An online scale for the Assessment of Language in Adults using Self-reported Scales

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Dyslexia Guild Conference
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Introduction

An online screening tool for adults with language difficulties

Incorporating objective language and self-perception measures to provide an in-depth understanding of the potential impact of language disorders beyond childhood

Language Disorders

Developmental Language Disorder (DLD) is a diagnosis given to children with **persistent** and **specific** difficulties with understanding and producing language that cannot be explained by a known biomedical cause (Bishop et al, 2017)

Features of DLD: [1] Prevalence

1. Over 7% of the population (SCALES study, Norbury & Sonuga-Barke, 2017)
2. It affects far more children than better known developmental disorders like Autism (Davidovitch et al., 2018)

Davidovitch, M., Stein, N., Koren, G., & Friedman, B. C. (2018). Deviations from typical developmental trajectories detectable at 9 months of age in low risk children later diagnosed with autism spectrum disorder. *Journal of autism and developmental disorders*, *48*(8), 2854-2869.

Norbury, C. F., & Sonuga-Barke, E. (2017). New frontiers in the scientific study of developmental language disorders. *Journal of Child Psychology and Psychiatry*, *58*(10), 1065-1067.

Features of DLD: [2] Recent

1. Specific Language Impairment (SLI) was a similar diagnosis, now replaced by DLD (CATALISE project, Bishop et al., 2016), but not exactly the same!
2. Hence, no current adults diagnosed with DLD

Bishop, D. V., Snowling, M. J., Thompson, P. A., Greenhalgh, T., & Catalise Consortium. (2016). CATALISE: A multinational and multidisciplinary Delphi consensus study. Identifying language impairments in children. *PLOS one*, *11*(7), e0158753.

Features of DLD: [3] Cognitive and social

1. Cognitive and social implications are now being observed in longitudinal studies of previously SLI-diagnosed children (Botting et al, 2016)
2. Unclear evidence according to Brownlie et al., 2016

Botting, N., Durkin, K., Toseeb, U., Pickles, A., & Conti-Ramsden, G. (2016). Emotional health, support, and self-efficacy in young adults with a history of language impairment. *British Journal of Developmental Psychology*, *34*(4), 538-554.

Brownlie, E. B., Bao, L., & Beitchman, J. (2016). Childhood language disorder and social anxiety in early adulthood. *Journal of abnormal child psychology*, *44*(6), 1061-1070.

Potential effects in adulthood

1. Literacy issues in young adults and social problems (Clegg et al., 2005)
2. Poorer educational results (Johnson et al. 2010)
3. 10% DLD adults with university degrees (Conti-Ramsdem et al., 2018)
4. Unclear evidence according to Brownlie et al. 2016

Botting, N., Durkin, K., Toseeb, U., Pickles, A., & Conti-Ramsden, G. (2016). Emotional health, support, and self-efficacy in young adults with a history of language impairment. *British Journal of Developmental Psychology*, *34*(4), 538-554.

Johnson, C. J., Beitchman, J. H., Young, A., Escobar, M., Atkinson, L., Wilson, B., ... & Wang, M. (1999). Fourteen-year follow-up of children with and without speech/language impairments: Speech/language stability and outcomes. *Journal of Speech, Language, and Hearing Research*, *42*(3), 744-760.

Conti-Ramsden, G., Durkin, K., Toseeb, U., Botting, N., & Pickles, A. (2018). Education and employment outcomes of young adults with a history of developmental language disorder. *International Journal of Language & Communication Disorders*, *53*(2), 237-255.

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In summary

1. Unclear effects of DLD beyond childhood
2. Need to search for potential interactions between language performance and other factors:
    1. Literacy
    2. Social functioning

Assessment of Language in Adults using Self-reported Scales (ALASS)

1. Adult-based, but asking about perception as an adult and as a child too
2. Self-reported: purposely subjective
3. What language-related things people find easier/harder

What things are hard when you are using language?

Dee: producing sentences is easy

Pete: producing sentences is hard

What things are hard when you are using language?

Dee: talking to strangers is hard

Minnie: Producing sentences is hard

Five studies included here

1. Validation of ALASS with other online tools
2. ALASS predictor of social intelligence
3. Links with implicit learning
4. Further validation with CELF-5
5. Links with mental health

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Study 1. Validation of ALASS with other online tools

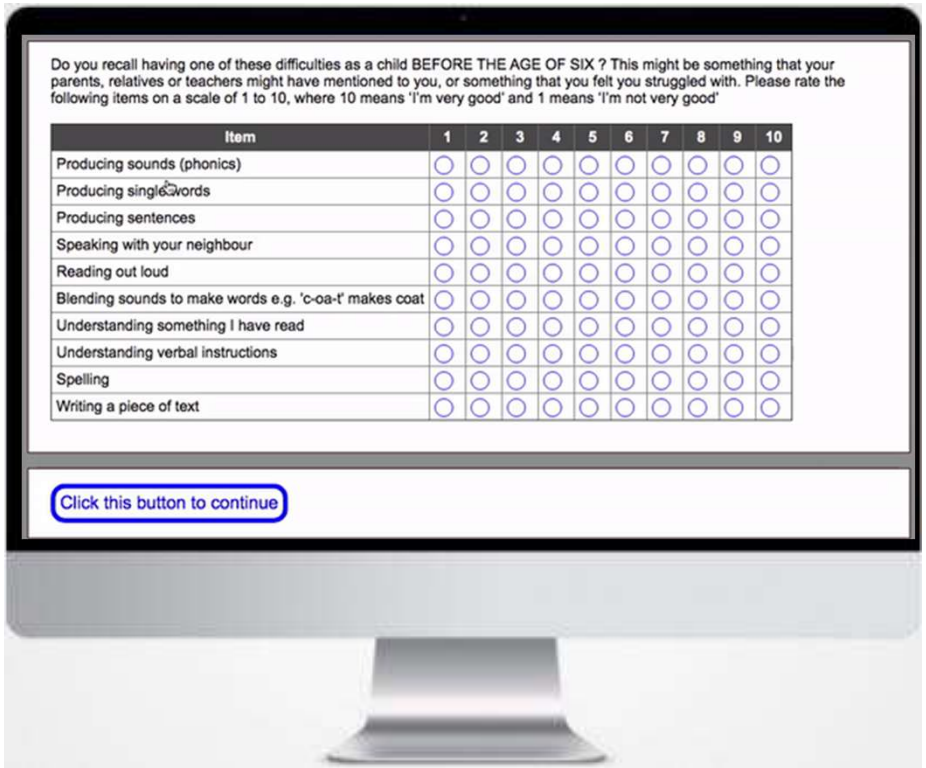
1. Do subjective scores correlate with two other objective tests (lexical and grammatical)?
2. Can some factors be extracted from the whole set of items?

