What does the CELF-IV Sentence Structure test index in bilinguals?

Cécile De Cat
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UNIVERSITY OF LEEDS

Background & aim

The CELF-IV Sentence Structure test (henceforth SST) aims to "measure the acquisition of grammatical (structural) rules at the sentence level" (manual:88).

- Designed for monolinguals (5 to 8 years old).
- Frequently used to **assess bilingual children's English proficiency** (e.g. [1]).

Independently known predictors of language proficiency in bilinguals:

- Language exposure [2]
- Socio-economic status (SES) [3]
- Age

Language proficiency tasks make **cognitive demands** on children. It is therefore desirable to include relevant cognitive measures as control variables in analyses (e.g. memory in a sentence repetition task [3]).

Aim of the study

To disentangle the effect of language exposure, cognitive factors and SES on bilingual children's performance in the CELF SST.

Participants

174 children from the North of England

		Gender	Min.	Max	Mean	St.Dev.
Bilinguals		F (n = 44)	5;1	6;9	5;10	0;5
(n = 87)		M (n = 43)	5;1	7;0	5;10	0;6
Monolinguals		F (n = 52)	5;0	7;0	6;0	0;7
(n = 87)		M (n = 35)	5;0	7;0	6;0	0;7

- Bilinguals: English (language of schooling for all) + one of 28 home languages. 46 children were sequential bilinguals.
- Information elicited via parental questionnaires:
  - Socio-economic status (parental occupation – Fig.3)
  - Languages currently spoken to the child (frequency by interlocutor) and by the child (frequency by interlocutor) = simplified version of the BiLEC [4] (Fig.1)
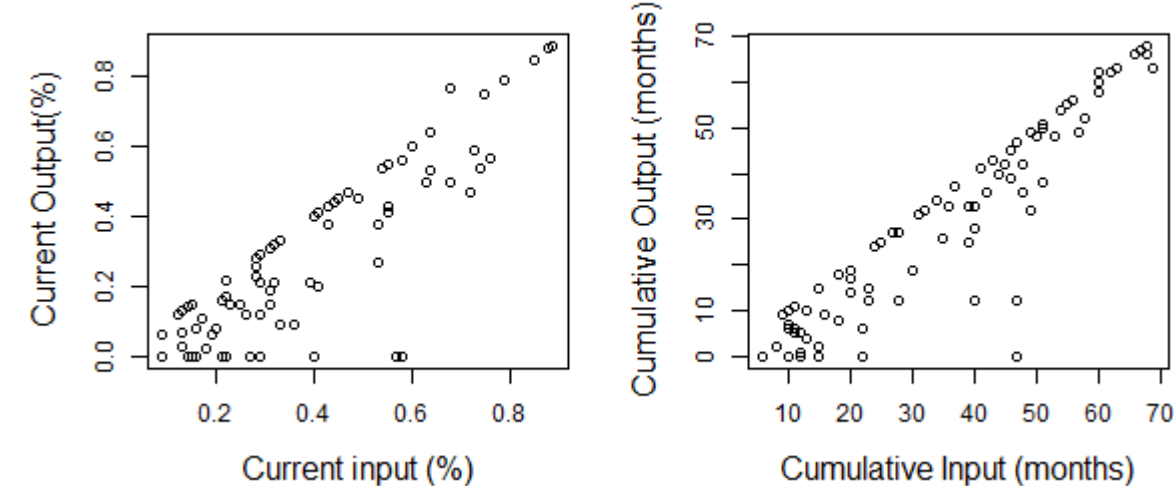 - Onset of bilingual exposure (Fig.2).

