Prof. Dr. Isabell Wartenburger

Professor of Patholinguistics / Neurocognition of Language and Spokesperson of the DFG Collaborative Research Centre SFB 1287, University of Potsdam

How does the brain benefit from multilingualism?

It is an ongoing debate, if and why multilingualism is advantageous for the brain. On the one hand, there are scholars who argue in favor of a bilingual or multilingual upbringing, because the multilingual brain is more flexible by constantly being required to switch between the languages and to access one language while inhibiting the other language(s). Furthermore, there are studies that show that bilinguals have an advantage in linguistic and/or non-linguistic switch-tasks; for example non-linguistic switch tasks in which geometric shapes have to be sorted, sometimes according to their shape and sometimes according to their color. Bilinguals are faster than monolinguals in switching between the task requirements and their brains are less active during the task, as shown by functional magnetic resonance imaging. Aging studies point in the same direction. It has been shown that elderly bilinguals have a general advantage over monolinguals, because bilinguals' brains suffer less from general cognitive decline than monolinguals' brains. Others argue that these differences are not caused by the bilingualism itself, but by other factors that had not been controlled carefully enough.

On the other hand, there are scholars who argue that there is a bilingual disadvantage, because language acquisition might be somewhat delayed in bilingual infants as compared to monolinguals. However, bilingual children usually catch up with acquiring their languages rather quickly and then have the same proficiency that monolinguals do. Another argument for a bilingual disadvantage is the finding that bilinguals have slightly enhanced reaction times compared to monolinguals, for instance, in naming objects. However, these delays can be accounted for by the fact that bilinguals have words from both languages stored in their mental lexicon and that the frequency of usage of these words in one of the languages is logically lower than it is for monolinguals. If frequency effects are taken into consideration, the reaction time differences, therefore, fade away.

The debate about multilingual advantages or disadvantages is also complicated due to the fact that it seems to matter when the second language is acquired and which linguistic processes are considered. The age of acquisition seems to matter most for syntax and grammar processing but not so much for lexical-semantic processes.

For the latter, a later age of acquisition can be compensated for by, for instance, exposure and experience.

To summarize, the question whether there is a bilingual advantage or not, in my opinion, is still not fully resolved, nor is the question about the underlying neural correlates.

The research project *PredictAble* focuses on understanding and predicting developmental language abilities and disorders in multilingual Europe. What are some of your key findings so far?

PredictAble is an Innovative Training Network (ITN) in the Marie Skłodowska-Curie Action (MSCA) of the EU Framework Programme for Research and Innovation (Horizon 2020). PredictAble aims to train early stage researchers as well as to improve the understanding and prediction of developmental language abilities and disorders. The consortium consists of research teams in Barcelona, Berlin, Jyväskylä, Paris, Potsdam, and is coordinated by Prof. Dr. Barbara Höhle from the University of Potsdam. We have partners at CEU in Budapest and at Haskins Laboratories, Yale, as well as partners from the clinical and industry sectors.

There are 15 doctoral students working on the question if and how problems in language acquisition can be predicted early in life for “pre-linguistic” infants who can’t give overt linguistic responses yet. We are doing this by using and combining multiple research methods, such as the Head-Turn-Preference Procedure, Eye-tracking, as well as EEG, MEG, or NIRS measurements. In addition, we are collecting existing best practice instruments to diagnose developmental language impairments as early as possible across the different languages involved in PredictAble. Most of the doctoral students are currently in the middle of the data analysis. For instance, in one project, we found that 6-month-old German infants already have learned that German bisyllabic words are usually stressed on the first and not on the second syllable, and that this knowledge helps infants find words in the speech they hear. This indicates that crucial steps of language learning already take place in the first months of life. The project now investigates whether individual differences in this very early development are related to later abilities in learning words and grammar.

A second question that this project follows is based on how reliable the measurements of these early language achievements in such a young population are. First results indicate that children’s responses to specific speech information show considerably constant patterns across several measurement points within individuals. These are promising results for the development of tools that can detect language development risks already at a very early age.

The infant brain is most flexible in learning. For this reason it is crucial to diagnose or validly predict developmental language disorders as early as possible, since they can have devastating and long-lasting effects for the individual, starting with problems at school up to career choice or professional activities.

Why is it easier for young children to learn a foreign language?

It seems to me as if the infant brain is like a sponge that takes all the information it can get and tries to make something meaningful out of it. In language acquisition, the first months of age seem to be a "sensitive" period. It has been shown that 6-month-old infants can discriminate phonetic contrasts in other languages that are not part of the native language phonetic inventory. This ability seems to get lost by an age of around 12 months. In other words, the brain can initially process these non-native (and in that sense "useless") contrasts, but later on, with increased exposure to the native language, the brain loses this capacity and focuses on learning the native language. A study by the research group of Prof. Friederici, MPI CBS Leipzig, indicates that 3-4-month-old infants are better in detecting violations in a just-learned "mini-language" than older children or adults.

In a current project of the DFG Research Unit FOR 2253, Crossing the borders: The interplay of language, cognition, and the brain in early human development), we are following this developmental trajectory in a more fine-grained manner to better understand when and why the underlying learning mechanisms change and if they change similarly for linguistic and non-linguistic material. Because the infant brain is especially tuned to make sense out of linguistic input, early infancy is often also thought to be the optimal period for learning more than one language. There is evidence that adult bilinguals who learned both languages at an early age process syntax and grammar of both languages similarly and probably more automatically than late bilinguals.

Could you tell us about some of the latest developments in the field of neurolinguistics?

In general, there is a tendency to go away from computing "average behaviors" from cross-sectional group data to the recognition of inter-individual and intra-individual differences as an interesting and important source of information. This can be observed not only in neurolinguistics research on acquired language disorders, such as aphasia (a difficulty in processing language as a result of a stroke), but also in research on impaired or unimpaired language acquisition and on language processing in healthy monolingual or multilingual adults. In addition, we more often combine different methods and compare different populations, such as healthy elderly individuals to individuals with aphasia. We use computational modeling to predict the individual behavioral patterns and to better understand the underlying mechanisms.

Furthermore, highly advanced methods for data analysis are available nowadays, also in the field of neurolinguistics. This requires interdisciplinary cooperation and teamwork. An example of a large interdisciplinary project is the DFG Collaborative Research Centre 1287 "Limits of Variability in Language: Cognitive, Grammatical, and Social Aspects." The CRC focuses on the variability within and between individuals, language communities, as well as specific languages from the perspectives of language interaction and change, of language processing, and of the grammar systems. By modelling the factors that influence linguistic behaviors across a variety of linguistic phenomena, the CRC aims to get a clearer picture of the underlying mental representations and processing architectures in the individual and of the grammatical options that are inherent in a language, in a specific variety of that language, or in a particular language-contact situation. In my opinion, the future of the neurolinguistics field lies in interdisciplinary cooperation and the open exchange of experimental paradigms, data, and analysis routines to make the best out of otherwise rather limited sources of evidence.