Method. Materials

Assessment of Language in Adults using Self-reported Skills

1. Three developmental stages
2. Ten point scale
3. E.g. *producing sentences, Speaking with your neighbour, Writing a piece of text, reading out aloud*

An average perception score for each participant at three key age points (before 6yrs; before 18yrs; at present) was produced.



Method. Materials Lexical test

Partly based on LexTALE
(Lemhöfer & Broersma, 2012)

1. Real vs nonce words
2. Fully randomised in this case
3. We are also considering reaction times

Method. Materials Grammar test

Grammaticality Judgement task

1. Grammatical vs ungrammatical sentences
2. Fully randomised in this case
3. We are also considering reaction times

Method. Design and Materials

A set of within participants scores:

1. **Two objective *online* language tests (both accuracy and reaction times)**

   [t2] A Lexical test

   [t2] A syntactic component

2. **[t3] Self-perception of language-related skills**

[Other demographic data not considered here, e.g. income]

Participants

- 192 English L1 adult speakers (49 men, 141 women, 2 undisclosed)
- aged 18-73 years (M=25.3 years; SD=2.2 years)
- either currently studying (n=150), or had previously studied at university or college level (n=42).
- Of 192 participants, 13 had achieved post-graduate qualifications, 52 undergraduate qualifications and 127 A-level qualifications.
- Modal participant yearly earnings was <£10,000
- Ethics approved by Sheffield Hallam University committee

Procedure and Analyses

Run online using *Psytoolkit* (Stoet, 2010; 2017) in this order:

FIRST: [t1] lexical test

SECOND: [t2] (grammar)

THIRD: [t3] (Assessment of Language in Adults using Self-reported Skills, ALASS)

[t1] and [t2] were converted into z scores and averaged into **language score.**

For [t3], the initial set of 31 items was reduced into three components with a Principals Components Analysis. Three components extracted:

[1] Processing language (performance/implicit-related tasks, e.g. producing words)

[2] Literacy (e.g. writing a story)

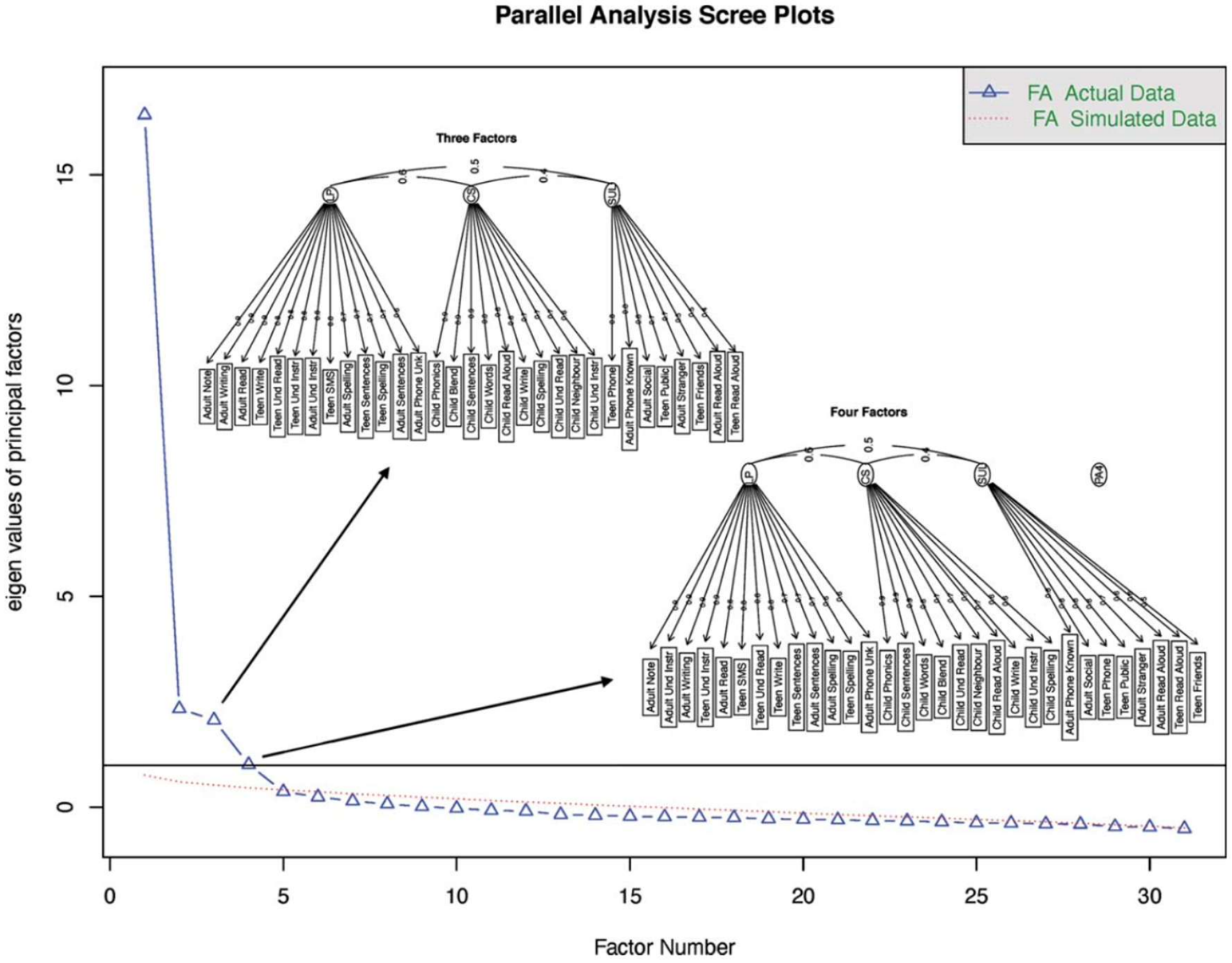
[3] Social skills (e.g. speaking with the doctor)

