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Exploring lexical profiles of bilingual Lebanese children using the LITMUS-CLT in Lebanese Arabic.

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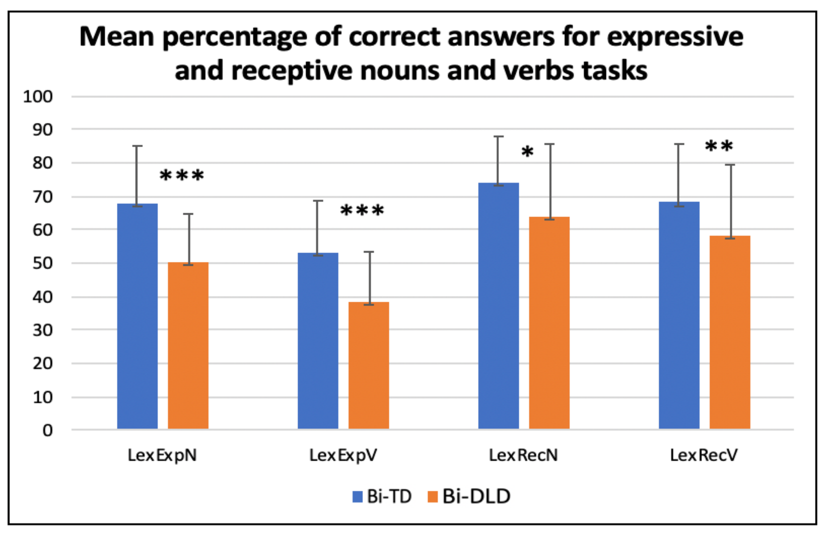
Introduction

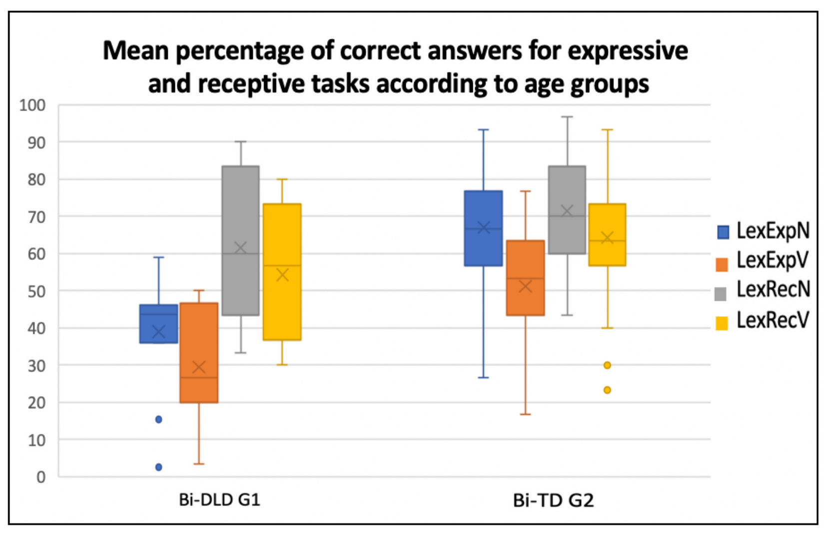
Lebanon is known for its rich multilingual context in which Lebanese children are often exposed to more than one language starting at a very young age (Bahous & al., 2011) The use of specific evaluation tools in this multilingual setting is important for a better identification of typically developing Lebanese bilingual children (Bi-TD) and bilingual children with a developmental language delay (Bi-DLD) (Thordardottir & al., 2013).

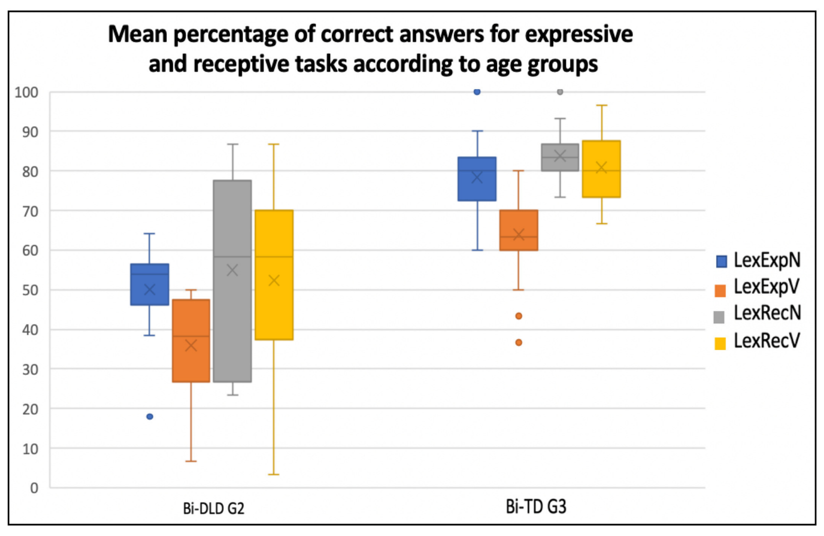
Aim of the study

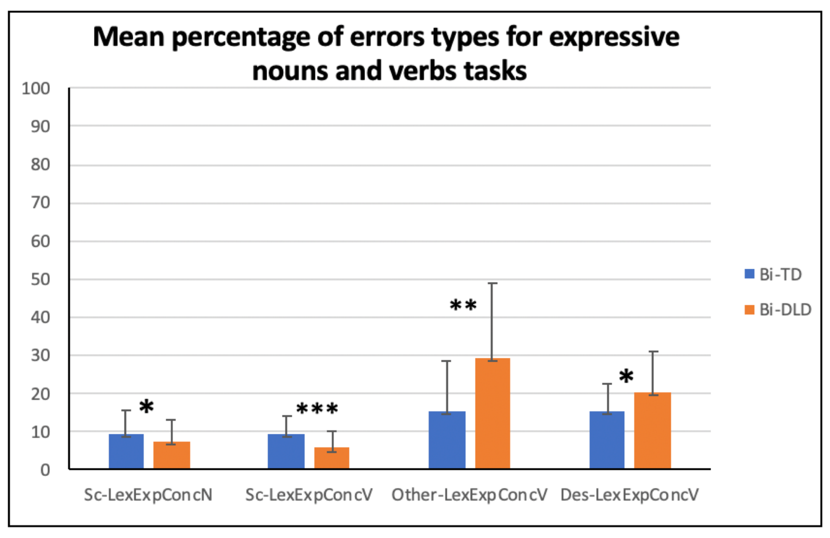
- Explore and compare lexical abilities of Lebanese Bi-TD and Bi-DLD children.
- Analyze naming errors in Lebanese Bi-TD and Bi-DLD children.
- Study the use of language according to age groups and grammatical word classes in Lebanese Bi-TD children.
- Examine vocabulary growth in one language according to the amount of exposure to languages.

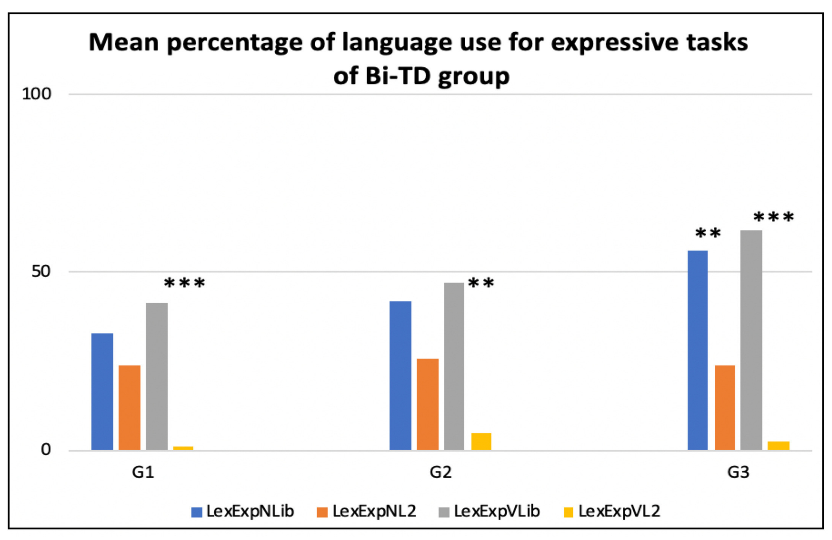
Results











Bi-TD	LexExpN-Lib	LexExpN-Fr	LexExpV-Lib	LexExpV-Fr
IRL-Lib	r_s= 0,298* p< 0,05	r_s= -0,334* p< 0,05	r_s= 0,201 p= 0,133	r_s= -0,257 p= 0,054
IRL-Fr	r_s= -0,319* p< 0,05	r_s= 0,367** p< 0,01	r_s= -0,234 p= 0,08	r_s= 0,202 p= 0,132