Fig.1: Current and cumulative estimates of input and output in the home language
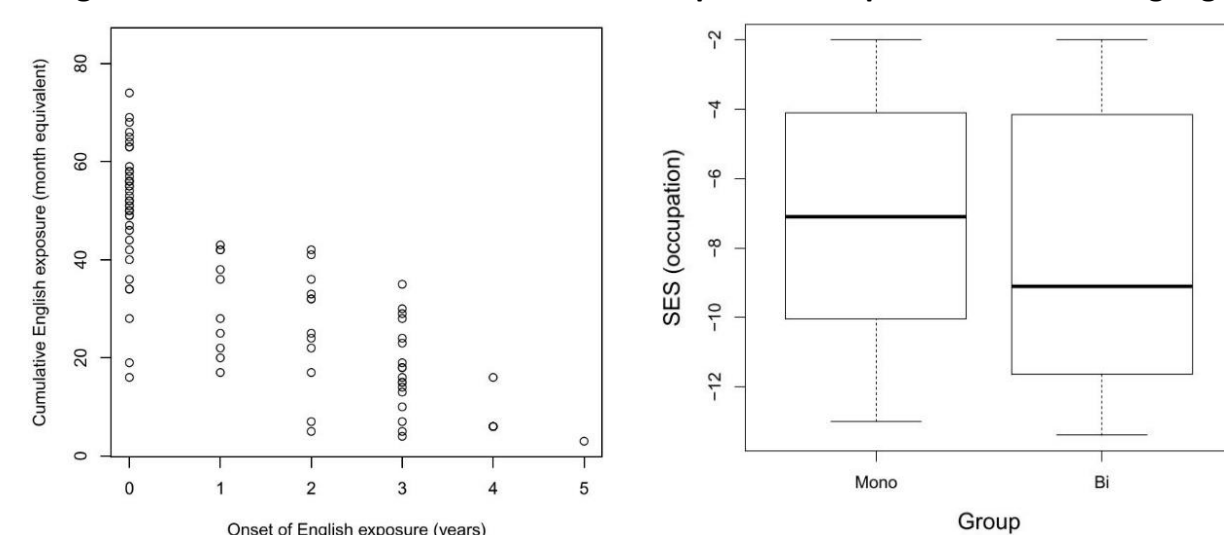

Fig.2: Cumulative English exposure according to onset of exposure

Fig.3: SES in monolingual vs bilingual children

Methods

CELF-IV (UK) SST 26 sentences to match with the correct picture (/4). Probes "structural complexity and syntactic compression" and the "integration of surface sentence structure and deep sentence structure".

Cognitive measures:

- **Memory**: Digit span task (forward & backward) (WISC-III)

Forward digit recall (# digits)	3	4	5	6	7
Bilinguals	13	34	37	2	1
Monolinguals	9	34	35	8	1

Backward digit recall (# digits)	0	2	3	4
Bilinguals	3	34	46	4
Monolinguals	0	32	52	3

No bilingual advantage [5].

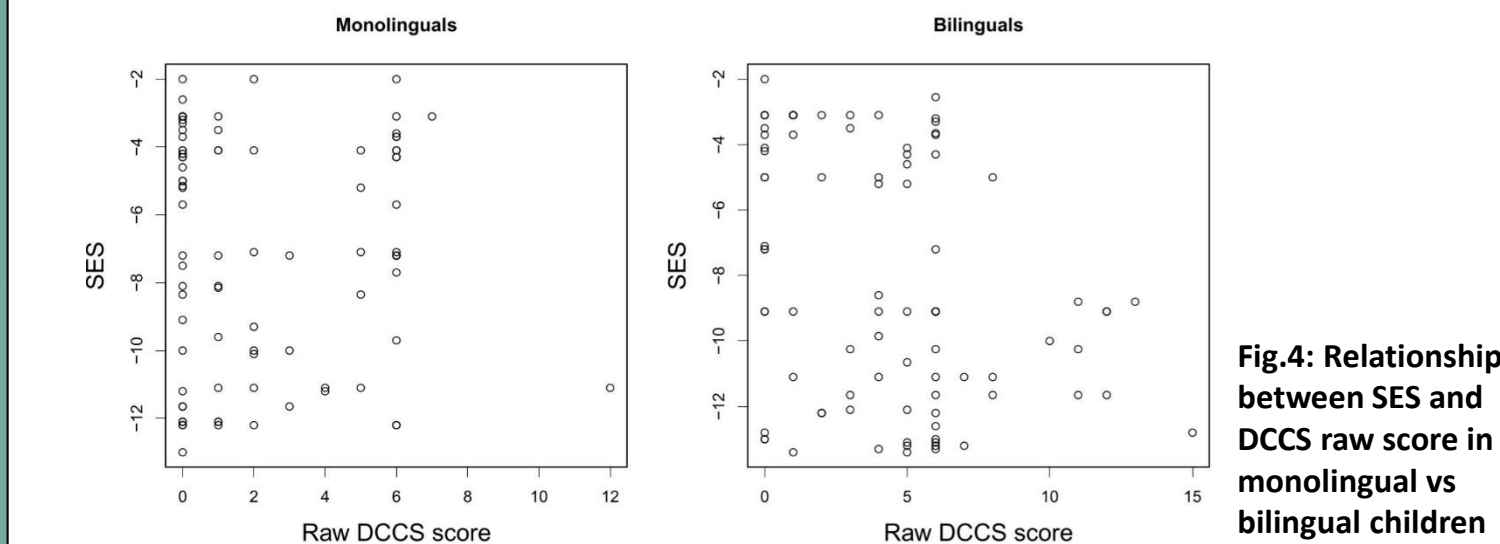- **Flexibility**: (Dimensional Change Card Sort: DCCS)

