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Supplementary Materials for

Stability of core language skill from infancy to adolescence in typical and atypical development

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Study 1 Supplementary Text

Child Language

Childhood language skills contribute to performance in a variety of domains because of their direct role in cognition and their consequences for behavioral adjustment (*23*). Early language skills predict, for example, domains of development such as spatial skills (*83, 84*), memory (*85-87*), theory of mind (*88-91*), and internalizing and externalizing behavioral adjustment *(5, 6)*.

Developmental Stability

As explained in Bornstein and Putnick (*92*), the study of individual developmental stability is important for several reasons. First, findings of stability indicate the overall developmental course of a given characteristic. Whether children maintain their order in language skill over development informs about individual variation and contributes to understanding more about the origins, nature, and future of the language skills (*93, 94*). Past cognitive performance is often the best predictor of future cognitive performance (*36*). Two additional reasons that understanding stability is important are that child characteristics – especially stable ones –affect the child's environment and they signal developmental status to the child and to others (*95*). Children judge themselves and are judged by others on their language skills, and children's vocalizations and words used during social interactions have been employed to quantify how children socialize with others (*96-98*). Furthermore, conversational partners often adjust to match another's consistent characteristics. Specifically, mothers adjust the semantic and syntactic aspects of their language to match their children's level of language *(99-102)*, and the mean length of mothers' utterances correlates with the mean length of their young children's utterances (*103*). Last, some degree of stability is required to ensure that a construct constitutes a suitable individual-differences measure (*104*). Hence, behavioral scientists are broadly interested in developmental stability.

Language Stability

Estimates of language stability vary with the domain and measure; the method, source, and context; the age of the child; and the temporal interval between assessments. Language stability also varies with caregiving experience. Most studies of developmental stability generally, and language stability specifically, do not take complementary endogenous or exogenous factors into consideration to rule out sources of stability alternative to the construct under investigation (here language) and to assign stability more unambiguously to the child.

Latent Variables in Language

Latent variables (LVs) rely on empirical covariation among their indicators and capitalize on the variance that those indicators share. Latent variables are purer representations of the underlying construct because they remove unshared (unique) variance of the indicators. Employing multiple measures (observations, reports, and tests) overcomes shortfalls associated with reliance on any single source. Multiple assessments also represent individuals better than do single assessments, and converging operations are necessary to demonstrate that inferred capacity is not simply an

artifact of a given procedure. Here, we examined stability of multiple language measures at each of 11 ages between infancy and adolescence. The use of latent variables therefore allows measurements of language to vary appropriately over time (as the manifestation does) but maintains comparability of the underlying construct across time, a prerequisite to stability assessment. As multimeasure, multivariate, multisource data take more different aspects of language into account, their shared latent variance provides a more comprehensive and therefore richer picture of language; the procedure has the added advantage that variance uniquely associated with rater bias, random measurement error, or specific error (error variance arising from some characteristic unique to a particular indicator that was not accounted for by the factor) is relegated to the residual term of the latent variable allowing more stable and more accurate estimates of the core language skill. Latent variables are therefore purer representations of constructs, so stability relations in the common variance can be assessed with greater precision to improve the stability of estimates *(15)*.

Extant evidence in the child language literature supports covariation among measures. In one multimethod approach, principal components analysis of five diverse language measures yielded a single factor that accounted for 65% of their common variance *(32)*. In a second, seven assorted measures of language intercorrelated and constituted a general factor of language *(30)*. In a third, analysis of nine distinct language measures yielded a general factor that accounted for 30% of the total variance (*34*). In a fourth, items reflecting sundry language components were examined at four time points across the age range of 6-14 years; at each wave, evidence of a dominant single factor emerged (*33*).

Study 1: Long-term Language Stability in Typical Development

Study 1 Materials and Methods

Participants

The ALSPAC study website contains details of all data that are available through a fully searchable data dictionary (http://www.bris.ac.uk/alspac/researchers/data-access/data-dictionary). Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committee.

Language Assessments

Under 1 year. At age 6 months, the "communication" scores from the ALSPAC-modified Denver Developmental Screening Test (*55*; hereinafter referred to as modified DDST) were used. It is a summary score from 8 items (e.g., "Turns toward someone when they are speaking.") to which the caregivers answered 0 = "not started yet," 1 = "once or twice," or 3 = "often."

