

“ONLY CONNECT!” CREATING CONNECTIONS WHEN READING FICTION AND DIGITAL TEXTS

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Abstract

The paper draws on work within neuroscience as well as literacy education and cognitive literary studies to examine differences between the deep reading of traditional narratives and the reading of digital media. Since game-playing, hyper-links and extended novel reading can affect how the brain develops, teachers need to understand how they can enable their pupils to develop the neural pathways that make flexibility of reading style possible. This means engaging with the impressive array of research available within the neurosciences on learning to read. The particular capacity examined is connectivity. The nature of instant access to anyone who is on-line and the use of hyperlinks are contrasted with the connectivity with fictional others proffered by the deep reading of novels, specifically fantasy series. The article concludes by calling for more sustained classroom reading as well as support for digital literacies.

Key words: Neuroscience, cognitive literary studies, reading, digital literacies

Resumen

Este artículo se basa en el trabajo dentro de la neurociencia, así como la alfabetización y estudios literarios cognitivos para examinar las diferencias entre la profunda lectura de narrativas tradicionales y la lectura de los medios digitales. Puesto que el juego, los hipervínculos y la lectura extensiva de novelas pueden afectar el desarrollo del cerebro, los maestros necesitan entender cómo lograr que sus alumnos desarrollen las vías neurales que hagan posibles estilos flexibles de lectura. Esto significa familiarizarse con el impresionante conjunto de investigaciones disponibles dentro de las neurociencias en relación con la lectura. Más en concreto, este artículo estudia la habilidad de la conectividad. La naturaleza del acceso instantáneo a cualquier persona que esté en línea y el uso de los hipervínculos se contrastan con la conectividad con otros ficticios que nos brinda la lectura profunda de novelas, sobre todo de series de novelas de fantasía. El artículo concluye haciendo un llamamiento para una lectura más sostenida en el aula, así como para el apoyo a las alfabetizaciones digitales.

Palabra clave: Neurociencia, alfabetización, estudios literarios cognitivos, alfabetización digital

1. Introduction

The epigraph to E.M. Forster’s modernist classic *Howard’s End* (1910) –“Only Connect!”– exhorts the reader to form close, intimate connections with others. This exhortation is ironically undermined as Forster exposes the *lack* of connection between Margaret Schlegel and Henry Wilcox. The sentence that follows “Only Connect! That was “the whole of her [Margaret’s] sermon” informs readers that “she failed” (Chapter 22). Margaret and Henry’s inability to build a “rainbow bridge” that would connect them despite their manifold differences still holds the power to fascinate as readers connect with the characters’ emotions and care about their dilemmas. Deep attachments with literary characters form part of the pleasure of becoming literate. Classroom teachers delight in that momentous event in a child’s reading career when the desire to know *what happens next?* to Harry,

Hermione and Ron or to the animals in Lucy Daniels' *Animal Ark* or whatever the cult series of the moment might be that transforms a child who can decipher text into a reader who is engrossed in books. In this article, I shall consider the nature of this connection with fictional characters and compare it with the connectivity enabled by on-line reading by using recent innovative work within the neurosciences to take our thinking further.

Digital media enable greater connectivity – *interactivity* – than any previous media. Instant access to anyone who is on-line at the same time as us or to information stored elsewhere is heralded as one of the most popular and positive aspects of the digital age. Governments and daily newspapers exhort teachers to pay attention to digital literacy from the moment the child enters school (*The Guardian*, for example, launched a campaign “to upgrade computer science, IT and technology teaching in schools” in January 2012, Chorley 2014). But when children start to enjoy digital literacy for hours on end, their behaviour is rarely met with approval. On the contrary, the very same newspapers that promote digital literacy also report extensively on the dangers of spending too long on-line (Carrick-Davies 2011; Jeffries 2013; Barrow 2013; Robinson 2013; Greenfield 2009).

