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How bilingualism as a life experience can change our brain and behavior

A cognitive neuroscience perspective

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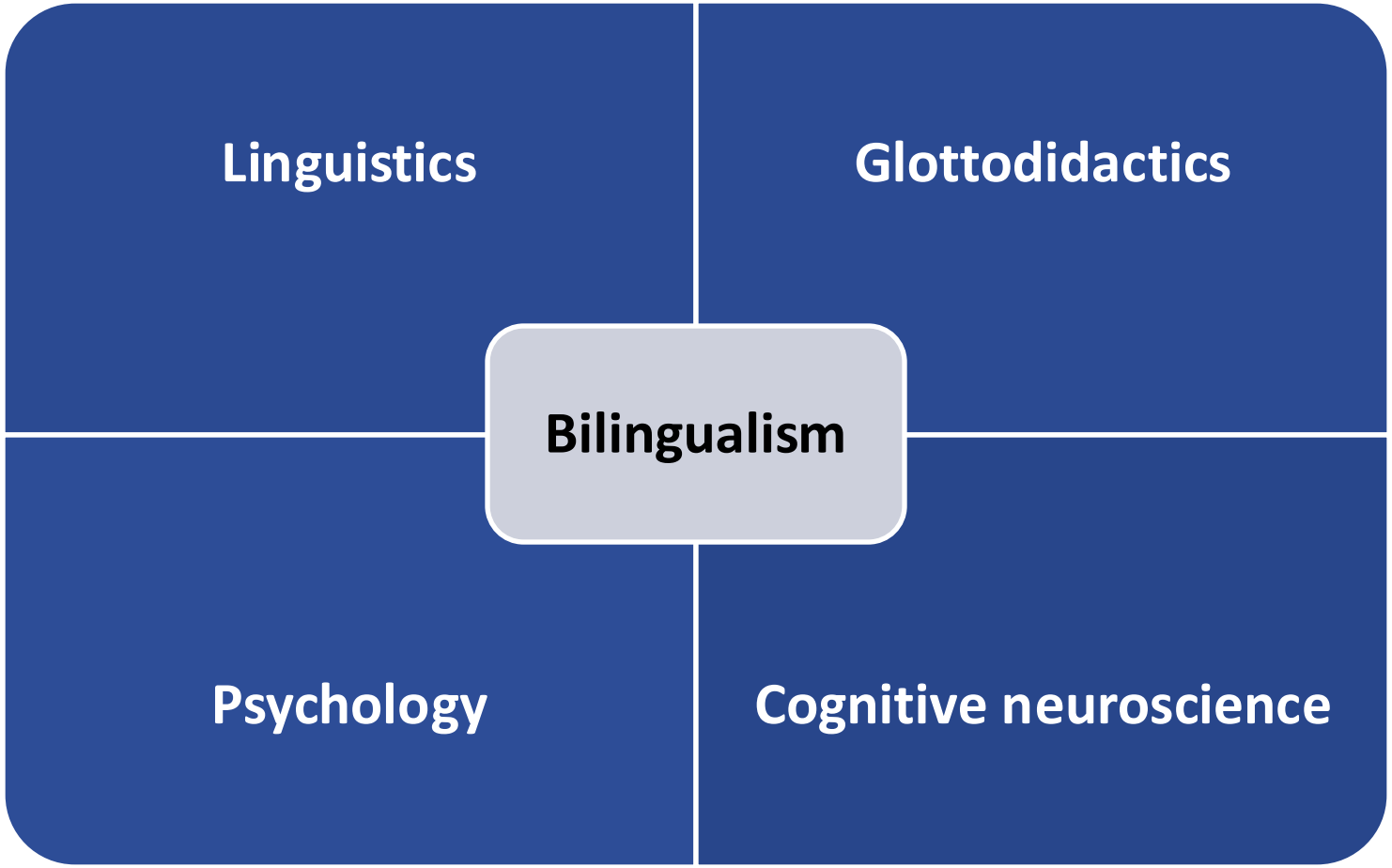
Bilingualism as object of inquiry



Bilingualism: the cognitive neuroscience perspective

Bilingualism is made possible by the brain's capacity to acquire, use and control multiple language systems efficiently

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Who's bilingual?

An individual exposed to different languages from birth?

An individual who knows an L2 perfectly regardless of AoA?

An individual who knows, even superficially, more than one language?

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No such thing as an 'ideal' bilingual

L2 learning is highly variable

Sources of variability

Language aptitude, learning strategies, cognitive ability, motivation, language experience, family environment, learning context

SOCIOECONOMIC STATUS AND BACKGROUND

Types of bilingualism

Different types of bilingualism can be identified based on a few parameters

L2 AoA

Simultaneous bilingualism: simultaneous acquisition of L1 and L2

Early sequential bilingualism: L2 learning within 'critical' periods (≤ childhood or puberty)

Late sequential bilingualism: L2 learning after 'critical' periods (> childhood or puberty)