Fig.4: Relationship between SES and DCCS raw score in monolingual vs bilingual children

Better performance in bilingual children from higher SES [5].

Other language proficiency tests (English):

- **Sentence repetition** (SASIT – precursor of the LITMUS SR test [6])
- **Lexical knowledge and discourse pragmatics** (DELV): 5 tasks

Results (overall scores)
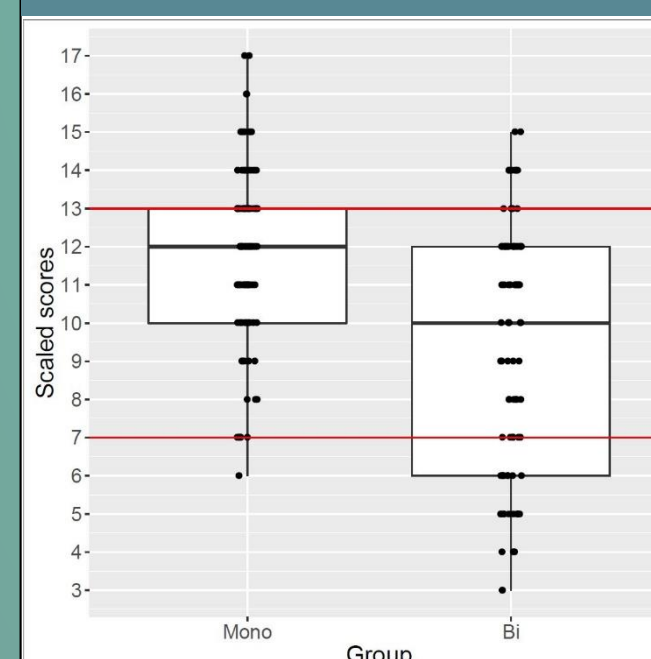
Scaled scores: compare the child's performance with same-age norm. TD Monolinguals: scaled scores expected to be within 1 SD (= 3 points) of a mean of 10 points (between the red lines in Fig.5).

Fig.5: Scaled scores in the CELF SST task, by group

Linear regression analysis on the overall scores for each test (Table 2):
- Predictors **tested for**: cumulative exposure to English, SES, short-term memory (Forward Digit Recall), working memory (Backward Digit Recall), cognitive flexibility (DCCS), age, gender.
- Predictors retained only if improving the model fit.

Language exposure predicts language proficiency in bilinguals … EXCEPT IN THE CELF SST

	Sentence repetition		DELV (overall)		CELF SST	
	Coefficient	p	Coefficient	p	Coefficient	p
Intercept	0.280	0.09	0.14	0.10	3.411	0.05
Cumulative exposure to Engl.	0.005	0.0005	0.001	0.02	-0.008	0.60
SES (occupation)	0.017	0.008	0.01	0.04	0.157	0.05
Memory (short term)	0.090	0.003	0.03	0.03	0.124	0.75
Memory (WM)	-0.017	0.61	0.04	0.04	0.955	0.016
Cognitive flexibility (DCCS)	0.066	0.07	0.07	0.001	2.148	< 0.0001
Age (months)	0.002	0.71	-0.001	0.71	/	/
Gender: M	-0.040	0.39	-0.02	0.33	0.412	0.47

Table 2: Predictors of overall score (%) in three English proficiency tests by bilingual children, identified through linear regression models. Figures in black font are from the optimal model (excluding n.s. predictors).

Results summary:

- Language exposure predicts performance *except* in the CELF SST, in spite of poorer performance by bilinguals (Fig.5).
- Disproportionate impact of cognitive measures in the CELF SST.