Year 1. At age 1 year 3 months, the understand, vocabulary, and social (non-verbal) communication scores on the ALSPAC-modified MacArthur Communication Development Inventories (*10, 11*; hereinafter referred to as modified MCDI) Words and Gestures were used. The scale "understand" includes 12 items which are answered "Yes" or "No" (e.g., "Be quiet.", "Sit down.") by caregivers to indicate if the child understood those phrases. Vocabulary was the summary score from a list of 134 words to which the caregivers answered 0 = "neither," 1 = "understands," or 2 = "understands and says." Social communication was the summary score

from 10 items (e.g., “Waves bye-bye on her own when someone leaves”) to which caregivers answered 0 = “not yet,” 1 = “sometimes,” or 2 = “often.” At age 1 year 6 months, the “communication” scores from the modified DDST were used. It is a summary score from 14 items (e.g., “Child says 'dada' and 'mama' and knows what they mean.”) to which caregivers answered 0 = “not yet started,” 1 = “done it 1-2 times,” or 2 = “yes, can do well.”

Year 2. At age 2 years, the vocabulary, grammar, plurals, and tense scores on the modified MCDI Words and Sentences were used. Vocabulary was the summary score from a list of 123 words to which caregivers answered 0 = “neither,” 1 = “understands,” or 2 = “says.” Grammar was the summary score from 4 items (e.g., “To talk about more than one thing, we add an ‘s’ to many words. For example, cars, shoes, dogs, and keys. Has your child begun to do this?”) to which caregivers answered 0 = “not yet,” 1 = “sometimes,” or 2 = “often.” Plurals were summary scores from 5 irregular plural nouns (e.g., “children,” “mice”) to which caregivers answered 0 = “neither,” 1 = “understands,” or 2 = “says.” Past tense was the summary score from 20 past tense verbs (e.g., “ate,” “blew”) to which caregivers answered 0 = “neither” 1 = “understands,” or 2 = “says.”

Year 3. At age 3 years 2 months, the vocabulary, plurals, past tense, and word combination scores on the modified MCDI Words and Sentences were used. Caregivers responded 0 = “not at all,” 1 = “understands,” or 2 = “says” to indicate the use of words by their children. Vocabulary was the summary score from a list of 123 words. Plurals were the summary scores from 6 items (e.g., asked if the child uses and/or understands “feet,” “men”). Past tense was the summary score from 21 items (e.g., asked if the child “adds ‘ed’ to verbs,” uses and/or understands “ate”). Word combination was derived from a list of 12 two- and three-word phrases.

Results

Study 1 Measurement Models

Before evaluating stability, measurement models were fit for each year of age except the 6-month and 13- and 15-year age points when only one observed variable at each was obtained. The 2-, 5-, and 9-year measurement models required one or two error covariances to account for shared source/test variance. Measurement models were fit at each age except the 6-month and 13- and 15-year measures where only one observed variable was obtained at each age. The year 9 measurement model required one error covariance to account for shared source/test variance. Good measurement models were achieved for all years, with indicators of child language that loaded significantly on their factors at each age, robust CFI ranged from .98 to 1, SRMR ranged from .01 to .03, and RMSEA ranged from .04 to .09. Good measurement models were achieved for all years, with indicators of child language that loaded significantly on their factors at each age, robust CFI = .99 or 1, SRMR ranged from .00 to .02, and RMSEA ranged from .00 to .07. To obtain stability estimates across ages, an *a priori* model in which all language indicator variables loaded on their respective factors (along with 4 source/test covariances we added to the measurement models), and each language latent/observed variable as a function of the immediately preceding language latent/observed variable was hypothesized and tested. Finally, the language stability model was reassessed controlling multiple covariates. General covariates were included as observed variables in the model, and specific covariates were controlled by removing shared variance in the relevant language indicators before fitting the model.

Study 2: Long-Term Language Stability in Typical and Atypical Development
Study 2 Supplementary Text

Risk status may have implications for stability in language development based on existing evidence of mean differences in language performance in children diagnosed with diverse biological risks.

Language in children born preterm. Worldwide, more than 15 million infants are born prematurely every year. As survival rates for preterm infants have risen as the result of improvements in obstetrics and neonatology, preterm birth has emerged as a risk factor for poor development in an increasing proportion of the population. According to guidelines from the World Health Organization *(105),* preterm birth can be subdivided into very preterm (births before 32 weeks' gestation), moderate preterm (births at 32 and 33 weeks' gestation), and late preterm (births between 34 and 36 weeks' gestation). Language skills are impaired in children born very preterm; however, findings regarding mean differences in language are less consistent for moderate-late preterm compared with term-born children. Very preterm children have the poorest language skills, followed by moderate-late preterm and full-term children, and there is some evidence that stability is stronger in very preterm children than term children (*25*).