Bi-DLD	LexExpN-Lib	LexExpN-Fr	LexExpV-Lib	LexExpV-Fr
IRL-Lib	r_s= 0,189 p= 0,484	r= -0,225 p= 0,403	r= 0,575* p< 0,05	r_s= -0,691** p< 0,01
IRL-Fr	r_s= -0,176 p= 0,513	r= 0,320 p= 0,226	r= -0,398 p= 0,127	r_s= 0,585* p< 0,05

Conclusion

Specific bilingual lexical assessment → Litmus-CLT (LB) is an assessment tool that contributes in identifying Bi-DLD children → Better diagnosis in the multilingual Lebanese context

Methods

Participants

Age groups	Bi-TD					Bi-DLD				
	N	*M*	*ET*	*Min.*	*Max.*	*N*	*M*	*ET*	*Min.*	*Max.*
G1	34	3;6	0;3	3;1	3;11	11	4;7	0.3;3	4;0	4;11
G2	42	4;6	0;4	4;0	4;11	13	5;7	0.4;3	5;3	5;11
G3	42	5;6	0;3	5;0	5;12	14	6;7	0.5;3	6;0	7;11
N	118	4;6	1;3	-	-	38	5;7	1;3	-	-

Material

Standardized tests :

- Lebanese language test: ELO-L
- French sub-test: ELO
- Raven matrices
- Questionnaire for Parents of Bilingual Children (PaBiQ)

LITMUS-CLT (Lebanese Version, Saliby et al., 2015) : Expressive (LexExp) and Receptive (LexRec) lexicon tasks (nouns "LexExpN", "LexRecN " and verbs "LexExpV", "LexRecV".

Discussion

Bi-TD group show better results in expressive lexicon tasks than the Bi-DLD group *(Kambanaros et al., 2013)*

Bi-TD G1(M=3;6) show better results in expressive lexicon tasks than age matched Bi-DLD G1 (M=4;0).

Lexical development of Bi-TD G3 (M=5;6) is faster than age matched Bi-DLD G3 (M=5;7).

Naming errors are found in both groups but vary in type and quantity. This shows under-elaborated semantic representations in Bi-DLD children (when naming verbs). *Saliby et al., 2017).*

Language use varies from one grammatical class to another *(Saliby et al., 2017).*

The amount of language exposure in one language affects vocabulary growth in this same language *(Hoff et Core, 2013).*

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Code-switching and gender assignment: asymmetrical gender systems

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Introduction

In code-switching research, most studies on gender assignment (GA) investigate the incorporation of nouns without gender (ex. English) in a language with grammatical gender (ex. Spanish). Two main GA strategies have been discerned:

- analogical gender assignment
- default gender

If both languages have grammatical gendera third strategy arises. Since the embedded noun is equipped with a gender feature, agreement can proceed as usual. This has been observed for Romance-Germanic language pairs (Cantone and Müller, 2008; Treffers-Daller, 1993). However, the neuter gender is not discussed in these studies.

Aim

Investigating GA in code-switching between languages with similar, yet asymmetrical gender systems.

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Simultaneous bilinguals **do not prefer** the analogical gender strategy.

Standard agreement is the preferred strategy. When this is not available, **default gender** is preferred.

Method

GJT: Simultaneous Flemish Dutch (M,F&N) – French (M&F) bilinguals rated audio-recordings on a three-point Likert scale.

Possible strategies

> Default gender:

J'ai dessiné	**un**	*ster*.
I drew	a_M	$star_F$

translational equivalent of *ster*: **étoile**$_F$

> Standard agreement:

Elle ne met jamais	**une**	*muts*.
She never wears	a_F	hat_F

translational equivalent of *muts*: **bonnet**$_M$

> analogical gender:

Mon frère a acheté	**une**	*huis*.
My brother bought	a_F	$house_N$

translational equivalent of *huis*: **maison**$_F$

Results

Dutch Ns in French show that the French probe agrees with the feature on the Dutch $N_{M/F}$, but that masculine default is applied for Dutch N_N. These findings are in line with Klassen (2016).

*

References

Cantone, K. F. and Müller, N. (2008). *Un nase* or *una nase*? what gender marking within switched DPs reveals about the architecture of the bilingual language faculty. *Lingua*, 118(6):810–826.

Klassen, R. (2016). *Asymmetric grammatical gender systems in the bilingual mental lexicon.* PhD thesis, Univeristy of Ottowa, Ottowa, Canada.

Treffers-Daller, J. (1993). Mixing two languages: French-Dutch contact in a comparative perspective. volume 9 of *Topics in Sociolinguistics*. Mouton de Gruyter, Berlin.

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Neural correlates of figurative language processing in proficient L2 speakers and emotional engagement

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Figurative expressions

His Spanish is *<u>rusty</u>*

I must pick her brains

- PERVASIVE (stats from Cameron; Pollio)
- MORE PERSUASIVE (Sopory & Dillard)

Metaphors as mappings

- Metaphors help us conceptualise something abstract in more concrete terms (Lakoff & Johnson, 1980)

He's a sweet guy; She's one of the brightest students;
The interview went smoothly; I was very moved at their wedding;
I hear you!

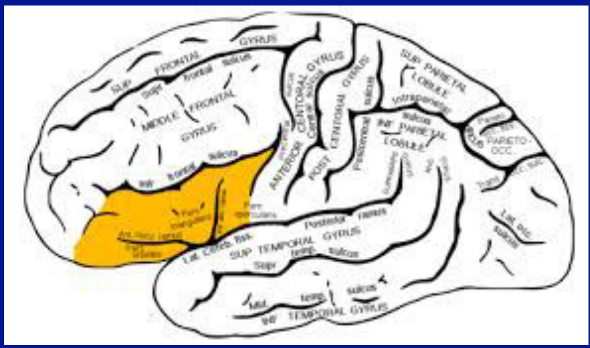
How are metaphors processed in the brain?

- Conventional metaphors are accessed directly and are no more difficult to process than literal expressions (Gibbs; Glucksberg)

How are metaphors processed in the brain?

- However, enhanced recruitment of **left prefrontal cortices** including the inferior frontal gyrus (IFG) (Bohrn et al., 2012; Rapp et al., 2012; Yang et al., 2012)

➢ Activation of multiple lexico-semantic representations, working memory, problem solving ☞ **executive functions**

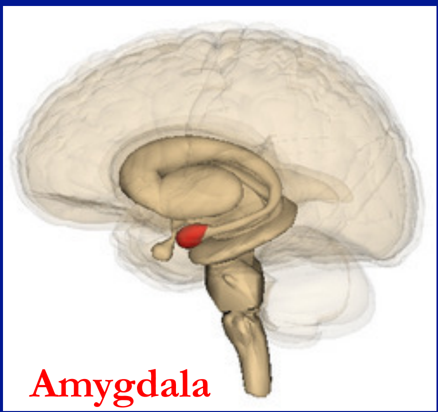


Metaphors & emotion

- In addition, recent neurophysiological research shows stronger emotional engagement in response to metaphorical formulations compared to their literal renderings:

➢ Stronger activation of left amygdala ☞ **emotion centre** (meta-analysis from Bohrn et al., 2012; Citron & Goldberg, 2014; Citron et al., 2016; Forgács et al., 2012)

➢ Stronger heart rate responses ☞ physiological arousal (Rojo et al., 2014)



Example of stimuli

She looked at him __sweetly__ vs. *She looked at him __kindly__**

*Stimulus pairs rated as highly similar in meaning, equal in emotional valence, arousal and imageability (Citron & Goldberg, 2014)

What we know about multilinguals

- Even highly proficient speakers of an L2 struggle with figurative expressions (Littlemore & Low, 2006)
- Multilinguals show more emotional distance from their L2 or less dominant language (see Pavlenko, 2012 for a review
- L2 comprehension activates the same extended language brain network as L1, but to a larger extent (see Perani & Abutalebi, 2005 for a review)
- *PLUS* the 'language switching' network (Abutalebi & Green, 2008

Aims

1) Replicate previous findings on native speakers using stimuli devoid of emotive content

2) Explore how L2 speakers process conventional metaphors, and whether they show any emotional engagement

Method: functional magnetic resonance imaging (fMRI)

- 25 native German speakers
- 22 proficient German speakers, L1 Italian
- Task: silent reading, occasional yes/no questions
- Stimuli: simple sentences, no taste words, no explicit mention of emotions, strict matching of psycholinguistic properties

The previously convicted man was found clean vs. *innocent*

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Metaphoricity, increasing…

The dancer tangled the theatre boss into an affair.

What a light life we had during summer!

