teacher did not submit a questionnaire, despite several reminders.

In the parent questionnaire, all three respondents answered with 'yes' or 'to a high degree' on the closed-ended questions, concerning whether they thought it was worth the effort of completing the intervention and whether they would consider another intervention period in the future. In the open-ended questions, all respondents expressed a perceived improvement in their child; however, one respondent believed that the preschool teacher did not give enough treatment during intervention. One parent did not submit a questionnaire, despite several reminders.

## Discussion

This single-subject design study had two aims. The first one was to explore the effects of intensive vocabulary treatment for preschool children with GDD and the other was to study if these words generalized to the home setting.

Three out of four participants, Musa, Linus and Edvin, responded positively to the intervention, with a clear mean difference in target word naming between pre-intervention baseline and intervention (see Table 5), which improved further, into post-intervention baseline. The fourth participant, Amina, barely increased at all in success rate of target word naming. Studying effects at follow-up, 3-4 months post-intervention, there was a notable drop from post-intervention baseline for two of the participants (Musa and Edvin); however, the mean difference in target word naming from pre-intervention baseline to follow-up displayed an overall increase in naming rate of trained target words for Musa, Linus, and Edvin (25.0%, 30.0%, and 35.0% respectively). Moreover, if only the trained word sub-sets were considered, the overall increase in naming rate reached even higher levels (i.e., 50% for Musa, and 40% for Linus). Causes of the decline in naming rate at follow-up could not be further explored in the context of this study, but would need to be examined in order to strengthen the outcome of intervention.

Since there is a lack of language intervention studies for children with GDD, and, to the knowledge of the author, none has used a methodology similar to the current one, it was difficult comparing the results to other studies. Studies on children with SLI have found significant improvement tied to intervention (32; 19) and one study including both children with SLI and GDD showed significant improvement also in the children with GDD (11); however, there was no follow-up after withdrawal in any of these studies. In a study by Van Der Schuit et al. (33), examining a broad language intervention for children with ID, a follow-up one year after completion of intervention did not show a sustained development post-intervention. Development was measured through standardized tests and did therefore not control for trained parameters, such as specific trained words. In the present study, the decline in performance on target words at follow-up, a few months after treatment withdrawal, seen in all participating children could be viewed as the most intriguing outcome in the current study. This particular result, i.e., difficulties maintaining treatment effects over time, is in line with clinical experience of language intervention with this particular group of children and thus needs further investigation.

By observing the behavior across subjects, we concluded that the increase of vocabulary in the participants was indeed an effect of the intensive vocabulary treatment. In particular, for

three out of four participants, an increase in target word naming rate was seen during the intervention phase, while the corresponding control subject maintained an unchanged target word naming rate during the simultaneous pre- or post-intervention baseline. During baseline, as stated earlier, the control subject underwent regular treatment at the preschool, with a general focus on language and communicative development. An additional control across items also supported the effect of treatment since, in general, only the naming rate of introduced word sub-sets increased, while untrained word sub-sets remained unaffected. The results of the current study are thus in line with other studies demonstrating effects of vocabulary intervention for other children with slow vocabulary development, e.g., disadvantaged children (14). In addition, the positive treatment effects also supports the use of a focused stimulation approach with children with GDD, even when the approach is used in a slightly modified manner as in the current study. This concurs with other studies using a focused stimulation approach, e.g., with children exhibiting expressive language delay (15).

For all participants in this study, several of the trained target words appeared post-intervention in the parent SECDI rates (Figure 2), signifying a generalization of the trained words to the home setting. Although decreasing in probe word naming success rate, both Musa and Edvin had an increase of trained words in parent SECDI rates at follow-up. By viewing the overall results of the parent SECDI rates, it is clear that there was a relative increase of vocabulary in all participants but one, exceeding the words retrieved from intervention (see Figure 4). This effect could not be further explored in present study, but may have been a generalization effect of treatment, an effect of the parents being more attentive to new words and/or a general development of the children's vocabulary.

Intensity of treatment was of main focus in this study, and in the three participants who exhibited a treatment effect, the intensity of treatment might have been contributory to the positive outcome, as proven in earlier studies (18; 19). However, since the target word success rates of the participants were limited (no participant acquired all four sub-sets), the optimal amount of training, i.e., amount of days, amount of sessions and amount of time each session (14), is still debatable and in need of further research. It is evident how the definition of intensity differs between studies and the combinations of duration, frequency and intensity are numerous (14). In this study, we decided on every day training, with at least one, preferably two, sessions a day. This amount was based on years of ongoing contact between the treating SLP and preschool teachers in the area, trying to find a manageable rate for teachers to cope. Still, training twice a day proved to be challenging for several of the preschool teachers for reasons such as shortage of facilities as well as the needs of other children and personnel in the group.