It matters what “they” say in the newspapers (whether digital or paper) because this is most parents’ main source of information about literacy, and quite probably many classroom teachers’ as well. Much of this reporting, unfortunately, distorts the nature of the information being presented. For instance, when *The Daily Mail* reported that 70% of head teachers are concerned that Facebook and Twitter are damaging children’s literacy skills (Barrow 2013), this was presented as though it were evidence that digital literacy *is* damaging children rather than a survey of opinions. Even when those commissioning a study are in charge of the media release, for instance the independent regulator and competition authority for the British communications industries, Ofcom, reported on their survey of how people in the UK are using communication technology the title of the news release was “Techie Teens are shaping the way we communicate”. What the survey actually measured was how much time various age groups spent using digital and non-digital communications technologies and also their “Digital Quotient” (DQ in an analogy to IQ). DQ purports to describe “confidence and knowledge of communications technology”, but in practice includes statements which are measuring attitudes towards and pleasure in using technology. It did not demonstrate that teenagers were the cause of the changes in the way we communicate, only that they used digital communications devices frequently and enjoyed doing so. When this was reported in *The Guardian*, the title shifted to “six-year-olds *understand* digital technology better than adults” (Garside 2014; my emphasis), although the survey did not test understanding, only the use of and attitudes towards communications technology (no other type of technology was examined in the survey). And in my reporting of these two surveys and the slippage in the reporting of the findings, I have adopted another useful technique in journalism: I have hidden the sources. Rather than referring to Becky Barrow and Juliette Garside in the running text, I have hidden their names in parentheses and highlighted the names of the newspapers instead. I now draw your attention to this to show how simply the voices of Barrow and Garside can be camouflaged and become simply part of the “they” in “what ‘they’ say in the papers”.

As a regular reader of academic journals, you obviously have access to more reliable, scientifically evaluated information than the newspaper reporting cited above. Yet I suspect that, like me, you are also drawn to such headings in the media – you “connect” with the ideas – and such

connections may inform your day-to-day practices within literacy education. What I want to do in this article is to step back from the politics and emotions tied up in responses to children's literacy practices to think through the gut reactions that are embodied in the reporting of literacy stories in the media. Why, for instance, are we delighted when children become avid readers of novels but fearful when they become avid game-players? Why do we criticise ourselves for wanting to print out a text in order to read it, whilst our children seem able to manage with digital texts alone?

Clearly there is a difference in how we respond to text we read on screens as opposed to texts we read on paper; this was already established in a review of the research by Andrew Dillon as early as 1992. Admittedly, the technology has advanced considerably since then, not least in terms of screen quality. As digital ink technology reduces eye-strain, enabling people to be physically more comfortable gazing at a screen than they would have been in the studies Dillon reviews, slightly different patterns emerge, but the physical strain on the body continues to be brought to the fore (e.g. Mangen 2013a) and the precise qualities of the digital form need to be clarified in future research (Margolin, Driscoll, Toland & Kegler 2013). Furthermore, a broad array of studies demonstrate that reading print-on-paper texts are better for memory recall after reading (Mangen, Walgermo & Brønnick, 2013), for digesting complex information (Stoop, Kreutzer & Kircz, 2013a, 2013b), and for immersing oneself in a story (Mangen 2013b; Mangen & Kuiken 2014). Digital texts, on the other hand, are only superior for "quick information gathering, communication and navigation" (Stoop, Kreutzer & Kircz, 2013a, 2013b). The reasons for these differences are not yet clear, but the physical ways in which our bodies perform literate acts and how our brain processes materials has led me to research in the neurosciences in search of an explanation as to how digital reading differs from reading on paper.