Language in children with dyslexia. Many neurodevelopmental disorders include deficits in language and communication skills in their diagnostic criteria, notably dyslexia (*106*). Developmental dyslexia is a severe reading disorder, characterized by dysfluent reading and impaired automaticity of visual word processing. Commonly, children with dyslexia are impaired on multiple dimensions of language, including, but not limited to, phonological processes (*107, 108*), acquiring the foundations of decoding skills (letter knowledge, phonological awareness, reading skills, and rapid automatized naming; *109*), speech perception and production (*110*), word formation and learning (*111, 112*), auditory processing (*113*), problems with subject-verb agreement (*107*), and receptive vocabulary (*114*). There are substantial genetic components in dyslexia with a risk gene *MRPL19* (*115*). Also, identified dyslexics have reduced gray matter volume in left-hemisphere middle temporal, occipital, and frontal regions. Alterations in middle temporal cortex in children with a retrospective report of early language delay are observed regardless of familial risk for dyslexia (*116*). Impaired reading is associated with atypical white matter microstructure in left inferior frontal gyrus (LIFG) and left temporo-parietal regions (*117*). Although there are longitudinal studies of language in children with dyslexia (*114*, *118),* the focus to date has been on mean-level performance and not on stability.

Language in children with ASD. Autism spectrum disorders (ASD) is a neurodevelopmental disorder that includes deficits in language and communication skills (*115*). Children with ASD show significant impairments on multiple dimensions of language compared to children with typical development (*119*), and so delayed language development may be an early indicator of ASD (*120*). Impairments include, but are not limited to, higher social communication (*121*), intact statistical learning abilities, subtle weaknesses in fast-mapping abilities (*122*), pragmatic language (*123, 124*), poorer expressive language (*125*), weak central coherence (processing details over gist), poor oral language abilities, poor suppression, semantic interference, and poor comprehension monitoring. All impairments affect reading

comprehension in individuals with ASD (*126*) and delayed production of wh-questions (*127*), semantic integration (*128*), syntax and morphology, and vocabulary (*129*), reading comprehension difficulties leading to academic disadvantage (*130*), meaning-related emergent literacy skills (*130*), and pragmatic aspects of language (*131*). ASD symptoms have high stability (*132*) and although there are longitudinal studies of language in children with ASD (*133, 134*), the focus has been on mean-level performance and not on stability.

Language in children with a hearing impairment. Hearing children avail themselves of two key sources of information when acquiring language; the speech of others and auditory feedback from their own speech. Unlike hearing children, hearing impaired or deaf children do not have full access to similar communicative information and tend to fall behind hearing children in language and literary skills *(135).* Nonetheless, language acquisition is generally believed to follow the same general course of development among deaf children acquiring sign language(s) as among hearing children acquiring spoken language *(136-138*). Deaf children of hearing parents typically manifest language delays and deficiencies (*137, 139-143*). Controlling for child age and mother education, as well as hearing in signed words. Bornstein et al. (*144*) found that deaf children of hearing mothers had fewer words than hearing children of hearing or deaf mothers, and deaf children of deaf mothers had fewer words than hearing children of hearing mothers. The two groups of deaf children also had lower Reynell Comprehension and Expressive Scale scores than did the two groups of hearing children.

Participants

Fifty-nine children fell into multiple at-risk groups. Because only 2.6% of the ALSPAC sample was non-White, and this group was heterogeneous (0.9% Asian, 1.0% Black, and 0.7% other), we focused on the majority group. From the 12,075 White European participants in the ALSPAC data, we selected the 11,756 children who were reported as singleton births, and we excluded children who were bilingual or spoke a language other than English as the main language, resulting in 11,482 children. An additional 925 children were excluded because they were in the CiF cohort and had already participated in Study 1. Of the remaining 10,557 children, 10,044 children provided data at one or more waves over 15 years. An additional 4,877 children were excluded because they had missing data on the variables (gestational weeks, dyslexia, autism, and hearing impairment) that we used to categorize children into control and comparison groups.

Table S1. Study 1: Child language measures and covariates: Descriptive statistics.

