

Linguistic complexity in bilingual children's grammars

Ianthi Maria Tsimpli

imt20@cam.ac.uk

The question

- Do bilingual show lower complexity than monolingual children's grammars?
 - How do we measure complexity?
 - What is 'linguistic complexity'?

Roadmap

- Some ‘costs’ of bilingualism and why complexity might be one of them
- Complexity issues in language acquisition
- Two studies on complexity
 - Study 1: Syntactic complexity
 - Study 2: Reference tracking
in connected speech (narratives)
- Back to the question

'Costs' of bilingualism

- Bilingual children usually have **smaller vocabularies** in each of their languages than monolingual children (Oller et al 2007, Bialystok et al 2010)
- Lexical retrieval problems
 - Competition between two language systems (Bialystok et al. 2011)
 - Frequency of use effect (Gollan et al. 2008)
- Bilinguals have **fewer cognitive resources** to resolve ambiguity in reference, hence they *overspecify*, i.e. they overuse overt pronouns or DPs (e.g. Sorace 2011)

'Costs' of bilingualism

- Bilinguals show reduced verbal fluency even when vocabulary size and frequency of use are controlled for
 - Giezen & Emmorey, 2017 for bimodal bilinguals → *interference* even with distinct articulators
- Competition between two languages has certain costs for language processing

'Costs' of bilingualism in school age children

- ❑ Children who are not fully fluent in English (EAL) generally perform less well than those who spoke **English only**, at all key stages of education (Demie, 2001, 2011; Sammons et al., 1997; Mujitaba & Sammons, 1999)
- ❑ Lack of fluency in English is a statistically significant predictor of performance in each subject area: English, Mathematics and Science.

‘Costs’ in written language processing

- Children who speak English as a first (L1) language show a significant advantage in **oral** language use and in **reading comprehension** compared to children with English as L2 (EAL children).
 - No monolingual advantage in word reading
- The problem seems to be with *complex language*

Babayiğit (2015)

Linguistic Complexity

→ Complexity can be relevant at any level of linguistic analysis with possible effects on language processing and language production

- **Lexicon**: argument structure but also psycholinguistic notions such as imageability; semantic features such as modality and associated concepts such as belief-predicates
- **Syntax** (clause or feature)
- **Discourse** (connected speech), e.g. iconicity in temporal relations

‘Before you leave, turn off the lights’ vs.

‘Turn off the lights before you leave’

Complexity and Language Development

- Measures of formal complexity mostly concern syntax
- **Complexity metrics** have been used to account for timing patterns in development (Tsimpli, 2014):
 - Relative clauses and wh- questions (Subject-Object asymmetry)
(Friedmann, Belletti and Rizzi, 2009; Frauenfelder et al, 1980; Grillo, 2008)
 - Subordination – Coordination
(Serratrice et al, 2011, Tsimpli et al 2011)
 - Clitics vs. strong pronouns
(Jakubowicz 1998, Tuller et al 2011)

Linguistic Complexity: Delays and Vulnerability

- Monolingual children: Developmental delays in ‘complex’ areas of language
- Bilingual children: delays depending on *crosslinguistic influence* in language development (*facilitation* or *inhibition*)
 - language *proximity/distance* (Grohmann, 2014) and/or the bilingual’s *proficiency* in each language

Linguistic Complexity: are non-verbal cognitive skills relevant?

- Working memory (crucial for storage and processing)
 - General intelligence
 - Executive control (cognitive functions important for controlling attention resources, inhibition, decision-making and action): **structural ambiguity** and the role of executive functions (Novick et al 2014)
-
- Linguistic complexity at the **discourse** level: Coherence in connected speech (narratives) requires an understanding of linguistic, *cognitive* and social domains (Tager-Flusberg et al., 1995)
 - **Reference management** and tracking: a prime measure of coherence

Complexity in syntax vs. reference tracking

- Are there differences in linguistic complexity between bilingual and monolingual children's grammars?

- If so, what are the causes:

in syntax?

in reference tracking?

- Data from monolingual and bilingual children's narrative production
- Additional factors considered: **language 'distance'** (Greek-Albanian/ Greek-English / Greek-German) and **non-verbal cognitive** skills.

Syntactic Complexity

Measure of complexity:
frequency and *diversity* of complex over simple sentences

(Banney et al. 2015)

frequency and *diversity* of different types of subordinate clauses (Tsimpli et al 2016)



ORIGINAL RESEARCH
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Syntactic and Story Structure Complexity in the Narratives of High- and Low-Language Ability Children with Autism Spectrum Disorder

Eleni Peristeri^{1*}, Maria Andreou² and Ianthi M. Tsimpli³

¹ Language Development Lab, Department of English Studies, Aristotle University of Thessaloniki, Thessaloniki, Greece, ² Department of English, School of Arts and Humanities, University of Cologne, Cologne, Germany, ³ Department of Theoretical and Applied Linguistics, University of Cambridge, Cambridge, United Kingdom

Although language impairment is commonly associated with the autism spectrum disorder (ASD), the Diagnostic Statistical Manual no longer includes language impairment as a necessary component of an ASD diagnosis (American Psychiatric Association

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Narrative production in monolingual and bilingual children with specific language impairment

IANTHI MARIA TSIMPLI
Aristotle University of Thessaloniki and University of Reading

ELENI PERISTERI and MARIA ANDREOU
Aristotle University of Thessaloniki

ADDRESS FOR CORRESPONDENCE
Ianthi Maria Tsimpli, School of English, Department of Theoretical and Applied Linguistics, Aristotle University of Thessaloniki, Thessaloniki 54124, Greece. E-mail: imt@ent.auth.gr or i.m.tsimpli@reading.ac.uk

ABSTRACT
The aim of this study was to identify potential clinical markers of specific language impairment (SLI) in bilingual children with SLI by using the Greek version of the Multilingual Assessment Instrument for Narratives. Twenty-one Greek-speaking monolingual and 15 bilingual children with



Bilingualism, biliteracy and syntactic complexity:
the role of crosslinguistic influence and cognitive skills

Maria Andreou¹ & Ianthi Tsimpli²
¹University of Cologne & ²University of Cambridge

Abstract

Language abilities in bilingual development have frequently been measured through vocabulary. However, vocabulary is causally linked to input quantity which is typically lower in bilinguals (Bialystok, 2010; Smith and Murphy, 2015). Syntactic or morpho-syntactic skills, on the other hand, usually reveal a different proficiency profile in bilinguals compared to vocabulary measures (Siu and Ho, 2015). Testing grammar skills requires selecting one or more phenomena or using standardized assessment measures for monolingual children. Our study focuses on syntactic complexity (SC) in language production as a measure of language ability in bilinguals. SC can be defined as the frequency and diversity of complex over simple sentences (Banney et al., 2015), with further distinctions between types of subordinate clauses, namely relative, adverbial and complement clauses (Tsimpli et al., 2016). Narrative production offers a sizeable set of individual data to measure syntactic complexity. Thus, the aim of our study by using oral narratives is to investigate the effect of bilingualism,

Participants (n=282)

- Bilingual children, **8-12** yrs old, with Greek as one of the two languages
- **Greek-English** (in Greece and in the UK) **N=67**
- **Greek-German** (in Greece and in Germany) **N=140**
- **Greek-Albanian** (in Greece and in Albania) **N=75**

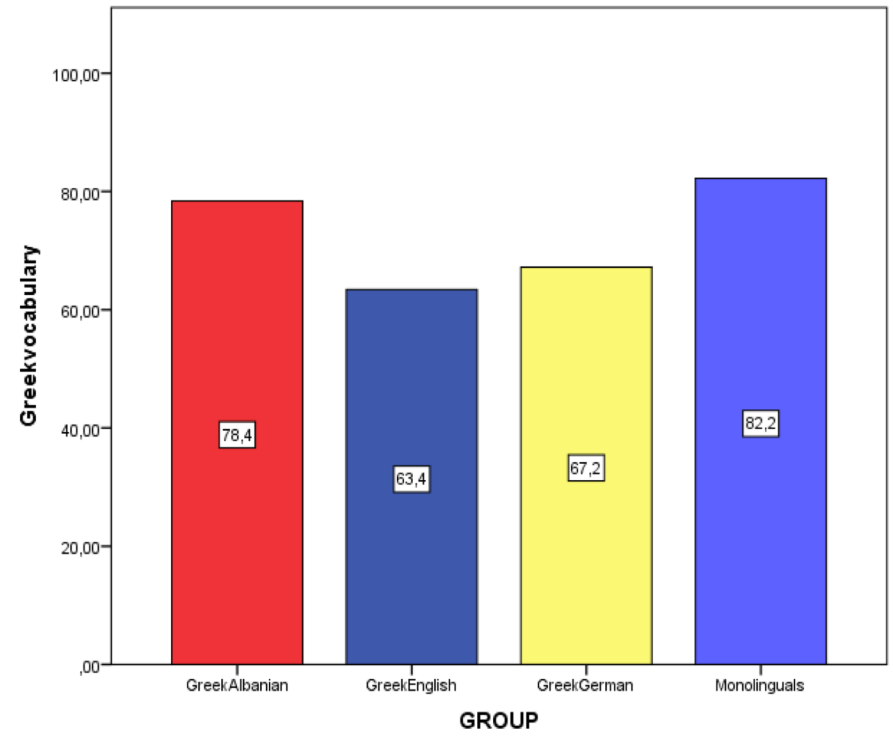
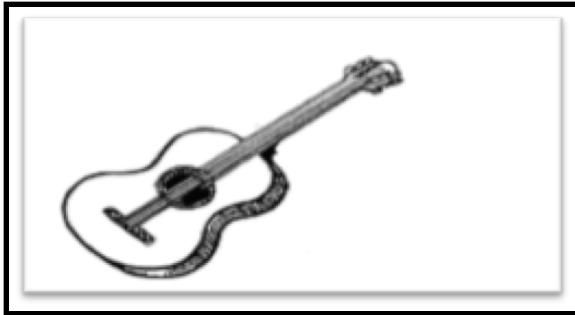
Andreou, M. & Tsimpli, I.M. (in press) Bilingualism, biliteracy and syntactic complexity: the role of crosslinguistic influence and cognitive skills. *Language Acquisition, Processing and Bilingualism, TRT7*