Unfortunately, most of the really valuable information about how the brain functions when we read is published in formats that are not easily available for classroom teachers. Each study typically examines a very small aspect of reading (for instance, observing upright forms in letters such as b, d and k versus upright forms in non-letters (Hruby and Goswami 2011, 159), is typically published in highly cited journals with other researchers as its target readers, using such highly specialized terminology that few classroom teachers would either be able to understand or wish to read after a day spent trying to teach children to read fluently. Fortunately, increasing numbers of neuroscientists are attempting to bridge that gap, and in doing so support literacy educators as they attempt to create supportive contexts for teaching children to read (Sousa 2005, 2011; Hruby and Goswami 2011). In this paper, I draw on work within neuroscience to extend our thinking about the differences between the deep reading of traditional book formats and the reading of digital media with the aim of considering how to enable our children to gain both types of skill, thereby enabling choice. The particular facility I wish to examine is related to our ability to connect with one another. Digital media enable greater connectivity – interactivity – than any previous media. Instant access to anyone else who is on-line is one of the most popular and positive aspects of the digital age. I wish to consider the nature of that connectivity and contrast it with the connectivity with fictional others that develops through the deep reading of novels. This comparison will not lead to a clear solution, but can help guide us away from false dichotomies and overly emotional or politicised responses.

2. The Reading Brain

Unlike speaking, reading is not an innate ability, but by learning to read “we rearranged the very organisation of our brain, which in turn expanded on the ways we were able to think, which altered the intellectual evolution of our species” (Wolf 2008, 3). As Maryanne Wolf observes, it took 2000 years to develop the alphabetic system, and yet in North America and most European countries, we expect children to have grasped this principle within 2000 days of life (2008, 19). By 3000 days we expect children to have a sufficiently strong command of the principles involved to be able to read silently and independently, and from 4000 days onwards we expect young people to conduct the majority of their learning by reading. Somewhat surprisingly, the majority of youngsters do in fact manage this impressive feat, even though “no areas of the brain are specialized for reading. ... As far as we know, the genes have not incorporated reading into their coded structure, probably because reading, unlike spoken language, has not emerged over time as a survival skill” (Sousa 2005, 32). Nevertheless, the social stigmatism and limited job opportunities for those whose reading is not proficient mean that, as educators, we should treat reading as though it were a survival skill.

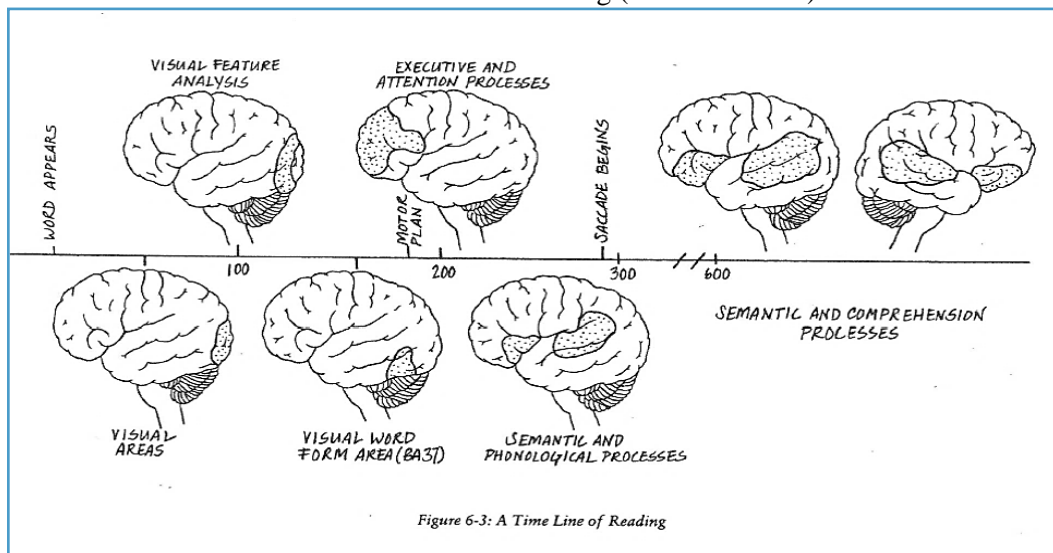
That said, the recognition that reading is *not* an activity the brain is designed to master is important for helping us to dismiss the claims of the so-called “real books” movement promoted by teachers such as Liz Waterland in the 1980s (Waterland 1985). Proponents of “real books” claimed that learning to read was like learning to speak, and that children simply needed to be immersed in good quality literature in order to *develop* the necessary skills. To be fair, Waterland did note that “This is not to claim that what goes on in the child’s head is the same for both skills but to suggest that the method of acquisition might usefully be compared” (1985, 10). As a metaphor, comparisons between learning to read and learning to speak are appealing; we have all encountered children who have grown up in literacy rich environments and learned to read for themselves. But it is only a metaphor. Many of the problems associated with the real books movement in its more extreme forms arose from taking this comparison literally, with the result that much of the excellent work teachers were doing to support grapheme-phoneme correspondence was dismissed, leaving children who come from homes that are not literacy rich to flounder (Beard and McKay 1998). Turning to neuroscience – “what goes on in the child’s head” – we can not only dismiss the over-extension of metaphors comparing speech and reading, we can also address Waterland’s real problem: the impoverished reading environments of phonics driven classrooms. Not only has neuroscience demonstrated that emotional states affect the memory processes needed for learning to read (Binney, Embleton, Jefferies, Parker, & Ralph, 2010), it has also provided us with more precise information about how sounds are encoded. Goswami and Szücs (2012) found that aural coding patterns are more sensitive to syllables and speech rhythm than phonemes. The implications for classroom practice are what every literacy teacher already knows: having fun playing with rhyming words, learning rhythm and rhyme together in nursery rhymes and clapping games are conducive to the development of literacy skills.