L2 Proficiency and Exposure

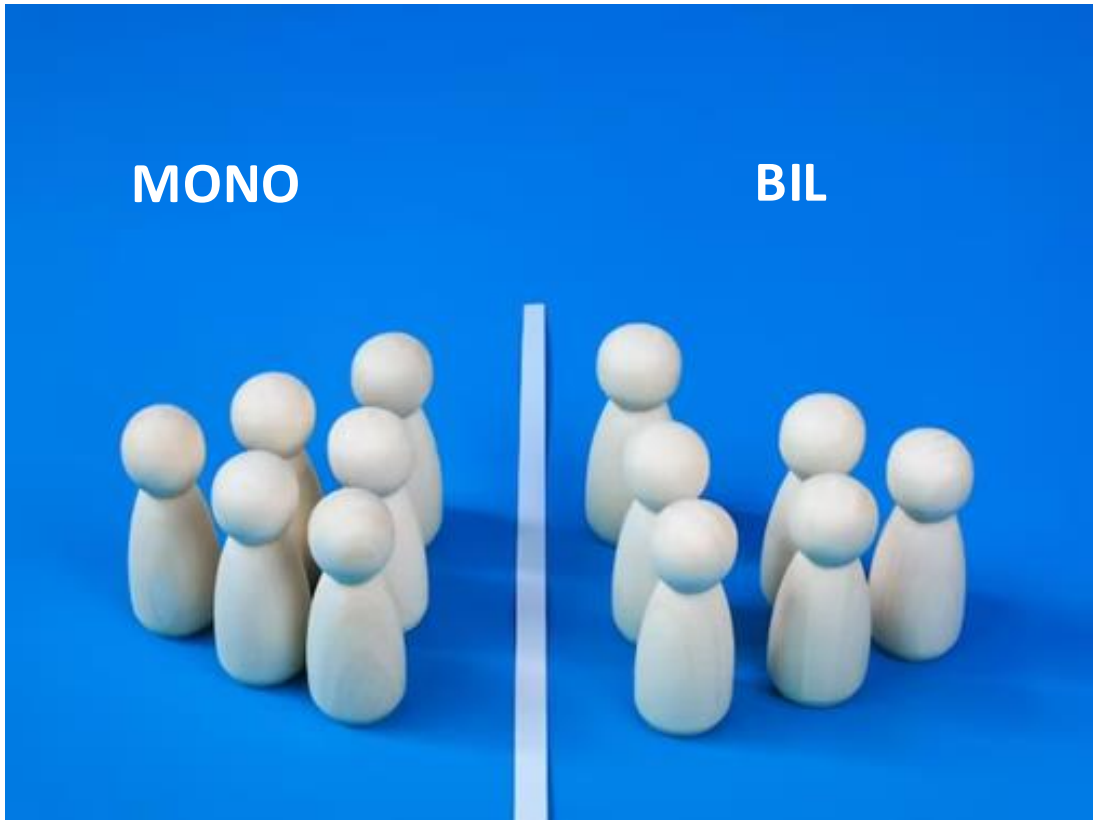
Balanced bilingualism: L1 = L2

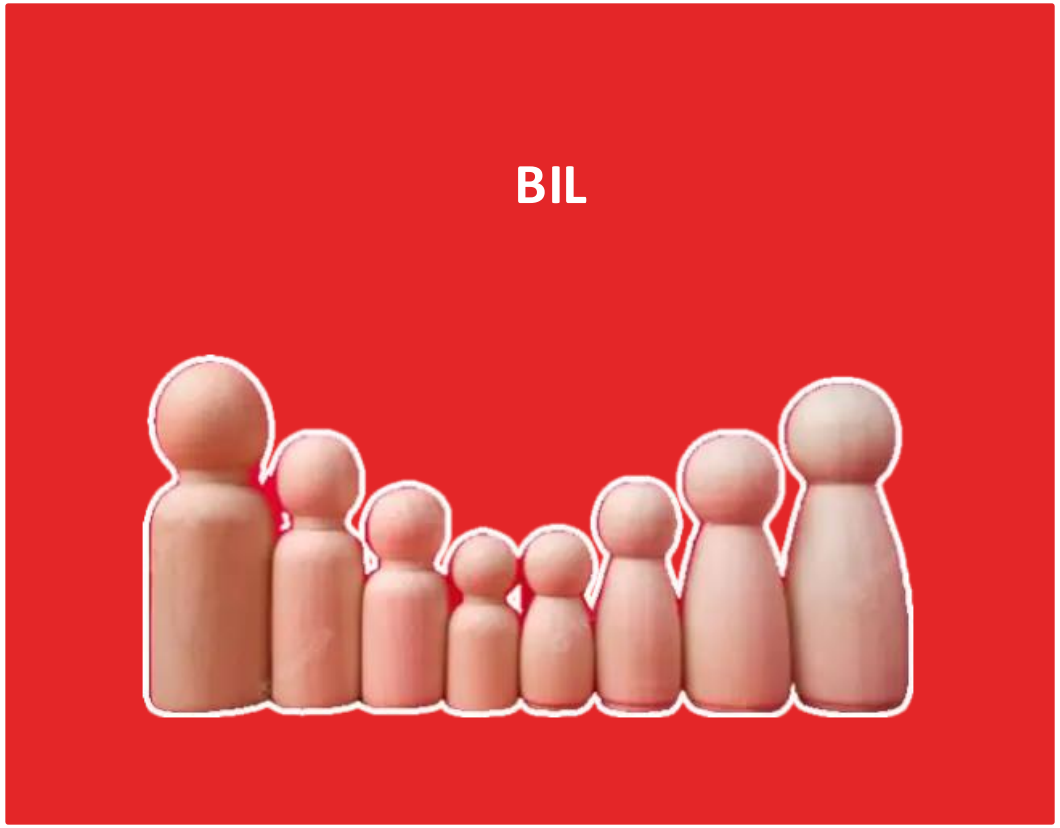
Unbalanced (or dominant) bilingualism: L1 > L2 / L1 < L2 (e.g., language attrition)

Bilingual competence

Body of knowledge that enables one to communicate in a language (or dialect) other than the native, regardless of factors such as AoA, proficiency and social valence of L2

How to conceptualize bilingualism?





Bilingualism as a spectrum of experiences

Bilingualism can be accurately measured as a continuous and multifactorial construct within which to place each individual according to the characteristics of his or her language experience

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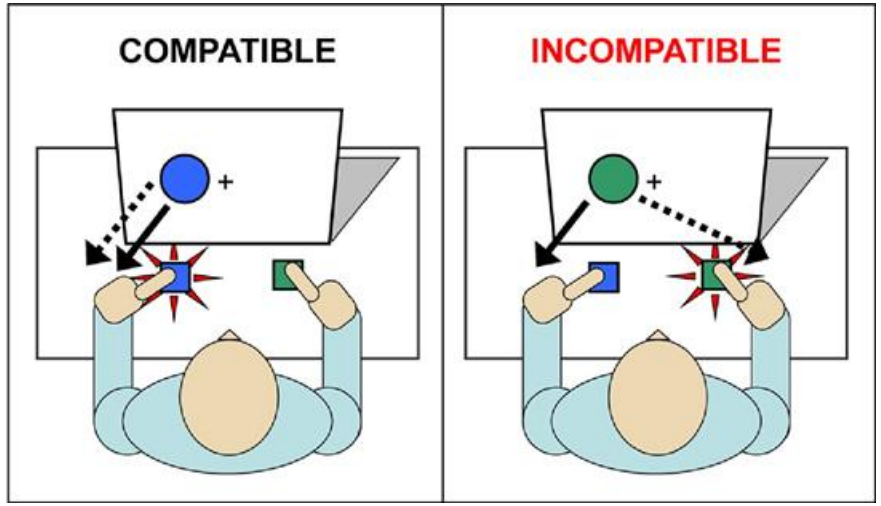
Bilingualism as a spectrum of experiences

The accurate characterization of bilinguals' language experience should illuminate what aspects are predictive of differences between individuals in terms of:

- Cognitive performance
- Brain activity



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Distribution of bilingualism in Italy

Italy has the greatest diversity of regional and minority languages in Western Europe

Forms of 'official' bilingualism are legally granted to 3 national minorities whose L1 is:

German (Trentino-Alto Adige)
Slovenian (Friuli Venezia Giulia)
French (Valle d'Aosta)

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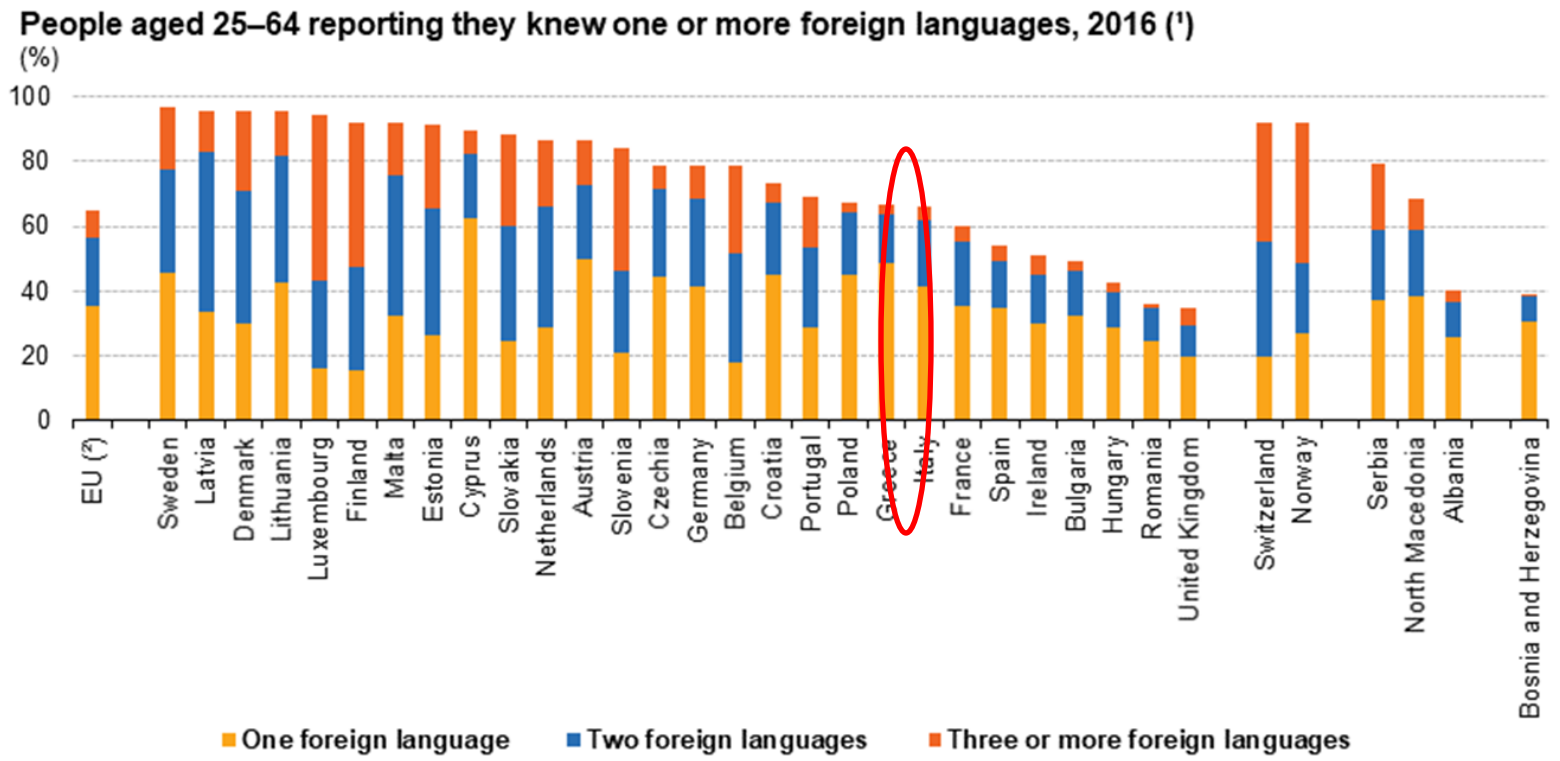
Foreign language knowledge in Italy (and Europe)



