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From language to literacy: understanding dyslexia

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I think there are some really interesting commonalities and differences when we talk about language versus reading. As Sharynne so clearly demonstrated, the general belief is that humans have what we call the "language instinct:" an innate natural ability, if they are neurotypical, to learn to speak. Children are typically born with this, and it occurs naturally through their interactions with the environment. The linguist Steven Pinker gave a very delightful summary of this when he said, "Short of raising a child in a barrel, they will learn to talk in the environment that they're in."

We have a very different situation when we talk about reading. If you place a child in the environment of books and leave them to discover what they discover, what you find is they don't discover very much about reading. We are not hardwired to naturally derive meaning from those squiggles, curves, and funny-looking letters that are on the page. Reading is a learned skill. This has come up many times already this morning, and it typically requires instruction. The very unfortunate thing, and the thing that I have spent so much of my time trying to understand, is that approximately 10 to 15% of children have a specific and long-standing difficulty with learning to read. These are children who don't have low IQs. There's quite often no other really obvious feature that would explain it.

There is a comorbidity with language difficulties, and I'll move on to that in a moment. It's a very specific disorder, and we see it in many different forms. I have decided to take the list approach and share with you the top five things I've learned about dyslexia in the time that I've been studying it.

1. Dyslexia usually involves words

The first thing might seem somewhat surprising, but in the vast majority of cases of dyslexia, the problem is at the word level. There are some unusual cases where the problem is at a text type level, a broader comprehension level. Typically, those children have other language disorders that go with that. But if we're talking about a dyslexia-specific reading problem, usually we can locate it at the level of the word, which is something quite valuable for teachers to know. You can probably, just with a few quick word tests, get an idea of which child might have a propensity to struggle. Now, in some ways, this might seem really surprising: like how easy it is for us to read "dog" — how could it possibly be such a difficult challenge that some children are unable to fully achieve? But if we break it down, even reading a single word is immensely complex. So for starters, you read this word in an enormous number of different forms; you read words in uppercase and lowercase;

1 This is an edited transcript of the address [Ed.]

you read them in different fonts; you read them in skywriting — it's not just a visual process, it's quite a complex, abstract knowledge of what the spelling of that word is that you can do. The other thing is that you can read words that don't follow the typical sounds that you would sound out. So a child first reading this word "y-ach-t" would say "yed." English is a particularly difficult language in that it has very many words like this[2] and in fact very many words that are quite frequent that are like this.

We're also able to read novel words. So I can put this made-up word that I've just put on the board for you, and you can instantly pronounce it as "glimp." So you have a separate process in your brain that's computing out the pronunciations of words in most cases and getting to their meaning that way. And of course, even as adults, we have to read novel words all the time: reading people's names that you don't know, names of towns and cities. I had an international visitor the other day, and I was driving her down to see the harbour and all around here, and she said, "Oh I really would like to go to wulu mulu," and for quite a while I was like, "What is she talking about?" Then I realised it was Woolloomooloo.

2. Dyslexia is heterogeneous

There's a lot of word learning that happens all the way through our life, so as well as being focused at the word level, even at that word level it's highly heterogeneous. It's really wrong to talk about dyslexia. We should talk about the dyslexias, because it's a complex learned skill and by that complexity, there's a whole range of different ways in which it can go awry. Taking our examples from before: if with our 10 to 15% of children in the classroom, some of them we know have difficulties with that sounding-out process which is essential for reading novel words, very many children with dyslexia have this problem. And it's one of the reasons that there's a big push for phonics instruction that's very systematic and structured and assessed in schools. Because you really need to be able to read novel words when you're learning to read. Every written word's a novel word. But you also find children who have difficulty with putting words to memory, so they've seen the same word over and over again. You and I would be familiar with it: we'd go, "Oh, yes, that's yacht, no worries." But they continue to struggle and they need to see many more exposures in order to be able to put that word to memory. And of course, that means that their reading is very slow: they have to devote a lot of cognitive resources to that processing, which interrupts their ability to comprehend the text, which is obviously the most important thing. You also get children whose problem is at the comprehension level. These are often the kinds of kids that Sharynne has talked about: they have difficulties with vocabulary, with spoken language, and that carries through to a difficulty in understanding written text.

The point that I want to make is, even with what seems the most simple task to us, there's actually, when you break it down, an awful lot of complexity. And all of that complexity is typically mastered by children within a couple of years amazingly. But we do see these children that struggle and we need to do more for them.

2 "yacht" comes from the Dutch "jaght" [Ed.]