Reading may not be genetically encoded in our DNA, but most people’s brains do, in fact, use the same areas for reading. In their review of neuroscience for reading education researchers, Hruby and Goswami caution against paying too much attention “noneophrenology ... wherein areas of dedicated function are mapped to precise locations in the brain” (2011, 157), because they fear that this will

result in the search for pinpointing aspects of reading (such as grapheme-phoneme correspondence) to localized brain areas. They also note that one does not need to use expensive technology to make diagnoses about problems such as dyslexia when cheaper, more child-friendly methods are available. I take their point, but suggest that since so much work on identifying how the various parts of the brain work together when reading has already been done, it would be helpful if literacy teachers were better informed, as this would deter assumptions that there are discrete areas of the brain that are designated to the various sub-skills involved in fluent reading.

In *Proust and the Squid* (2008), Wolf outlines how the brain learns to read. She also reveals how dyslexic readers' brains differ from those of proficient readers and differences which relate to whether the text is logographic, syllabic or alphabetic. (The differences are primarily in terms of the firing of neurons in areas specialized for visual information versus neurons in areas specialized for auditory information.) She has produced a timeline which breaks down the process of reading into microseconds showing how various different parts of the brain respond and then process the information.

A Time Line of Reading (Wolf 2008:144)



Novice readers are less precise than skilled readers, and so make more generalized use of the various areas of the brain. Indeed, Wolf's overview makes the point that, in terms of forging neural pathways, the primary task of the novice reader's brain is to automate these processes. A brief excursion into neophrenology reveals how demanding this task is.

For readers of alphabetic languages, the process begins in the occipetal lobes and, deep within them, the fusiform gyrus. These are areas concerned with processing visual information – the fusiform gyrus are particularly important for identifying colour and recognizing faces – and it seems that they play a vital role in word-recognition. The so-called “visual word form area” quickly identifies features of letters (distinguishing between b and d but not worrying about loops in the upright section, for instance) and determining whether the shapes do constitute a letter or a word. These areas seem to have slightly different roles in each hemisphere, with the left seeking out determining features and the right determining whether or not the parts do constitute a face or word. The second large areas used in

reading are the temporal & parietal lobes, including Wernicke's area, which are associated with phonology and language comprehension. Novice readers make more general use of these areas than skilled readers except when skilled readers are faced with a text so difficult they are forced to resort to childhood reading strategies. The third main areas involved are the frontal lobes – associated with decision-making and executive functions such as memory. This includes Broca's area, which plays such a vital role in semantics. The cerebellum ("little brain") is also involved & is critical for the timing of the connections. Novice readers' main task is to connect the processing skills in these various areas. This becomes automated, as Carla Shatz's helpful summary of Donald Hebb's 1949 classic *The Organization of Behaviour* succinctly puts it: "Neurons that fire together wire together". Pathways are formed as the brain habituates the connections between the aforementioned parts of the brain to create efficient networks. In adolescence, these pathways are pruned such that the most valuable are left unfettered by rarely needed neurological paths. Typically, the pathways for reading concentrate in the left hemisphere known as the ventral route (Wolf 2008, 142).