The sudden change was a cold shower for her.

The school reform was on shaky ground.

The coffee I drank in Vienna was heavenly!

The previously convicted man was clean this time.

Her Spanish was rusty.

She left everything behind and went away.

That was a superficial reaction.

The sudden change was a shock for her.

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Results in native speakers

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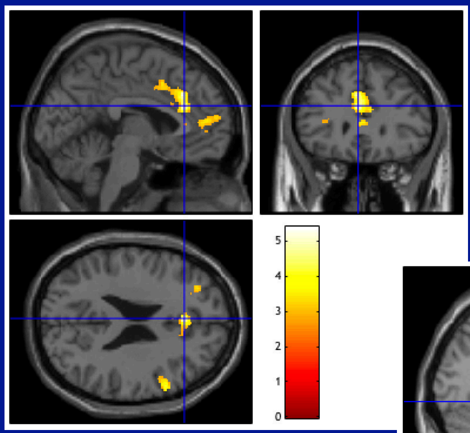
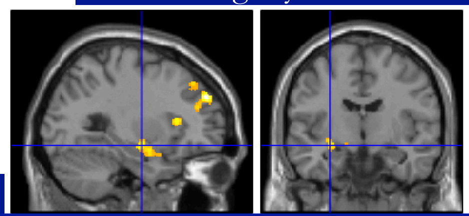
Increasing Metaphoricity in L1 only



- Bilateral IFG
- Bilateral medial frontal areas: dm/ vmPFC, (rostral) ACC
  ➔ ToM and conflict/ ambiguity resolution



Left amygdala!
(whole-brain level)

Interim discussion

- L1 speakers activate multiple lexico-semantic representations, need more working and ambiguity resolution processes in response to conventional metaphors than their literal counterparts
- This ‘problem solving’ activity may be in itself rewarding and in turn evoke stronger emotional engagement

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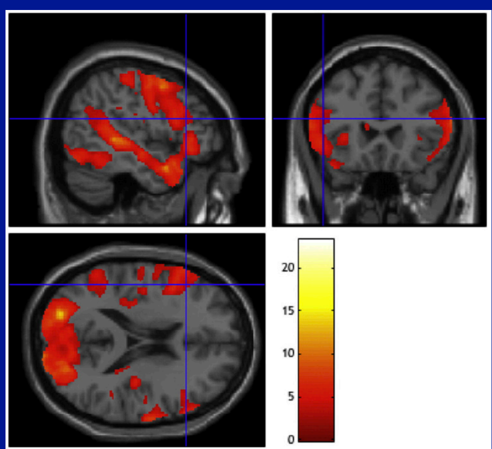
What do we expect in L2 speakers?

L2 comprehension

- Requires the same neural network used for L1 comprehension (see Perani & Abutalebi, 2005 for a review)
- especially at high levels of proficiency or usage

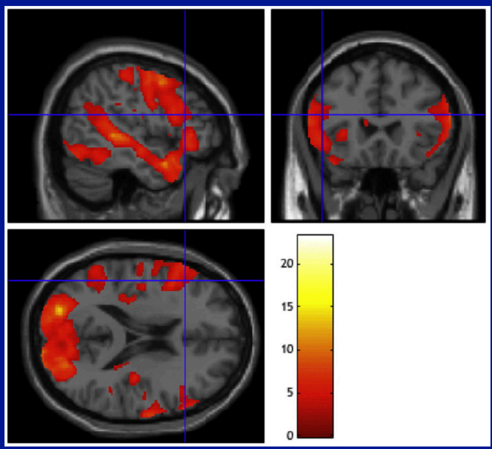
➢ **i.e., a bilateral fronto-temporal network** (Ferstl, 2008)



Picture from Citron et al., 2016

L2 comprehension

- This network is more strongly activated for L2 than L1 processing
- Additional recruitment of the 'switching network' in L2 speakers



Picture from Citron et al., 2016

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Language switching network

When multilinguals switch between languages, it includes:

- ➢ Supplementary motor area (SMA), anterior cingulate cortex (ACC) → **task/conflict monitoring**
- ➢ Caudate nucleus → **selection of (the less proficient) language** (Abutalebi & Green, 2007; Abutalebi et al., 2013; Luk et al., 2015)

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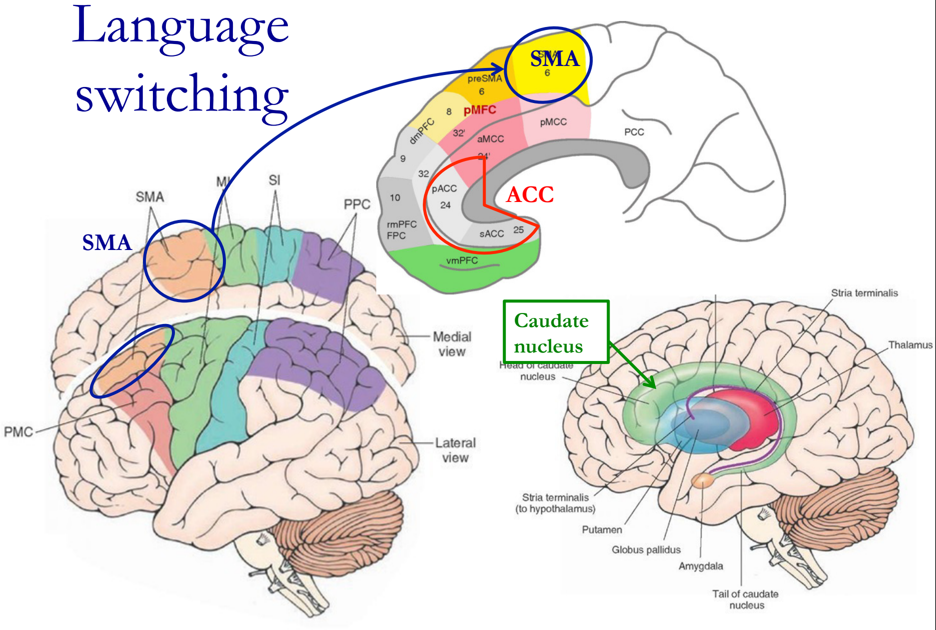
Language switching



Results in L2 speakers

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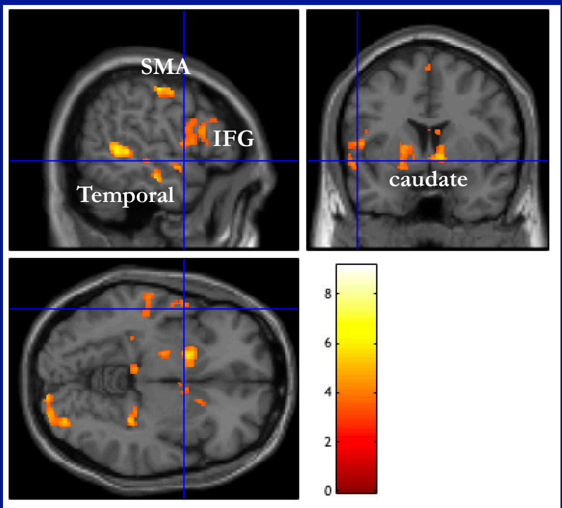
L2 speakers > L1 speakers



- Left IFG, left temporal cortex: extended language network
- Additionally, SMA and caudate nucleus: switching network

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What happens in response to increasing metaphoricity?

Increasing Metaphoricity (all speakers)

- No significant clusters of activation!

➢ Apparently L1 and L2 speakers do not process increasingly metaphorical stimuli in the same way….

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Speaker group*Metaphoricity

- Significant interaction ☺

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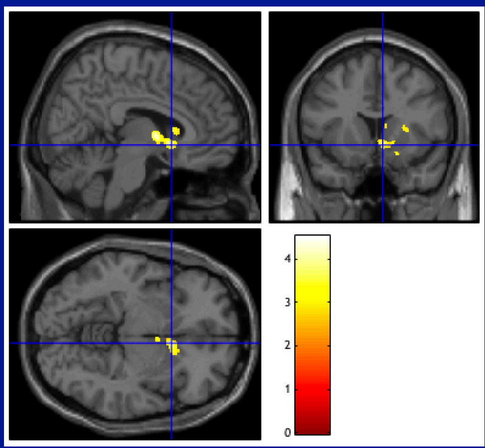
Increasing Metaphoricity in L2 only



- Only 1 significant cluster in caudate nucleus → selection of 1 language or 1 representation
- Small-volume correction revealed one significant peak in the left amygdala (MNI -18 -6 -19)

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Discussion

- L2 speakers seem to process metaphorical and literal sentences similarly
  - Very little distinction (in caudate nucleus and one peak in amygdala)
- By engaging the language network and the switching network for both stimuli
- Perhaps L2 speakers juggle multiple representations in both conditions:
  - L1 and L2 representations for literal sentences
  - Metaphorical and literal, and two languages, for metaphors

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Discussion cont.