According to the results, however, effects of the intervention were obtained even with one session a day. Yet, the question remains whether it would be cost effective to implement this intervention on a regular basis. Since the main effort was assigned to the preschool teacher, this approach would be beneficial for the habilitation services; however, in this study, the first SLP was in close contact with the preschool teachers, aiding them in the intervention and thus spending a greater amount of time and effort than usual on services for each of the participating children. Additionally, during this study, the preschool teachers made great efforts to carry out the implementation, but the clinical experience tells us that it has become harder for preschool teachers to allocate time for individual treatment, which in turn shows the importance of the motivational work in beforehand.

Before the execution of this study, first SLP was in direct contact with the parents, preschool teachers and also the preschool directors. Regarding the preschool teachers' part, in the preschool social validity questionnaire, two out of three respondents stated that they would consider another intervention period in the future. The teacher stating 'absolutely not' was the teacher of Amina, who did not see any improvement in the intervention. Overall, we believe that all the extra attention invested by the teachers may have improved their ability to interpret the children's speech and understand the words they were expressing, which would be a great value of teacher-led training. In particular, this might have been the case for Linus and Edvin, where SECDI teacher scores increased by 105 and 375 words, respectively, between pre-intervention and post-intervention. Since the training was carried out by preschool teachers only, our outcomes cannot be directly compared to other studies, which used SLP-led training (e.g., 32; 19); however, Marulis et al. (14) indicated that also teacher-led training showed good effect size when performed by a certified preschool teacher. Comparing vocabulary intervention for children with GDD carried out by preschool teachers and SLPs, respectively, might be of interest to investigate in future studies, since there is no clear answer as to which is the better option. An assumption is that an SLP would be even more tuned in on the child's communicative and linguistic expressions and therefore be able to enhance the effect of training, but as addressed above, there might be more of a long-term gain letting the teacher perform training and thus learning more about the child's expressive language.

In establishing the inclusion criteria, focus rested on the ability to combine words and being able to collaborate in an arranged situation, since these two factors should be, and proved to be, sufficient to construct a learning environment. However, at the start of pre-intervention baseline probe assessments, we realized that two of the participants, Linus and Edvin, had various difficulties, possibly leading to deficient performance and certainly to difficulties interpreting

what they were saying when naming the target words in the probes. Linus presented quite significant limitations of syntagmatic and/or paradigmatic phonological processes and possibly childhood apraxia of speech, resulting in difficulties in intelligibility. He had the lowest overall SEDCI rates of all participating children (Table. 5), but definitely had a larger vocabulary than perceived by parents and preschool teachers. For Edvin, it was difficult to stay focused during word probe assessment, as he was restless. He also talked fast and quite indistinctly. During intervention, the teacher was able to customize the tasks in order to keep him focused, but that was not possible during probe assessment, leading us to question whether Edvin performed optimally. Since the purpose of this study was to examine acquisition of nouns, we chose to assess Linus' and Edvin's utterances by following them over time and comparing phonological patterns, to determine whether they could be regarded as correct or not. In a study context, exclusion of these participants would have improved the statistical outcome, in particular in the inter- and intra-rater scores. Still, by using this method, as described earlier, we were able to observe an improvement in these two participants as well, which is of great value since many of the children with GDD have similar deficiencies.

Regarding Amina, it is intriguing as to why there was a lack of improvement in her performance. Talking to the preschool teacher, it was obvious that they had worked hard during the intervention phase, with no or minor outcome. During word naming probe measurement, Amina used body language to display what words she did not know, and a few of the target words were expressed solely with manual signs, but, since the focus of this study was spoken language without aid of AAC, these utterances were considered incorrect. However, given the absence of development for Amina, AAC, such as manual signs, would be a strong recommendation in further intervention. Research of multimodal representations, such as AAC, clearly states that it increases the learning rate of language (22; 33) and is therefore widely used and recommended within the language development programs of the Swedish habilitation. However, in clinical work, the groundwork of a good AAC implementation requires a lot of time and effort (34). In addition, in cases of children who have begun talking, it is often proven hard to motivate the network into adapting an AAC system. In this study, we were interested in exploring a way of developing a child's vocabulary without the use of AAC. All participating children had been, or still were, in an AAC using environment at home and/or at the preschool.

## Conclusions

Findings from this study indicate a positive effect of intensive vocabulary treatment using a focused stimulation inspired approach on children with GDD, with increased target word naming rate in three out of four participants. Additionally, all participants were able to generalize part of the trained words to the home setting. Still, the long-term effects need to be examined further, as results in two out of three participants decreased after 3-4 months.

This study might be helpful in the discussion and development of language treatment models for children with GDD, but further research is necessary. Future studies should preferably address maintaining the effects of intensive training in the withdrawal phase by examining the decrease in word naming rate, why it occurs and how it may be prevented. It is also of great importance to further discuss and study in what way assessment of language development might be of aid in predicting the future outcome of children with GDD.

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