Dos (o más) lenguas y un cerebro. Neurolingüística, el cerebro bilingüe y el español como recurso económico.

Fitting two (or more) languages into one brain: neurolinguistics, the bilingual brain and Spanish as an economic resource.

Prof. Miguel Martínez López
University of Valencia
La Nau, Martes, 15 de diciembre / Tuesday, December 15
“El cerebro no es un vaso que llenar, sino una lámpara por encender”
(Plutarco, S. I)
“The brain/mind is not a vessel to be filled but a fire to be kindled.”
(Plutarch, 1st Century)

Myths about the brain
Aprendizaje: mundo-cerebro-enlaces neuronales.
Learning: world-brain-internal connections within the brain.

Plasticidad: especialización indeterminada al nacimiento y definida a través de la experiencia y el aprendizaje.
Plasticity: specialization not fixed at birth but shaped by experience and learning.

Bilingües y políglotas: mayor densidad material gris (volumen-intelecto, especialmente áreas de memoria, atención, inteligencia y capacidad de abstracción).

Bilinguals and polyglots: denser gray matter compared to monolinguals (volume-intellect, specially in areas of memory, attention, intelligence and abstract ability).
Different languages in different areas of the brain?
¿Lenguas distintas en diferentes zonas del cerebro?

S-FLL = grey matter density increase
2L-LE = aumento de densidad de materia gris
Inferior parietal cortex
Córtex parietal inferior

Early bilingualism vs. Late bilingualism
(less density increase as age of acquisition increases).
Bilingüísmo temprano vs. tardío
(menor aumento de densidad al aumentar la edad de la adquisición).
Brain scans of bilingual individuals found greater gray-matter density (yellow) in the inferior parietal cortex, an area in the brain’s language dominant left hemisphere. The density was most pronounced in people who were very proficient in a second language and in those who learned a second language before the age of five.
BENEFITS OF BILINGUALISM & FLL
BENEFICIOS DEL BILINGÜISMO Y ELE

- Improves academic excellence & linguistic competence in 2 or more languages (US students: 4 years of FL study = +100 points in each section of SAT vs. half year or less (Research and Policy Committee for Educational Development).

- Lower HS dropout rates, higher college attendance rates, bilingual students perform at or above grade level in two languages.

- Menor tasa de fracaso en Secundaria-Bachillerato, mayor tasa de estudios universitarios, mayor tasa de aprobados...
Students in dual/2-way (TWBI) programs are best by Middle School (11-13), performing at or above grade level.

Estudiantes de programas de inmersión de doble vía consiguen mejores resultados académicos cuando llegan a la edad de 11-13 años...

Cognitive advantages: delay in onset of dementia in Alzheimer and other neurodegenerative pathologies
Ventajas cognitivas como el retraso en el inicio de la demencia del Alzheimer y otras patologías neurodegenerativas.

Bilingualism prevents some of the cognition decline seen in same age monolinguals.
El bilingüismo, comparado con el monolingüismo, previene el declive cognitivo asociado al envejecimiento.
Appreciation of other languages and cultures and prevention of nationalist arrogance.

Aprecio de otras lenguas y culturas y prevención de la arrogancia nacionalista.

Better job opportunities. Better equipped to compete in global job market.

Mejores oportunidades laborales. Mejor preparación para competir en nuestro mercado laboral globalizado.

Bilingual speakers are better able to focus.

Mejor capacidad de concentración.

Greater cognitive flexibility and improved powers of concept formation.

Mayor flexibilidad cognitiva y mayor capacidad de conceptualización.

Intensive exposure to 2 or more languages helps build the cognitive basis of creativity.

La exposición intensiva a 2 o más lenguas activa las bases cognitivas de la creatividad.
Bilinguals have different frames of reference for concepts; different ways of looking at things in the world provided by the different languages.

For many objects and actions they have several words, one in each language, enhancing their ability to be lexically selective.

Greater morphosyntactictic and semantic awareness in language.

• Los hablantes bilingües exhiben diferentes marcos de referencia conceptual; diferentes perspectivas de aproximación a la realidad facilitadas por los distintos códigos lingüísticos.