	M(SD)	*Range*
Child Language		
6 months		
Modified DDST Communication skills	16.09 (2.63)	6-24
Year 1		
Modified MCDI Understand score	9.31(2.38)	0-12
Modified MCDI Vocabulary score	89.62 (40.93)	0-268
Modified MCDI Social Communication	13.84 (3.18)	0-20
Modified DDST Communication	15.89 (4.55)	2-28
Year 2		
Modified MCDI Vocabulary	151.50 (53.92)	1-246
Modified MCDI Grammar	3.37 (2.47)	0-8
Modified MCDI Plurals	5.77 (2.43)	0-10
Modified MCDI Tense	12.58 (11.30)	0-40
RDLS Comprehension	24.37 (8.34)	0-51
Year 3		
Modified MCDI Vocabulary	228.52 (31.25)	0-246
Modified MCDI Plurals	10.10 (2.22)	0-12
Modified MCDI Past Tense	33.41 (10.24)	0-42
Modified MCDI Word Combination	22.29 (4.62)	0-26
Year 4		
WPPSI Information	10.85 (3.03)	2-18
WPPSI Comprehension	10.15 (2.72)	4-19
WPPSI Vocabulary	10.04 (2.92)	3-19
WPPSI Similarity	9.61 (2.43)	3-19
Year 5		
RDLS Comprehension	60.92 (4.16)	20-67
Bus Story: Information score	27.64 (11.16)	1-51
Bus Story: Sentence Length	9.48 (2.53)	3-20
Initial Consonants Detection Test	8.34 (2.05)	1-10
Year 7		
WOLD Reading	28.87 (8.70)	3-52
WOLD Spelling	8.32 (4.19)	0-15
Phoneme deletion Task	20.75 (9.22)	0-39
Year 8		
WISC Information	12.05 (3.08)	4-24
WISC Comprehension	16.83 (4.39)	0-30
WISC Vocabulary	23.91 (8.04)	0-46
WISC Similarities	14.03 (4.91)	0-29
WOLD Comprehension	7.60 (2.00)	2-15
WOLD Expressive Vocabulary	7.55 (1.76)	0-10
Year 9		
WOLD Word Reading	7.87 (2.22)	0-10
WOLD Non-real Word Reading	5.44 (2.44)	0-10

	M(SD)	*Range*
NARA II Accuracy	68.95 (19.06)	8-99
NARA II Comprehension	26.04 (7.31)	2-41
Year 13		
TOWRE Words	83.13 (10.23)	27-104
TOWRE Non-real Words	51.93 (8.88)	10-63
Year 15		
WASI Vocabulary	44.27 (9.87)	4-66
Covariates		
Child Non-verbal IQ		
Year 4 WPPSI Performance IQ	108.61 (14.58)	55-151
Year 8 WISC Performance IQ	99.98 (16.45)	52-140
Year 15 WASI Matrix Reasoning	24.66 (7.26)	7-76
Child Sociability		
6-month DDST Social Skills	16.80 (4.44)	5-30
Year 1 DDST Social Achievement	18.90 (3.80)	0-28
Year 2 DDST Social Achievement	18.71 (3.65)	0-26
Year 3 EAS Sociability	18.10 (3.04)	6-25
Year 4 EAS Sociability	18.13 (2.49)	9-25
Year 5 EAS Sociability	18.08 (2.41)	11-25
Maternal age	29.26 (4.48)	14-43
Maternal Education (%)		
Certificate of Secondary Education	13.0	
Vocational	10.8	
O level	35.2	
A level	25.9	
University Degree	15.1	

Table S2. Study 2: Sample size and child age at each data collection wave.

	Control		Moderate-late Preterm		Very Preterm		Dyslexia		Autism		Hearing Impaired	
Data Collection Wave	*N*	*Child Age M (SD)*	*N*	*Child Age M (SD)*	*N*	*Child Age M (SD)*	*N*	*Child Age M (SD)*	*N*	*Child Age M (SD)*	*N*	*Child Age M (SD)*
1	3818	6.40 (0.83)	379	6.63 (1.17)	43	6.63 (1.25)	300	6.42 (0.82)	82	6.34 (0.58)	204	6.36 (0.71)
2	3933	1.28 (0.07)	384	1.29 (0.07)	47	1.30 (0.13)	307	1.27 (0.05)	85	1.27 (0.05)	213	1.27 (0.04)
3	3960	1.51 (0.06)	380	1.52 (0.05)	47	1.52 (0.06)	313	1.52 (0.05)	83	1.51 (0.04)	214	1.52 (0.08)
4	3898	2.03 (0.08)	365	2.04 (0.09)	45	2.04 (0.13)	306	2.03 (0.07)	85	2.03 (0.07)	207	2.03 (0.07)
5	3862	3.20 (0.09)	350	3.22 (0.15)	42	3.22 (0.12)	305	3.20 (0.09)	83	3.20 (0.10)	210	3.19 (0.07)
6	3698	7.47 (0.16)	272	7.50 (0.22)	29	7.52 (0.17)	271	7.47 (0.17)	55	7.47 (0.12)	192	7.47 (0.15)
7	3708	8.59 (0.24)	262	8.61 (0.28)	30	8.63 (0.22)	260	8.61 (0.23)	48	8.61 (0.22)	196	8.64 (0.29)
8	4098	9.83 (0.30)	267	9.89 (0.35)	28	9.88 (0.30)	258	9.85 (0.28)	48	9.93 (0.34)	218	9.85 (0.31)
9	2883	13.82 (0.18)	192	13.83 (0.20)	24	13.87 (0.20)	188	13.83 (0.21)	43	13.82 (0.30)	146	13.84 (0.18)
10	2755	15.42 (0.27)	180	15.44 (0.30)	21	15.40 (0.28)	173	15.42 (0.27)	38	15.45 (0.26)	149	15.43 (0.33)

Note. N represents number of available observations. Except for the wave 1 (child ages in months), child ages are in years.