Bilingual Acquisition & Bilingual Education: The Development of Linguistic & Cognitive Abilities in Different Types of Bilingualism

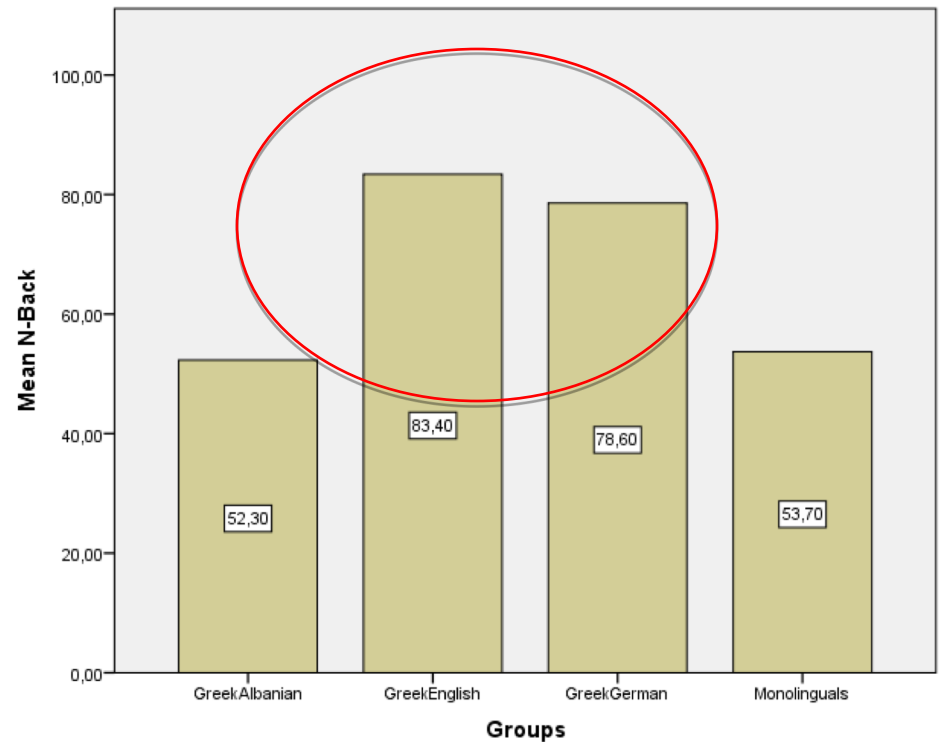
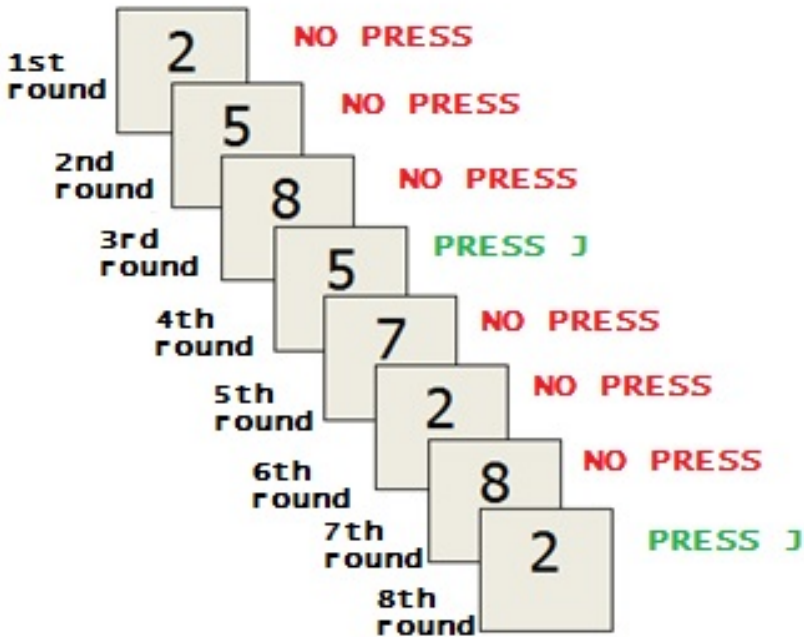
Proficiency in Greek (Expressive Vocabulary)

Standardized adaptation of
Renfrew (Vogindroukas et al 2009)



MLs & Greek-Albanian >
Greek-English & Greek-German

Cognitive skills: Updating (2-back)

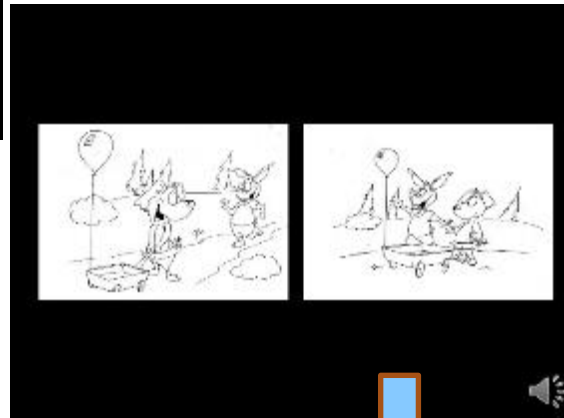


Press a button if the current digit matches a digit presented 2-digits back

Narrative Production: ENNI (Edmonton Normed Narrative Instrument)– Schneider, Dubé & Hayward, 2005

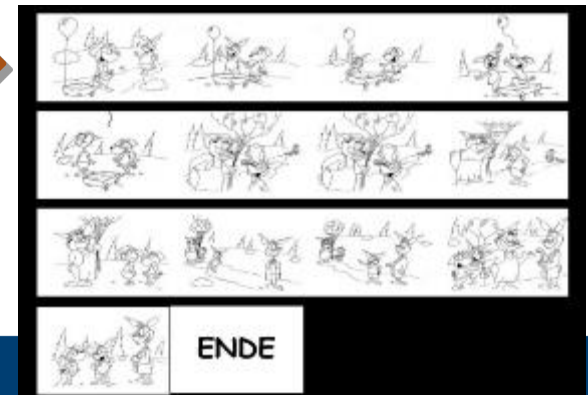


1. Child looks at computer screen and chooses one envelop



2. Child looks at pictures two by two and listens to the story

3. Child retells the story to an uninformed listener



Measures of syntactic complexity

Frequency of:

Complex sentences include clause coordination and/or subordination vs. *simple* sentences (monoclausal)

Subordinate clauses over total number of *complex sentences*

Diversity in subordination:

Adverbial clauses: Temporal and causal

Relative clauses: Subject and Object RCs

Complement clauses: Subjunctive, Indicative, Factive

Complement clauses

Theli na vutisi mesa stin pisina

‘(She) wants to dive in the swimming pool’

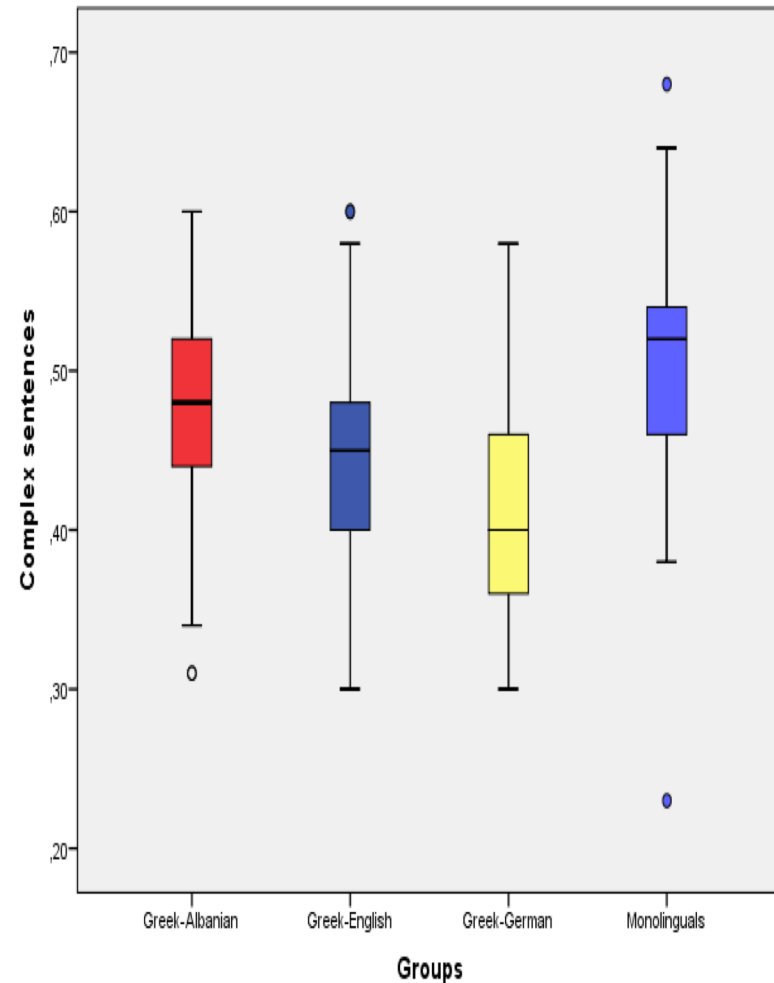
Idhe oti to aeroplanaki epese stin pisina

‘(She) saw that the airplane fell in the swimming pool’

