Dr. Stanislas Dehaene's Responses to The Reading League

On April 24, 2024, the California Association of Bilingual Educators hosted a webinar, *Debunking SoR Neuroscience Claims*, that attempted to undermine findings from neuroscience, including the research conducted by Dr. Stanislas Dehaene. To clarify the information presented, The Reading League posed the following questions to Dr. Dehane.

The Reading League:
Dr. Dehaene, there are still many misconceptions about reading in the U.S., and many are working against the movement to learn from reading research. Recently, a webinar featuring a neurologist, Dr. Steven Strauss, made some claims against your work. Many Californians tuned in to this webinar, and we would like you to address some statements that were made against your work.

Dr. Strauss stated the following information about the limits of functional MRI:

"MRI[s] are limited to taking pictures of subjects reading very short pieces of language…syllables, single words, maybe a nonsense word, but it cannot study text. It cannot study what children and adults actually read, and therefore the principles and discoveries they make, which they call studies of reading, are inherently limited by the MRI machine."

On a presentation slide, Dr. Strauss stated, "fMRI is not able to study the normal reading of text…it can study spatial resolution, not temporal resolution…The limitations of fMRI force it to study very small pieces of language. This is likely the reason Science of Reading regards the fundamental initial step of reading as the identification of letters…"

Is this accurate?

Dr. Stanislas Dehaene:
What Dr. Steven Strauss says is so utterly false that it betrays a dramatic lack of knowledge of the scientific literature. There are literally hundreds of brain-imaging studies of sentence processing. For more than twenty years, we and many other researchers have routinely used sentences and texts, both written and spoken, as stimuli during functional MRI. In my talk, for instance, I showed a picture from my book, *Seeing the Mind* (Dehaene, 2023), which showcases the gorgeous research performed at Berkeley by Alexander Huth and Jack Gallant. Their fMRI images vividly demonstrate that written and spoken texts activate extremely similar brain circuits for meaning (Deniz et al., 2019). We and others have used fMRI to dissect the brain circuits for reading at various levels, from single word processing to syntactic and semantic integration (Fedorenko et al., 2024; Pallier et al., 2011; Regev et al., 2013; Vagharchakian et al., 2012).

It is equally false to state that fMRI has no temporal resolution. True, the brain responses that we record in fMRI are temporally smeared by the slow coupling between neurons and blood vessels. Nevertheless, this coupling only takes a few seconds. As a consequence, fMRI remains fast enough to track the speed of sentence comprehension and dissect its successive stages (Pallier et al., 2011; Vagharchakian et al., 2012). It should also be stressed that functional MRI results are confirmed by higher-resolution techniques of electro- and magneto-encephalography as well as by intracranial recordings (e.g., Marinkovic et al., 2003; Woolnough et al., 2020, 2022).

Concerning the science of reading and its acquisition, the key finding is that, whenever we read, be it pseudowords, words, phrases, sentences, or paragraphs, brain activity starts in visual cortex and then, by about 170 ms, reaches the visual word form area (the brain's "letter box"). This region is a bottleneck common to all languages, scripts, and reading tasks—and from there, the brain activity quickly moves to other areas involved in phonological, lexical, syntactic, and semantic information. Thus, the accurate recognition of letters is an essential early stage common to all reading tasks.

The Reading League:
In the webinar, Dr. Strauss critiqued neuroscience using the idea of predictions. He stated, "Good readers make good predictions if we are reading for meaning and not reading to sound out letters." He goes on to say that readers use fixations and saccades, which proves that we do not read every word. He also stated that "making predictions is better than sounding it out."

What are your thoughts on these statements?

Dr. Stanislas Dehaene:
The idea that the brain is a predictive machine is strongly established, including in the domain of written and spoken language processing (e.g., Heilbron et al., 2020, 2022; Smith & Levy, 2013). However, what does this mean? It means that the brain uses the context of previous words to project **tentative** predictions about upcoming words, and then compares those top-down predictions with the incoming sensory evidence. Ultimately, the bottom-up evidence wins, and the predictions get revised accordingly. The letters in a word determine what the word is, not the prediction or the context, which very often can be wrong or misleading.

Predictions only do a very small part of the work in reading. Faithful letter knowledge is essential because of the following:

- We often read unlikely ~~elephants~~ utterances (how likely was *that* word?). Predictions can only go so far. The only solid information about the text lies in its letters and how they convey the identity of phonemes and words.

- When you start reading a new story, how do you think that the brain can build a representation of context in the first place, if not by using letters?

- Even when it makes a strong prediction, the brain still needs to compare it with the identity of the incoming letters in order to correct its internal model of the text—otherwise, how would it figure out that, now, I want you to think of a ~~diplodocus~~ ~~chameleon~~ toothbrush?

- Young readers do not yet possess the full mastery of language that would allow them to generate accurate top-down predictions. For them, focal attention to letter identities is even more important than in adults.

- When moving their eyes through a text, expert readers sometimes skip short words—but that does *not* mean that they are guessing and do not process the letters, only that they process more than one word at a time (Snell & Grainger, 2019). Once again, this option is not available to beginners.

In summary, young readers must be taught explicitly how to attend to letter strings, left-to-right, letter by letter, and how to sound them out, in order to connect them to spoken words that they already know. They should never be distracted from this task by guessing, by using contextual pictures or other "cues" as substitutes for letter-sound knowledge to decode words, etc. The best guidance in instructional materials is, when coming to a word that is not immediately recognizable in a text, focus on letter-sound correspondences and decoding. Context is used only to help confirm word reading accuracy and to integrate the current word in the ongoing phrase, sentence, and discourse.

In agreement with those conclusions, a large-scale study of 90,265 French children and their 6,440 teachers shows that the most efficient teaching practices do not teach sight memorization of *any* words and do *not* encourage guessing (Deauvieau, 2024).

The Reading League:
One of the main ideas of the presentation was undermining the value of neuroscience in understanding how children learn to read. Do you think the convergence between neuro-research and behavioral research strengthens the proposition that, regardless of the language, readers need to connect the language's sound system to the orthographic representation and then to the semantic system of the language to read?

Dr. Stanislas Dehaene:
Indeed. As I stated in my book, *Reading in the Brain*, I am struck by the convergence between psychological, neuroscientific, and educational research on reading. This has now become a very stable part of science. Furthermore, although I personally love our neuroscientific findings because they clarify the brain mechanisms of reading, the most important findings for teachers are behavioral and educational. They clearly demonstrate the key role of grapheme-phoneme conversion, and how explicit teaching of phonics leads to the fast and painless acquisition of reading more efficiently than other methods. Neuroscience only strengthens the conclusions that were already drawn by the National Reading Panel almost 25 years ago (Ehri et al., 2001; National Institute of Child Health and Human Development, 2000) and have been constantly confirmed since then (Castles et al., 2018; Dehaene, 2009). We must now accept them and implement them in our schools.

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