

LINGUISTIC DEFICIT AS A RESULT OF WORKING MEMORY DEFICIT IN DEVELOPMENTAL LANGUAGE DISORDER: EVIDENCE FROM THE ACQUISITION OF GRAMMATICAL ASPECT

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ABSTRACT

The present study examines the linguistic (i.e. grammatical aspect) and cognitive abilities of 8;0 to 8;9-year-old Greek-speaking children with Developmental Language Disorder (DLD). Previous studies on Greek-speaking children with DLD have indicated that, both in comprehension and production, the perfective is more prevalent than the imperfective. However research on the acquisition of the habitual feature is scarce, although it is a problematic feature even in typical development. The results of this study indicate that aspectual asymmetries are task-dependent. Interestingly, language deficit in DLD children seem to be due to their general cognitive deficit.

Keywords: Developmental Language Disorder, grammatical aspect, comprehension, production, working memory.

INTRODUCTION

Children with Developmental Language Disorder (DLD; also known as Specific Language Impairment) manifest lower verbal than non-verbal abilities (Conti-Ramsden et al. 1997, Leonard 1998, Alt et al. 2004, Gray 2006). Hence, they have lower scores in vocabulary compared to their typically developing peers (Conti-Ramsden et al. 1997, Leonard 1998). Interestingly, studies on children with DLD have revealed high standard deviations in the performance of those children, which indicates the reason why the DLD group exhibits very different profiles (Leonard 1998). In terms of their linguistic deficits, they are mainly detected at the morphosyntactic level; however deficits are not universal across languages (Marinis 2008). For instance, English-speaking children with DLD omit tense marking in past events (-ed), face problems with subject-verb agreement (ending -s in 3. person singular), among other errors (Leonard 2015). On the other hand, Greek-speaking children with DLD face problems with determiners, clitics and subject-verb agreement (Tsimpli et al. 2016, Tsimpli & Stavrakaki 1999). As far as the acquisition of grammatical aspect is concerned, there have been limited studies (Konstantzou 2015, Konstantzou et al. 2013), the results of which indicate that in both comprehension and production, the perfective is more prevalent than the imperfective. Notwithstanding, at this point we should note that methodological issues may lead to different findings in the acquisition of aspect even in non-impaired populations (Tracy-Ventura & Myles 2015, Dosi 2016).

Some features of grammatical aspect seem to be more demanding even in typical development (Dosi 2016, Dosi et al. 2016, Papadopoulou 2005). Hence, habitual feature is more problematic than the continuous feature of the imperfective aspect. Interestingly, the research on the acquisition of the two features of the imperfective in Greek-speaking children with DLD is absent.

Apart from the linguistic deficits, children with DLD have issues in terms of their cognitive abilities. More specifically, verbal working memory abilities (phonological loop) seem to be impaired in DLD (Gathercole & Baddeley 1990a). According to Gathercole & Baddeley (1990b, 1993), children with DLD face problems with the acquisition of vocabulary and the comprehension of complex sentences (e.g. passive voice), conceivably, due to their limited verbal working memory capacity. Adding to this argument, recent studies suggest that the deviant cognitive deficits have a negative impact on linguistic skills (Tsimpli et al. 2016, Dosi & Koutsipetsidou 2019). Thus, the lower linguistic skills seem to be the result of limited cognitive skills rather than language capacity as such.

Continuing this line of inquiry, the aim of the present study is twofold: (a) to detect possible asymmetries in the acquisition of aspect, both in comprehension and production, and (b) to investigate the role of working memory in the acquisition of aspect in the Greek-speaking children with DLD.

LITERATURE REVIEW

Before presenting the acquisition of aspect and cognitive abilities in Greek-speaking children with DLD, grammatical aspect in Greek will be briefly presented.

Grammatical aspect in Greek

Grammatical aspect exhibits the perspective of the speaker, namely whether they deem the event as ongoing or completed. Grammatical aspect is mainly divided in imperfective (for ongoing events) and perfective (for completed events) and can refer either to present or to past events. In this paper the main focus will remain in the presentation of the Greek aspectual system.