Table S3. Study 2: Child language measures and covariates: Descriptive statistics.

	Control		Moderate-late Preterm		Very Preterm		Dyslexia		Autism		Hearing Impaired	
	M (SD)	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*
Child Language[a]												
6 months												
DDST Communication skills	16.18 (2.65)	3-24	15.67 (2.65)	5-24	14.12 (3.97)	0-21	16.24 (2.50)	8-24	16.02 (2.43)	10-22	16.37 (2.83)	6-24
Year 1												
MCDI Understand score	9.20 (2.41)	0-12	8.44 (2.62)	0-12	7.28 (3.35)	0-12	8.72 (2.68)	0-12	7.31 (3.49)	0-12	8.91 (2.48)	0-12
MCDI Vocabulary score	88.39 (43.38)	0-268	77.13 (42.79)	0-232	60.89 (44.12)	0-154	82.77 (40.39)	0-213	62.13 (42.21)	1-180	80.66 (42.73)	5-216
MCDI Social Communication	14.00 (3.21)	0-20	13.07 (3.35)	0-20	10.00 (4.85)	0-18	13.65 (3.25)	2-20	11.33 (4.39)	0-20	13.97 (3.26)	4-20
DDST Communication	16.05 (4.57)	1-28	14.25 (4.49)	1-26	12.68 (6.29)	0-28	15.50 (4.71)	2-28	11.84 (5.44)	0-28	15.17 (4.76)	2-26
Year 2												
MCDI Vocabulary	157.77 (53.88)	0-246	136.88 (54.28)	1-246	110.11 (63.06)	7-246	150.85 (49.88)	20-246	108.02 (61.54)	7-234	142.19 (55.05)	11-246
MCDI Grammar	3.63 (2.56)	0-8	2.78 (2.39)	0-8	2.11 (2.65)	0-8	3.14 (2.48)	0-8	1.75 (2.40)	0-8	2.95 (2.54)	0-8
MCDI Plurals	5.86 (2.52)	0-10	5.32 (2.47)	0-10	4.67 (2.80)	0-10	5.77 (2.34)	0-10	3.88 (2.86)	0-10	5.38 (2.46)	0-10
MCDI Tense	13.60 (11.87)	0-40	10.26 (10.35)	0-40	8.09 (10.65)	0-38	11.97 (10.43)	0-40	7.06 (9.51)	0-40	11.30 (11.22)	0-40
Year 3												
MCDI Vocabulary	231.97 (24.76)	0-246	225.59 (36.41)	0-246	225.64 (42.46)	40-246	229.42 (27.73)	87-246	179.14 (75.55)	0-246	225.12 (35.30)	41-246
MCDI Plurals	10.32 (2.05)	0-12	10.01 (2.32)	0-12	9.90 (2.47)	0-12	9.96 (2.30)	0-12	7.59 (3.76)	0-12	9.63 (2.75)	0-12
MCDI Past Tense	34.07 (9.70)	0-42	32.36 (11.61)	0-42	32.05 (12.43)	0-42	32.76 (10.50)	0-42	20.04 (15.89)	0-42	32.60 (11.27)	0-42
MCDI Word Combination	22.68 (4.41)	0-26	21.55 (5.41)	0-26	20.95 (6.50)	0-26	22.24 (4.23)	4-26	18.06 (7.47)	0-26	21.59 (5.80)	0-26