Table 3
Summary of the Exploratory Factor Analysis for ALASS

	Factor			
	LP (1)	CS (2)	SUL (3)	Uniqueness
Childhood				
– Producing sounds (phonics)		0.89		0.22
– Producing single words		0.85		0.17
– Producing sentences		0.87		0.15
– Speaking with your neighbour		0.68		0.41
– Reading out loud		0.67		0.37
– Blending sounds to make words e.g. 'c-oa-t' makes coat		0.84		0.21
– Understanding something I have read		0.68		0.30
– Understanding verbal instructions		0.64		0.27
– Spelling		0.64		0.24
– Writing a piece of text		0.66		0.32
Adolescence				
– Producing sentences	0.72			0.19
– Speaking with your teacher	0.40		0.49	0.24
– Talking on the telephone			0.81	0.27
– Speaking in public			0.80	0.45
– Reading out loud			0.56	0.44
– Understanding something I have read	0.79			0.26
– Understanding verbal instructions	0.86			0.17
– Spelling	0.61			0.19
– Writing a long piece of text	0.77			0.26
– Writing a text (SMS)	0.79			0.34
Adulthood				
– Producing sentences	0.69			0.36
– Speaking with strangers			0.67	0.25
– Talking on the telephone with someone you know well	0.60			0.28
– Talking on the telephone with someone you don't know well			0.83	0.33
– Speaking in social events			0.82	0.28
– Reading out loud			0.60	0.32
– Spelling	0.66			0.20
– Understanding something I have read	0.82			0.19
– Understanding verbal instructions	0.86			0.15
– Writing a long piece of text	0.86			0.19
– Writing a note	0.89			0.22

Notes. (1) Language Performance, (2) Childhood Skills, (3) Social Use of Language. The table is only showing correlation values equal or above 0.4. Root Mean Square of Residuals (RMSR) = 0.05, Fit based upon off diagonal values = 0.99.

Results of the Principal Component Analysis



Results

Everything introduced into a multiple linear regression model:

lm(language score ~ Processing + Literacy + Social + Age_grouped)

```
             Estimate    Std. Error t value  Pr(>|t|)
(Intercept) -0.72945     0.25221    -2.892   0.004281 **
PERFORMANCE -0.21998     0.07438    -2.957   0.003505 **
LITERACY     0.20141     0.05709     3.528   0.000527 ***
SOCIAL       0.08911     0.04489     1.985   0.048578 *
Age_grouped  0.22176     0.07327     3.027   0.002823 **

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7387 on 188 degrees of freedom
Multiple R-squared:  0.0896,  Adjusted R-squared:  0.07507
F-statistic: 6.167 on 3 and 188 DF,  p-value: 0.0005087
```

All factors with significant coefficients

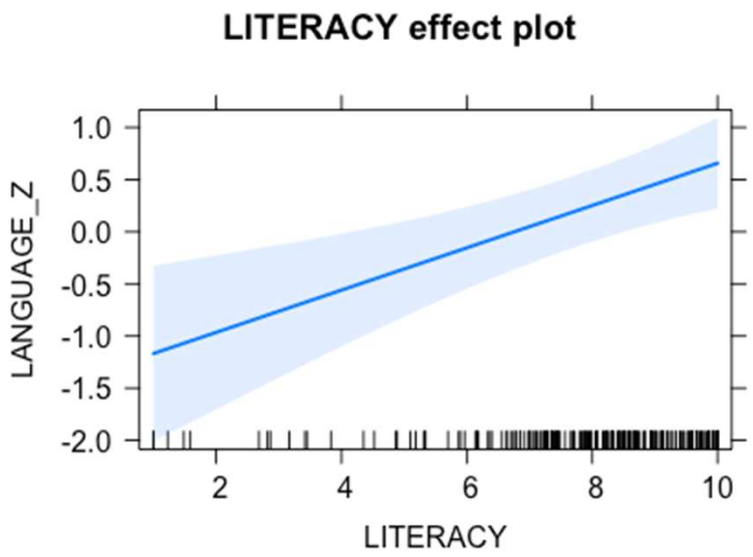
Results

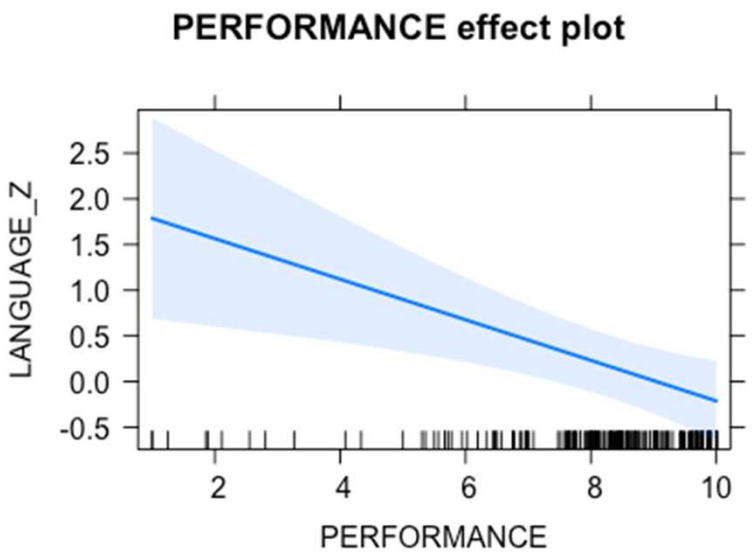
Then into a mixed model:

lmer(LANGUAGE_Z ~ LITERACY + PERFORMANCE + SOCIAL + (1 | Age_grouped) + (1 | INCOME_LEVEL) + (1 | NO_OF_GCSES) + (1 | EDUCATION_LEVEL) + (1 | DIAGNOSIS) + (1 | FAMILY) , data = ALASdata))

```
REML criterion at convergence: 432.2

Scaled residuals:
     Min       1Q   Median       3Q      Max
-2.60594 -0.62326  0.09773  0.59558  2.33713

Random effects:
 Groups           Name        Variance  Std.Dev.
 NO_OF_GCSES      (Intercept) 6.343e-11 7.964e-06
 DIAGNOSIS        (Intercept) 1.075e-02 1.037e-01
 INCOME_LEVEL     (Intercept) 8.987e-03 9.480e-02
 EDUCATION_LEVEL  (Intercept) 3.127e-10 1.768e-05
 Age_grouped      (Intercept) 5.934e-02 2.436e-01
 FAMILY           (Intercept) 3.180e-08 1.783e-04
 Residual                     5.079e-01 7.127e-01
Number of obs: 191, groups:  NO_OF_GCSES, 15; DIAGNOSIS, 12; INCOME_LEVEL, 6; EDUCATION_LEVEL, 3; Age_grouped, 3; FAMILY, 2

Fixed effects:
            Estimate Std. Error t value
(Intercept) -0.20012    0.28957  -0.691
LITERACY     0.20279    0.05830   3.478
PERFORMANCE -0.22211    0.07439  -2.986
SOCIAL       0.08822    0.04467   1.975
```