For my purposes, the most important insight gained from looking at how the brain processes the written text is how these processes release the time and space needed for deep thought. The language of books encourages vocabulary learning, analogical linguistic forms (such as similes and metaphors) and complex syntax, all of which are vital for precise thought. This increased workload on the level of decoding the input from the page actually increases our capacity for thinking and feeling. "Paradoxically, the developmental shift to specialised left-hemisphere activation for basic decoding purposes allows more bilateral activation for meaning and comprehension processes. ... We are no longer mere decoders of information" (Wolf 2008, 143). As the pathways for decoding become automatized, feeling and thinking become more possible. The result is what Birkerts terms "deep reading" (1994). The term refers to the intense submersion in the world or argument of the book, when the world outside the reader seems temporarily suspended. For Wolf, and I believe many of us who work with literacy education, the greatest achievement of the reading brain is that it allows for reflection and intellectual development. More specifically, she comments on the way reading encourages empathy: "While reading, we can leave our own consciousness, and ... enter for a brief time the wholly different perspective of another person's consciousness", as a result of which "we are no longer limited by the confines of our own thinking" (Wolf 2008, 7-8). Wolf's examples are drawn from reading stories depicting the thoughts, feelings and actions of fully developed characters. Nevertheless, one would think that moving beyond the confines of our own thinking would be even better developed by encounters with real human beings, the kinds of social activity that is promoted through the internet. I shall explain why that does not happen in just a moment, but first let me explain what I mean by empathy in more detail, and specifically why empathy is encouraged in the reading of novels.

3. Connecting with Fictional Characters

In two recently published monographs, Blakey Vermeule and Suzanne Keen draw on research in the cognitive sciences to investigate readers' emotional attachments with fictional characters. They demonstrate that fiction encourages a less guarded empathetic response to human situations because the reader recognizes the freedom from real world responsibilities. Caring for fictional characters is

analogous to, but not quite the same as, the way we care about real people. Emotional encounters with fictional characters can be even more profoundly felt because fiction provides us with “large doses of really juicy social information, information that it would be too costly, dangerous, and difficult for us to extract from the world on our own” (Vermeule 2010:14). Fiction enables us to care without making ourselves vulnerable.

This investment in the lives of fictional others has been explained in terms of “Theory of Mind” or “mind-reading”, that is, our ability to accurately assess what another person is thinking and feeling and to anticipate how they may respond as a result. Mind-reading is an evolutionary survival skill: the brain has specific areas which are devoted to this task. These processes need to learn to fire together to be effective, but when they do, we are pretty good at assessing what others are thinking. Reading fiction helps to hone these abilities (Kidd and Castano, 2013). We find such social information incredibly valuable; we actively seek it out, and feel rewarded (by which I mean very literally that the pleasure centres in our brains are stimulated) when we obtain such information. The pleasure of this type of information is a common impetus for children to become proficient readers. Wolf terms this the “tipping point between leaping into reading life or remaining in a childhood bog where reading is endured only as a means to other ends” (2008, 132). The leap into reading typically occurs in the pre-teen years and is often fuelled by the desire to know what happens to a character. This is where series books come into their own for literacy educators.

Series such as *Harry Potter*, *Twilight*, *Inheritance* and *The Hunger Games* are all very lengthy, and the breadth of their spines alone clearly signal the demands they will place on the reader up front. They require “two stiff tariffs at the outset ... First, it asks us to suspend our disbelief. Second, it asks us to give it the valuable gift of our attention” (Vermeule 2011, 14). So the books are self-selecting, but because of the hype (and a certain amount of peer-pressure) surrounding these stories, starting with the first book (which is consistently shorter than the later books) is not so difficult. Once the series has begun, the reader enters a fantasy world and engages with the traditional, linear quest narrative, following a flawed protagonist in the battle between good and evil. Fantasy, to a greater extent than even realistic novels, signals its own artificiality and constructedness and so allows readers to let down their guard and immerse themselves in the lives of a small number of characters. The extended focus over thousands of pages on just three central characters in each series allows readers to gain a wealth of mind-reading experience, to build a relationship with the fictional characters. At the same time, the hours and hours of extended reading practice enable neural pathways to form.