> → What causes difficulty in the CELF SST?
> Are bilinguals affected differently to monolinguals?
> → Item analysis required

Structural complexity in the CELF SST

- SST designed to probe the effect of **structural complexity**, which we interpret as the presence of:
  - Embedded clause(s):
    The boy began gathering apples after they fell to the ground.
  - Syntactic movement (e.g. wh-questions, passives)
    The girl is being pushed by the boy.
  - Relative clauses (combining embedding and wh-movement)
    The woman who is holding the baby dropped her handbag.
- **Monolingual scores**: some surprises
  - Items with the most errors were among the least structurally complex: *The boy will feed the cat.* (63%)
  - Relative clauses yield highest sores:
    The girl who is standing in front of the line is wearing a rucksack. (99%)
  - Similar structures sometimes yielded very different scores.
    The boy is washing dishes and his mum is drying them. (70%)
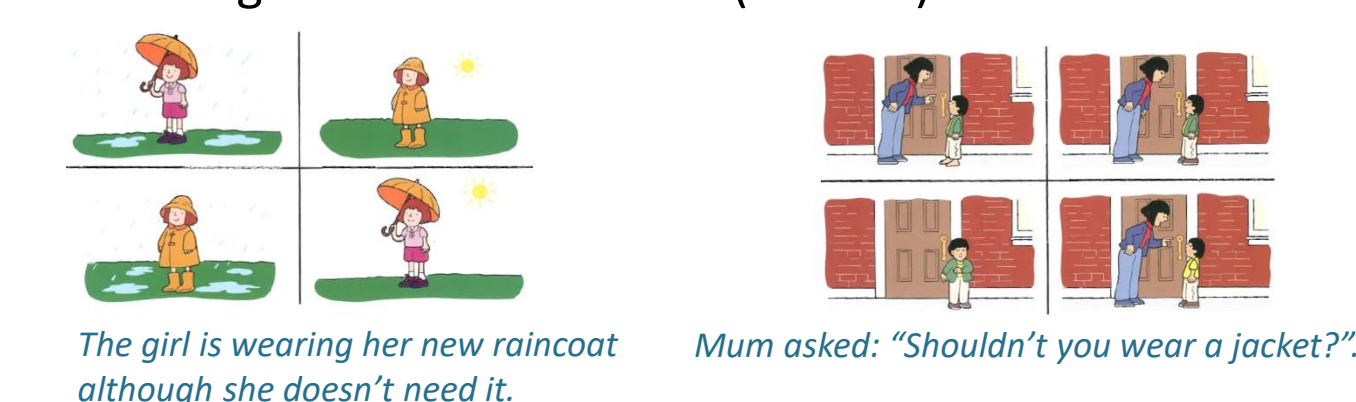   *She is climbing and he is swinging.* (87%)

→ Test the effect of structural complexity in the item analysis, focusing on passives and relative clauses (difficult for bilinguals [6])
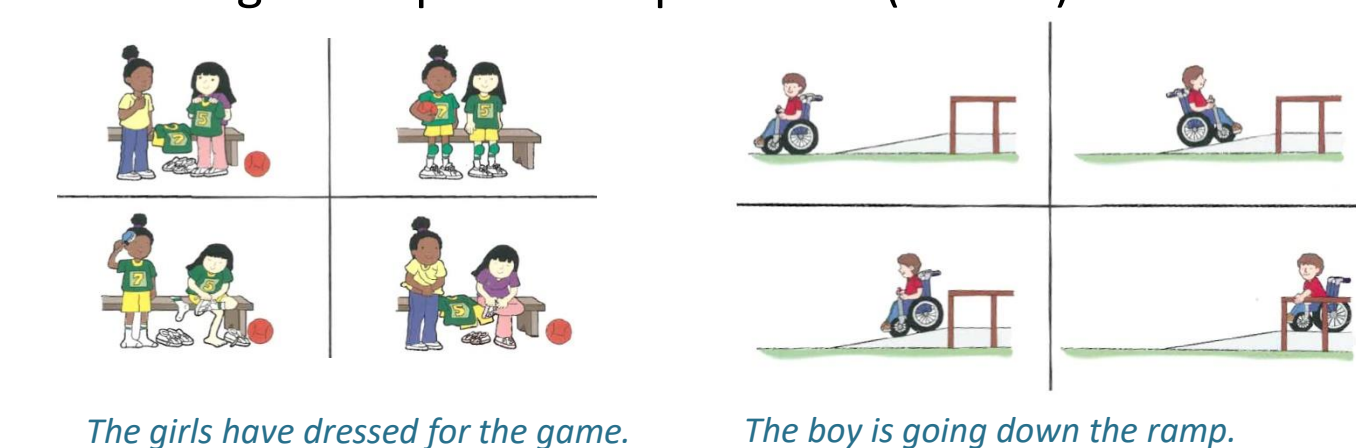
Cognitive complexity in the CELF SST