Results


LITERACY effect plot
LANGUAGE_Z
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
2
4
6
8
10
LITERACY


PERFORMANCE effect plot
LANGUAGE_Z
2.5
2.0
1.5
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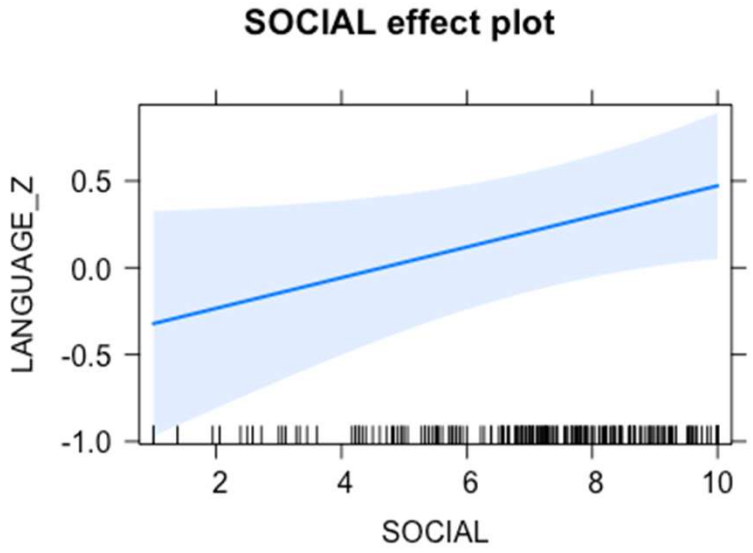
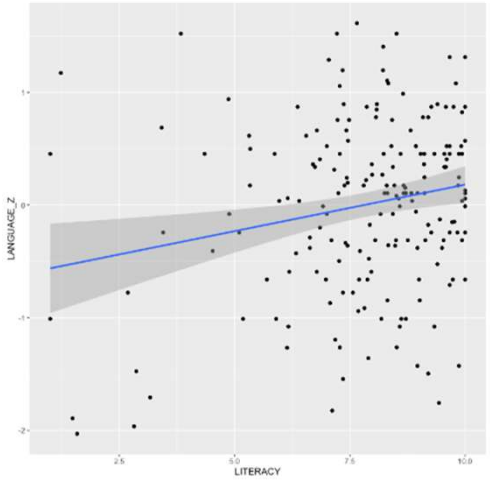
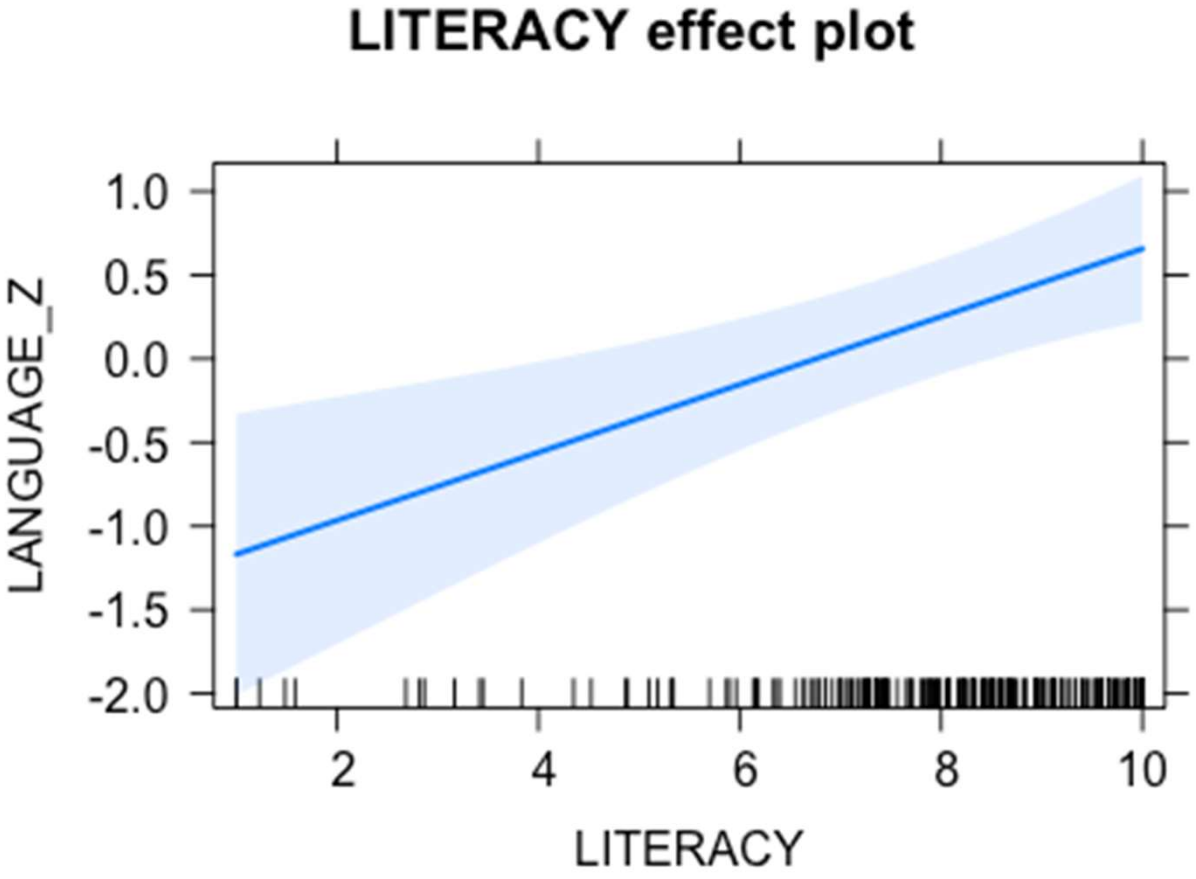
0.5
0.0
-0.5
2
4
6
8
10
PERFORMANCE


SOCIAL effect plot
LANGUAGE_Z
0.5
0.0
-0.5
-1.0
2
4
6
8
10
SOCIAL

Literacy over Language score

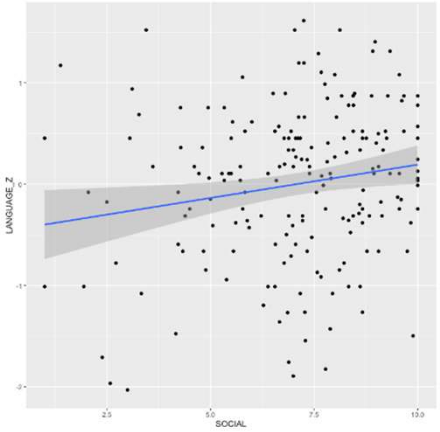
- Self-perception of literacy-related scores can be significantly predicted by the scores in the language test
- Negative intercept