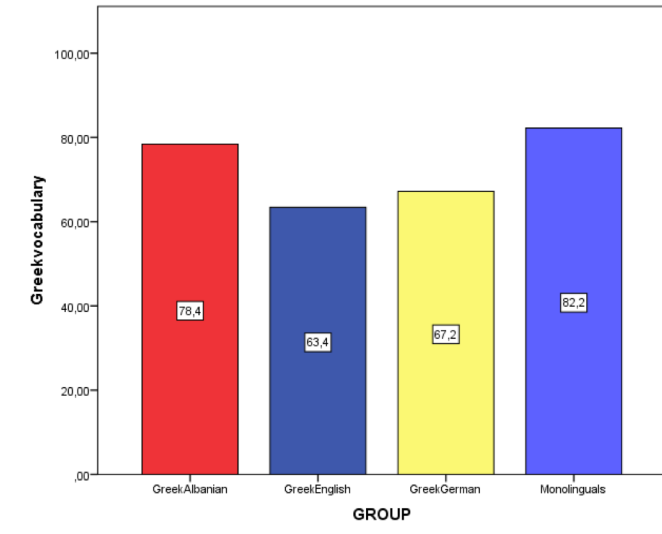
Harike pu pire to aeroplanaki

‘(She) was happy that she took back the aeroplane’

Frequency of Complex Sentences

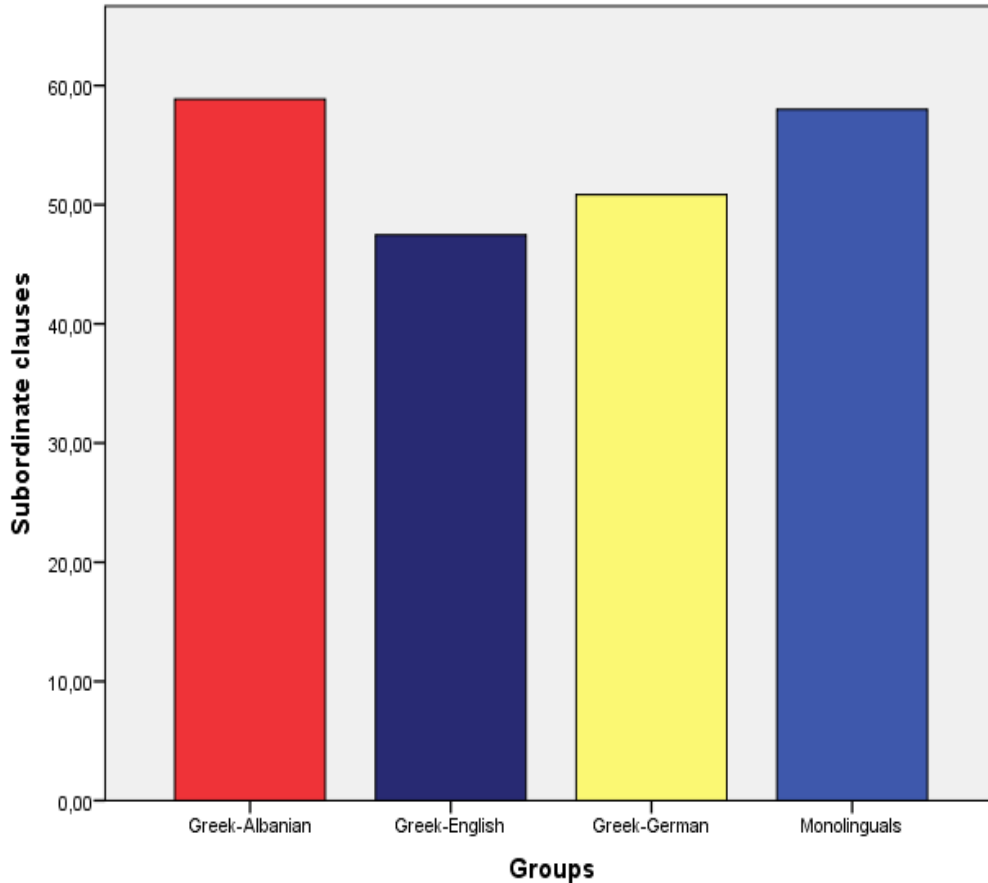


Vocabulary

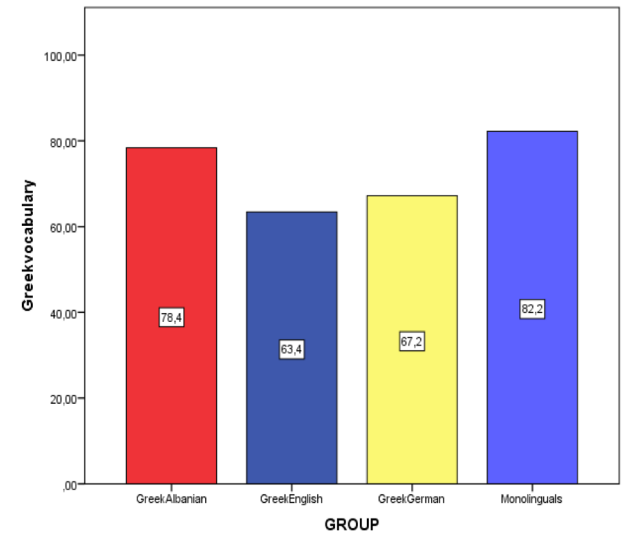


Greek-Albanian & Greek monolinguals use more complex sentences than the Greek-German and the Greek-English children.

Frequency of Subordinate clauses



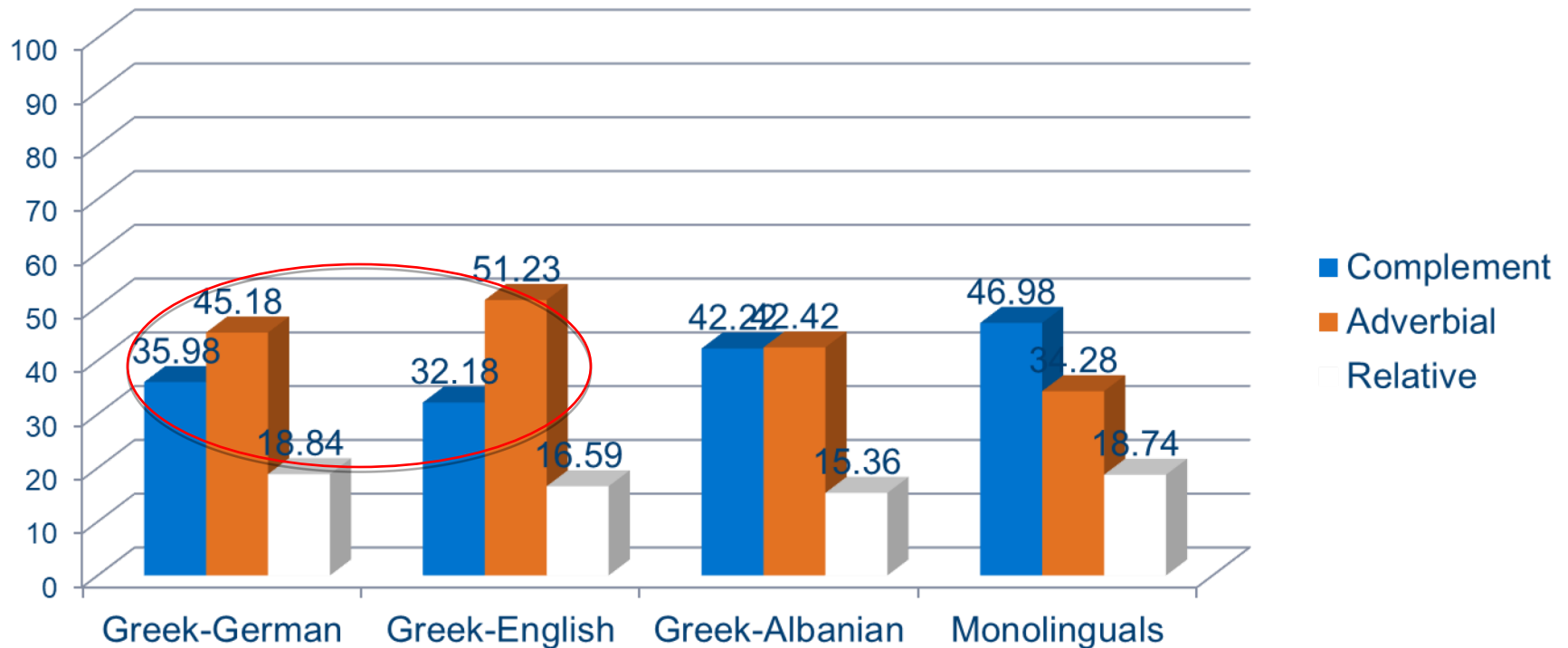
Vocabulary



Greek-German & Greek-English use fewer subordinate clauses

($p = .038$ and $p = .000$ for Greek-Albanian
 $p = .009$ and $p = .007$ for Greek monolinguals)

Frequency of Complement, Adverbial & Relative clauses (%)