- In L2, more selection processes may be used when metaphoricity increases (caudate nucleus)
- In L2, the outcome of the juggling may also be rewarding and evoke emotional engagement (amygdala)

Conclusion

- The more executive functions (working memory, problem solving) required to understand (metaphorical and literal) sentences, the stronger the emotional engagement
  - For L1 and (less reliably so) for L2 speakers
- This is supported by research on idioms using functional connectivity analysis (Citron et al., 2019, Neuropsychologia)
  - whereby increasing IFG activation was positively coupled with amygdala activation

Thank you!

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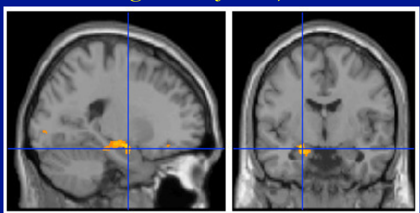
Metaphors & emotion

- Metaphors > Literal counterparts elicited significantly stronger activation of the *left amygdala* at the whole-brain level (Citron & Goldberg, 2014 *JoCN*)



- Associated with processing of evolutionary relevant or contextually salient (emotional) stimuli (Cunningham & Brosch, 2012; Garavan et al., 2001; Hamann & Mao, 2002; Seeley et al., 2007)

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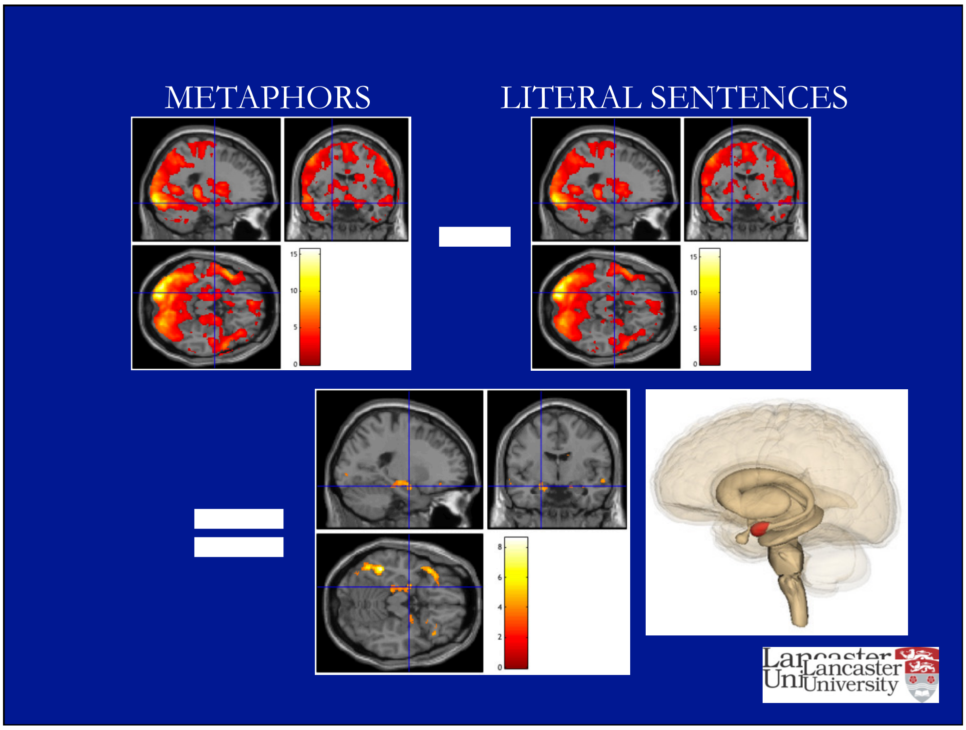
METAPHORS
LITERAL SENTENCES
Lancaster University

The relation between speaking multiple languages and attentional control

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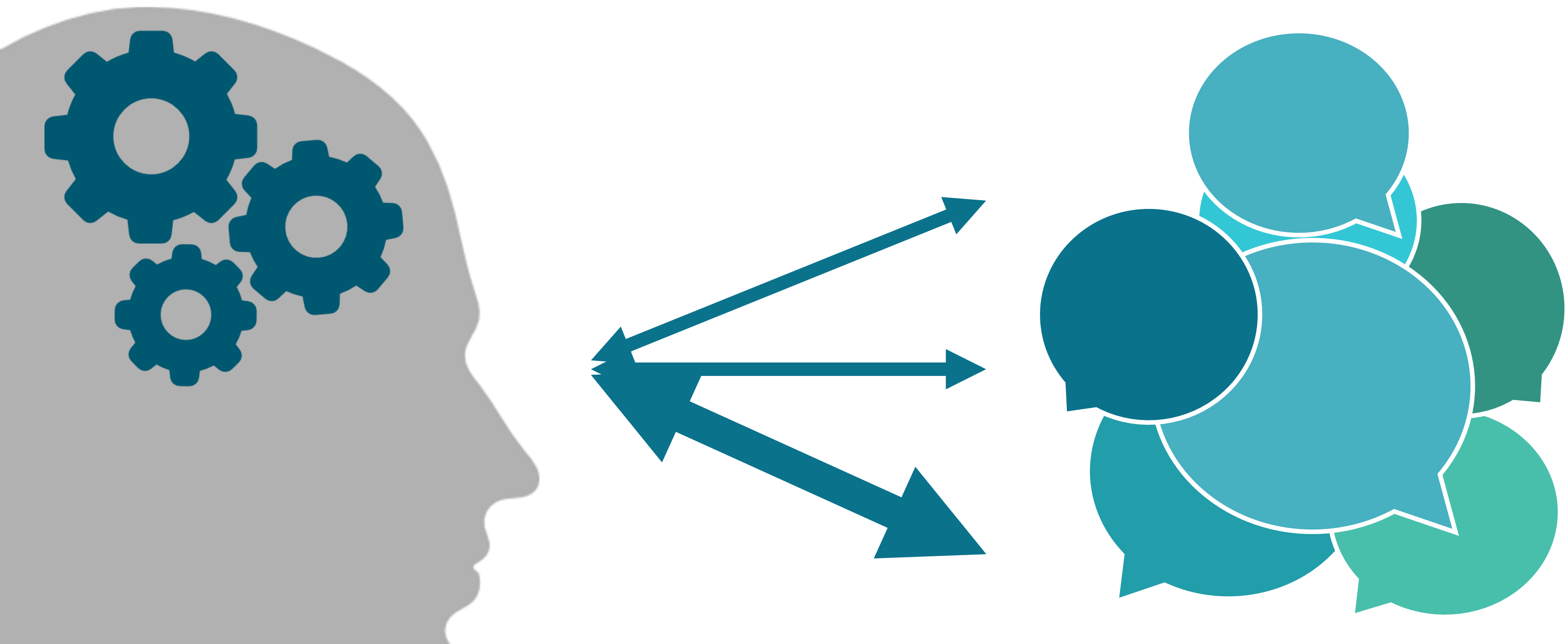
Outline

- Introduction
- Method
- Results
- Discussion

Introduction

Multilingualism and cognition



Hilchey & Klein, 2011, *Psychonomic Bulletin & Review*
Lehtonen et al., 2018, *Psychological Bulletin*

Individual differences

Bak et al, 2016, *PloS One*
Valian, 2015, *Bilingualism- Language and Cognition*

Individual differences

- Patterns of language use
  - Frequency of language use
  - Language switching
  - Balance
- Spoken languages
  - How many
  - Similarity between them
- Age of acquisition
- Language proficiency

Language Entropy

- The relative balance in language use of two or more languages.