	Control		Moderate-late Preterm		Very Preterm		Dyslexia		Autism		Hearing Impaired	
	M (SD)	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*
Year 7												
WOLD Reading	29.51 (8.67)	0-50	27.00 (9.22)	2-48	26.72 (10.06)	9-42	18.97 (8.28)	0-44	23.81 (11.51)	0-44	27.61 (9.49)	5-48
WOLD Spelling	8.28 (4.24)	0-15	7.04 (4.33)	0-15	6.67 (4.96)	0-15	3.43 (2.93)	0-15	6.81 (4.39)	0-15	7.75 (4.39)	0-15
Phoneme deletion Task	21.02 (9.18)	0-40	18.45 (9.32)	0-40	18.90 (10.99)	1-37	13.17 (8.55)	0-38	15.43 (11.36)	0-36	19.01 (9.23)	1-38
Year 8												
WISC Information	12.17 (3.09)	0-26	11.63 (3.13)	4-22	11.00 (2.21)	8-16	10.55 (3.07)	4-30	10.54 (4.42)	0-20	11.56 (3.03)	6-22
WISC Comprehension	17.35 (4.72)	0-34	17.14 (5.28)	4-30	16.60 (4.14)	4-26	16.75 (4.86)	4.32	14.79 (5.38)	0-24	16.90 (5.02)	2-28
WISC Vocabulary	23.74 (7.79)	0-48	22.98 (8.05)	0-46	23.33 (6.81)	12-38	22.45 (7.74)	0-44	21.41 (9.05)	0-40	22.25 (7.96)	0-48
WISC Similarities	14.09 (4.81)	0-33	13.84 (4.97)	0-29	13.87 (3.39)	9-21	13.64 (4.42)	0-27	12.37 (5.79)	0-25	13.52 (5.19)	0-29
WOLD Comprehension	7.54 (1.90)	2-15	7.45 (1.86)	3-13	7.47 (2.19)	3-12	7.59 (1.90)	2-13	6.65 (2.76)	2-12	7.27 (2.04)	2-14
WOLD Expressive Vocabulary	7.56 (1.81)	0-10	7.37 (1.77)	1-10	7.60 (1.52)	4-10	7.25 (1.84)	1-10	6.53 (2.39)	0-10	7.15 (1.81)	0-10
Year 9												
WOLD Word Reading	7.78 (2.27)	0-10	7.27 (2.59)	0-10	7.46 (2.63)	1-10	5.13 (2.89)	0-10	6.56 (3.29)	0-10	7.42 (2.47)	0-10
WOLD Non-real Word Reading	5.45 (2.43)	0-10	4.88 (2.51)	0-10	4.93 (2.20)	1-9	3.00 (2.24)	0-10	4.64 (2.94)	0-10	5.26 (2.38)	0-10
NARA II Accuracy	68.36 (19.33)	0-100	62.81 (20.91)	13-99	67.92 (21.08)	16.98	46.80 (21.55)	0-99	59.89 (26.97)	1-99	65.47 (19.56)	13-99
NARA II Comprehension	25.83 (7.53)	0-44	24.41 (7.86)	4-40	26.65 (9.48)	4-41	19.74 (8.87)	0-41	22.23 (10.50)	1-38	24.12 (7.55)	4-42
Year 13												
TOWRE Words	83.34 (9.81)	18-104	82.55 (9.88)	58-104	84.00 (10.23)	67-104	75.24 (10.87)	40-103	76.98 (11.71)	44-97	81.08 (10.33)	40-104

	Control		Moderate-late Preterm		Very Preterm		Dyslexia		Autism		Hearing Impaired	
	M (SD)	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*
TOWRE Non-real Words	51.42 (8.93)	4-63	50.37 (9.44)	25-63	52.74 (7.40)	38-63	43.10 (10.14)	14-63	48.63 (9.98)	12-63	50.29 (9.28)	19-63
Year 15												
WASI Vocabulary	46.29 (9.68)	8-71	45.73 (9.45)	20-66	47.48 (10.13)	27-64	44.49 (10.43)	16-67	41.76 (13.09)	13-62	43.09 (10.01)	16-66
Covariate												
Child Non-verbal IQ												
Year 8 WISC Performance IQ	101.49 (16.55)	46-151	99.30 (17.58)	46-145	91.43 (20.97)	48-135	97.14 (16.41)	54-134	93.48 (16.73)	46-130	95.78 (17.88)	50-145
Year 15 WASI Matrix Reasoning	24.78 (6.94)	3-80	24.12 (6.67)	5-65	24.52 (10.90)	7-64	25.50 (8.08)	7-67	23.53 (8.87)	5-54	24.82 (6.45)	7-53
Child Sociability												
6-month DDST Social Skills	17.29 (4.61)	3-30	15.10 (5.09)	3-30	10.50 (5.54)	3-26	17.57 (4.86)	7-30	16.11 (4.99)	3-28	16.56 (5.31)	6-30
Year 1 DDST Social Achievement	19.27 (3.64)	6-28	17.81 (4.01)	7-28	14.34 (4.55)	5-23	18.96 (3.87)	6-27	15.60 (4.68)	5-26	18.95 (3.89)	8-27
Year 2 DDST Social Achievement	19.08 (3.59)	5-26	17.96 (3.98)	3-26	16.23 (5.28)	1-24	18.40 (3.85)	8-25	14.05 (5.38)	1-25	18.92 (3.83)	7-26
Year 3 EAS Sociability	18.24 (3.02)	7-25	18.19 (3.23)	10-25	18.39 (3.39)	9-24	18.45 (2.95)	5-25	15.33 (4.42)	5-24	18.05 (2.98)	9-25
Maternal Age (in years)	29.14 (4.45)	16-44	27.76 (4.77)	15-42	27.06 (5.21)	18-38	29.82 (4.62)	17-44	29.73 (3.83)	19-38	28.72 (4.42)	18-41
Maternal Education (%)												
Certificate of Secondary Education	12.5		22.2		24.0		8.1		16.8		11.4	
Vocational	8.2		11.8		12.0		8.4		3.4		10.0	
O level	36.5		33.8		30.0		35.7		36.0		36.3	
A level	26.6		22.9		22.0		28.3		25.8		29.1	
University Degree	16.2		9.3		12.0		19.6		18.0		13.2	