In Greek, aspect is morphologically encoded in the verbal system and it is often denoted via morpho-phonological changes in the verbal stem (Holton et al. 1997). The imperfective aspect can assign – without any morphological differentiation – either a habitual or a continuous interpretation (Moser 1994); however it cannot denote progressivity, as it is the case in English. On the other hand, the perfective aspect is marked by morphophonological changes in the verbal stem (in more detail see Dosi et al. 2016). The imperfective aspect in Greek can assign either a habitual or a continuous interpretation (Moser 1994). There is no morphological differentiation between the two features (continuous and habitual). The difference between them is supported by temporal adjuncts or pragmatically. Thus, these lexical cues can lead to a different interpretation (in more detail see Dosi et al. 2016).

The acquisition of grammatical aspect in Developmental Language Disorder

Children with DLD have problems in both the linguistic and cognitive domain. Although we have a clear picture about the difficulties with clitics, determiners and subject-verb agreement that the Greek-speaking DLD children face, little is known about the acquisition of the Greek aspectual system.

Studies in typical developing children have shown that the perfective is acquired earlier than the imperfective aspect and it is more preferable in early stages of development (Shirai & Andersen 1995). Additionally, some features of the imperfective aspect seem to be more demanding than others. The habitual seems to be more problematic than the continuous feature of imperfective aspect. However, there is no consensus among researchers. Some studies involving L2 learners of French and Italian have demonstrated that, in oral narratives,

habituality is acquired before progressivity (Wiberg 1996). By contrast, in Greek-speaking typical development the habitual seems to be more problematic than the continuous (Dosi 2016, Dosi et al. 2016). Apart from the acquisition of the features of aspect, we should bear in mind that grammatical aspect, in general, is challenging in acquisition, since it involves more than one linguistic levels (i.e. morphosyntax, semantics and pragmatics). The role of pragmatics in the interaction of the two types of aspect has been emphasized by many researchers (Avrutin 1999 Chien & Wexler 1990). Therefore, the interplay of the aforementioned interfaces makes the acquisition of grammatical aspect more demanding, in comprehension but also in production.

Studies in English-speaking children with DLD have demonstrated that both grammatical and lexical aspect (i.e. the inherent characteristics of the verbs) seem to be impaired and affect the use of aspect (in past events; Leonard 2015). Studies in Greek-speaking children with DLD have indicated that they can distinguish early on (5;9 years) between the imperfective and the perfective aspect (Konstantzou 2015, Konstantzou et al. 2013). Additionally, they appear to understand the semantic differentiation between the two aspectual features. Interestingly, when these children refer to ongoing events, they prefer to use the perfective aspect along with the phrase "... half of it" (Konstantzou 2015). For instance, "he drew half of it". The researchers conclude that even though both features are fully acquired and the children can morphologically mark them accurately, the imperfective aspect is more demanding in use when pragmatic information is involved. However, at this point, we should pay attention to methodology used in different studies, since it may lead to different findings (Tracy-Ventura & Myles 2015, Dosi 2016).

Continuing to this line of argument, there is evidence showing that the performance of children with DLD in grammatical aspect is highly dependent on the type of the task (Dosi, Andreou & Peristeri 2018). More specifically, in the study of Dosi et al. (2018), where an elicitation sentence completion task and a picture-based narrative telling task were administered, the results suggested that in the elicitation completion task, the use of imperfective aspect was more preferable compared to perfective aspect; whereas in the picture-based narrative task the use of perfective preferred over the use of imperfective aspect. The researchers interpreted the result due to pragmatic coercion; thus, participants construed the events as telic or completed, since the pictures are static (Dosi et al. 2016).

Although studies in Greek-speaking children examine the acquisition of the two features of aspect (the perfective and the imperfective), little is known about the acquisition of the two features of the imperfective aspect (i.e. habitual and continuous). Most of the studies investigate the two features of imperfective either in bilingual speakers or second language learners (Dosi 2016, Papadopoulou 2005). To our knowledge, none of the studies in Greek-speaking children with DLD have investigated separately the two features (i.e. the habitual and the continuous) of imperfective aspect.

Working memory skills in Developmental Language Disorder

Apart from the linguistic deficits, working memory skills seem to be impaired in DLD (Gathercole & Baddeley 1990a). More specifically, the verbal working memory skills of children with DLD are deviant compared to their typical developing peers. These deficits are probably responsible for their deviant linguistic skills (Gathercole & Baddeley 1990b, 1993, Montgomery 2002). Therefore, the limited verbal working memory skills hamper the acquisition of vocabulary and morphosyntax (Archibald & Gathercole 2006). In Alloway & Gathercole's study (2005) children were found to have problems with the acquisition of

vocabulary and the comprehension of complex sentences (i.e. passive voice), and the researchers claim that the low performance on linguistic tasks is caused by the participants' poor working memory skills. So far, very few studies of Greek-speaking individuals with DLD have focused on the interaction between linguistic and cognitive skills (Tsimpli et al. 2016, Dosi & Koutsipetsidou 2016, 2019).