(1) Turkey: not available.
Source: Eurostat (online data code: edat_aes_l21)

eurostat

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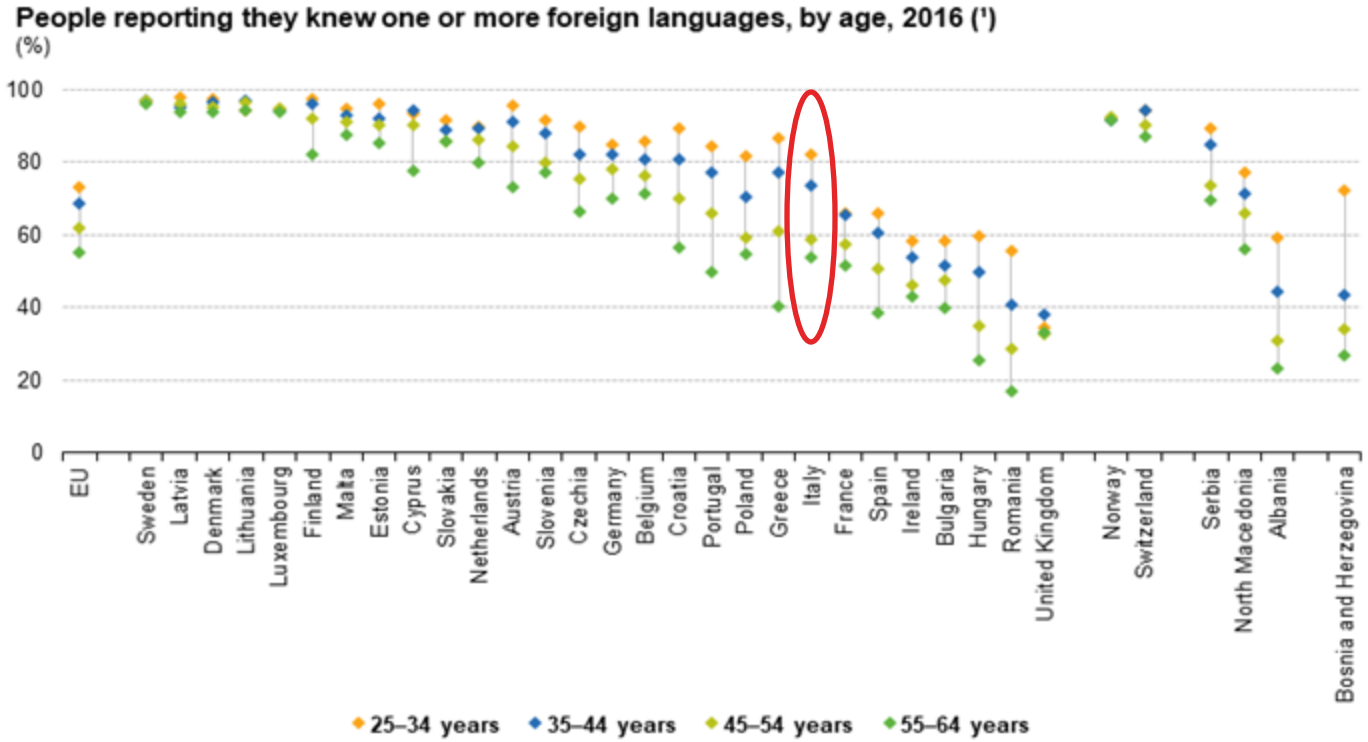
Foreign language knowledge in Italy (and Europe) by age



(¹) Ranked on the share for all persons aged 25–64. Turkey: not available.
Source: Eurostat (online data code: edat_aes_l22)

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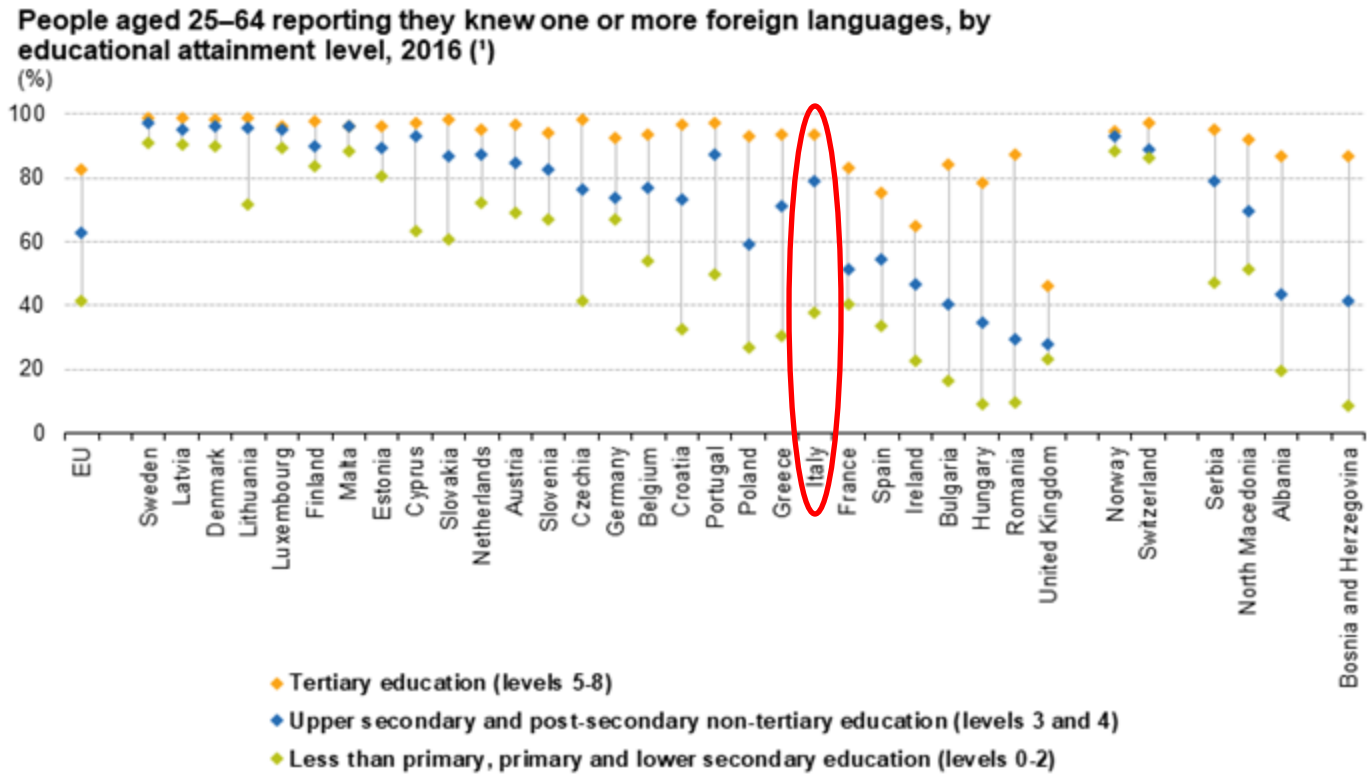
Foreign language knowledge in Italy (and Europe) by edu



