Participant Performance on Additional Instruments

Measures administered during the testing session, but not included in the confirmation and classification of group membership, are as follows.

We obtained measures of phonological processing and verbal working memory as supporting skills to spoken language processing. Phonological processing was assessed using the Elision, Blending, and Nonword Repetition subtests of the Comprehensive Test of Phonological Processing (CTOPP; Wagner et al., 1999) at the University of Connecticut (UCONN), and CTOPP-2 (Wagner et al., 2013) at the University of Delaware (UD). The Digit Span Forward, Digit Span Backward, and Digit Span Sequencing subtests of the Wechsler Adult Intelligence Scale (WAIS-IV; Wechsler, 2014) were administered to measure verbal working memory.

We obtained measures of reading comprehension and reading fluency to characterize the literacy abilities in all participants. Reading comprehension was assessed through the Passage Comprehension subtest of the Woodcock Reading Mastery Tests–Third Edition (WRMT-III; Woodcock, 2011). Reading fluency was measured using the Sentence Reading Fluency subtest of the Woodcock-Johnson Tests of Achievement–Third Edition (WJ-III; Woodcock et al., 2001). We also obtained measures of rapid automatized naming using the Letters, Numbers, and 2-Set subtests of the Rapid automatized naming and rapid alternating stimulus tests (RAN/RAS; Wold & Denckla, 2005).

Finally, for all participants, we obtained measures of nonverbal cognitive ability and executive function. Nonverbal cognition was measured by the Block Design and Matrix Reasoning subtests of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) at UCONN, and the Wechsler Abbreviated Scale of Intelligence-II (WASI-II; Wechsler, 2011) at UD. Executive function ability was measured using the Behavioral Regulation Index for Executive Function–Adult (BRIEF-A; Roth et al., 2005).

Means and standard deviations of performances on the above measures by group are presented in **Table S1**.

Relationships Between Experimental Measures of Memory and Language-Related *Functions*

The findings presented in the main manuscript describe group-level differences in procedural and declarative memory function in adults with and without DLD. However, it is unclear if differences in memory skills continue to inform language-related functions in adulthood, after language abilities have matured. Therefore, in the following analyses, we explored the predictive value of memory performance on individual differences in performance on the measures that comprise the index by which DLD is identified, according to the method described by Fidler et al. (2011, 2013). In other words, the analyses below are not concerned with group differences, but with individual differences on the skills that determine whether or not the individual is identified as having DLD or not. Therefore, the analyses below are carried out over all participants.

Spelling

First, we conducted a linear regression analysis with the raw scores on the spelling test as the dependent variable, with the scaled procedural and declarative memory scores obtained shortly after learning (Day 1). The model significantly accounted for performance on the spelling test ($F(2,96) = 4.26$, $p = .017$, $r^2 = .08$), with procedural memory performance accounting for the significant portion of variance ($EST = 4.47$, $SE = 1.54$, $t = 2.91$, $p = .005$, $r^2 = .08$), after accounting for declarative memory performance ($EST = -1.15$, $SE = 2.69$, $t = -.43$, $p = .670$, $r^2 =$

.02). We then conducted a second linear regression analysis on the spelling test scores, with the scaled procedural and declarative memory scores obtained after a 12-hour delay (Day 2) as the two predictors. This model did not significantly account for spelling performance, $F(2,96) = 1.41$, $p = .250$, $r^2 = .03$.

In order to ensure that the observed relationship between procedural memory and Spelling ability did not reflect group effects, we performed the same analysis as above on the subset of TD participants' data. We observed a similar pattern of results, Day 1 procedural memory: $EST = 3.19$, $SE = 1.61$, $t = 1.990$, $p = .050$, $r^2 = .05$; Day 1 declarative memory: $EST = -.45$, $SE = 2.47$, $t = -.182$, $p = .856$, $r^2 < .01$; Day 2 not significant.

Modified Token Test

We conducted another linear regression analysis with the raw scores on the modified token test as the dependent variable, with the Day 1 scaled procedural and declarative memory scores as predictors. This model did not significantly account for token test performance, $F(2,96) = .98$, $p = .378$, $r^2 = .02$. We then regressed the modified token test scores with the scaled procedural and declarative memory scores obtained on Day 2. This model accounted significantly for modified token test performance, $F(2,96) = 12.63$, $p < .001$, $r^2 = .21$, with declarative memory performance accounting for a significant portion of the variance, $EST = 14.82$, $SE = 2.95$, $t = 5.02$, $p < .001$, $r^2 = .21$, after accounting for procedural memory performance, $EST = -.44$, $SE = 2.37$, $t = -.19$, $p = .852$, $r^2 < .01$.