$$Entropy = \sum_{i=1}^{n} P_i \log_2(P_i)$$

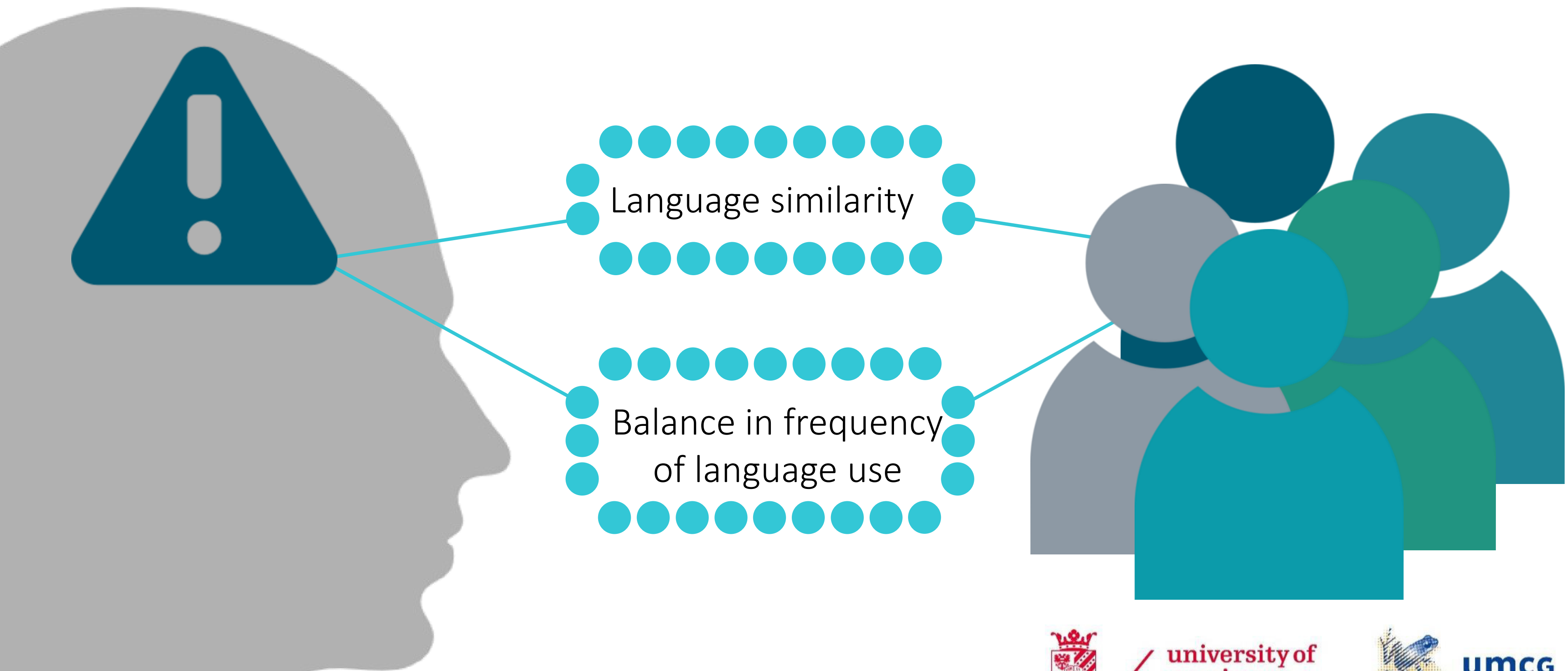
Dutch: 80%
English: 20%

$$0.80 * \log_2 0.80 + \ 0.20 * \log_2 0.20 = 0.72$$

$$0 \longleftrightarrow \log_2 \mathrm{n}$$

Gullifer and Titone, 2019, *Bilingualism*

Individual differences – cognition



Yamasaki, Stocco & Prat, 2018, *Language, Cognition and Neuroscience*

This study

- Relate individual differences in bilingualism to attentional control
- Relate findings to brain activation during cognitive performance

- Language experience and language use factors are related to attentional control

Method

Sample characteristics

Statistic		N	Mean	St. Dev.	Min	Max
Gender	**Male**	17				
	Female	30				
Age			20.45	1.79	18	27
Educationyears			12.55	1.25	10.00	18.00
Spokenlang*			2.98	0.85	2	5

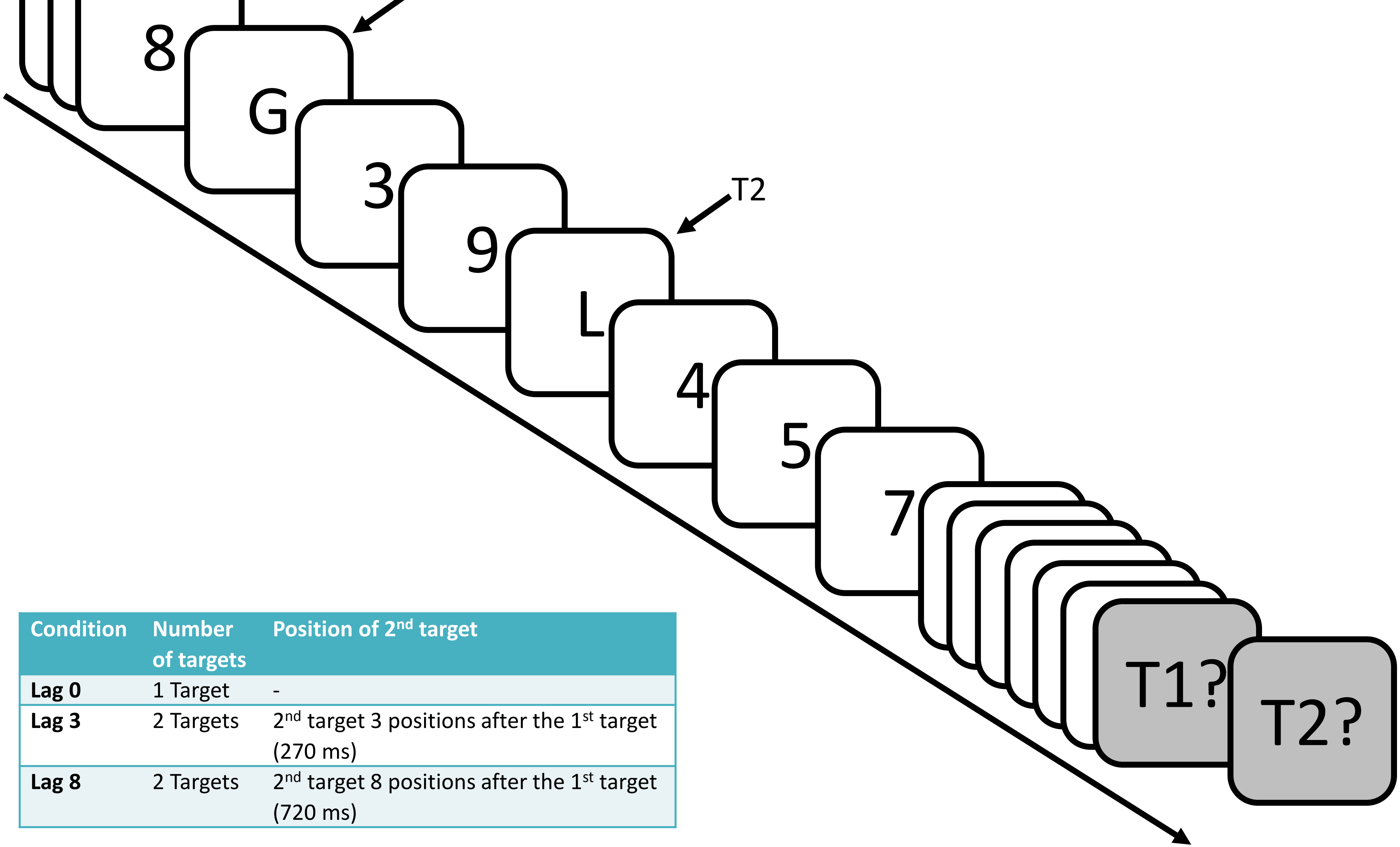
*To ensure that only languages that were regularly used and could thus be expected to have an effect on the executive performance were included, only languages spoken daily, weekly or monthly were considered in the count of languages spoken.

L3		L4		L5	
French	18	Dutch	10	Dutch	5
Spanish	9	French	7	French	2
Dutch	6	Spanish	6	Other	2
Latin	2	Other	4	None	38
Turkish	2	None	20		
Other	6				
None	4				