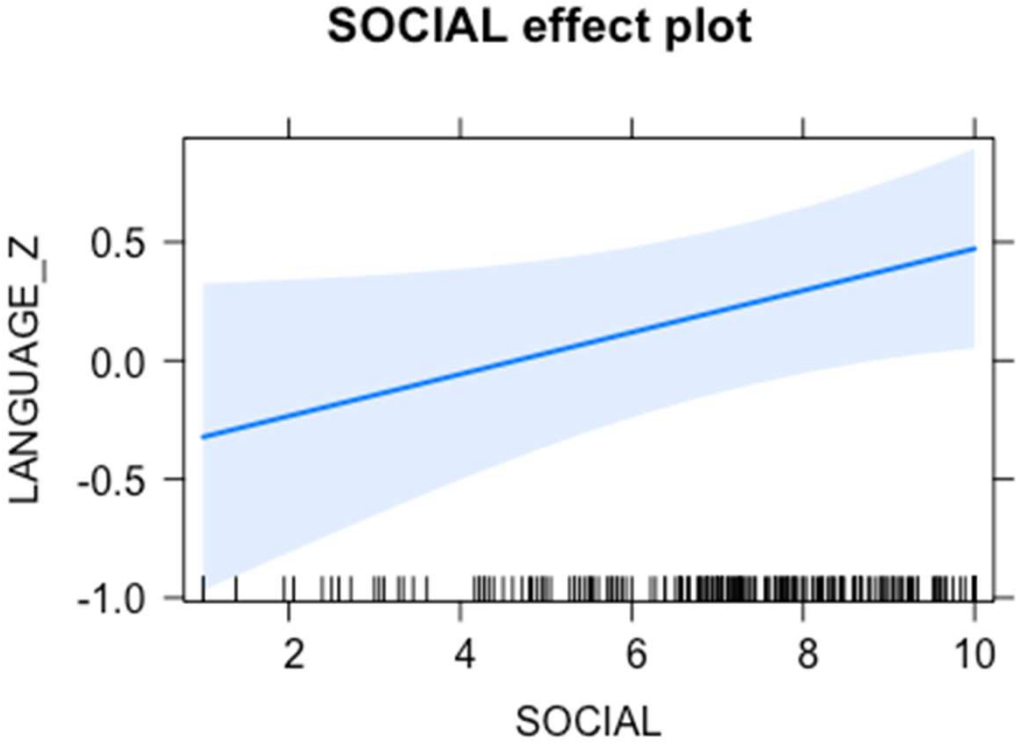




Social over Language score

- Self-perception of social-related scores can be significantly predicted by the scores in the language test
- Negative intercept



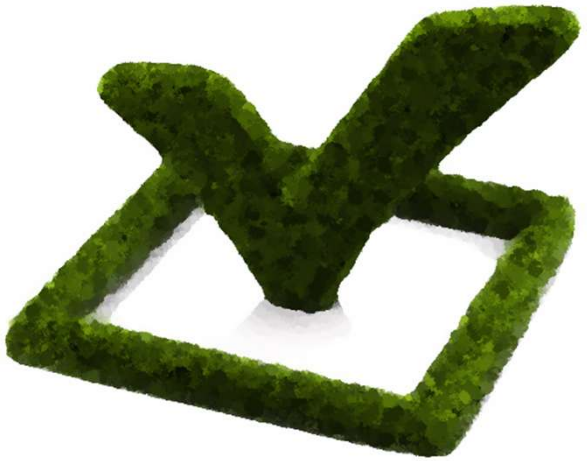


Discussion: Summary of results

1. ALASS scores highly associated with both literacy and social items
2. The different patterns observed across components shows the power of ALASS questionnaire (i.e. poor scores overall are not explaining the differences across participants)
3. A more focused analysis shows that speaking on the phone and talking to strangers are the items with a higher differentiating value

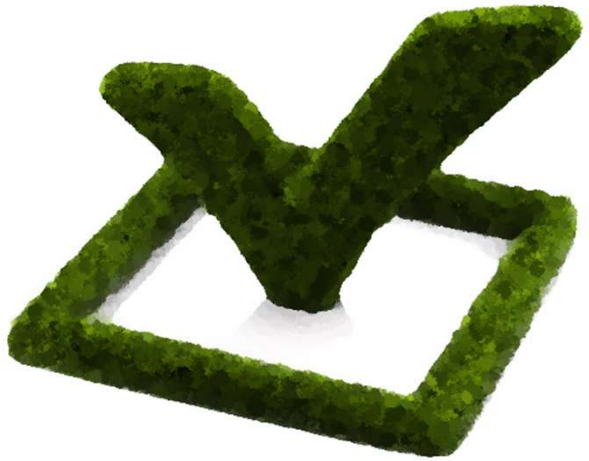
What's next?

- Further connections with social cognition, beyond "objecti language scores
- Further validations
- More general learning-related effects
- Child-language perception not significant



Discussion: Summary of results

- We have now added a social intelligence scale (Silvera et al., 2001), significant relationship with ALASS, but not with the objective language score



Five studies included here

1. Validation of ALASS with other online tools 
2. ALASS predictor of social intelligence
3. Links with implicit learning
4. Further validation with CELF-5
5. Links with mental health

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Study 2. ALASS predictor of social intelligence

1. Do ALASS scores scores predict perception of higher social skills?
2. If so, what factors of ALASS are stronger predictors of social skills

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The Tromsø Social scale was used (Silvera et al., 2011). It has 21 items for three components:

1. social information processing
2. social skills
3. social awareness

It was selected because it is particularly transparent for language, for instance:

- *Other people become angry with me without me being able to explain why*
- *I can often understand what others are trying to accomplish without the need for them to say anything*

Study 2. ALASS predictor of social intelligence

Same method as in Study 1, adding one more factor (Tromsø scale).