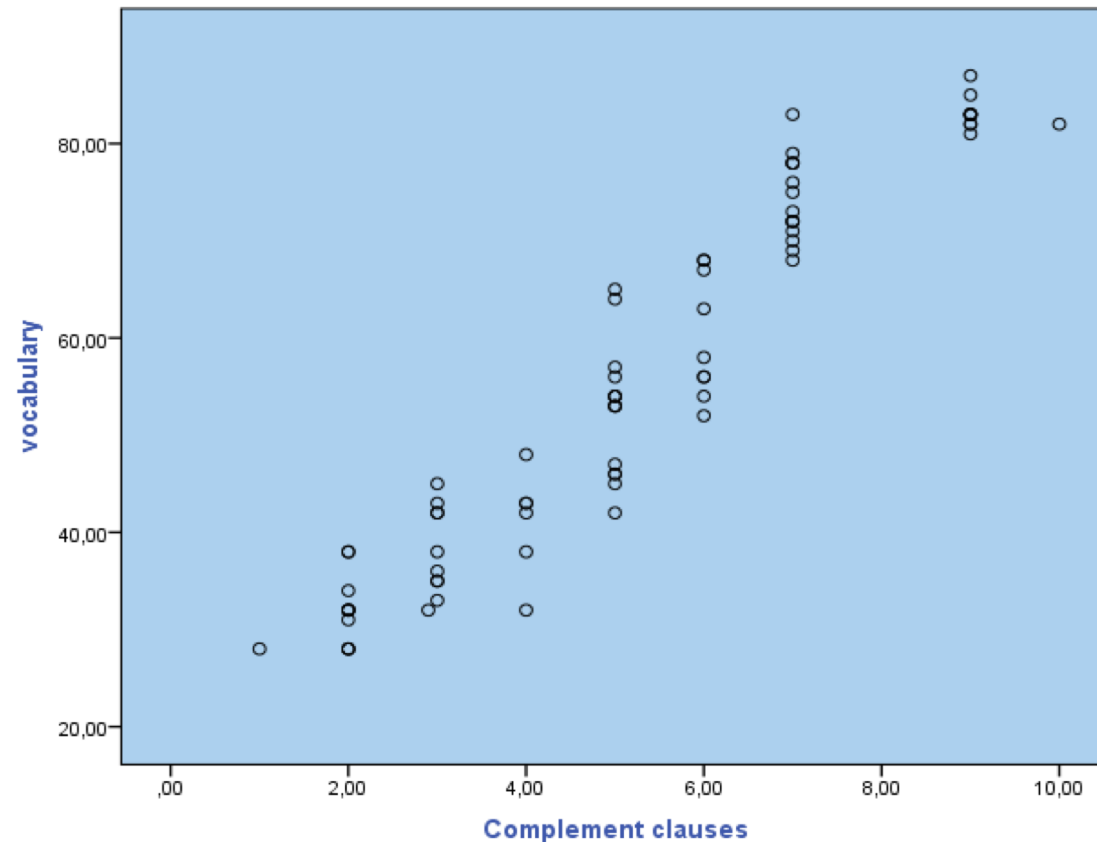
German and English bilinguals use significantly more adverbial clauses

($p = .028$ and $p = .038$ for Greek monolinguals
 $p = .029$ and $p = .035$ for Greek-Albanian)

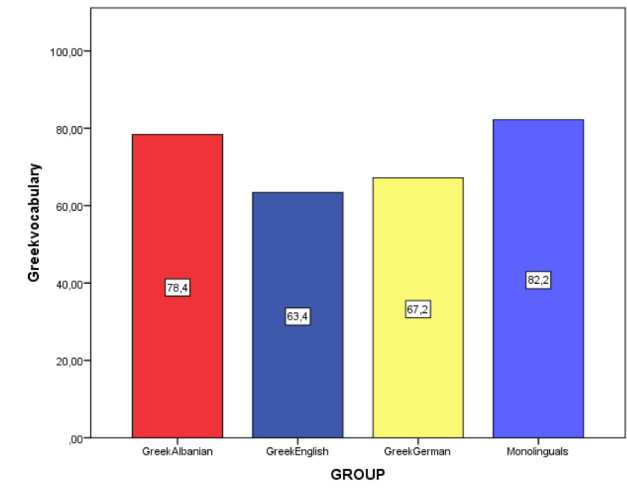
Complement, Adverbial & Relative clauses (raw numbers)

Groups	Complement	Adverbial	Relative
Greek-German (N=140)	Mean:4 Total:560	Mean:6 Total:840	Mean:2 Total:288
Greek-English (N=67)	Mean:3 Total:201	Mean:7 Total:469	Mean:2 Total:134
Greek-Albanian (N=75)	Mean:6 Total:450	Mean:5 Total:375	Mean:2 Total:150
Monolinguals (N=70)	Mean:7 Total:490	Mean:4 Total:280	Mean:2 Total:145

Age, Proficiency, 'Other' language or Cognitive skills: predictors of Complement clause frequencies

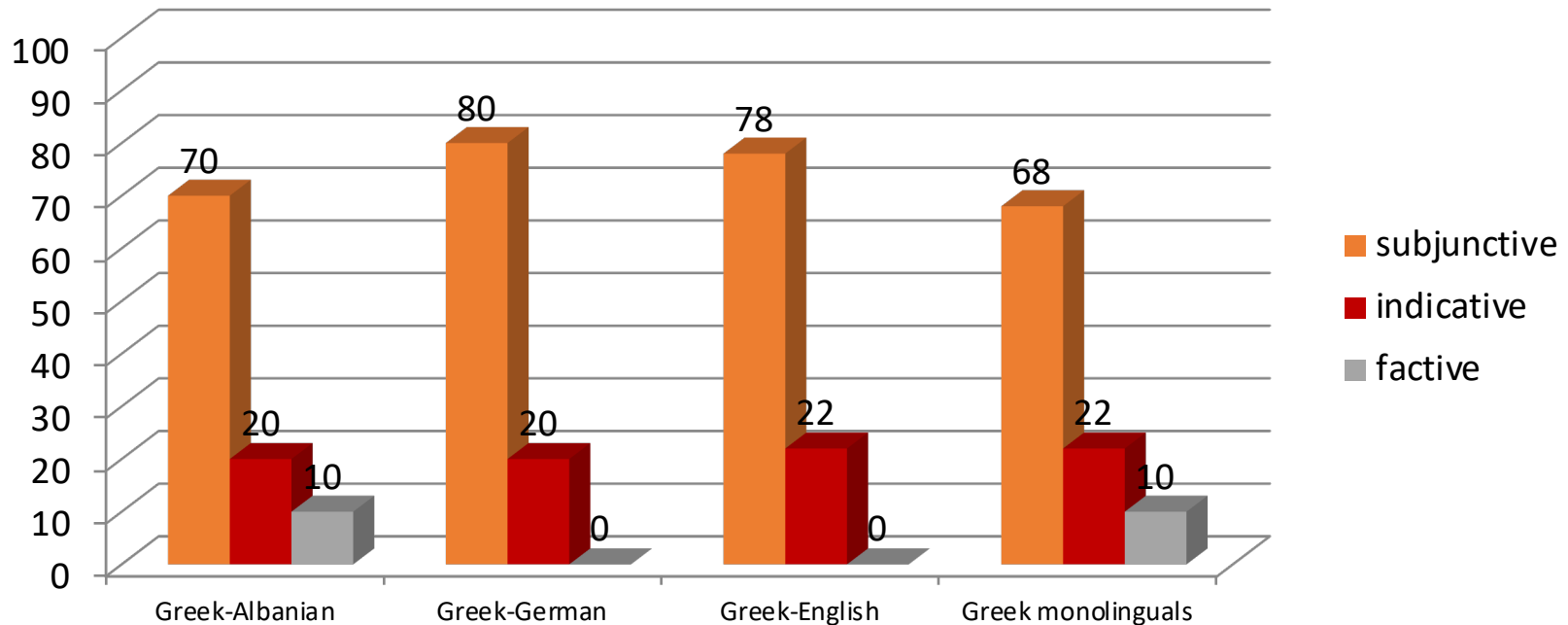


Vocabulary



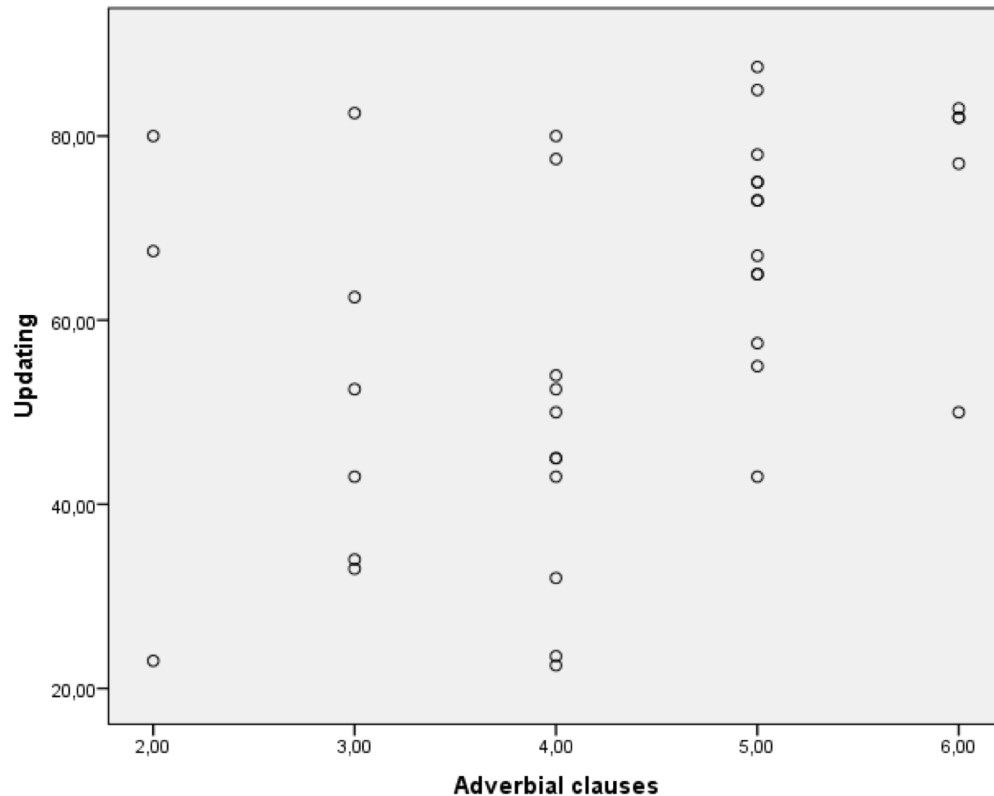
- The strongest predictor of complement clauses is vocabulary [$R^2 = .302$, $F(3,208) = 7.996$, $p = .007$]