(1) Ranked on the share for all education levels. Turkey: not available.
Source: Eurostat (online data code: edat_aes_l23)

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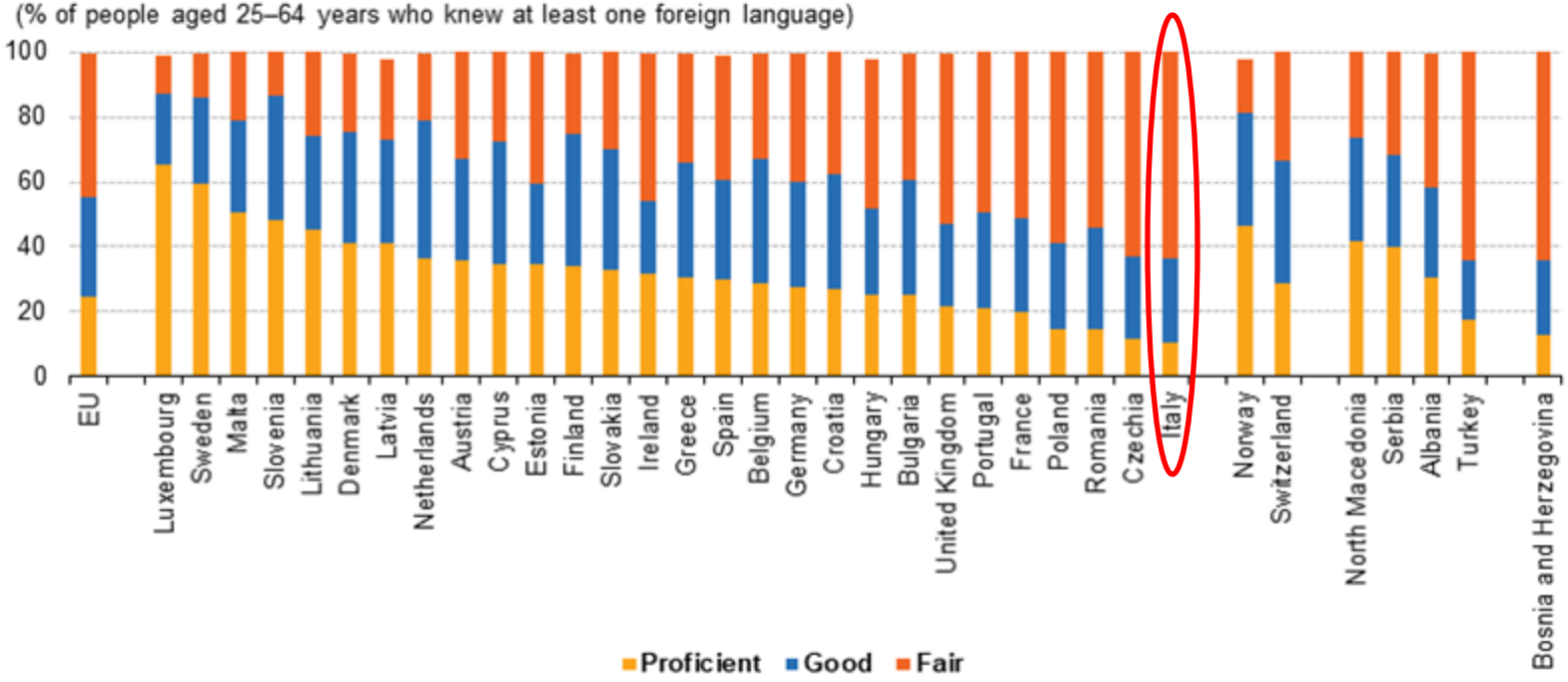
Foreign language proficiency in Italy (and Europe)

Distribution of the level of command of the best-known foreign language, 2016 (¹)

(% of people aged 25–64 years who knew at least one foreign language)



(¹) Ranked on the share with a proficient command of their best-known foreign language.

Source: Eurostat (online data code: edat_aes_l31)

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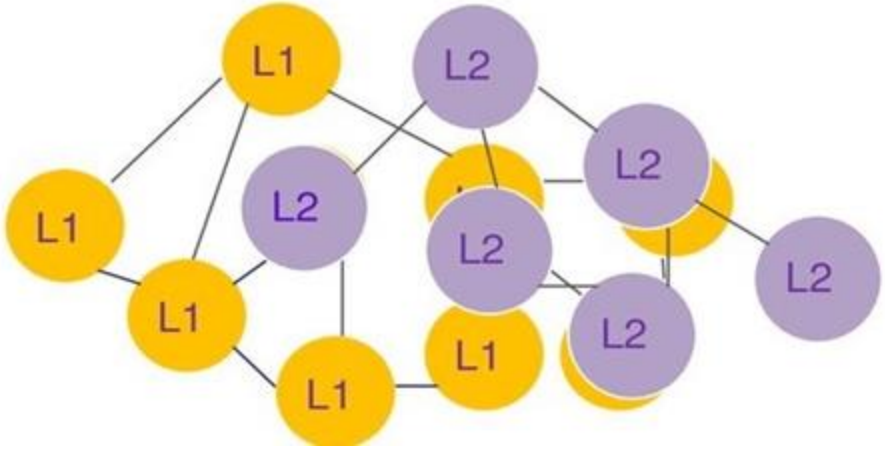
The bilingual mind

Even in monolingual contexts, bilinguals activate representations of both languages (L1, L2)

Cross-linguistic interactions are persistent

At the phonological level
At the lexical level
At the grammar level



The bilingual mind

The co-activation of L1 and L2 is associated with cross-linguistic competition for selecting the target language depending on features and demands of the environment

The bilingual mind

Cross-linguistic competition requires cognitive control mechanisms

- To inhibit the activation of the non-target language during language selection
- To inhibit interference from the non-target language during conversation

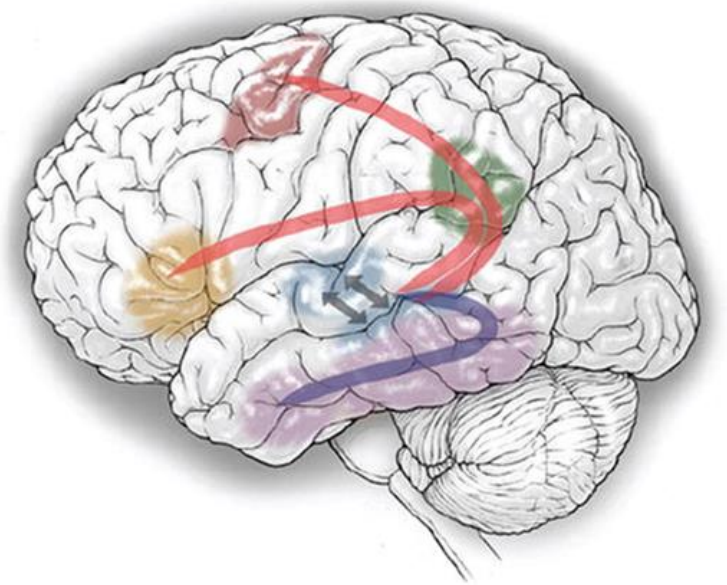
Bilingualism: cognitive consequences

The need to resolve cross-linguistic interference and select a target language for communicative purposes would determine:

- Effects on ordinary language processing [cf. word retrieval]
- Effects on more general cognitive processing [cf. executive 'enhancement']

