Why are Numbers so Difficult? Language, Short-term Memory and Aphasia

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A Case Example: EE

• Damage to a small brain area involved in language (the left parietal lobe).

• EE made a good recovery, returned to work (small business)

• But he then discovered that:
  – He made mistakes when writing down phone numbers.
  – He couldn’t do arithmetic, especially when it involved large numbers
  – He sometimes missed things people said to him, and had to ask them to repeat themselves

• E.E.’s difficulties really affected his work, and forced him to retire from his business altogether

(Markowitsch, Kalbe, Kessler, et al., 1999).
A Case Example

• In the digit span task, you have to listen and repeat a series of numbers. EE could repeat back a series of 3 numbers, but no more (normal is around 7).

• He had a similar problem with words. He could repeat back one word (e.g. “cat”), but couldn’t do two (“cat-sun”).

• E.E.’s has a difficulty with verbal short-term memory – he can cannot retain verbal material over short intervals.
A Case Example

• For E.E., that was his only problem

• But many people with aphasia have this problem too.

• In fact, virtually ALL individuals with aphasia have verbal STM problems, regardless of their specific diagnosis.
What *is* Verbal Short-term Memory?

It’s the ability to “hang onto” chunks of speech for a few sentences.

The language regions of the brain, when operating well, provide a sort of “playback” feature.

Damage anywhere in the circuit (red regions) can affect this ability.

About 90% of people with aphasia have damage somewhere in this circuit.

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Majerus (2013)
*Frontiers in Human Neurosci*
So what is Verbal short-term memory for?

- To hold information when planning a long sentence
- To hold information when listening to a long sentence, especially where word order is crucial to the meaning (e.g., “The dog that the pig chased was injured”).
- As a “back-up” device in conversation in case we miss something (we can “back track” over what we heard)
- To hold information in verbal form to solve a problem (e.g., arithmetic)
What happens when it’s not working right?

• You may “miss” things in conversation. Even when you know you understand the words.

• You may be okay okay one-to-one, but have trouble following group conversations.

• You may have trouble getting details right over the phone (appointment times addresses, etc.)

• You may have difficulty with arithmetic, things you found easy before your stroke?
Some people describe

“Sometimes things go in one ear and out the other”

“Sometimes I get things around the wrong way. Is Ben is driving Mary to town, or is it the other way around?

“I feel really stupid when I can’t work out the change in the supermarket”

“I have to write a shopping list slowly, checking it each time to make sure. I can’t cope with more than one thing at a time!”

“Writing down times and dates on the phone is a killer. In fact times and dates are always a problem”

“It’s so much harder to understand people on the phone than in real life”
Some rules of thumb

• Auditory information is usually most difficult. Try to get visual help when you can (e.g., subtitles on the tv)

• The more meaning something contains, the easier it is to remember (this is probably why numbers are so hard!)
What can be done?

• It helps to understand what you’re up against. You’re not stupid or dementing, it’s part of the aphasia.

• Recent research suggests we may be able to “train” verbal STM (Kalinyak-Fliszar, Kohen & Martin, 2011, Aphasiology).

• However, this research is still in its early stages.

• Probably the best approach for now is to use support.

• Some techniques -> next slide.
For You (the person with aphasia)

• If you have a new TV, try using the English subtitles for the deaf. Not to read in full, just to help you out occasionally.

• When dealing with numbers, try using a coloured number grid or wheel (whatever you prefer)

• Have copies of these in front of you when on the phone etc.
For Partners, Friends, Family

• Keep sentences short, repeat your message several times, in different ways.

• Multiple modalities: if the person is good at reading, use written support (e.g., pen and paper)

• Add meaning to the information in any way you can:
  – Numbers: using a colour wheel or grid to communicate numbers.
For those who want to learn more

Special issue of *Aphasiology* edited by N. Martin & J. Reilly:

“Short-term/working memory impairments in aphasia: Data, models, and their application to aphasia rehabilitation” *Aphasiology*, 2012, 26(3-4).