- Reasoning / visual inferencing required for picture choice
- Possible types of reasoning challenges:
  - Working out the relative timing of events (4 items)

The boy began gathering apples after they fell to the ground.   *He's ready to go to bed.*

  - Working out counterfactuals (2 items)

The girl is wearing her new raincoat although she doesn't need it.   *Mum asked: "Shouldn't you wear a jacket?".*

  - Working out aspectual implications (3 items)

The girls have dressed for the game.   *The boy is going down the ramp.*

→ Test the effect of cognitive complexity in the item analysis based on exploratory categories.

Results (item analysis)

Binomial logistic regression model fitted to the CELF SST response accuracy data (item analysis).
Complexity factor levels: None, Passives, Relative clauses, Aspectual implications, Counterfactuals, Relative events

- **Monolinguals' accuracy**:
  - No difficulty with passives (0.18, p = 0.43)
  - Facilitation (!) effect of relative clauses (1.76, p < 0.0001)
  - Difficulties with
    - aspectual implications (-1, p < 0.0001)
    - counterfactuals (-0.6, p = 0.02)
    - relative events (-0.73, p = 0.003)
- **Bilinguals' accuracy**:
  - Significantly below that of monolinguals (-0.31, p = 0.0008)
  - Lower than monolinguals on
    - Passives (-0.93, p = 0.001)
    - Relative clauses (-1.07, p = 0.006)
  - Not significantly worse than monolinguals on any of the cognitive complexity levels

Across groups: main effect of
  - cognitive flexibility (0.53, p < 0.0001)
  - working memory (0.27, p < 0.0001)
  - age (0.02, p = 0.001)
  - SES not significant if cognitive predictors and age are included (0.02, p = 0.6)

No effect of language exposure within bilinguals (0.001, p = 0.79).

Discussion and implications

- **The CELF SST picks up on some bilingual-specific difficulties** (lower score overall; specific difficulties with relative clauses and passives).
- **Structural complexity does not predict accuracy in monolinguals.**
- The CELF SST **does not correlate at all with English language exposure in bilinguals,** contrary to expectations (whereas all other proficiency tests do in this study).
- There appears to be a **confound** between cognitive complexity and structural complexity (but seems to affect monolinguals and bilinguals to a comparable extent).

→ The exact nature of the bilinguals' difficulties requires further scrutiny.

- **IMPLICATIONS**:
  - need to include control variable for cognitive abilities
  - need to modify the CELF SST to better probe structural complexity

SELECTED REFERENCES
[1] Ebert, K.D. & Pham, G. (2017). Synthesizing Information From Language Samples and Standardized Tests in School-Age Bilingual Assessment. *Language, Speech, and Hearing Services in Schools*, 48(1): 42-55
[2] Armon-Lotem, S., de Jong, J. & Meir, N. (2015). eds. *Methods for assessing multilingual children: disentangling bilingualism from Language Impairment*. Bristol: Multilingual Matters.
[3] Meir, N., & Armon-Lotem, S. (2017). Independent and Combined Effects of Socioeconomic Status (SES) and Bilingualism on Children's Vocabulary and Verbal Short-Term Memory. *Frontiers in Psychology*, 8(1442).
[4] Unsworth, S. (2013). Assessing the role of current and cumulative exposure in simultaneous bilingual acquisition: The case of Dutch gender. *Bilingualism: Language and Cognition*, 16, 86-110.
[5] De Cat, C., Gusnanto, A. & Serratrice, L. (2017). Identifying a threshold for the executive function advantage in bilingual children. *Studies in Second Language Acquisition*, 40(1): 119-151.
[6] Marinis, T., & Armon-Lotem, S. (2015). Sentence Repetition. In [2].