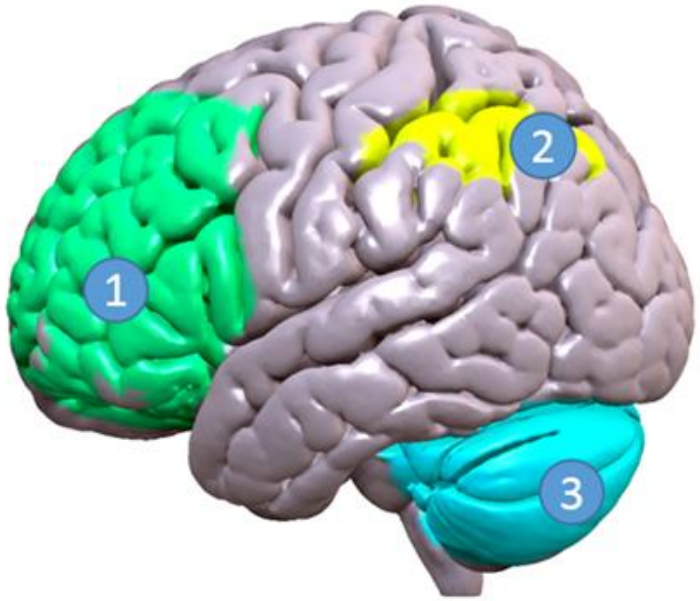
Modulated by context and speaker-related factors

Language processing in bilingual brain

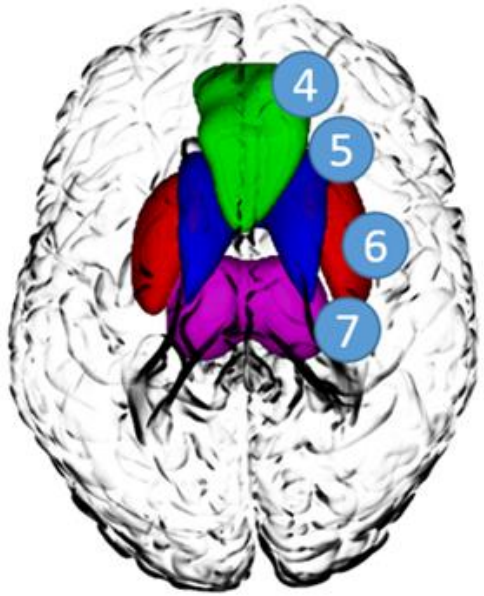


Dorsal stream for sensorimotor integration (mostly dominant)

Ventral stream for speech comprehension (bilateral)



1. PFCs
2. IPLs
3. Cerebellum



4. ACC
5-6. Basal ganglia
7. Thalamus

Does bilingualism shape our brain?

1. Does bilingualism give rise to neurocognitive adaptations?

2. What dimensions of bilingualism affect our brain?

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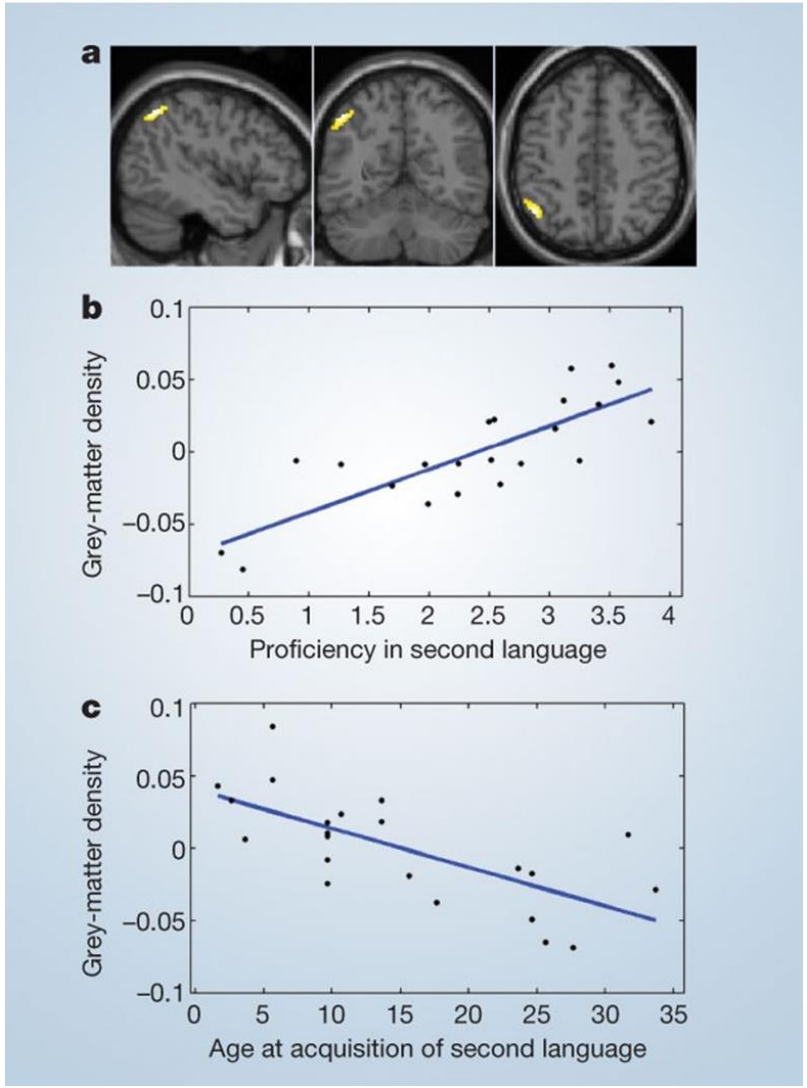
Bilingualism gives rise to neurocognitive adaptations

Learning an L2 increases the density of grey matter in the left inferior parietal cortex

The degree of structural reorganization in this region is modulated by proficiency and AoA



Mechelli et al. (2004)

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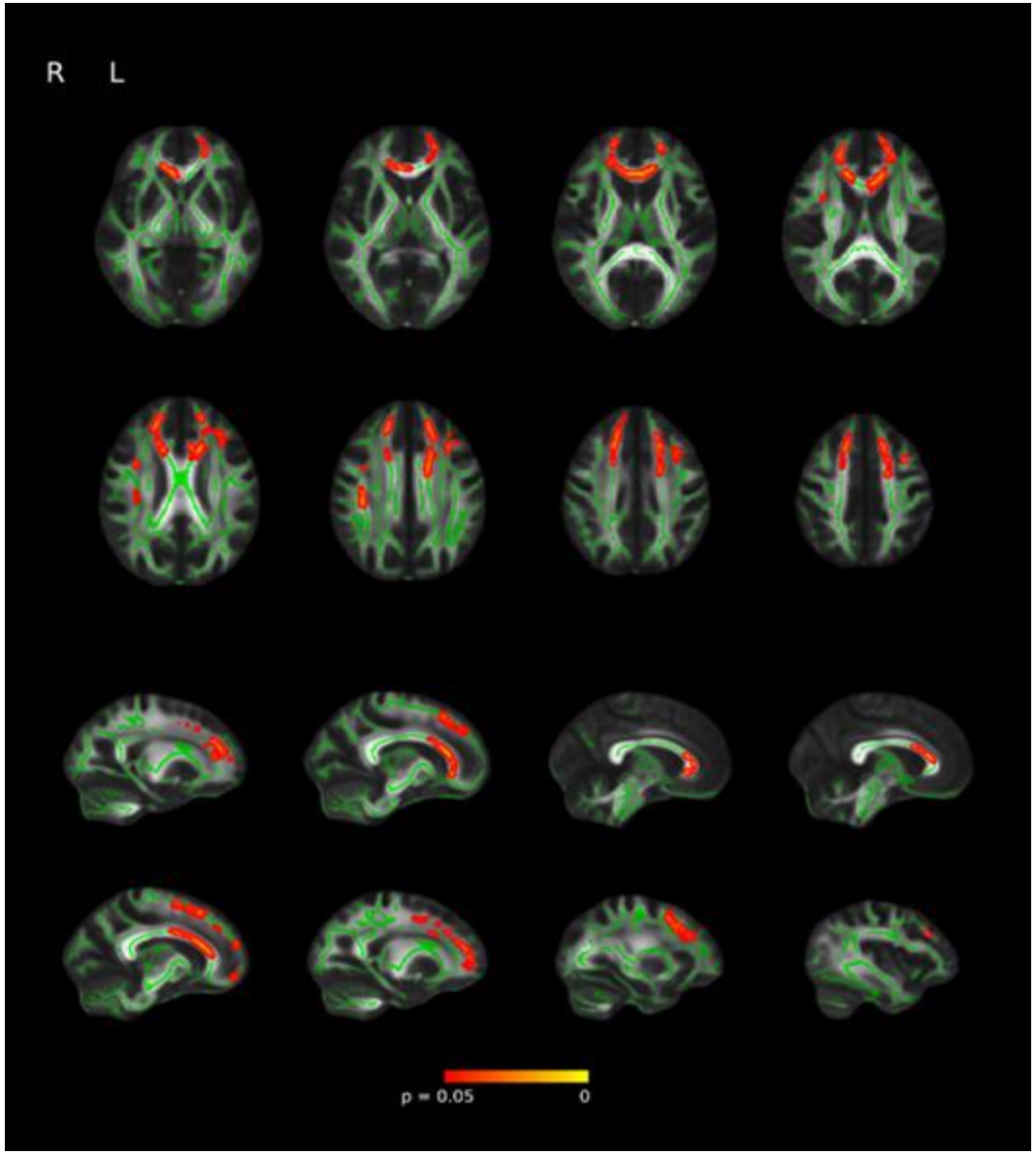
Specific dimensions of bilingualism affect our brain