Diversity of Complement clauses

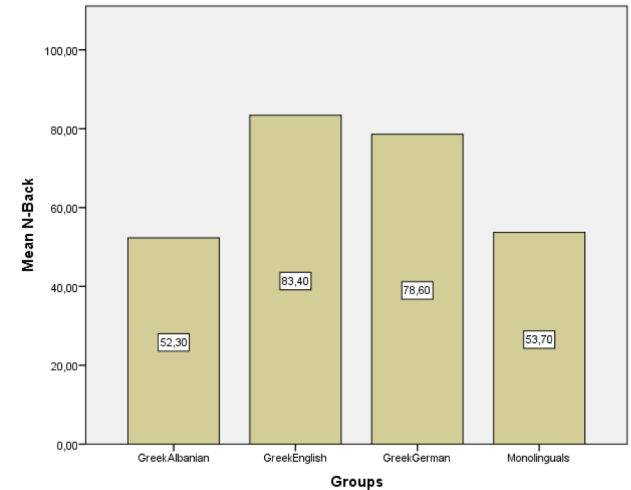


- No significant differences among groups

Age, Proficiency, Other language or Cognitive skills: predictors of Adverbial clause frequencies

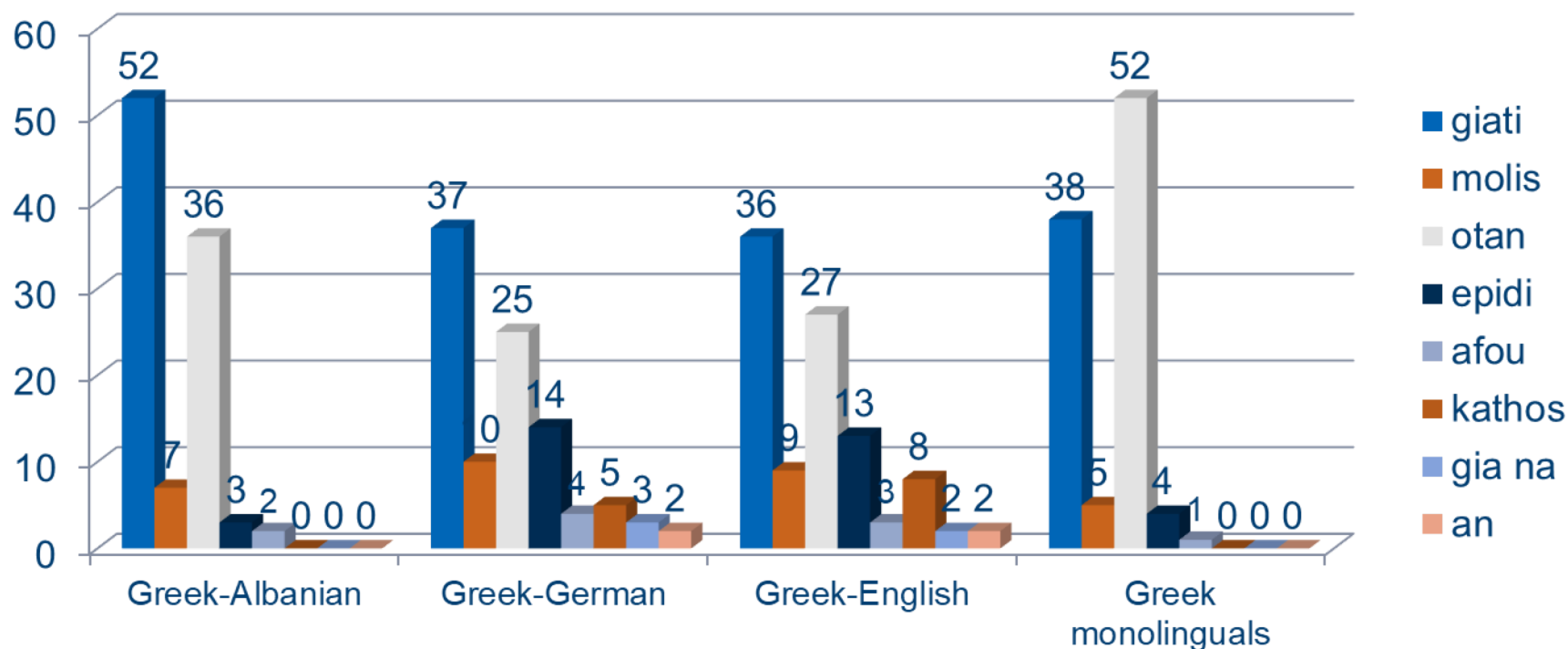


Updating



- The stronger predictor of adverbial clauses is **updating** [$R^2 = .411$, $F(3,208) = 8.992$, $p < .001$; $\beta = .422$]