METHODOLOGY

Participants

Ten Greek-speaking monolingual children (8;0-8;9 years old) participated in the present study. Half of them (N=5) formed the DLD group to get form the participants' profile, two baseline tasks were given. The first task was an expressive vocabulary task (Vogindroukas et al. 2009), and the second was a non-verbal intelligence task, which measures the participants' fluid intelligence (Raven 2004). As Table 1 shows, both groups scored within or above the range of their chronological age in the non-verbal intelligence task and no differences were attested ($U(10)= 12.500$; $z < .001$; $p = 1$), which makes the two groups comparable. By contrast, differences were found in the expressive vocabulary task ($U(10)= 1.000$; $z = -2.410$; $p = .016$), where the control group outperformed the DLD group.

Table 1. Participants' performance on the baseline tasks.

Group	Age (SD)	Vocabulary task (%) (SD)	Non-verbal intelligence task (%) (SD)
<i>DLD</i>	8.6 (0.4)	65.6 (5.6)	70.6 (3.1)
<i>controls</i>	8.6 (0.4)	82.8 (2.4)	72.7 (2.5)

Materials

Apart from the baseline tasks, all participants were tested in terms of their linguistic and cognitive abilities by means of three tasks. The acquisition of grammatical aspect (in past events) was tested by means of a production task and a comprehension task (Dosi, 2016). Cognitive skills were tested via a verbal working memory task (Chrysohoou, 2006).

The comprehension task

The comprehension task was a forced choice oral task administered in two sessions, in which participants had to choose the appropriate aspectual form in past events taking the context into account. Three experimental conditions were examined: perfective, [+continuous] imperfective and [+habitual] imperfective, as described in details in Dosi et al. (2016) and in Dosi (2016, 2017). For the purposes of this study only the first session was administered. There were 6 short stories in total (2 stories per condition with 5 target verbs each); thus the total target items were 30, i.e. 10 verbs per condition.

The participants listened to the stories via headphones. They listened to each story twice; during the first listening, the whole story was presented, in order to form the context of the story. The target verbal forms were acoustically distorted. During the second listening the story was divided into five parts; in each part both perfective and imperfective forms of a specific target-verb were presented and the participants had to choose the correct one. Only one answer was correct with respect to the context. The participants' answers were written down by the examiner investigator. If the answer was correct the participant received 1 point, whereas if the answer was wrong, they received no points.

The production task

This task was an elicitation task adapted from the aspect production task by Dosi (2016). The goal of the task was the production of grammatical aspect in past events. Similar to the comprehension task, the same three experimental conditions were used (i.e. perfective, [+continuous] imperfective and [+habitual] imperfective). For each condition 6 sentences were provided (in total 18 target verbs). Only one answer was acceptable with respect to the context. No fillers were used in the task.

The examiner read out the sentences and the participant had to produce the aspectual form of a verb in brackets. For instance, in the example “*On Saturday the whole morning Kate an essay (write)*” the participant was expected to answer “was writing”, namely to produce the imperfective past verb form. Both tasks were provided orally in order to avoid any effects of literacy; however the participants could look at the sentences. Similar to the previous way of coding, if the answer was correct the participant received 1 point, whereas if the answer was wrong, they received no points.

Verbal working memory task

This task was the Backwards digit recall task adapted from Alloway (2007), and normed for Greek by Chrysochoou (2006). The child listens to a series of digits and is required to recall them in a backward order. This task is a span task where digit recalling increases progressively. In order for the participant to move on to the next block, they have to accurately recall 4 out of the 6 trials. The task consisted of 6 blocks, starting with 2-digit trails in the first block and increasing to 7-digit trails in the last block. This is a complex memory task, which requires both manipulation and temporary storage of verbal information.

Participants were asked to accurately recall as many trails as they could. The testing stopped if the child failed in 3 trials within one block. If the recall was accurate the participant received 1 point, whereas if the recall was inaccurate, they received no points. The highest possible score was 36 points.