Significant effect of L2 exposure in a large cingulo-frontal network related to language control

No effects of AoA and proficiency on brain connectivity



Del Maschio et al. (2019)

Effect of L2 exposure (RED) on brain connectivity

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Bilingualism as a protective factor against healthy and pathological aging?

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Bilingualism delays age at onset of dementia, independent of education and immigration status

Suvarna Alladi, DM, Thomas H. Bak, MD, Vasanta Duggirala, PhD, Bapiraju Surampudi, PhD, Mekala Shailaja, MA, Anuj Kumar Shukla, MPhil, Jaydip Ray Chaudhuri, DM, and Subhash Kaul, DM | AUTHORS INFO & AFFILIATIONS

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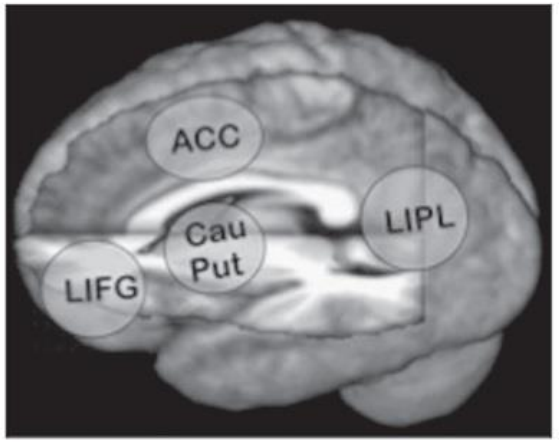
Lifelong usage of two or more languages

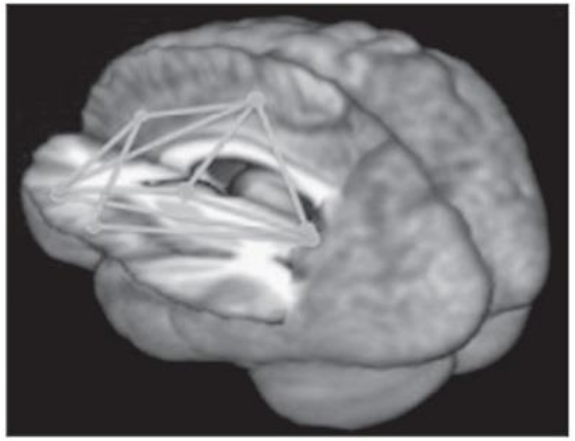
Enhancement of executive control

Neurostructural changes (grey/white matter)



NEURAL RESERVE

Neurofunctional changes (brain connectivity)



NEURAL COMPENSATION

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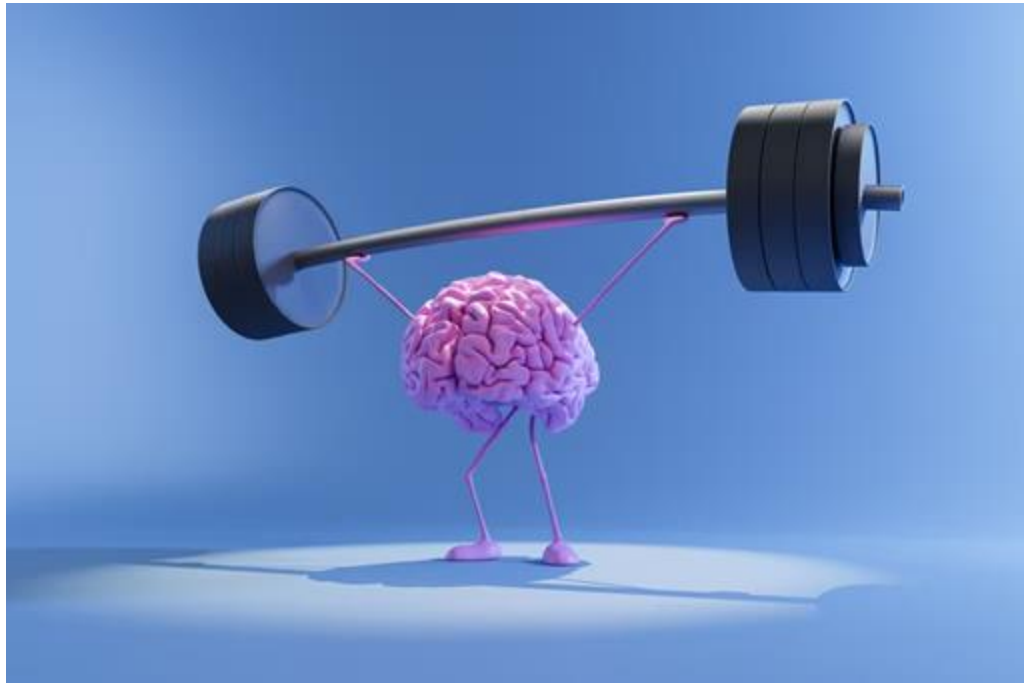
Bilingualism shapes our brain

Bilingualism is able to modulate both the anatomical and functional organization of our brain

Enhancement especially in circuits supporting executive functioning [both in the young and elderly]

Dimensions of bilingual experience contribute to generate specific neurocognitive adaptations [cf. > L2 exposure/switching behavior]



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Does bilingualism affect behavior?