[a]DDST assessed at 6 months and year 1 and MCDI assessed at years 1, 2, and 3 were all ALSPAC modified versions.

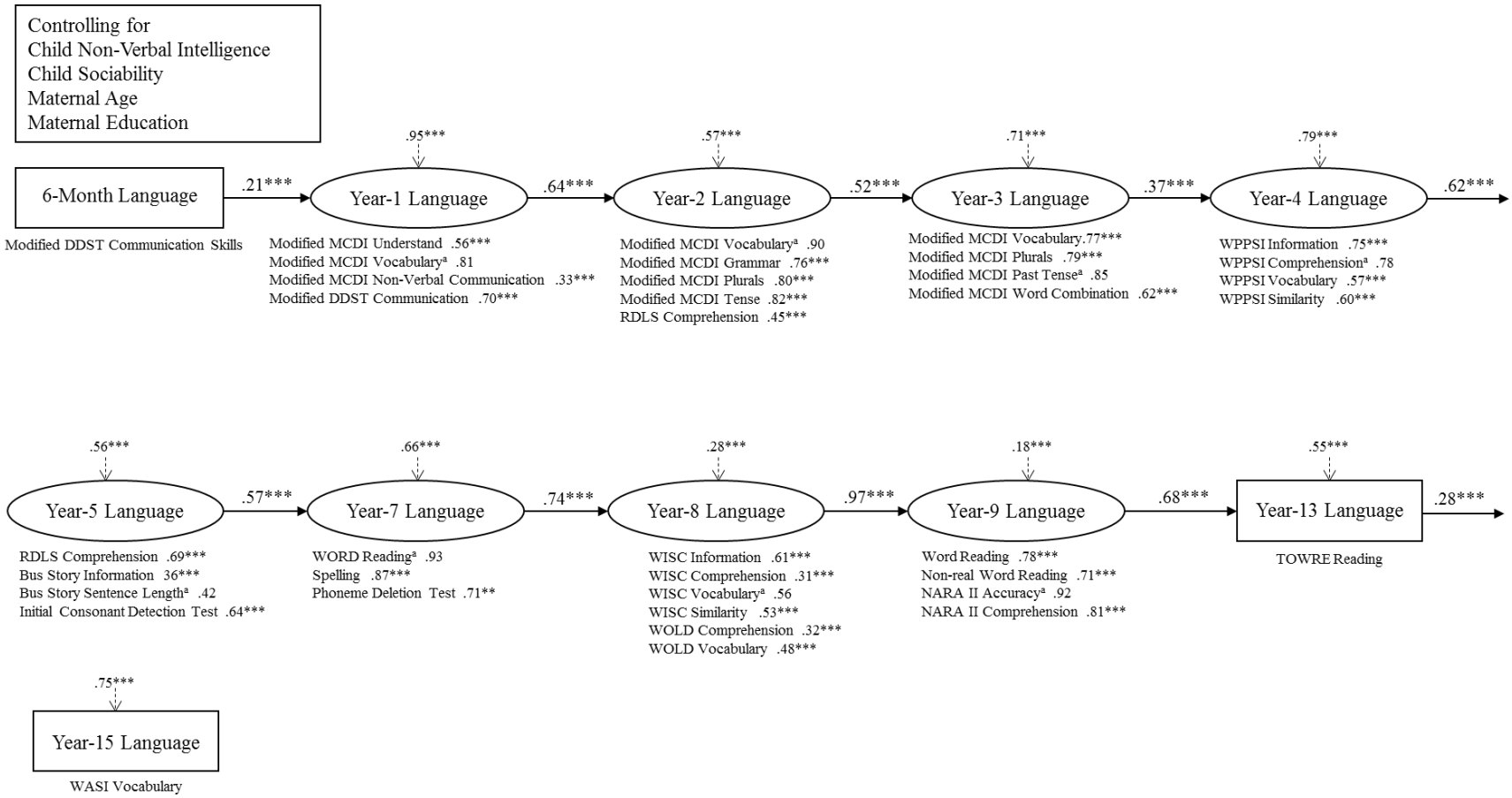

Fig. S1. Study 1. Standardized solution for covariate model (N = 925). Numbers associated with single-headed arrows are standardized path coefficients; numbers associated with dotted single-headed arrows are error variances or disturbances, the amount of variance not accounted for by paths in the model. Indicators of each latent variable are listed below the latent variable with their factor loadings; marker indicators of the latent factors (loadings set to 1 to scale and identify the factor) are indicated by the superscript letter a. To simplify presentation, paths from maternal age and education to language variables were not shown in the Figure. Covariances that were in the model, but not shown in the Figure included year 2 MCDI Vocabulary and RDLS comprehension, standardized coefficient = .25, p < 001; year 5 RDLS Comprehension and Initial Consonant Detection