Again, in order to ensure that the observed relationship between declarative memory and token test ability did not reflect group effects, we performed the same analysis as above on the subset of TD participants' data. We observed a similar pattern of results, Day 1 not significant; Day 2 procedural memory: $EST = 4.11$, $SE = 2.57$, $t = 1.600$, $p = .113$, $r^2 = .05$; Day 2 declarative memory: $EST = 8.68$, $SE = 2.91$, $t = 2.92$, $p = .004$, $r^2 = .105$.

Summary

Taken together, it appears that procedural and declarative memory are significantly predictive of performance on both measures that comprise the index by which DLD is identified in adulthood according to Fidler et al. (2011, 2013). Specifically, individual differences in procedural memory performance assessed on Day 1 is predictive of performance on the spelling test, and individual differences in declarative memory performance assessed on Day 2 is predictive of performance on the modified token task. This may suggest that individual differences in initial procedural learning, and declarative memory following a period of sleep-mediated consolidation, contribute to different weaknesses in individuals with DLD.

The specific relationships that were observed between procedural and declarative memory, as well as the timing of these associations, are interesting and warrant further discussion. First, Spelling was associated with procedural memory, but not declarative memory. The component skills of spelling ability are complex, however there is a reasonable degree of consensus that phonological awareness is a core component (Caravolas, 2006). Procedural learning has been previously associated with better outcomes for forming speech sound representations (Chandrasekaran et al., 2014), and thus the relationship observed here between spelling and procedural memory may be an indirect index of phonological awareness, mediated by the quality of speech representations. It is important to point out however that the retention of procedural learning was not associated with spelling ability. Thus, an alternative interpretation may be that spelling and procedural learning may share some aspect of processing that is required by the two tasks, such as the prediction of the following elements in a sequence.

In contrast, performance on the token task was associated with declarative memory following a 12-hour delay, but not when assessed shortly after learning. Performance on declarative memory recall after a period of overnight consolidation reflects one's ability to access long-term knowledge, as may be applicable for accessing lexical representations (e.g., Dumay & Gaskell, 2003). Therefore, the observed association with the token task may reference individual differences in the ability to rapidly recall long-term linguistic representations during spoken language processing.

While a full investigation into the precise mechanisms underlying the above relationships is beyond the scope of the current paper, that differences in procedural and declarative memory performance predict language abilities in adults is an interesting insight. Specifically, the influences of memory system function may extend beyond initial learning, to the processing of information, after language development has already taken place. This preliminary look at the relationships between memory and language abilities in adulthood warrant further investigation in the future.

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Table S1
Raw Performance on Standardized Test Scores

Construct		Site	TD *n* = 71	DLD *n* = 21
Phonological Processing	*Elision*	UCONN	18.72(.89)	18.22(.67)
		UD	31.09(1.51)	28.75(3.67)
	Blending	UCONN	17.06(2.11)	17(2.06)
		UD	28.84(2.67)	27.25(2.80)
	Nonword Repetition	UCONN	14.31(1.91)	13.56(1.94)
		UD	20(2.15)	20.08(2.19)
Verbal Working Memory	*Digit Span Forwards*		11.73(2.22)	10.7(2.45)
	Digit Span Backwards		9.38(2.20)	8(1.56)
	Digit Span Sequencing		8.83(1.66)	8.15(1.42)
	Reading Comprehension		31.01(4.28)	28.24(4.18)
	Reading Fluency		89.31(8.76)	82.26(14.93)
Rapid Automatized Naming	*Letters*		17.28(3.18)	18(4.16)
	Numbers		16.87(3.06)	18.19(4.79)
	2-Set		18.47(3.23)	20.19(4.64)
Nonverbal Cognition	*Block Design*	UCONN	53.19(12.55)	51.89(7.74)
		UD	47.94(9.84)	44.08(10.89)
	Matrix Reasoning	UCONN	27.94(3.61)	26.89(2.94)
		UD	22.49(2.39)	21(3.52)
Executive Function	*Behavioral Regulation Index*		41.46(6.78)	41.62(6.08)
	Metacognition Index		57.45(9.24)	57.62(9.26)
	Global Executive Composite		97.84(17.64)	99.24(14.12)

Table S1 presents means and standard deviations of scores obtained on various language and cognitive tests by Group. All values are expressed in raw scores across the various subtests.