1. Does bilingualism influence our judgment ad choices?

2. What dimensions of bilingualism affect our decision-making?

The Foreign Language Effect (FLE)

Different choices have been reported when decision problems are presented in a native (NL) vs a foreign (FL) language

In different types of problems, people are more ‘rational’ when making decisions in their FL as compared to their NL

The Foreign Language Effect (FLE)

"Language could be used as a nudge to promote better – i.e., more 'rational' – choices"
(Costa et al. 2017)

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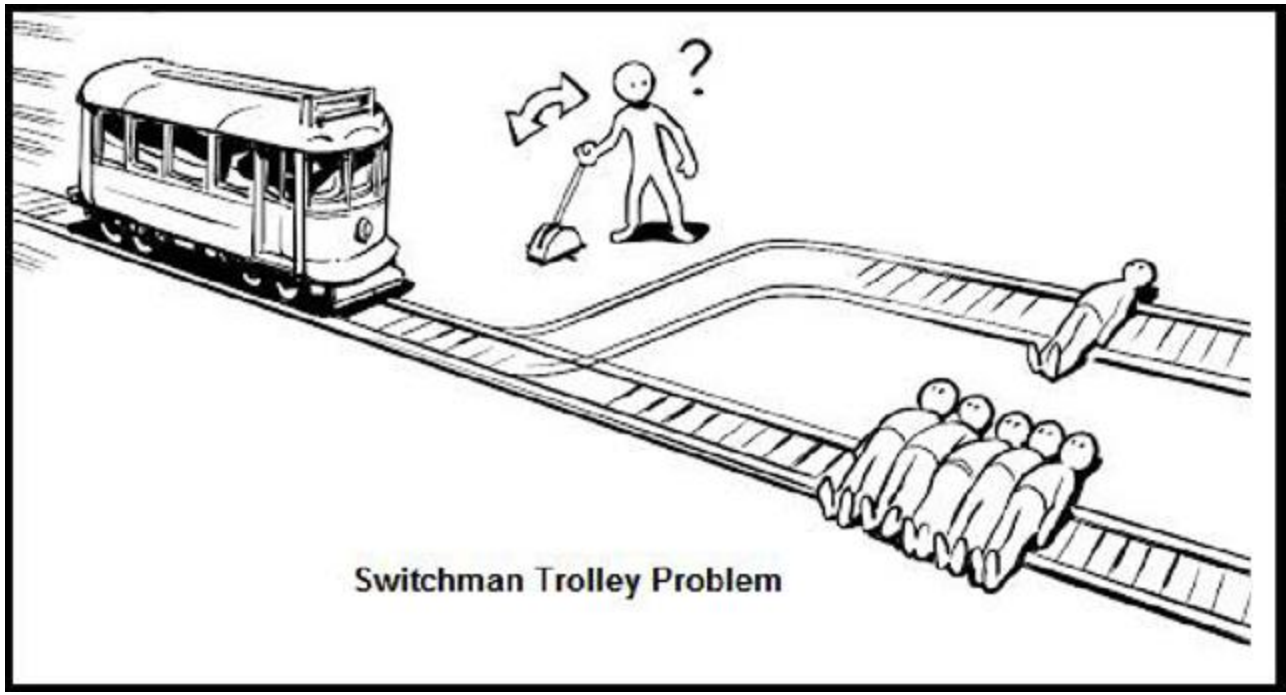
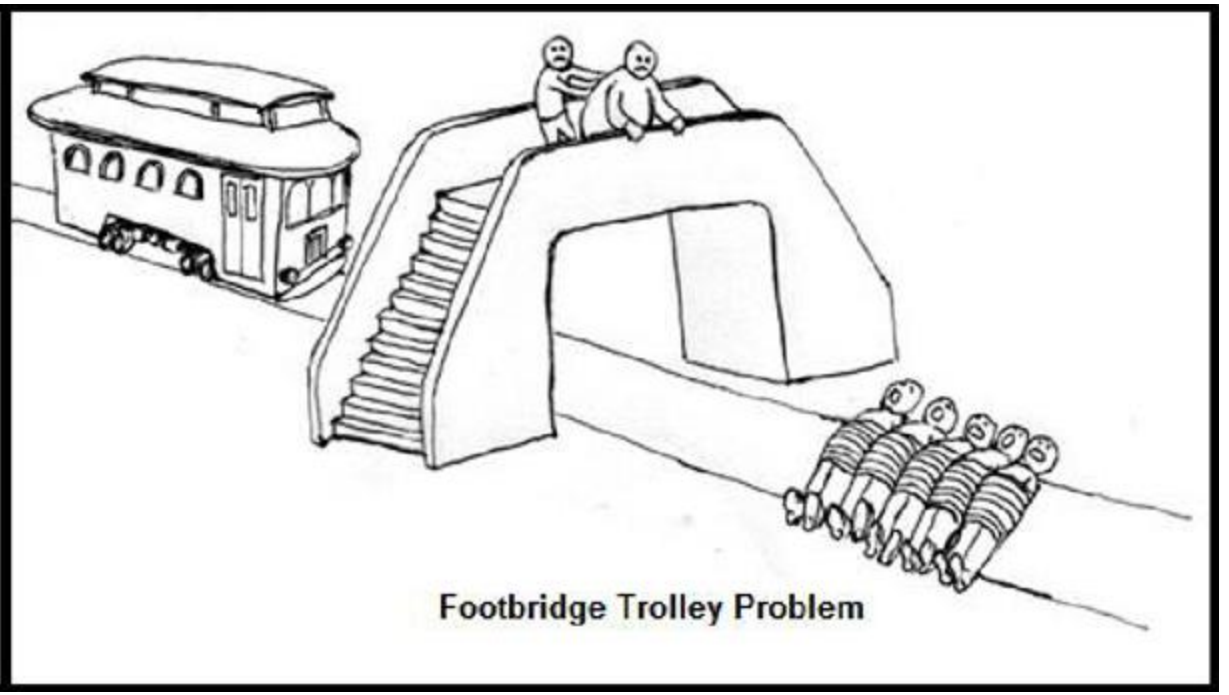
The Trolley problem





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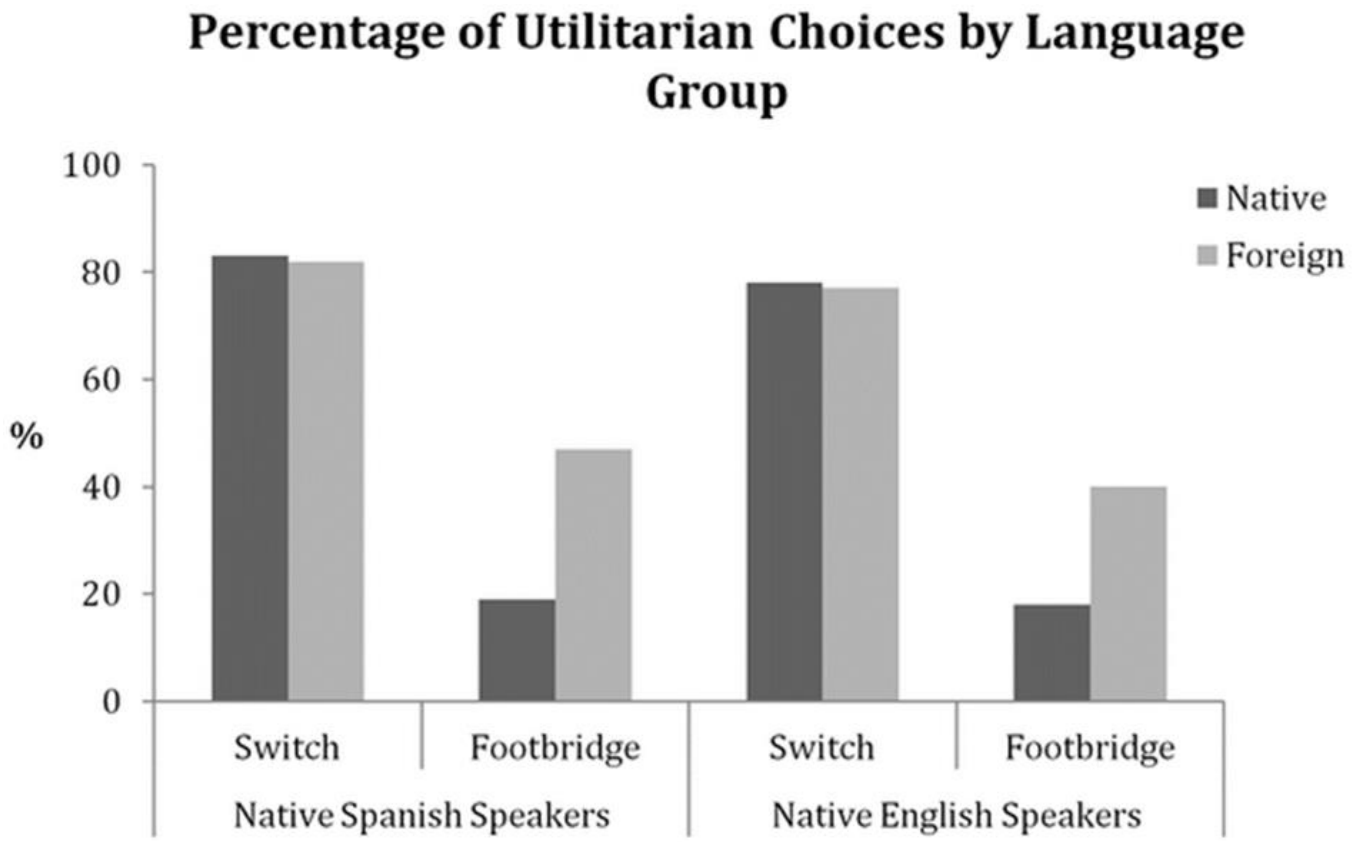
Bilingualism influences our judgment ad choices