Measurements

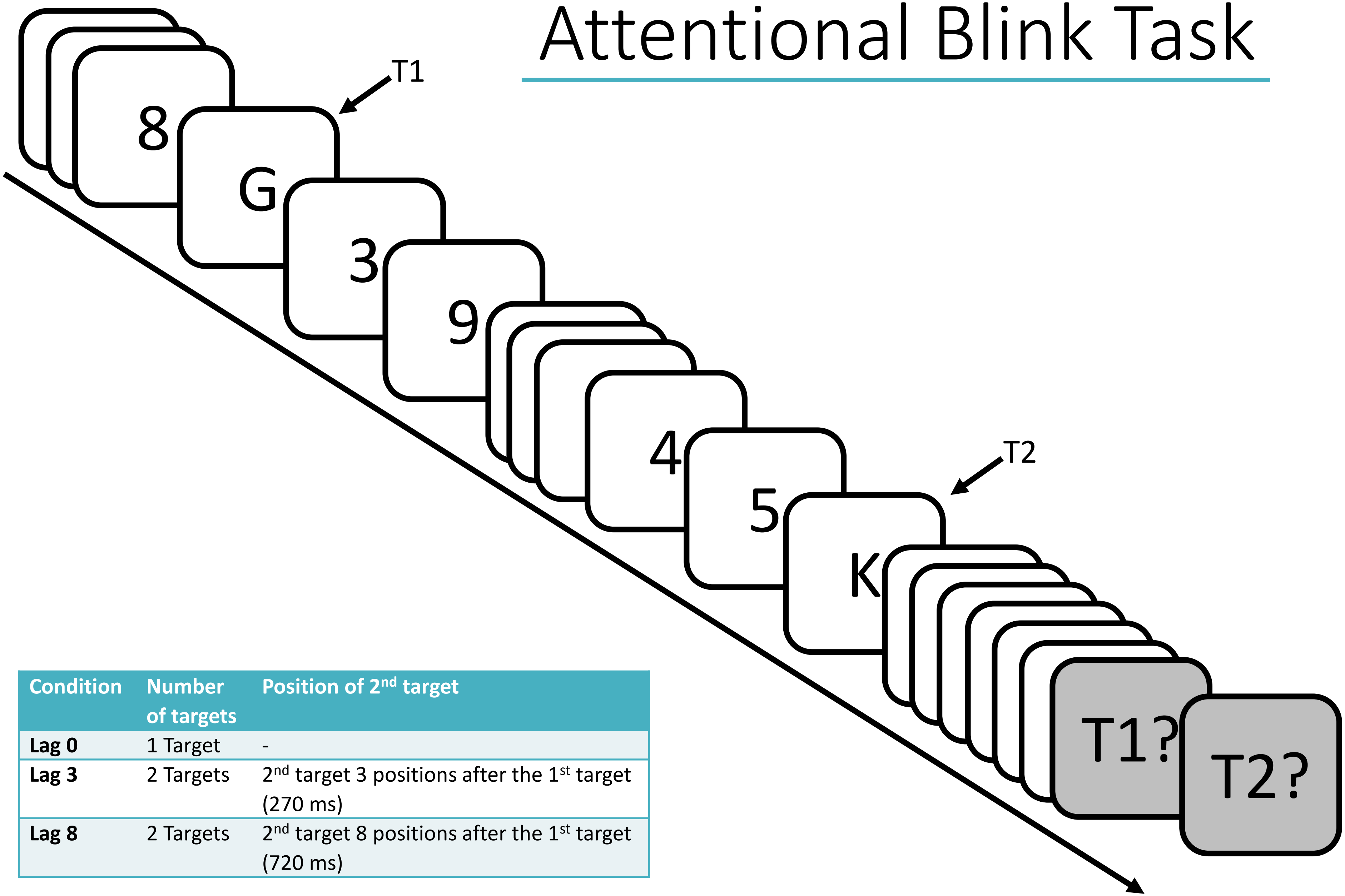
- Language experience and proficiency questionnaire
  - LEAP-Q
- Bilingual Switching Questionnaire
  - BSWQ
- LexTALE
- Attentional Blink task

Attentional Blink Task



Condition	Number of targets	Position of 2nd target
Lag 0	1 Target	-
Lag 3	2 Targets	2nd target 3 positions after the 1st target (270 ms)
Lag 8	2 Targets	2nd target 8 positions after the 1st target (720 ms)

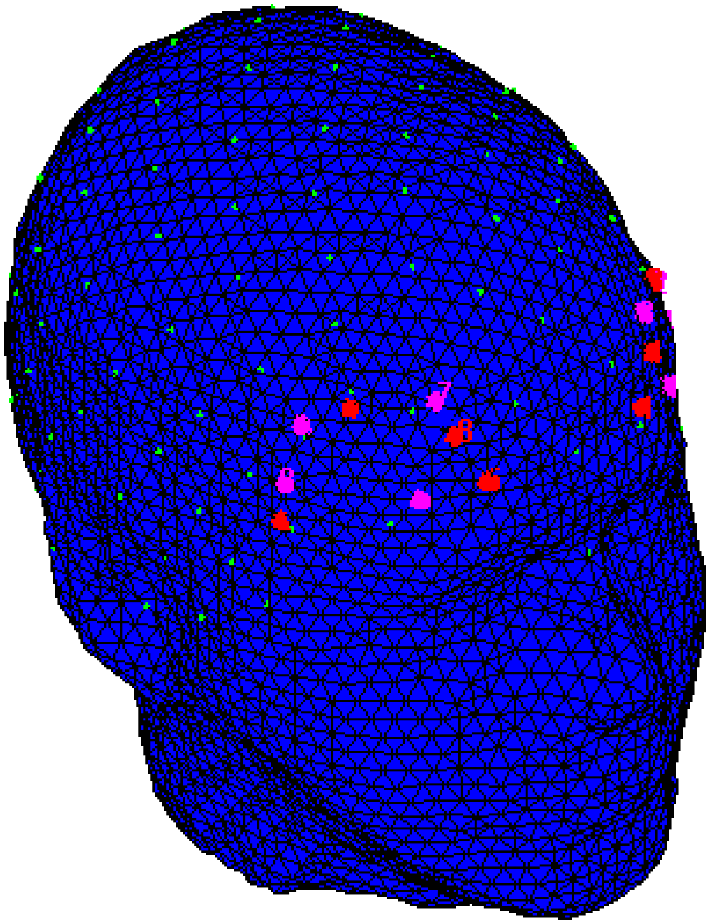
Attentional Blink Task



Condition	Number of targets	Position of 2nd target
Lag 0	1 Target	-
Lag 3	2 Targets	2nd target 3 positions after the 1st target (270 ms)
Lag 8	2 Targets	2nd target 8 positions after the 1st target (720 ms)

fNIRS

- Functional Near Infrared Spectroscopy
- Blood-oxygen-level dependent response **(BOLD-response)**

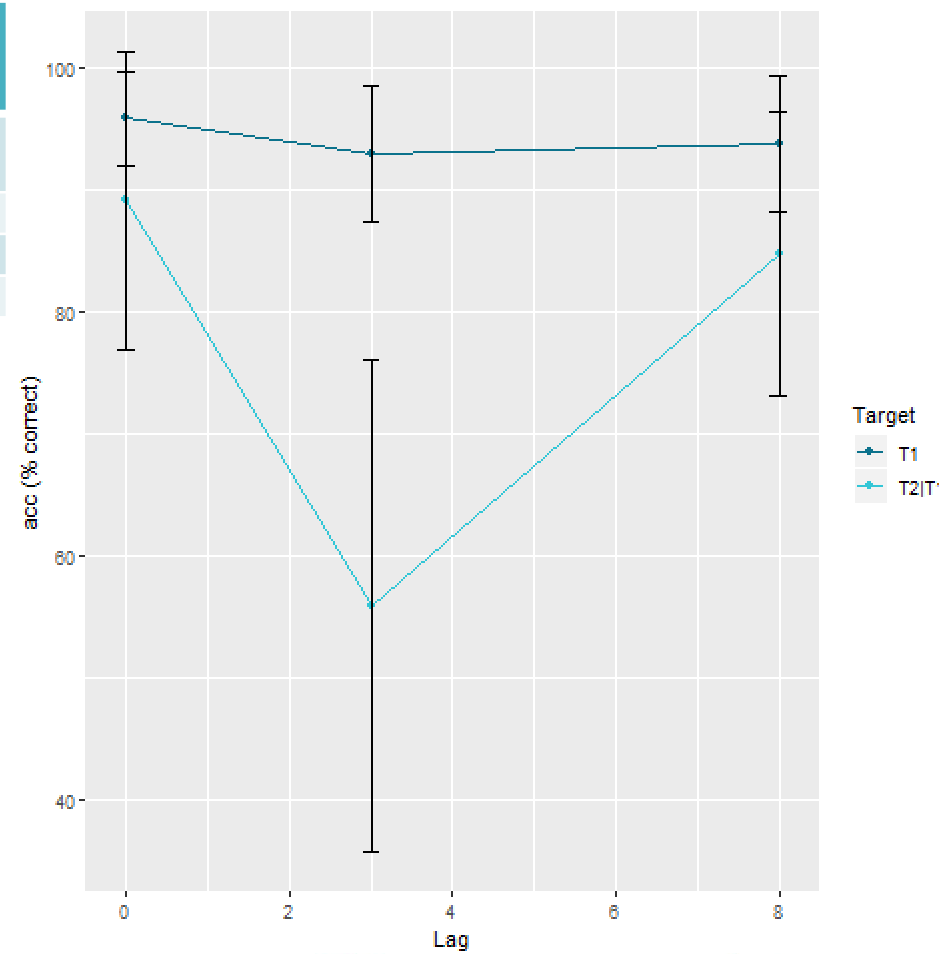


Results

Attentional Blink

	Average T1 accuracy	Lag 0 T2|T1 accuracy	Lag 3 T2|T1 accuracy	Lag 8 T2|T1 accuracy	Blink Effect
mean	93.92	89.66	54.95	84.52	41.93
sd	4.34	10.51	20.65	9.77	20.53
min	78.99	43.18	10.59	60.00	0.96
max	99.31	99.46	95.60	100.00	88.71

$$Blink\ effect = \frac{(\overline{T1} - T2|T1lag3)}{\overline{T1}} * 100$$



Individual differences in bilingualism

Variables of interest	Correlations (p-value)
• Age	0.11 (0.46)
• Years of education	0.05 (0.77)
• Number of spoken languages	0.15 (0.30)
• L2 Proficiency	-0.13 (0.37)
• Self-reported L2 proficiency (productive)	-0.23 (0.12)
• L2 age of acquisition	0,08 (0.58)
• Switching	0.27 (0.07)
• Exposure to L2 via media	0.00 (0.98)
• Exposure to L2 via social network	-0.06 (0.70)
• Attitude towards L2	-0.24 (0.11)
• Language Entropy	-0.37 (0.01)*