• Para cada objeto o acción disponen de diferentes términos en cada lengua, facilitando su potencial léxico.

• Mayor competencia lingüística en las áreas morfosintáctica y semántica.
Using more than 1 language boosts blood supply to brain and ensures nerve connections remain healthy. Bilingual children develop a mental agility monolinguals lack, perform cognitive tasks better, are more creative, better at problem-solving, score higher on literacy tests and this intellectual ability transfers to study of 3rd & 4th languages.

Being fluent in 2 languages helps prevent some effects of aging on brain function, delaying 4-7 years the onset of dementia in Alzheimer patients. The Canadian Alzheimer society estimates in 2000 Canada spent CAD 5.5 billion. In US over 100 billion p.a.

(See Bialystok, 2007 & Laura-Ann Petitto, (2010) New Discoveries From the Bilingual Brain and Mind Across the Life Span: Implications for Education. *Mind, Brain, and Education* 3:4, 185-197 Online publication date: 1-Jan-2010.)
Data from the Alzheimer’s disease international world report 2009

- Number of persons 60+ in 2009: 758 million
- Number of patients 2010: 36 million
- Number of patients 2030: 66 million
- Number of patients 2050: 115 million
- Increase 2010-2030: 85%
- Increase 2010-2050: 225%
- Direct+indirect costs: ca. 315.000 million US$ p.a. (2005)
- Per capita cost: 1521 / 4588 / 17964 US$ p.a.
- Bilingual education

Data & projections provided by the Karolinska Research Group (Sweden).
See: http://www.ceaafa.es/files/pdfs/4ab8fa616f.pdf
Broca's Area of the Human Brain

- Located in the left frontal lobe.
- Area associated with language production or language outputs.
Located in the temporal lobe. Area associated with the processing of words we hear being spoken, language inputs, and comprehension.
Current neuroimaging technologies used to study the bilingual brain
Técnicas actuales de diagnóstico por imagen para el estudio del cerebro bilingüe:

- Structural Magnetic Resonance Imaging
  (MRI) / Resonancia magnética estructural

- Functional Magnetic Resonance Imaging
  (fMRI) / Resonancia magnética funcional

- Positron Emission Tomography Scans (PET) / Tomografía por emisión de positrones (TEP)

- Near infrared spectroscopy (NIRS) / Espectroscopia de infrarrojo cercano
Bilingual Brain Images

Cfr. www.innovations-report.com

Bilingual Brain Images

Distinct cortical areas associated with native and second languages.
Causes still largely unknown: accumulation of proteins forming neurofibrillary tangles and the Beta protein replaces brain neurons resulting in a decrease of its normal level of activity.

Aún se desconoce la causa exacta de la enfermedad de Alzheimer. Algunas teorías sugieren que la acumulación de unas proteínas en forma de placas neurofibrilares (‘neurofibrillary tangles’) y de la proteína Beta amiloidea reemplazan a las neuronas del cerebro provocando una disminución de su actividad usual.

Aproximadamente 5% de las personas con 65 años de edad, y 50% de las personas mayores de 85 años sufren de algún grado de demencia
Lady Macbeth, speaking of Duncan's two chamberlains, says:

"Will I with wine and wassail so convince
That memory, the warder of the brain,
Shall be a fume, and the receipt of reason
A limbeck only."

(W. Shakespeare, Macbeth, 1623, I, vii –First Folio-)

Lady Macbeth, hablando de los dos guardianes de Duncan, dice:

“He de dejar a sus dos guardianes con vino y aguardiente, tan vencidos, que la memoria, guardiana del cerebro, será humo, y el recipiente de la razón tan sólo un alambique.”
Differences between the bilingual 
And the monolingual brain (fMRI)