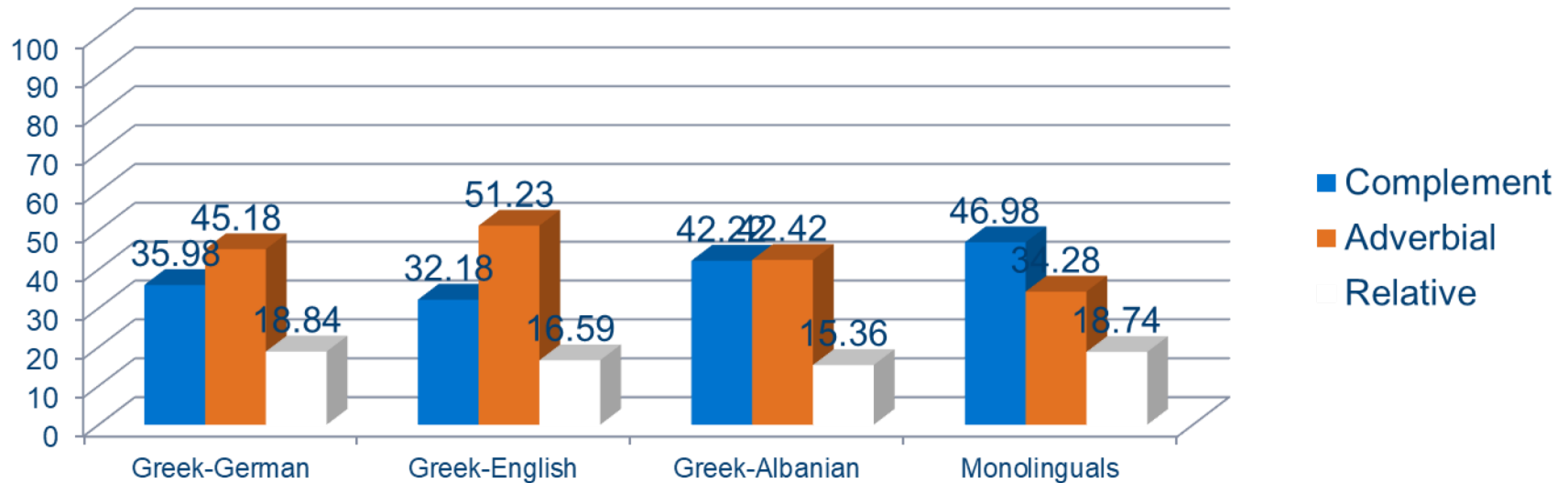
Diversity of adverbial clauses



Greek-German & Greek-English = same performance & more diversity

Greek-Albanian & Greek-monolinguals almost similar performance

Relative clauses are the least frequent



Object relative clauses are **avoided** only by German and English bilinguals

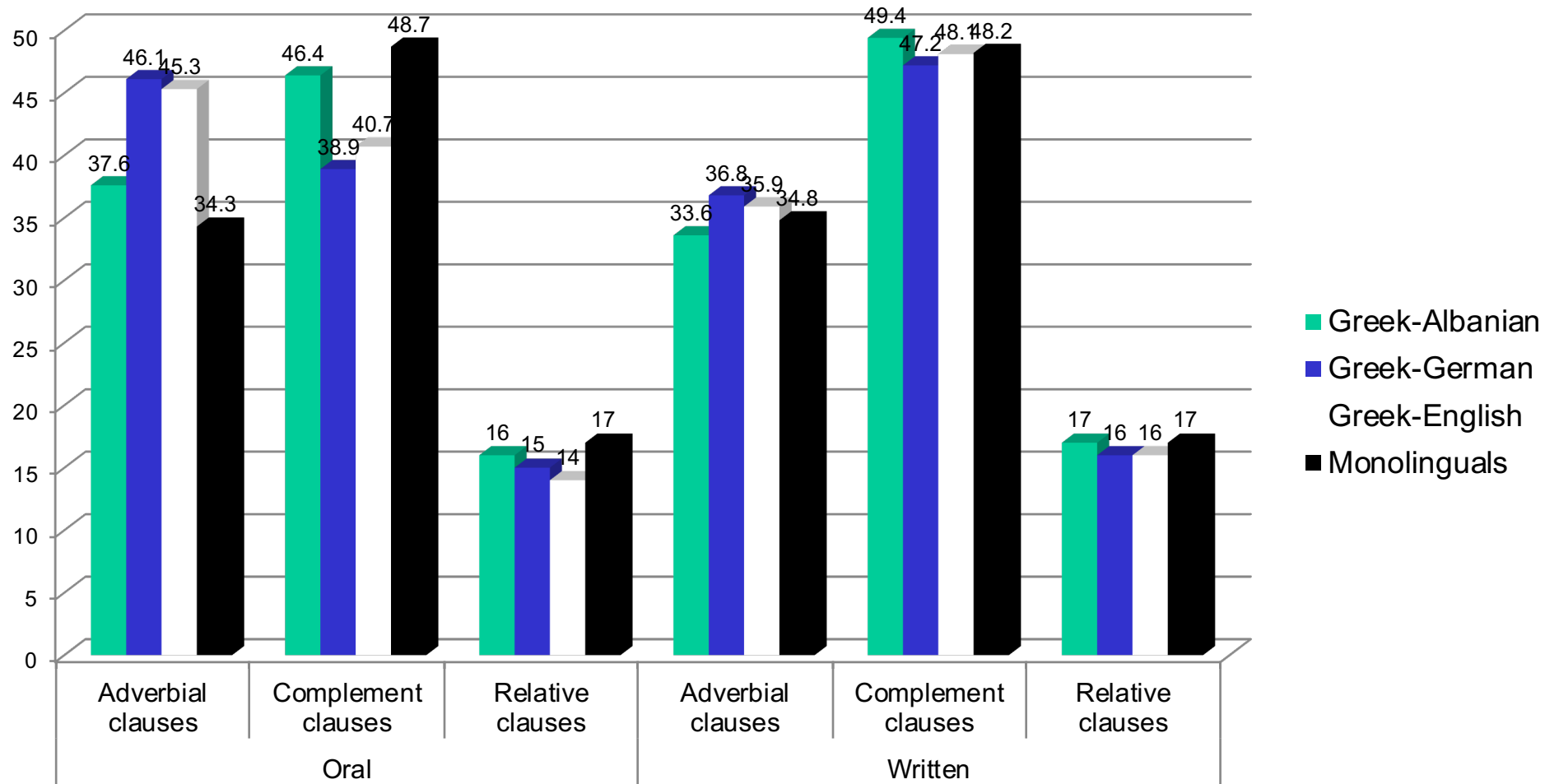
	subject	object
Greek-Albanian	Mean:0,8	Mean:1,2
Greek-German	Mean:1,1	Mean:0,9
Greek-English	Mean:1,3	Mean:0,7
Monolinguals	Mean:0,6	Mean:1,4

Interim Summary: syntactic complexity

- Bilingual groups produce more adverbial and fewer complement clauses overall compared to monolingual children
 - Complement clauses predicted by proficiency (vocabulary)
 - Adverbial clauses predicted by cognitive skills (updating)
- Bilinguals may resort to different but not less complex structures than monolinguals

NB: Written vs. oral language production in bilinguals

Frequency of Complement, Adverbial & Relative clauses (%)



Reference tracking: complexity at the interface

- Is **overspecification** of reference a characteristic of bilingual grammars?
- Is it an index of *reduced* cognitive resources? (Sorace, 2011)

Torregrossa, J., Andreou, M., Bongartz, C., Tsimpli, I. (under review) Bilingual acquisition of reference: The role of language experience, executive functions and cross-linguistic effects. *Bilingualism, Language and Cognition*.

Torregrossa, J., Bongartz, C. & Tsimpli, I. (2018). Bilingual reference production: A cognitive-computational account. *Linguistic Approaches to Bilingualism*.

BILINGUAL REFERENCE PRODUCTION

Serratrice (2007)

English-Italian bilinguals (8 y.o.)

Overspecification (full NPs vs. clitics) in character maintenance
in object position in Italian

Chen & Lei (2012)

Chinese-English bilinguals (9 y.o.)

Overspecification (full NPs vs. Null subjects) in character
reintroduction in Chinese

BILINGUAL REFERENCE PRODUCTION

Montrul (2004): underspecification

S1: Caperucita Roja salió

Little Red Riding Hood went out

S2: a ir a la casa de su abuelita con una canasta de comida

to go to her grandmother's house with a basket of food

S3: porque Ø estaba

because Ø was

S4: Ø iba a visistarla

Ø was going to visit her

S5: porque Ø estaba enferma.

because Ø was sick





(...) *The giraffe* sat on the side
and \emptyset watched

and *the elephant* wanted to jump into the water
ignoring a sign
that said 'no running'



And as *the elephant* was jumping off the edge of the
swimming pool

she slipped

and \emptyset fell

and \emptyset hurt *her* knee

She was sitting on the side of the swimming pool in
pain,

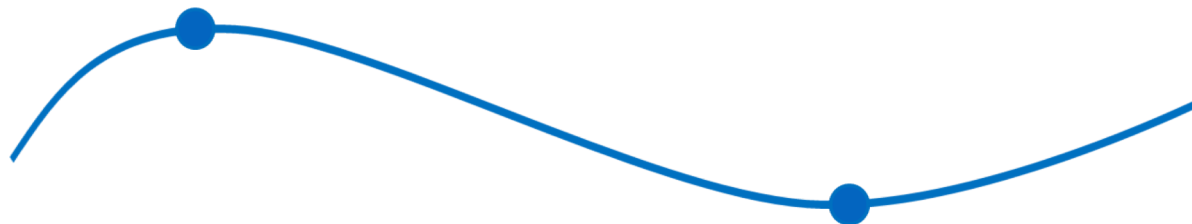
and *the giraffe* came running over behind



ACTIVATION OF A REFERENT

the more active a referent in discourse, the more reduced the referring expression used to refer to it (i.e., a pronoun instead of a full noun)

HIGH ACTIVATION → PRONOUNS



LOW ACTIVATION → FULL NOUNS

Participants (living outside Greece)

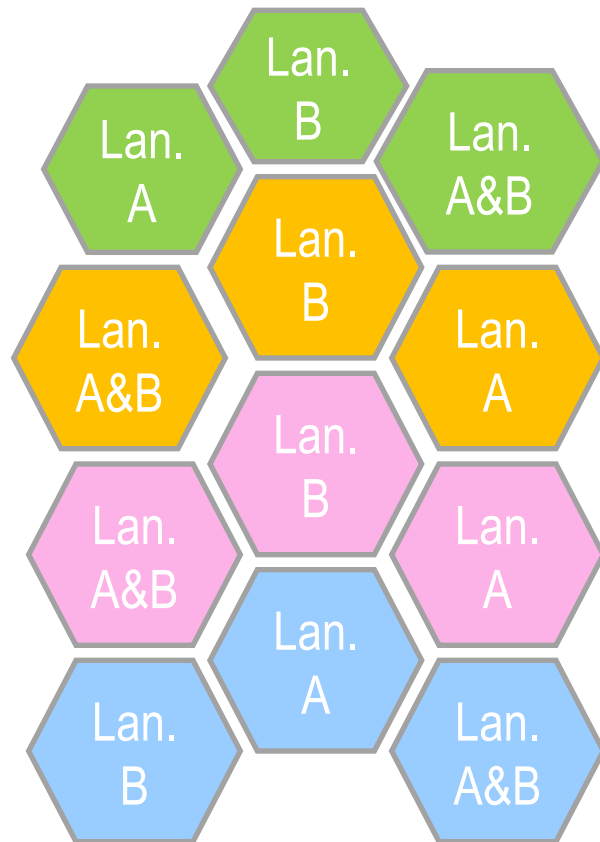
GROUP	N.	COUNTRY	AGE
Greek-Albanian	23	Albania	10.6 (8.7-13.1)
Greek-English	48	UK & USA	10.9 (7.2-13.1)
Greek-German	65	Germany	10.7 (8.3-12.8)
TOTAL	136		10.7 (7.2-13.1)

Bilingual Index Score (BIS)

- Based on:
 - the difference between **vocabulary** scores in each language (dependent variable showing *language proficiency*)
 - Input* in each language in preschool and school years
 - Schooling* in each language
- BIS is an index of *language dominance & proficiency*

Linguistic proficiency component + an external component (input) + a functional component (context of use) (Montrul, 2015)

Bilingual Index Score (BIS): a gradient and continuous component



HOME LANGUAGE HISTORY

Language input/output before age 6

EARLY LITERACY

Shared book-reading

CURRENT LITERACY

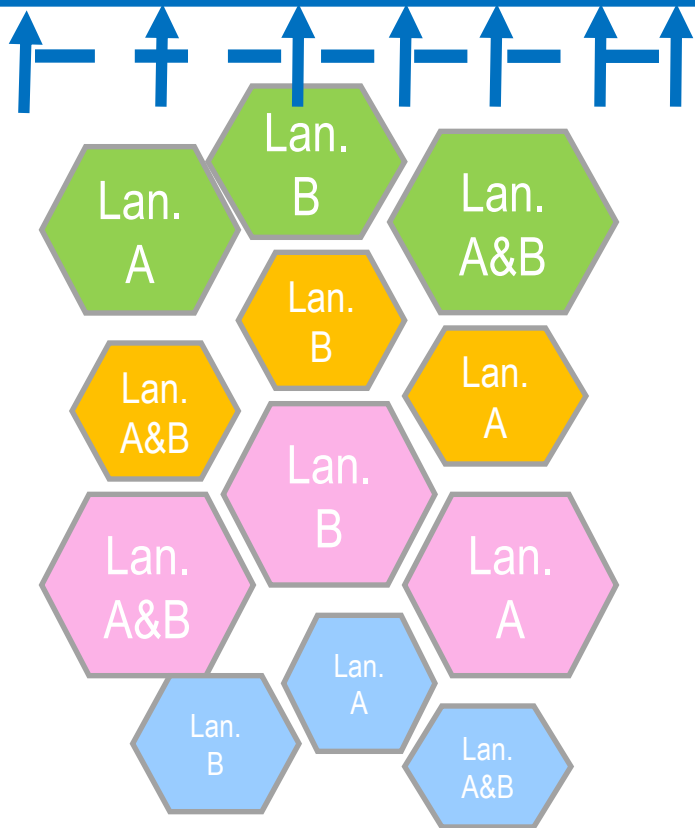
School, reading, language courses

CURRENT LANGUAGE USE

Family, friends, hobbies ...