Making decisions in a FL promotes utilitarian (i.e., more ‘rational’) behavior

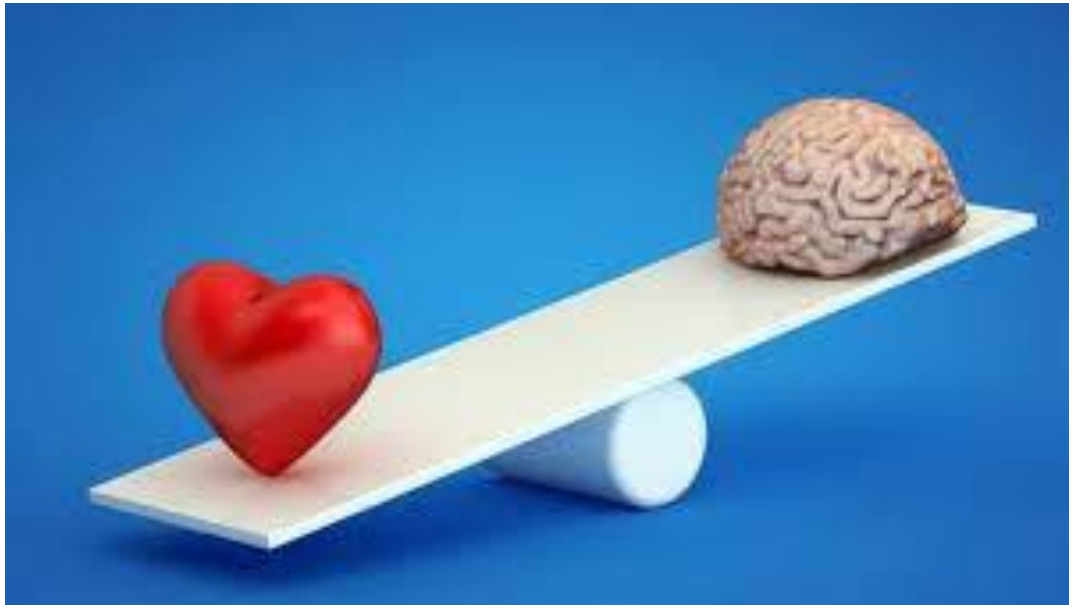


Costa et al. (2014)

A potential explanation for the FLE

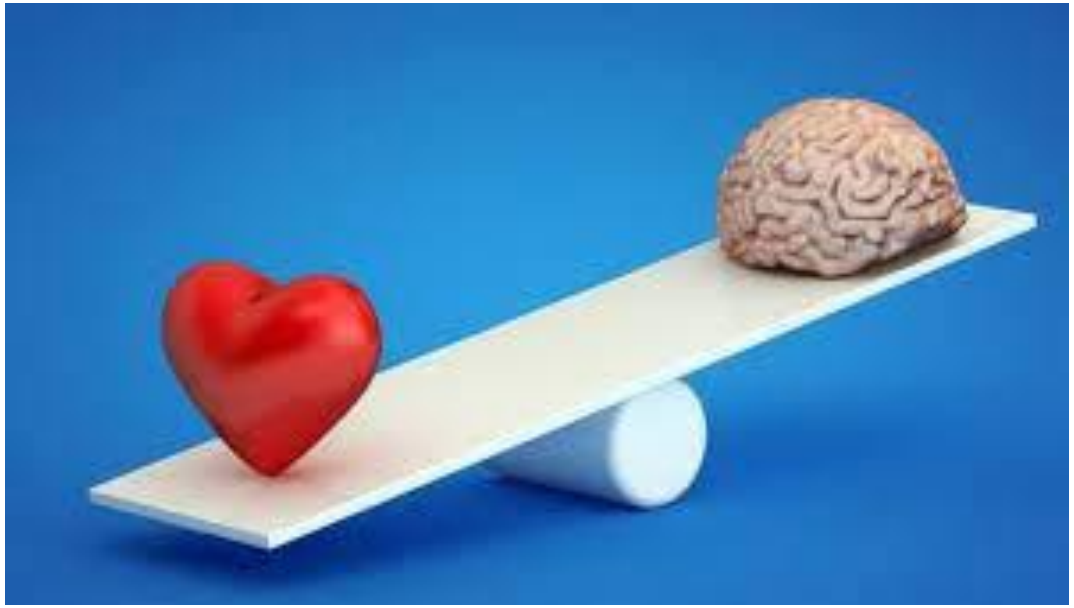
FL is generally perceived as less emotional than NL

The reduced emotional resonance of FL leads to decisions that are less distorted by ‘gut instinct’



Specific dimensions of bilingualism affect our decision-making

- L2 AoA
- L2 learning context
- L2 proficiency and exposure



The FLE is more robust when emotionality differences between NL and FL are stronger

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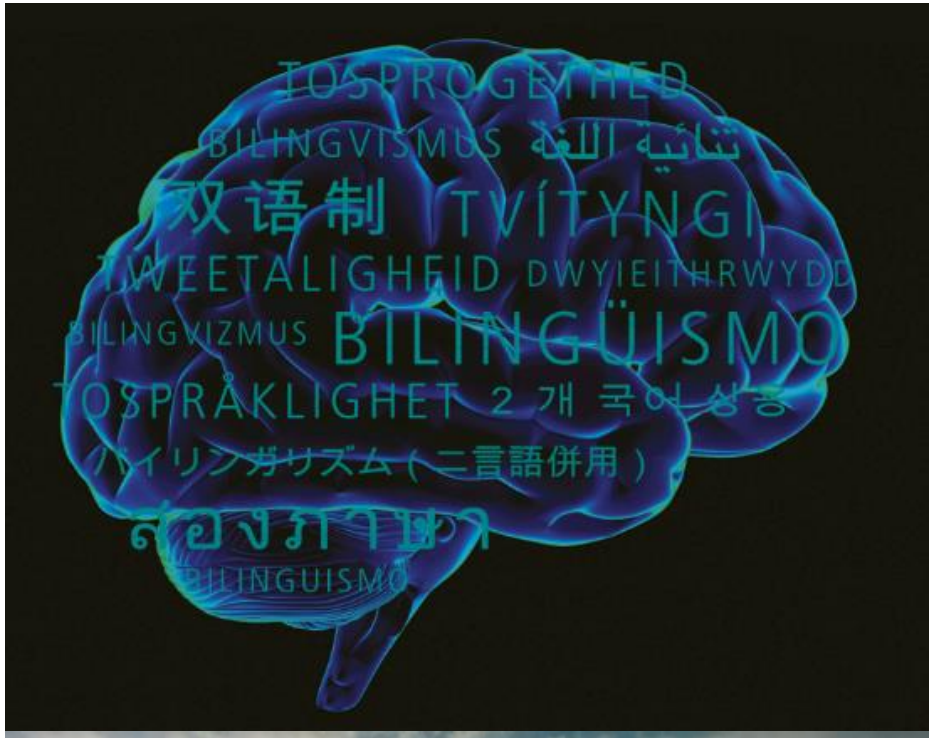
Conclusions

The acquisition and control of more than one language has profound effects on our neurocognitive system

The impact of bilingualism on our brain and behavior is modulated by environmental demands and bilinguals' language experience



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