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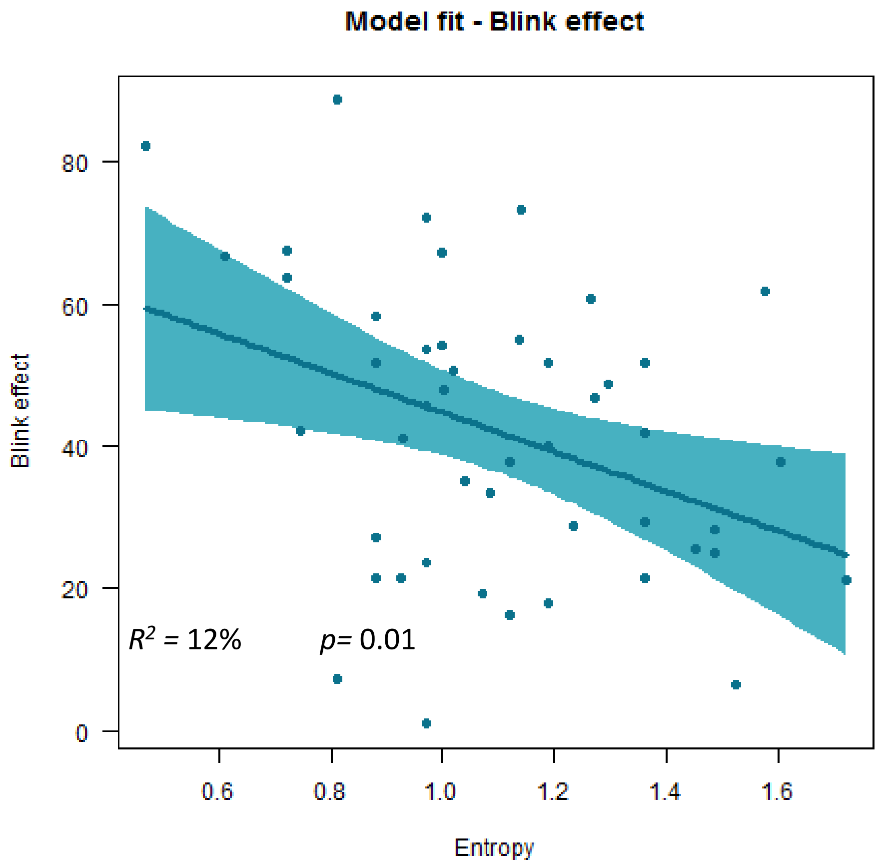
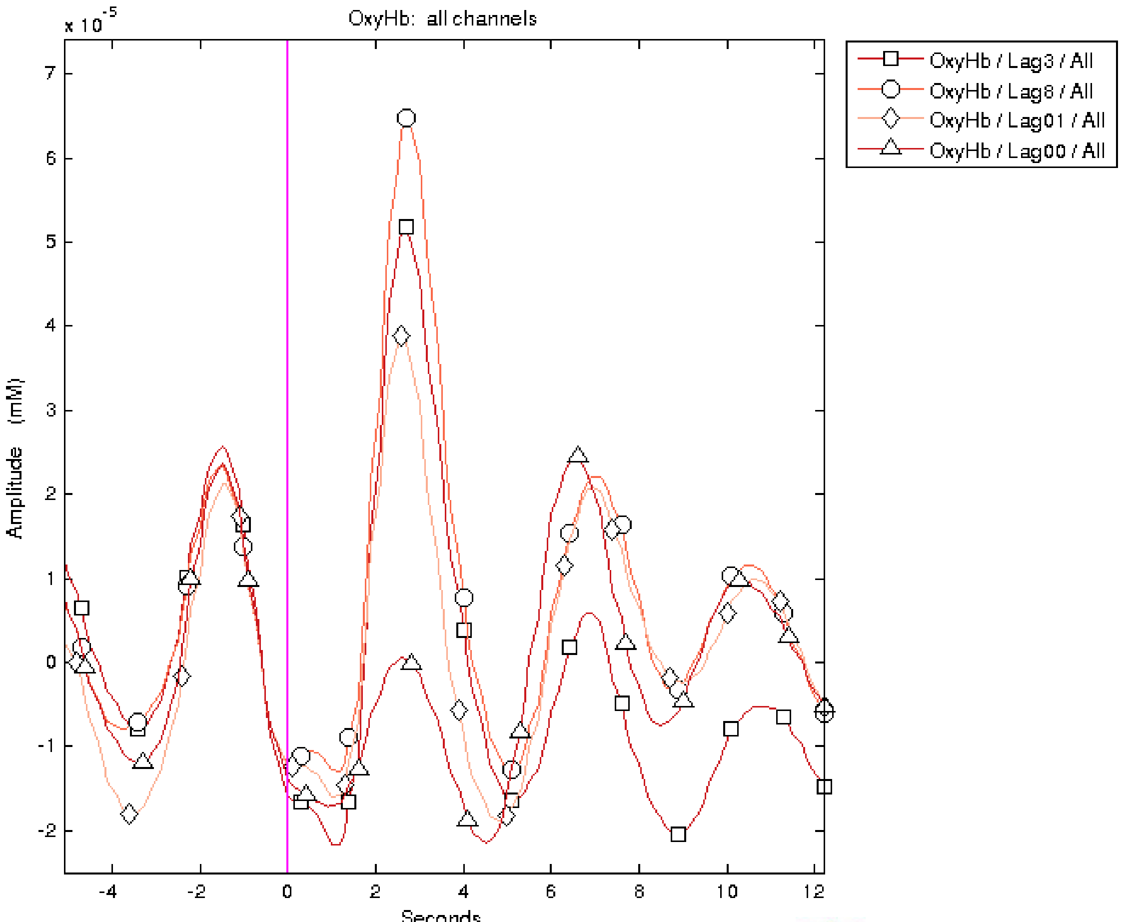
Regression model

Dependent variable	Predictor	β	SE	t-value	p	R^2
Blink effect	Intercept	72.45	11.74	6.17	1.74e-07*	0.12
	Entropy	-27.69	10.34	-2.67	0.01*	



fNIRS data


OxyHb: all channels
x 10^-5
Amplitude (mM)
Seconds
OxyHb / Lag3 / All
OxyHb / Lag8 / All
OxyHb / Lag01 / All
OxyHb / Lag00 / All
7
6
5
4
3
2
1
0
-1
-2
-4
-2
0
2
4
6
8
10
12

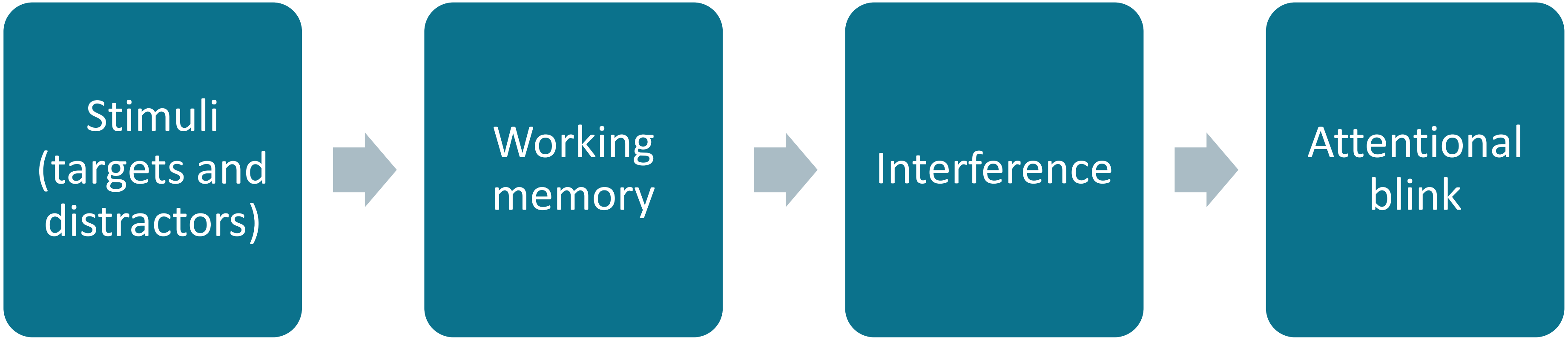
Discussion

Discussion

- Relate individual differences in bilingualism to attentional control

- Attentional blink occured
- Individual differences in bilingual language use predict attentional blink performance
  - Language entropy