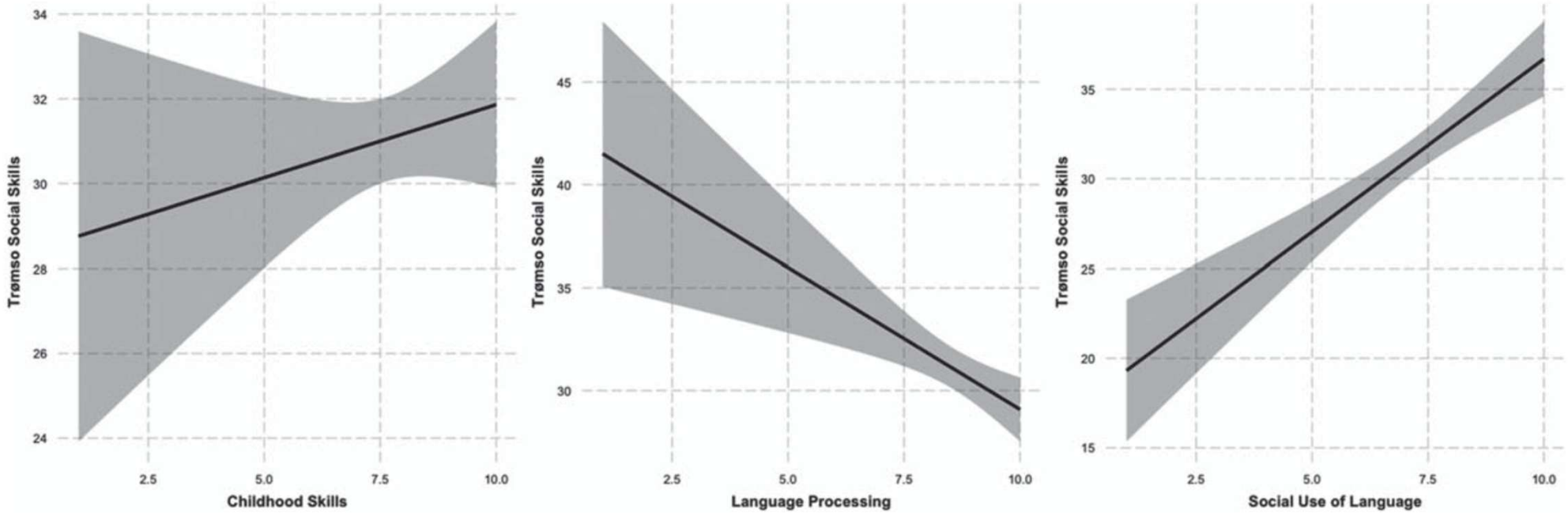

Figure 3. Summary of the effects of all three ALASS factors over Tromsø's social skills component (Childhood Skills did not show a significant effect, but both Language Performance and Social Use of Language are significant).

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Implicit Learning: What is it?

1) A really weird and hypothetical situation: First. A group of aliens have arrived to Earth. They make some weird signs. There's absolutely no clue about what they are trying to tell us because we don't share any knowledge with them. We watch the sequences of signs, but they don't make any sense to us.

2) The aliens go back (wherever they came from), but new sporadic visits take place and they seem to be using the same language. Some people say that these new aliens are actually imposters because that language doesn't seem to be the same.

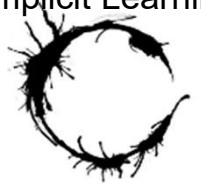
Can we tell if the new aliens are actually using the same language without having any clue about its meaning?

we should be able to spot imposter aliens

Two possible options (by now):

1) We humans are prepared to abstract the **rules** of languages without noticing them. Therefore, we should be sensitive to the sequences of items, as long as they have **structure!** Once we get the rules, we can spot the imposter aliens (i.e. their emissions are not grammatical)

2) We humans are really bad at detecting rules, but we can **memorise** tons of different elements and we compare the new items against the old ones. This we can also catch imposter aliens. If the new emissions are too different, they must be incorrect!



A classical study in Cognitive Science (Reber, 1967)

JOURNAL OF VERBAL LEARNING AND VERBAL BEHAVIOR 6, 855–863 (1967)

Implicit Learning of Artificial Grammars[1]

ARTHUR S. REBER[2]

Brown University, Providence, Rhode Island

Two experiments were carried out to investigate the process by which Ss respond to the statistical nature of the stimulus array, a process defined as "implicit learning." An artificial grammar was used to generate the stimuli. Experiment I showed that Ss learned to become increasingly sensitive to the grammatical structure of the stimuli, but little was revealed about the nature of such learning. Experiment II showed that information gathered about the grammar in a memorization task could be extended to a recognition task with new stimuli. Various analyses of the data strongly implied that Ss were learning to respond to the general grammatical nature of the stimuli, rather than learning to respond according to specific coding systems imposed upon the stimuli. It was argued that this "implicit" learning is similar in nature to the "differentiation" process of perceptual learning espoused by Gibson and Gibson (1955).

In recent years, the model of the verbal organism as an imitative and generalizing mechanism has been largely replaced by a model that characterizes him as a "sentence generating machine" who has learned a "generative grammar" in some implicit fashion (cf. Chomsky 1957, 1959; Miller and Chomsky 1963). The "implicit" and Gibson (1955) under the rubric "perceptual learning." The Gibsons argued that the phenomenon of perceptual learning, whereby an organism comes to perceive and respond to his environment in a reliable and efficient manner, should most parsimoniously be thought of as a "differentiation" process, as opposed to an "en-

Reber (1967)

Grammatical Items. A finite-state language (cf. Chomsky and Miller, 1958) was constructed with the five letters P,S,T,V,X as the vocabulary and Miller (1958), it can also be shown that each symbol in this language contains an average of .552 bits of information. The 6-, 7-, and 8-