Bilingual Index Score (BIS)

DIFFERENCE IN VOCABULARY



HOME LANGUAGE HISTORY

weight: .30

EARLY LITERACY

weight: .17

CURRENT LITERACY

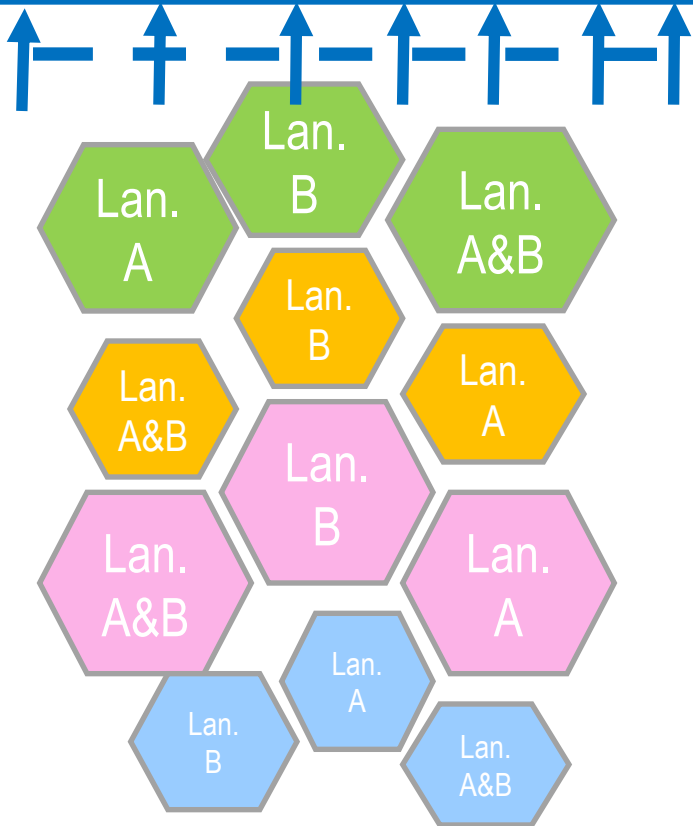
weight: .22

CURRENT LANGUAGE USE

weight: .07

Bilingual Index Score (BIS)

DIFFERENCE IN VOCABULARY



HOME LANGUAGE HISTORY

$.30 \times -.81$

EARLY LITERACY

$.17 \times -.75$

CURRENT LITERACY

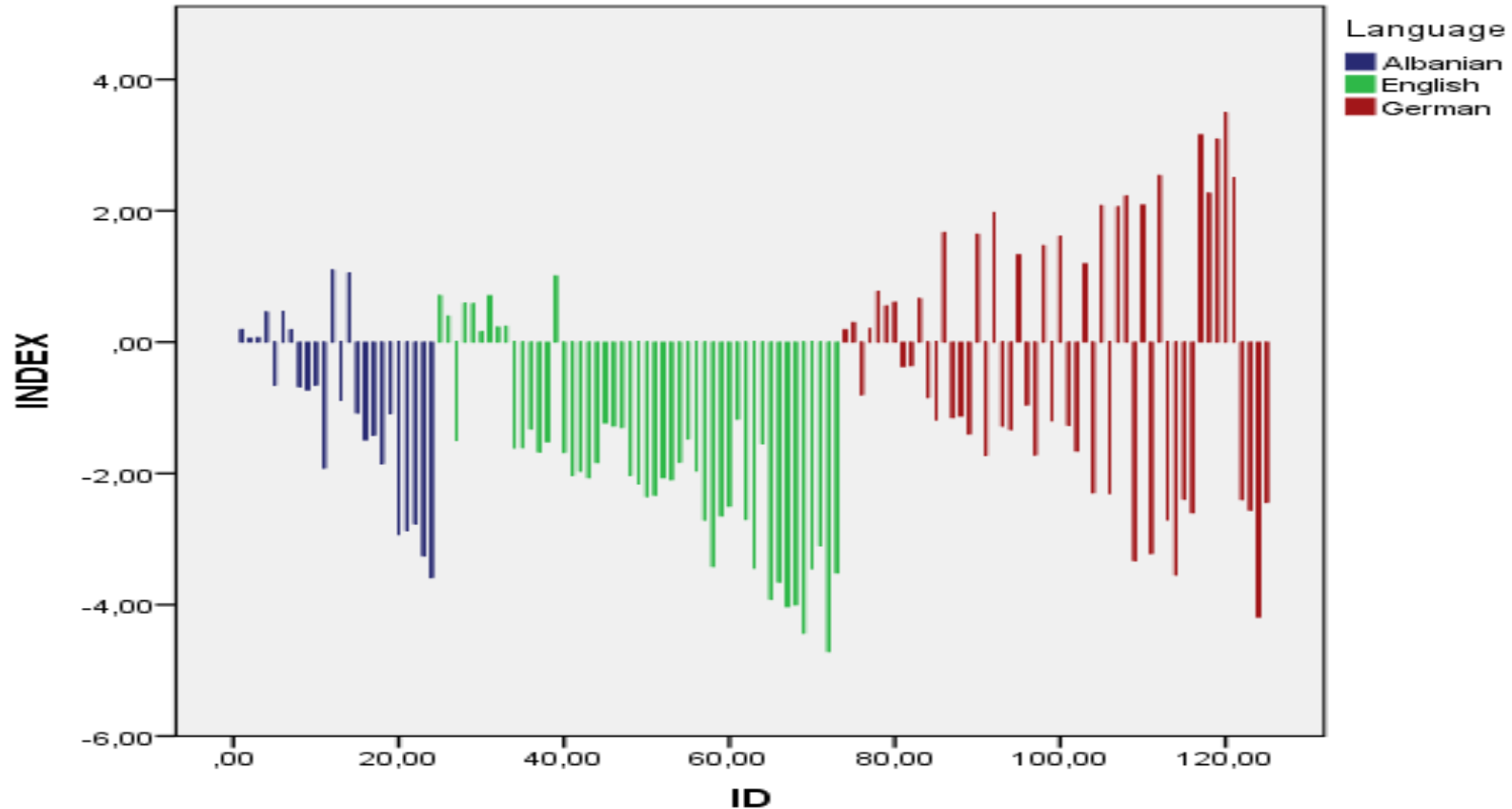
$.22 \times -.21$

CURRENT LANGUAGE USE

$.07 \times -.36$

$= -.44$

BILINGUAL INDEX SCORE (BIS)



Distribution of BIS across participants

DOMINANCE

GROUP	Dominant in GREEK	Dominant in the OTHER language
Greek-Albanian	8	16
Greek-English	9	40
Greek-German	28	24

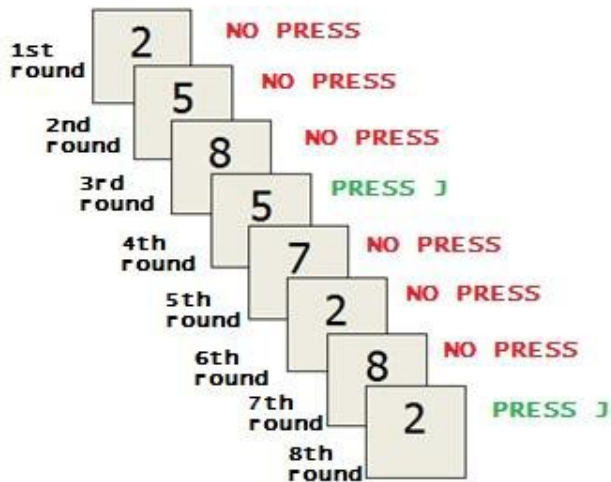
Socio-Economic Status & Cognitive skills

SES:

Parents' educational level (5 point scale)

[1 = primary education; 5 = post-graduate education]

Complex working memory / updating:



Referent activation: Distance & number of intervening characters

U1: The giraffe sat on the side.

U2: The elephant jumped into the water.

U3: he slipped

U4: The giraffe ran to him.

DISTANCE & INTERVENING CHARACTERS

U1: The giraffe sat on the side.

U2: The elephant jumped into the water.

U3: he slipped

3 CLAUSES DISTANCE
1 INTERVENING CHARACTER

U4: The giraffe ran to him.

OVERSPECIFICATION

The use of a definite DP or an overt pronoun where the use of a null pronoun or a clitic would be appropriate.

[...] and *the female dog* cried: „Oh! My favorite balloon!“. And then *the female dog/she* looked angry at the rabbit.

[...] *The rabbit* ran fast to take a balloon, but *the old rabbit* said *to the rabbit*.