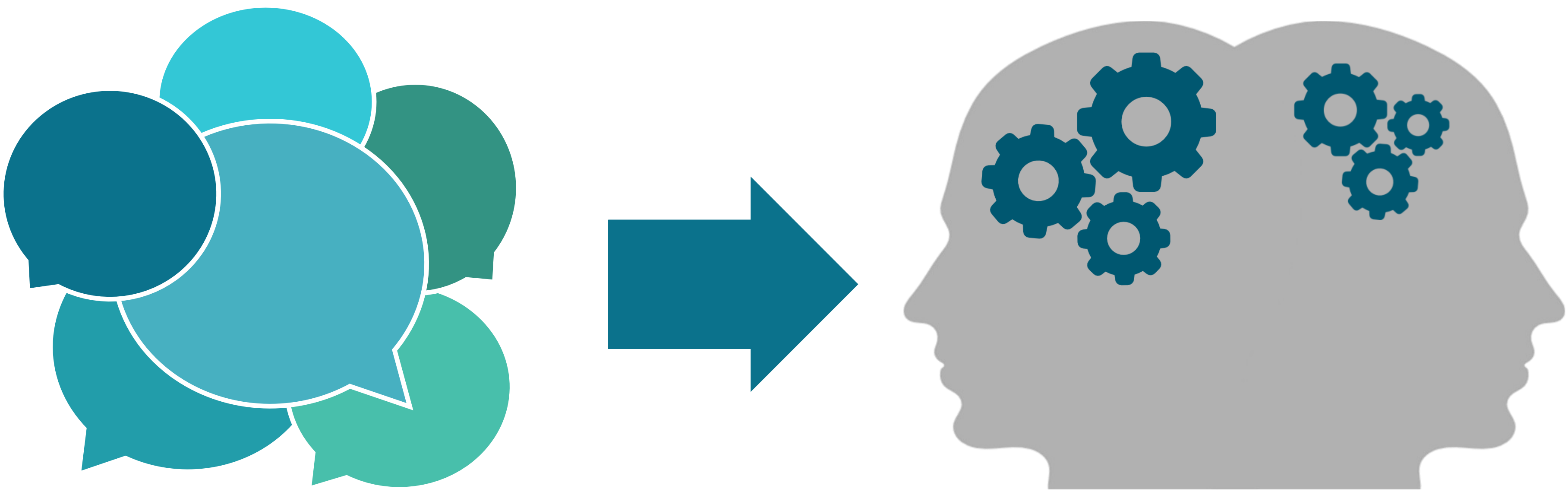
Interference model theory



Shapiro, Raymond & Arnell, 1994, *Experimental Psychology: Human perception and performance*

Conclusion

Bilingualism enhances attentional control



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Thank you!

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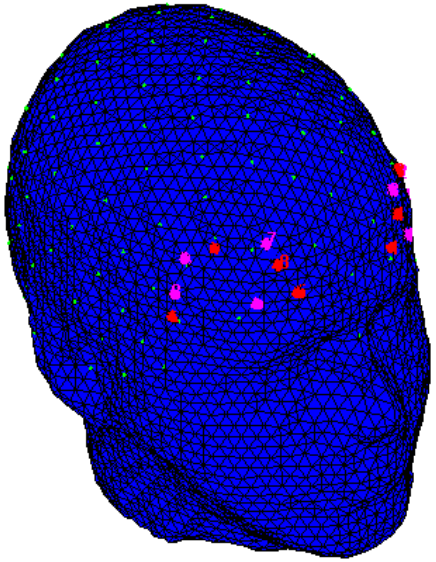
	English Proficiency (1-100)	Self-reported English proficiency in productive skills (1-10)	L2 Age of Acquisition (start)	L2 Age of Acquisition (fluent)	Switching (1-5)	Exposure to English media (1-10)	Exposure to English via Social Network (1-10)	Attitude towards English (1-5)	Entropy
N	47	47	47	47	47	47	47	47	47
Mean	74.15	8.18	8.59	14.56	2.93	8.06	3.19	4.80	1.10
St. dev	Dev.	8.57	0.93	1.37	2.29	4.37	1.72	1.57	0.29
Min	52.50	6	5.75	9.25	2.1	2.50	0.00	4.00	0.47
Max	90.00	10	11.50	20.50	4.1	10.00	7.50	5.00	1.72

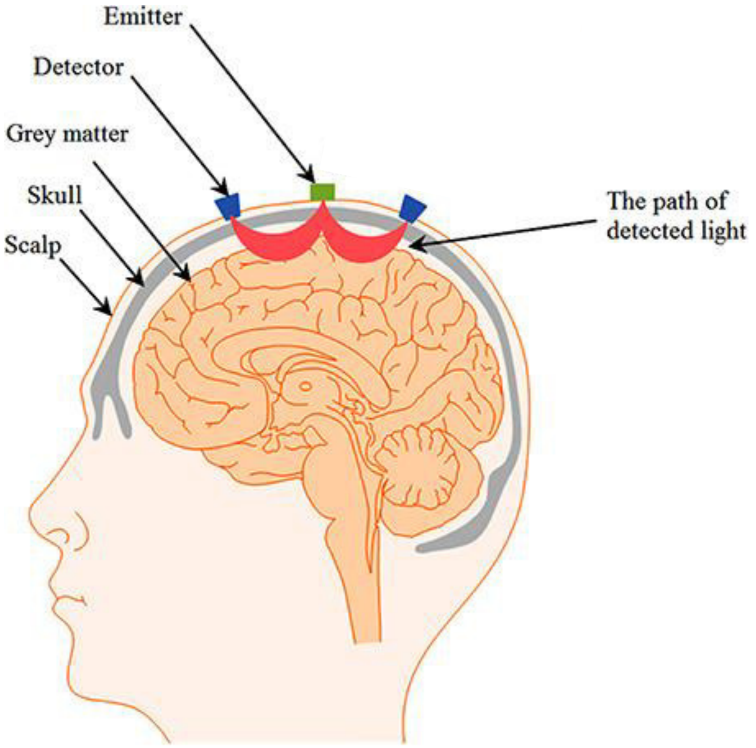
	Self-reported English proficiency in productive skills	Switching	Entropy
Average T1 accuracy	*r* = -0.09 (*p* = 0.54)	*r* = -0.3 (*p* = 0.04)*	*r* = 0.19 (*p* = 0.19)
T2|T1 accuracy Lag 3	*r* = 0.20 (*p* = 0.17)	*r* = -0.28 (*p* = 0.05)	*r* = 0.36 (*p* = 0.01)*
Blink effect vs mean T1	*r* = -0.23 (*p* = 0.12)	*r* = 0.27 (*p* = 0.07)	*r* = -0.37 (*p* = 0.01)*
Blink effect vs lag 8	*r* = -0.3 (*p* = 0.04)*	*r* = 0.22 (*p* = 0.14)	*r* = -0.35 (*p* = 0.02)*

Dependent variable	Predictor	β	SE	t-value	*p*	R^2
Average T1 accuracy	Intercept	1.026	0.0419	24.45	<2e-16*	0.07
	Switching	-0.003	0.001	-2.09	0.043*	
Blink effect	Intercept	72.45	11.74	6.172	1.74e-07*	0.12
	Entropy	-27.69	10.34	-2.67	0.01*	

fNIRS

- Functional Near Infrared Spectroscopy
- Blood-oxygen-level dependent response **(BOLD-response)**





Blink effect magnitude

$$Blink\ effect = \frac{(\overline{T1} - T2|T1lag3)}{\overline{T1}} * 100$$

$$\frac{(95-60)}{95} * 100 = \qquad \frac{35}{95} * 100 = 36$$

$$\frac{(95-40)}{95} * 100 = \qquad \frac{55}{95} * 100 = 57$$