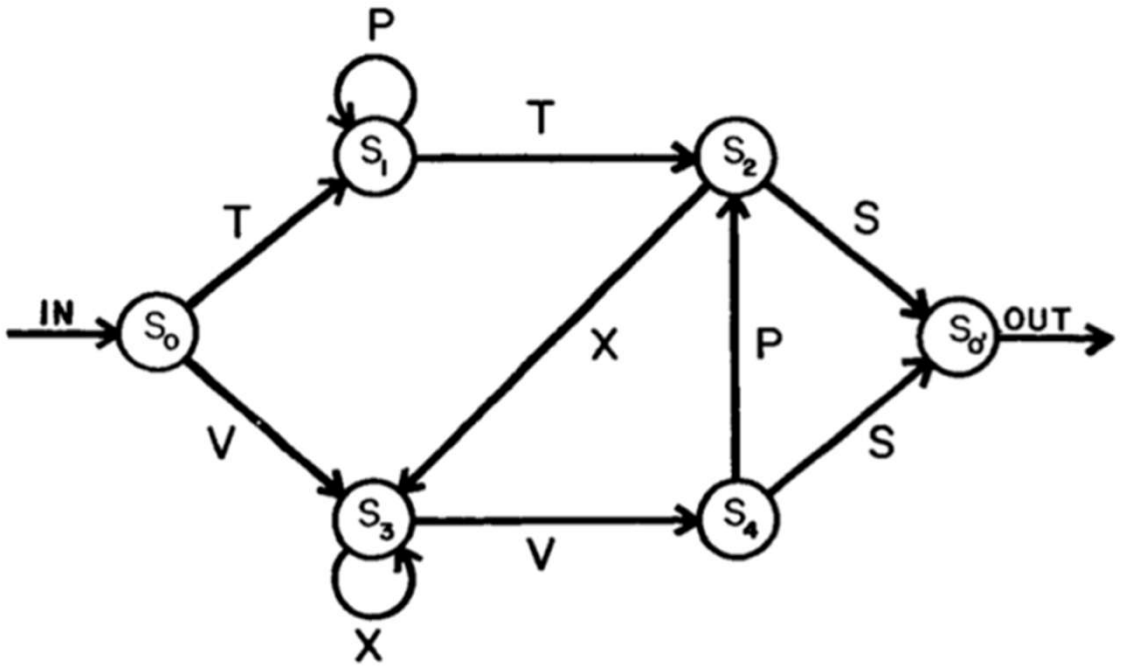


FIG. 1. Schematic state diagram of the grammar used to generate the grammatical stimulus items.

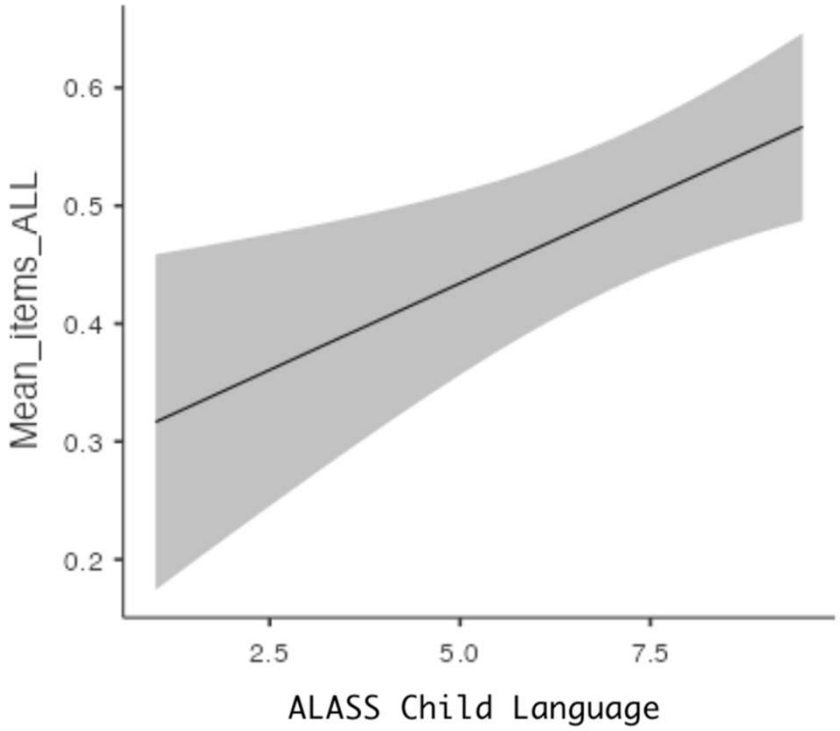
To Know more:

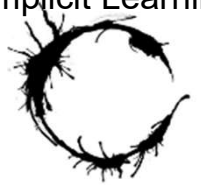
Dulany, D. E., Carlson, R. A., & Dewey, G. I. (1984). A case of syntactical learning and judgment: How conscious and how abstract? *Journal of Experimental Psychology: General*, *113*(4), 541–555. https://doi.org/10.1037/0096-3445.113.4.541

Study 3. ALASS predictor implicit learning

1. Do ALASS scores scores predict better scores in **visual** implicit learning tasks?
2. If so, what factors of ALASS are stronger predictors of implicit learning

ALASS Child Language scores are a very good predictor of scores in Implicit Learning!

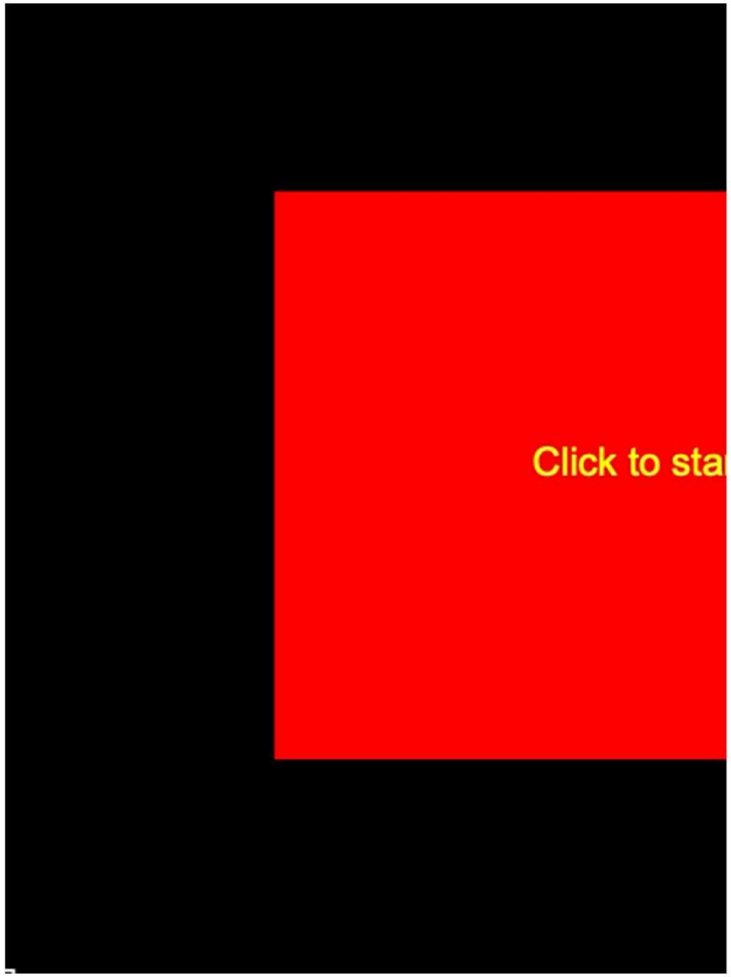




Study 3. ALASS predictor implicit learning

Method: Implicit Learning task and ALASS

1. Training phase



2. Test phase

The rules allow only certain shapes to follow other shapes
To test if you have learned these rules,
you will now see more series of shapes
Watch the item and decide whether each series
is well-formed or violates the rule.