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Bilingual and Monolingual Brains Compared: A Functional 
Magnetic Resonance Imaging Investigation of Syntactic 
Processing and a Possible “Neural Signature” of Bilingualism
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“Highly proficient and early-exposed adult Spanish-English bilinguals and English monolinguals participated. During functional magnetic resonance imaging (fMRI), participants completed a syntactic “sentence judgment task” [Caplan, D., Alpert, N., & Waters, G. Effects of syntactic structure and propositional number on patterns of regional cerebral blood flow. *Journal of Cognitive Neuroscience, 10*, 541-552, 1998]. The sentences exploited differences between Spanish and English linguistic properties, allowing us to explore similarities and differences in behavioral and neural responses between bilinguals and monolinguals, and between a bilingual's two languages. If bilinguals' neural processing differs across their two languages, then differential behavioral and neural patterns should be observed in Spanish and English. Results show that behaviorally, in English, bilinguals and monolinguals had the same speed and accuracy, yet, as predicted from the Spanish-English structural differences, bilinguals had a different pattern of performance in Spanish. fMRI analyses revealed that both monolinguals (in one language) and bilinguals (in each language) showed predicted increases in activation in classic language areas (e.g., left inferior frontal cortex, LIFC), with any neural differences between the bilingual's two languages being principled and predictable based on the morphosyntactic differences between Spanish and English. However, an important difference was that bilinguals had a significantly greater increase in the blood oxygenation level-dependent signal in the LIFC (BA 45) when processing English than the English monolinguals. The results provide insight into the decades-old question about the degree of separation of bilinguals' dual-language representation. The differential activation for bilinguals and monolinguals opens the question as to whether there may possibly be a “neural signature” of bilingualism. Differential activation may further provide a fascinating window into the language processing potential not recruited in monolingual brains and reveal the biological extent of the neural architecture underlying all human language.”
CASES IN POINT: EU (FINLAND) AND CANADA

BEST RESULTS IN OECD-PISA 2006 (School systems ranking)

- Finland: bilingual Finnish and Swedish + English spoken fluently by over 70% of the population.

- Canada: bilingual English and French; Spanish is studied by more people than French in Alberta

- Finland and Canada ranked 1st-3rd (2000, 2003 and 2006 in reading, math, and science)

ECONOMIC VALUE OF THE SPANISH LANGUAGE.

- 3 main elts. shape economic value of the great world languages of intl. exchange: globalization of processes, markets, goods & services. Increase in demand of cultural products, as income & information flows multiply in the information society. Development of knowledge-based society (what we know and how we transmit it) largely through linguistic strategies.

- Spanish-lang. communities (ca. 400 million speakers) unique in their influence on Brasil, USA and Europe through dynamic cohesion. Economic value of Spanish for Spain: 16% GDP (ca. 100.000 million Euros). Cfr. J.L. Delgado’s ongoing research project (2007-...). Beyond cultural, social & political relevance...economic value.

- Relevance of Spanish in economic development of 21 + USA + Brasil. USA: 43 million /14% (legal citizens or residents).
Traditional sectors: teaching Spanish & cultural industries (publishing, tourism,...). Cfr. Fundación de la Lengua.

Services: IT, Internet, linguistic engineering. ...

Google search: Spain vs. España = 886 million. vs. 322 m. Other Google searches:

Science: 4.350 million   Ciencia: 88,1 million
Technology: 5.650 million  Tecnología: 190 million
Nanotechnology: 128 million  Nanotecnología: 1,64 million

EU LANG. POLICY: Multilingualism and the EU indicator of lg. competence (May 2006). Eurobarometer 63:4. 50% of Europeans are capable of maintaining a conversation in a language other than his/her mother tongue. 99% Luxembourgers vs. 64% monolinguals in Spain, Italy and Portugal. Content and language integrated learning. (http://ec.europa.eu/public_opinion/standard_en.htm)

“[…]it has been estimated that the world’s top 20 companies providing translation services employ over 10,000 people and have an annual revenue of over €1.200 million; around two fifths of this activity is estimated to take place in the European Union.”


- Major areas (economic return): Sales, logistics, subtitling, public relations, marketing, communication, cinema, advertising, journalism, banking, tourism and publishing.

- Shortages of highly qualified personnel, standardized certification systems, etc.
REFERENCES


Fundación de la Lengua Española (2008), Spanish language as an economic resource in Castilla-León. www.fundacionlengua.es


Thank you!

Q&A

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