Analysis

- Normalization for the total number of character mentions (narratives of different length).
- Regression analysis including the bilingual index score (BIS) with:
 - Overspecified REs

Data overview

TYPE OF REFERRING EXPRESSION	FREQUENCY	MEAN
<i>Full DPs</i>	901	7.20
<i>Null</i>	1039	8.31
<i>Clitics</i>	138	1.10
<i>Overt pronouns</i>	54	0.43

OVERSPECIFICATION with BIS ≥ 0 (N: 45), Greek-dominant bilingual children

Hierarchical regression

EFs \rightarrow language combination \rightarrow language experience

Model 1 (EFs)	$R^2 = .21$ ($r = -.46^{**}$)
Model 2 (language combination/distance)	$R^2 = .30$ (+9)
Model 3 (Language experience)	--

- Only **EFs** and **language combination** are significant predictors

- Greek-German children overspecify more than the other two groups

OVERSPECIFICATION with BIS < or = 0 (N: 45), children dominant in the 'other' language

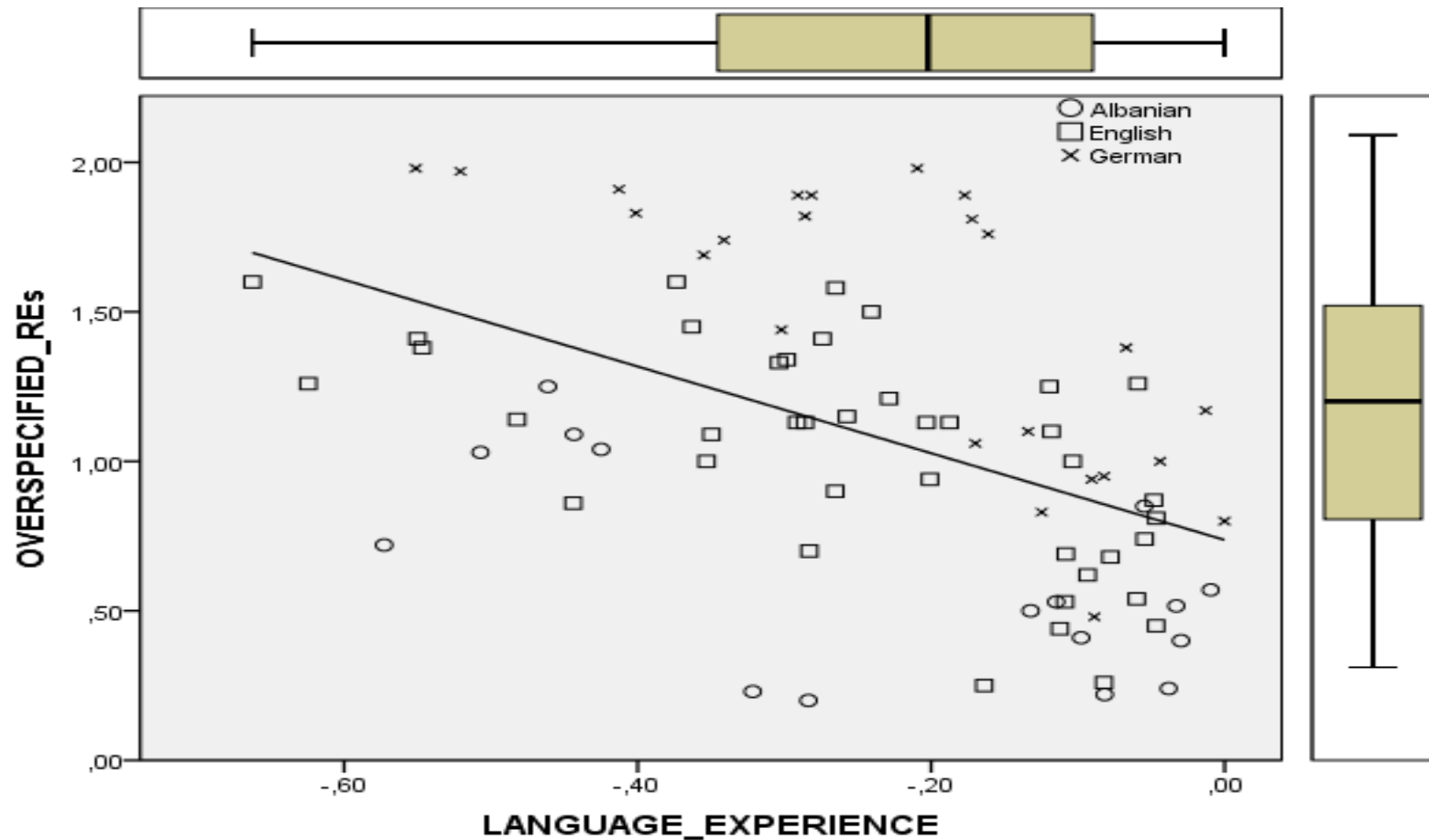
Model 1 (EFs)	$R^2 = .33$ ($r = -.57^{**}$)
Model 2 (language combination)	$R^2 = .45$ (+12)
Model 3 (Language experience)	$R^2 = .66$ (+21) ($r = -.49^{**}$)

EFs, language combination but also language experience accounts for an additional 21% of variance

- Greek-Albanian < Greek-English < Greek-German

OVERSPECIFICATION

(with $BIS \leq 0$) (i.e. children dominant in the 'other' language)



Summary

Overspecification in reference is an effect of:

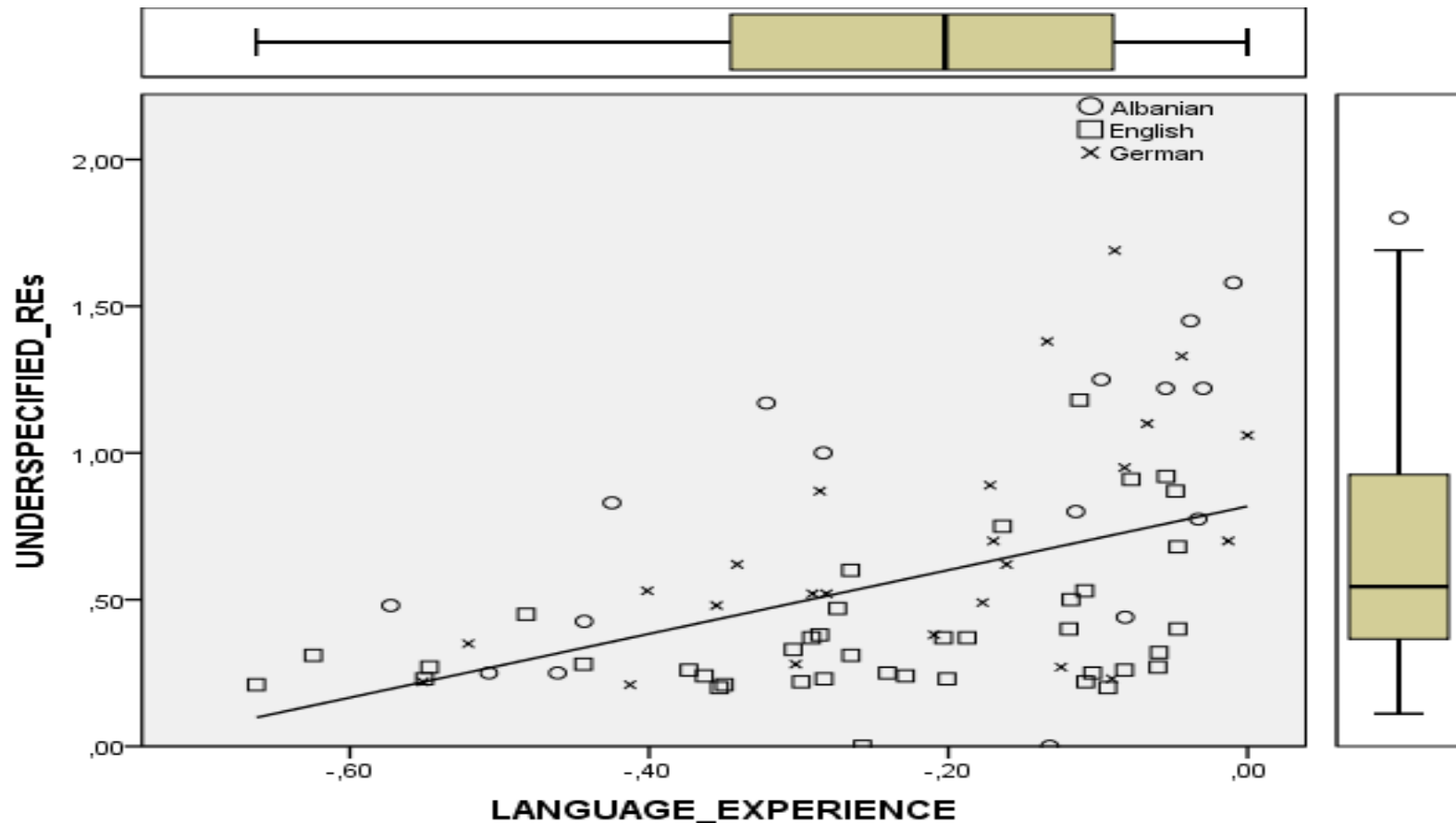
Lower cognitive control

Language combination

Greek-Albanian < Greek-English < Greek-German

Language input in the weak language (for bilinguals dominant in the 'other' language)

UNDERSPECIFICATION (ambiguity) (with $BIS \leq 0$) (i.e. children dominant in the 'other' language)



UNDERSPECIFICATION (with $BIS \leq 0$) (i.e. children dominant in the 'other' language)

UNDERSPECIFICATION with $BIS \leq 0$ (N: 80)

Model 1 (EFs)	--
Model 2 (language combination)	--
Model 3 (Language experience)	$R^2 = .21$ ($r = .47^{**}$)

Language experience makes the only significant contribution to the model

-- Underspecification is an effect of 'balanced' bilingualism

Back to the question

Complexity in syntax:

- Bilingual grammars show a distinction between complement and adverbial clauses (both 'complex')
- Language ability for complement clauses vs. cognitive skills for adverbial clauses

→ Complexity cannot be solely defined on formal linguistic grounds

NB: Linguistic theory does not seem to distinguish between complement and adverbial clauses in terms of complexity

Complexity in syntax-discourse: Reference tracking

Overspecification always depends on cognitive skills and partly on language combination/distance

Underspecification is something found mostly in ‘balanced’ bilingualism (a proficiency issue)

→ Reference tracking in syntax-discourse depends on both language and cognitive skills

Linguistic complexity

Bilingual children's grammars are not less complex than monolingual grammars

→ **But, is there a construct for *Linguistic Complexity*?**

Thank you for your attention!