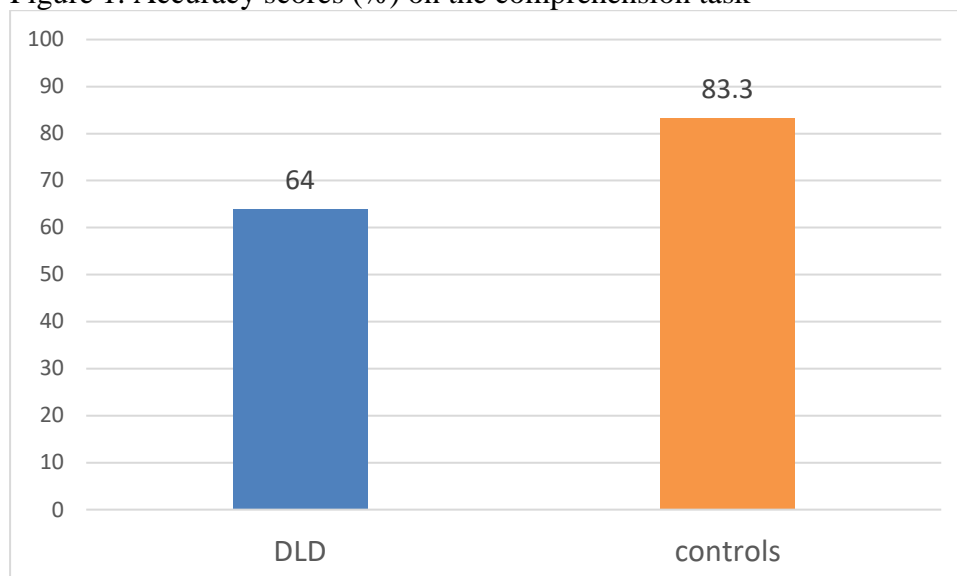
RESULTS

Since the distribution was not normal and the number of the participants was small, all tasks were analyzed using the non-parametric tests Mann Whitney U (for between group comparisons) and Wilcoxon (for within group comparisons).

The comprehension task

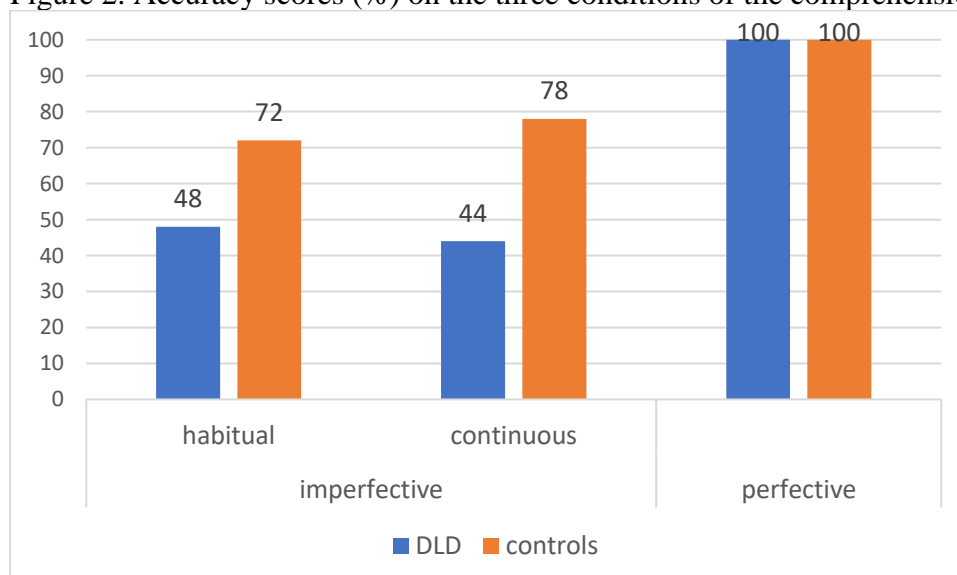
In this task, differences were attested between the two groups ($U(10) = 2.500$, $z = -2.108$, $p = .032$). As expected, the control group outperformed the DLD group. The control group scored higher than the DLD group (83.3% and 64%, respectively; see Figure 1).

Figure 1. Accuracy scores (%) on the comprehension task



If we focus on the three experimental variables, we see that differences were only found in the continuous feature ($U(10)= 2.500$, $z= -2.108$, $p= .032$), where the control group scored higher than the DLD group (78% and 44%, respectively). No differences were found in the habitual feature ($U(10)= 5.000$, $z= -1.581$, $p= .151$) and in the perfective aspect ($U(10)= 12.500$, $z= .000$, $p= 1$). We should mention at this point that the DLD group's scores on imperfective (habitual and continuous) were below chance level (48% and 44%, respectively). In the perfective aspect, both groups exhibited ceiling effects (see Figure 2).