Test, standardized coefficient = -.27, p < 001; year 5 Bus Story Information and Bus Story Sentence Length, standardized coefficient = .79, p < 001; year 9 word and non-real word reading, standardized coefficient = .40, p < 001; maternal age and education, standardized coefficient = .25, p < 001.

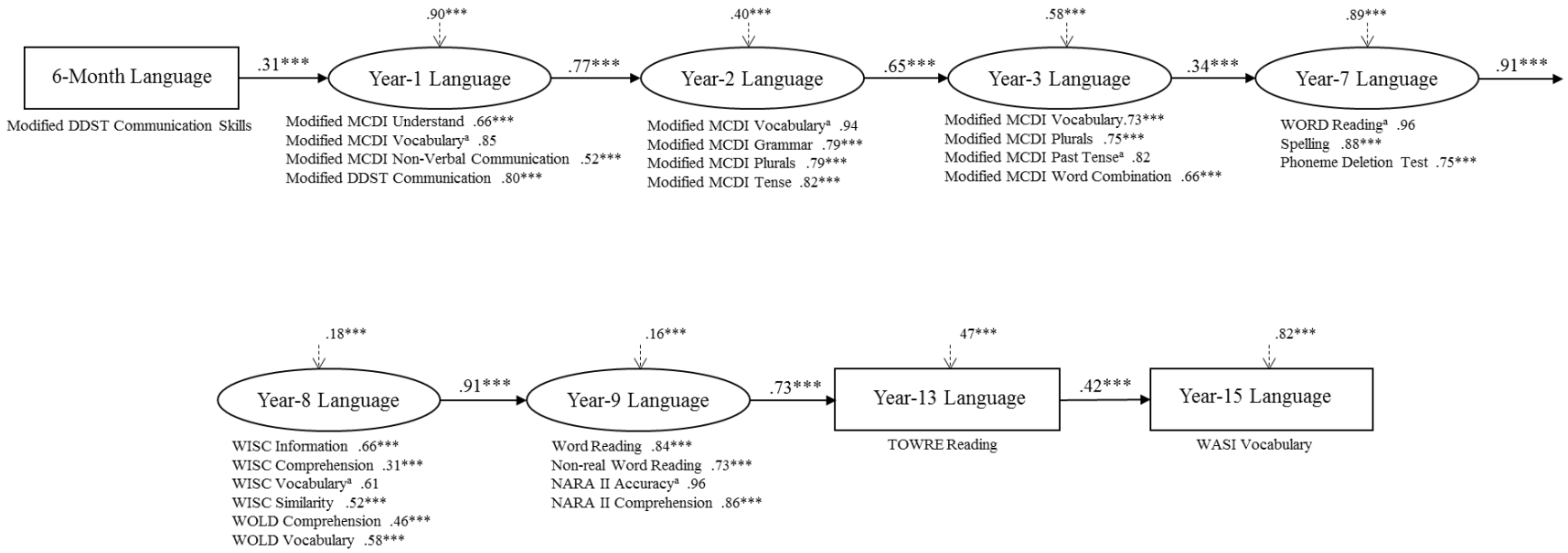

Fig. S2. Study 2. Standardized solution for stability model (N = 5,167). Numbers associated with single-headed arrows are standardized path coefficients; numbers associated with dotted single-headed arrows are error variances or disturbances, the amount of variance not accounted for by paths in the model. Indicators of each latent variable are listed below the latent variable with their factor loadings; marker indicators of the latent factors (loadings set to 1 to scale and identify the factor) are indicated by the superscript letter a. Covariance that was in the model, but not shown in the Figure was year 9 word and non-real word reading, standardized coefficient = .31, p < 001.