If you think it is well formed, press 1.
If you think it violates the rules, press 0.

Press the space bar to start phase 2.

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2. ALASS predictor of social intelligence

3. Links with implicit learning

4. Further validation with CELF-5
5. Links with mental health

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4. **Further validation with CELF-5**

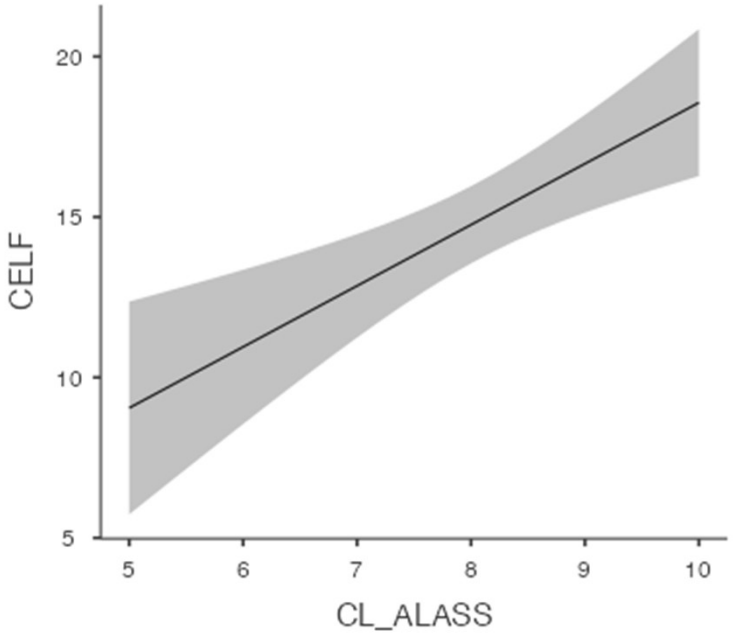
CELF5 UK
Clinical Evaluation of Language Fundamentals – Fifth UK Edition

5. Links with mental health

Study 4. Further validation of ALASS with CELF-5

1. Clinical Evaluation of Language Fundamentals (5th version, UK)
2. Do ALASS scores correlate high with CELF-5?

ALASS Child Language scores are a very good predictor of CELF-5!



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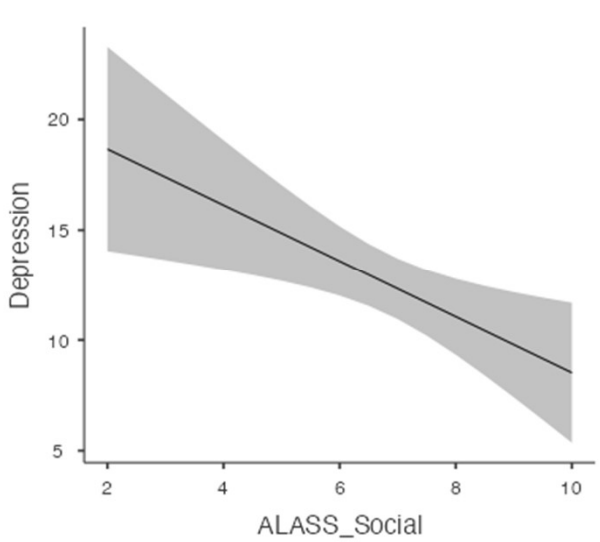
CELF 5 UK
Clinical Evaluation of Language Fundamentals - Fifth UK Edition

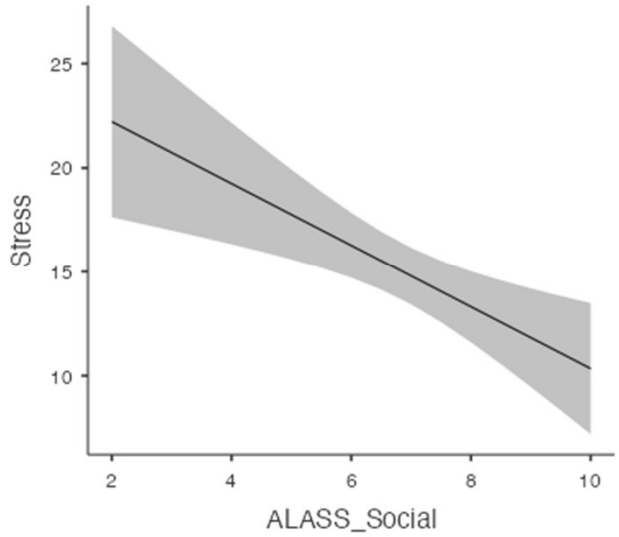
5. Links with mental health

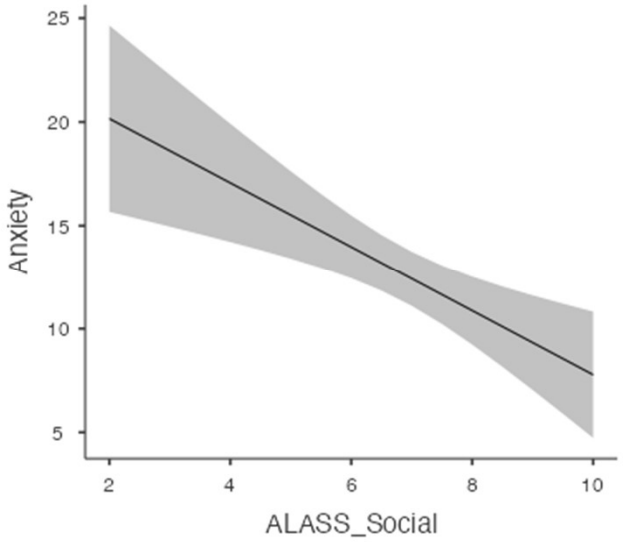
Study 5. ALASS as predictor of Mental Health

1. Do ALASS scores correlate high with DASS-21?

High scores in ALASS Social factor are excellent predictors of low depression, anxiety and stress!







Assessment of Language in Adults using Self-reported Scales (ALASS)

1. Adult-based, but asking about perception as an adult and as a child too
2. Self-reported: purposely subjective

Discussion: Summary of results

1. ALASS scores highly associated with both literacy and social items
2. The different patterns observed across components shows the power of ALASS questionnaire
3. Social component is an excellent predictor of Social intelligence
4. Child-Language component correlates high with implicit learning
5. Child-Language is also an excellent predictor of CELF-5 scores
6. Social component is also an excellent predictor of mental health resilience
7. What's next? Start using it in combination with other scales

Acknowledgements

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