Figure 2. Accuracy scores (%) on the three conditions of the comprehension task

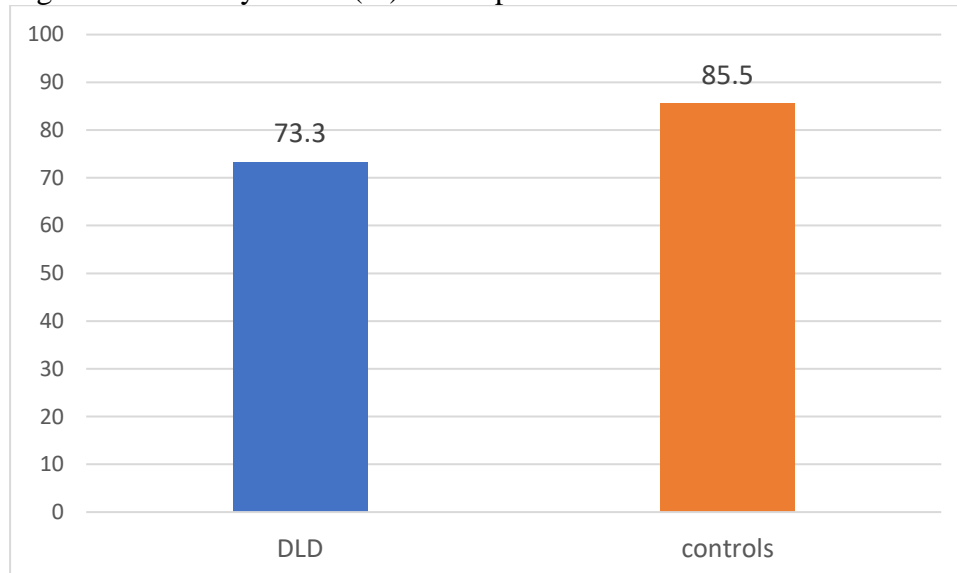


Within group comparisons show that in the DLD group, scores on perfective were higher (100%) than on the habitual (48%) and the continuous (44%) imperfective ($z= -2.032$, $p= .042$; $z= -2.023$, $p= .043$; respectively), as depicted in Figure 2. No differences were detected between the two features of the imperfective ($z= .412$, $p= .680$). Similarly, in the control group scores on the perfective aspect (100%) were higher than on the habitual (72%) and continuous (78%) imperfective ($z= -2.041$, $p= .041$; $z= -2.060$, $p= .039$; respectively). No differences were detected between the two features of imperfective ($z= .756$, $p= .450$).

The production task

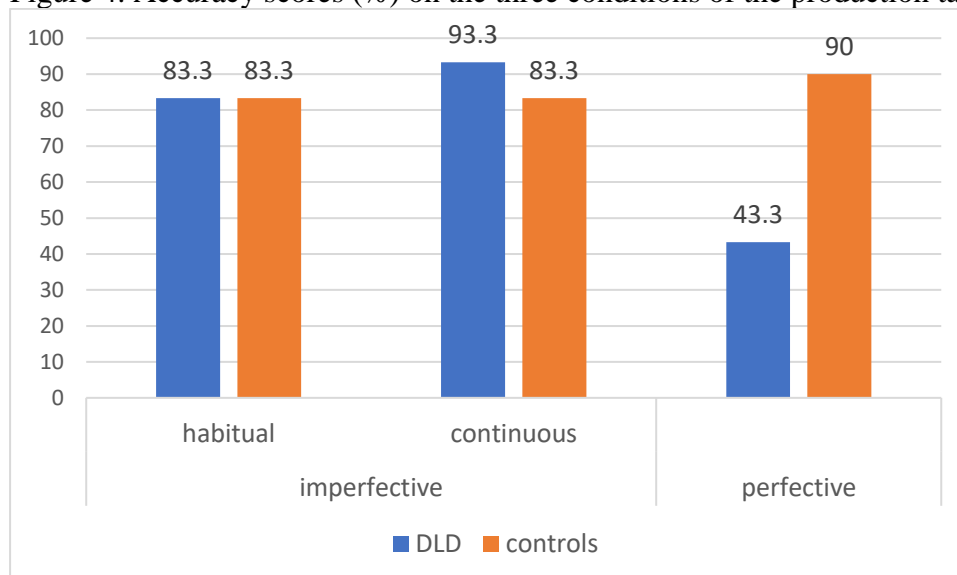
In the production task, differences were detected between the groups ($U(10)= 1.500$, $z= -2.333$, $p= .016$). The control group outperformed the DLD group (85.5% and 73.3%, respectively; see Figure 3).