3. Dyslexia is highly heritable

The third thing that I've learned — and this may seem in some ways counter to the point I made earlier that we don't have a reading instinct — you would have noticed that on none of those brain pictures has there been an area of the brain for reading. We don't have a "reading gene," but that doesn't mean that it's not heritable because what is heritable are the complex set of more general abilities that are heritable that have to be applied to the task of reading. We're talking about memory, we're talking about visual processing, we're talking about language, and that combination of skills is highly heritable and it plays out in the dyslexias that you see.

The neatest evidence for this in my view has come from twin studies. I think most of you would be aware of the logic of twin studies. We have identical twins — sometimes called monozygotic twins — who share 100% of their genes: they're genetically the same. We also have our non-identical dizygotic twins who share 50% of their genes, and if they're living within the same family and going to the same school, they're relatively well-controlled in terms of their environmental experience, so we can use the contrast between identical and non-identical twins to get an estimate of how heritable reading difficulties are. And not just one type of reading difficulty, but all of the different types of dyslexia that I've mentioned.

We would select one twin who is struggling with some reading at the bottom of the bell curve. Then we look at what's going on with their co-twin: are they identical or non-identical twins? What you clearly see is that when we look at the co-twin of a child with dyslexia, the co-twin in both cases tends to be below the average on the overall bell curve, but our monozygotic twins are much worse than the dizygotic twins. That tells us we can compute essentially a heritability estimate. And these estimates are very high, surprisingly high, over 50% of reading difficulties are heritable, by most estimates.

4. Dyslexia is a learning difficulty

This doesn't mean — and I think this can often be something that's hard for parents or teachers to process — that these reading difficulties can't be treated. We know a lot about how to teach reading, and we know that we can apply those same principles to children with reading difficulties and get good outcomes. We just need to do it more intensively and probably for longer.

Learning has come up a lot in the sessions so far, and, as I've emphasised, dyslexia is a difficulty in learning. We know much of it is based on genetics. We know it's happening somewhere in the brain. And many researchers look at exactly that kind of thing: what are the areas of the brain that seem to be different in children with dyslexia? But we can see a causal pathway that goes down to maybe a language-processing difficulty that may then go down to a difficulty in learning those letter-sound mappings, and then we have a behavioural outcome that's the reading difficulty.

So we think there are multiple causal pathways that can lead to reading difficulties. And as I've already emphasised, there are multiple different types of reading difficulties as well, so this is a complex task to try and unpack these causal pathways.

5. Best to treat the reading

Although we know that there's this complex causal pathway — and we researchers spend a lot of time trying to tease these causal pathways out —based on the science we have so far, we know if you have a child with a reading difficulty, the very best focus of your intervention should be at the level of the reading difficulty itself. We just don't know enough about the complex causal pathways that lead to that for intervening at earlier levels to be effective. And of course, there are many cases where we wouldn't be able to intervene obviously. But what we do know is that if we identify using very carefully evidence-based assessments exactly where a child's problem is and target that, we can have the best outcomes for a child. This is one of the reasons why my research group always suggests being a little bit wary of any dyslexia treatment that is focusing at one of those earlier levels. Not that those aren't important questions, but we're just not at the point where that is helpful for intervention: brain training, coloured lenses, visual problems — all of those sorts of things — we know there are associations. We also know from large RCTs that those kinds of interventions are not as effective as working at the level of the reading system itself. So I'll leave it there.

I feel a bit sad in a way that I can summarise my research career in five points but we still have a lot to learn. One thing that is absolutely crucial — and what my laureate project is focusing on — is reading difficulties once children move into secondary school. We know from international reading studies, PAA studies — I think the last estimate from the PAA international study had 40% of 15-year-old Australian children did not meet the criteria for functional literacy. We have many children who are coming into high school not having been picked up as having a reading difficulty or a language difficulty in primary school. They move into high school where nobody looks at that anymore. No teachers — they're not doing that, they're teaching content, and the children are expected to access that content. We know that a large number of those children can't read, and, as echoed in the points that Sharynne made, we also know that things get really tricky once you get to this age because of self-esteem issues and anxiety and other sorts of comorbid factors, which often lead to these children being very resistant to reading and to things like school refusal. What we need to do, and what we hope to do, in the seven years that the ARC has so generously given us, is to not just look at the basics of the reading trajectory in these children in high school, but how it how it interacts with all of those other contextual factors that are going on in high school. So maybe in seven years' time I can come back and tell you some more insights.