Figure 3. Accuracy scores (%) on the production task



In the three experimental variables, between group analyses showed that differences only in the perfective aspect ($U(10)= .000$, $z= -2.660$, $p= .008$). Specifically, the control group scored higher than the DLD group (90% and 43.3%, respectively; see Figure 4). No differences were found between groups in the habitual and the continuous features ($U(10)= 12.000$, $z= .110$, $p= 1$ and $U(10)= 6.500$, $z= -1.386$, $p= .222$; respectively).

Figure 4. Accuracy scores (%) on the three conditions of the production task



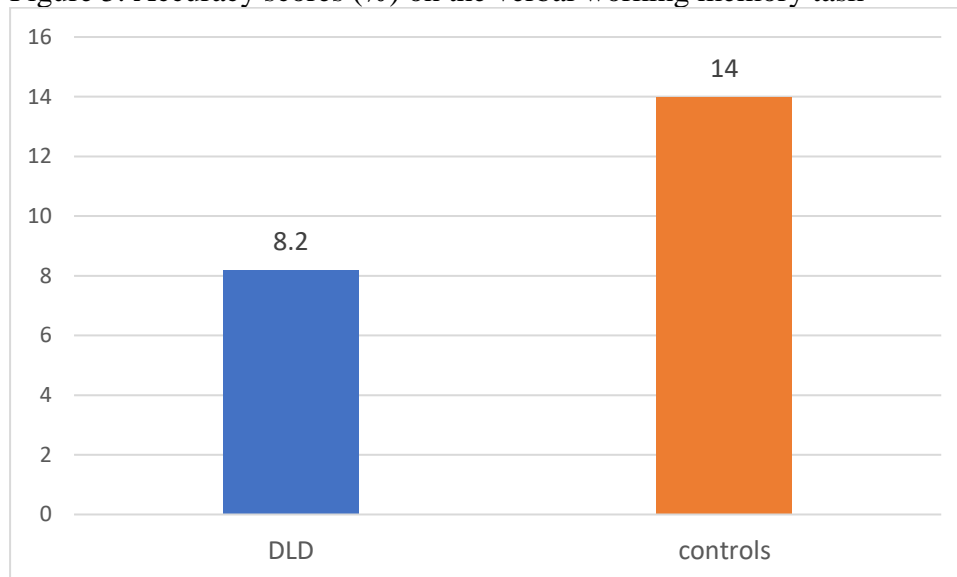
In terms of the three experimental conditions, the DLD group performed very low on the sentences that denoted perfectivity (43.3%), compared to the ones that denote habituality (83.3%) and continuity (93.3%) ($z= -2.032$, $p= .042$; $z= -2.060$, $p= .039$; respectively). No other differences were detected (see Figure 4). By contrast, no differences among the

variables were detected in the control group (habitual-continuous: $z = .000$, $p = 1$; habitual-perfective: $z = .552$, $p = .581$; continuous-perfective: $z = .816$, $p = .414$; see Figure 4).

Verbal working memory task

In the WM task, differences were found between groups ($U(10) = .000$, $z = -2.700$, $p = .008$), where the control group scored higher than the DLD group (in raw numbers: 14.0 and 8.2, respectively; see Figure 5).

Figure 5. Accuracy scores (%) on the verbal working memory task



Correlations between linguistic and cognitive skills

In order to determine the factors that explain the participants' performance on the acquisition of aspect, Pearson's correlations were performed for each group separately, since conceivably the two groups' performance is not affected by the same factors. For the DLD group, the scores on the comprehension task are highly correlated with the scores on the verbal working memory task ($r = .982$, $p = .003$). The scores on the production task are highly correlated with the scores on the non-verbal fluid intelligence ($r = .980$, $p = .003$). Interestingly, no correlations were found in the control group.

DISCUSSION

Summing up the findings of the present study, no differences were found in terms of non-verbal intelligence between the DLD and the control group, which is in line with previous studies findings (Alt et al. 2004, Conti-Ramsden et al. 1997, Gray 2006, Leonard 1998). On the contrary, differences in vocabulary knowledge were manifested between the two groups (Conti-Ramsden et al. 1997, Leonard 1998). Apart from the vocabulary scores, they two groups performed differently in the acquisition of aspect (as reported in other studies, Dosi et al., 2018). Hence, the control group outperformed the DLD group both in the comprehension and in the production task, similar to previous studies (Konstantzou 2015, Konstantzou et al. 2013). Differences were also detected in terms of their verbal working memory skills. Thus, the control group outperformed the DLD group (Gathercole & Baddeley 1990, 1993, Montgomery 2002).

With respect to the two features of aspect in each task, the results are different, conceivably, depending on the methodology used (Dosi 2016, 2017, Dosi et al. 2018). In the comprehension task, between-group comparisons have exhibited differences only in the continuous feature. The finding is not in line with the majority of the previous studies, where the habitual feature is normally more problematic than the continuous one (Papadopoulou 2005). However, at this point we should bear in mind that both in habitual and continuous features the scores of the DLD group were below chance level (48% and 44%, respectively), whereas in the control group the performance was higher (72% and 78%, respectively). Additionally, the participants were few and there were high standard deviations in both groups. By contrast, the perfective aspect was fully acquired by all participants, by both groups, since the standard deviations were really low. The results corroborate previous studies (Dosi & Koutsipetsidou 2019, Dosi et al. 2016, Konstantzou 2015, Konstantzou et al. 2013).

In the production task, between-group comparisons show that the DLD fared worse only in the perfective aspect, where they scored below chance level (43%). The results do not agree with those of previous studies (Konstantzou 2015, Konstantzou et al. 2013). Notwithstanding, we should note that in the aforementioned studies static pictures were used, which leverage the use of perfective aspect (Dosi 2016, Dosi et al. 2018). Moreover, the difficulties participants face with the use of perfective aspect might be due to the fact that the perfective aspect requires more morpho-phonological changes (see also Nicoladis & Paradis 2012). Hence, they, conceivably, use the less demanding morphological marking, since, without any visual cues, they should store and update the sentence in order to process it and choose the correct aspectual form (cognitive limitations). However, the finding remains open for further research.

Within-group comparisons have shown that in the comprehension task both groups performed better in the perfective aspect, compared to the imperfective one (similar to, Dosi 2016, Dosi et al. 2016, Papadopoulou 2005, Shirai 2002). This might have stemmed from the fact that the stories were presented by means of static pictures, as mentioned before (Dosi et al. 2016). However, we should point out that the scores in the DLD group were lower (see above) and the standard deviations were higher. In the production task, in the DLD group, the scores on the perfective aspect were lower compared to both features of the imperfective aspect. As noted above, the result might be due to the morpho-phonological changes (Nicoladis & Paradis 2012) that the imperfective requires and the updating skills that the task requires. In the production task, no differences were detected in the control group. The result strengthens the argument that the cognitive skills affect the linguistic ones only in the DLD group and not in typical development (similar to previous studies, Dosi & Koutsipetsidou 2017, Gathercole & Baddeley 1990a, 1990b, 1993).

Deviant performance of the DLD group in the verbal working memory task is in line with the results of previous studies (Gathercole & Baddeley 1990a, 1990b, 1993, Montgomery 2002). Correlations between linguistic and cognitive abilities were significant only in the DLD group and not in the control group (similar to other studies, Tsimpli et al. 2016, Dosi & Koutsipetsidou 2017, 2019). Therefore, regarding aspectual marking, problem solving abilities seem to enhance the performance of children with DLD; on the other hand, in the comprehension task working memory skills are necessary, in order to update the story and to choose the appropriate aspectual feature (similar to Dosi 2016, Dosi et al. 2016).

CONCLUSIONS

All in all, aspectual asymmetries are not the same across groups (DLD and typical development) and across tasks (comprehension and production). The habitual feature has not been found to be problematic either for the DLD or the control group, finding that is opposite to previous studies and needs further research. The performance on the two tasks seems to be methodologically dependent (as other studies indicate, Dosi et al. 2018). Interestingly, linguistic and cognitive skills seem to highly correlate only in DLD and not in typical development. From our findings, we may conclude that the limited cognitive abilities of the children with DLD hamper the normal development of the linguistic abilities.

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