I find it no coincidence that mind-reading activities are central to both the plot and the characterisation of the key characters in all the multi-million selling series of the past two decades. In *The Hunger Games*, guessing how others will behave is central to Katniss’s survival in the arena. The climax of the *Harry Potter* series comes when Harry learns that he is one of Voldemort’s Horcruxes, which explains why Harry has had access to Voldemort’s mind and his evil thoughts. He dislikes this connection as does Edward in *Twilight* who cannot help knowing what other people are thinking. He is attracted to Bella because she is the only person whose mind he cannot read. And in Christopher Paolini’s *Inheritance* cycle, the intimate connection between the minds of dragons and their riders is celebrated. Increasingly, however, we are becoming aware that the leap into reading involves digital

texts, and the subject matter that is appealing to the child is not an engagement with a fictional character but with information texts.

4. Connecting with Digital Others

When children play video games or surf the net, they are wholly consumed: like the deep reader of the book, the world outside their experience appears to disappear as they focus intently on the screen. Unsurprisingly, many teachers and journals on literacy practices endeavour to integrate this fascination into literacy education. For instance, a recent issue of *Innovation in Language Learning and Teaching* includes a discussion by Li, Snow and White (2015) on the impact of access to digital media on literacy skills, other examples include providing a rationale for incorporating this media into our literacy education practices (Hampel, 2009; Morrell, 2012), advice on selecting apps to support beginning readers (Cahill and McGill-Frazen, 2013), a study of the use of iPads in literacy education (Hutchison, Beschorner and Schmidt-Crawford, 2012) and teaching tips on the incorporation of smartphones (Bromley 2012) and digital texts (Thoermer and Williams 2012) in reading education. I applaud such innovations and the recognition that children need to learn to use these technologies effectively, not least because other studies have shown that pre-teens are far from efficient in their use of even simple digital techniques such as feeding search terms into google and scrolling through the outcomes (Leu et al. 2008; Goldman Braasch, Wiley, Graesser and Brodwinska 2012). We still need to teach children how to read these media, but we also need to improve our understanding of how digital literacies differ from the traditional reading of narratives (Coiro 2003).

For the most part, it would seem that the texts we read digitally do not differ so very greatly from those we read on paper. Indeed, the shape of the traditional narrative has been changing, at a dramatic pace over the past two decades, so that novels resemble digital formats. Linear plot development – often enhanced with sub-plots on a related theme – with rising tension leading to epiphanal moments has given way to finding and comparing information. We can see this in our television watching. As Margaret Mackey’s recent study of young adults engaging with film, novel and video games – *Narrative Pleasures* – reveals, many video games resemble traditional narratives more closely than recently published novels. Mackey’s conclusions, grounded in hundreds of hours of interviews and recordings of young adults engaging with different kinds of narrative reveals how central narrative is to the formation of her subject’s thinking, also when playing video games, and how well they are able to remain focused and produce complex responses to the narrative of the video game. Her findings are supported by Elson and Ferguson’s summary of 25 years worth of empirical research into the relationship between violent digital gaming and real world behaviour. Elson and Ferguson (2014) debunk the myth that violent games inevitably lead to violent behaviour, but their review also demonstrates that, unlike paper fiction, these digital narratives do not increase empathy. Mackey’s subjects entered what Csikszentmihalyi refers to as “flow” (1990); a total immersion in the activity of engaging with a narrative world, which appears to be the same regardless of whether the medium is paper or digital, but as I have already pointed out, there are significant differences between digital and paper literacies.

Early internet pages showed a close resemblance to traditional books. Gradually, however, printed forms – including many academic journals – are starting to mimic the internet with the increased use of images, shorter texts and clearer metatextual markers for guiding the reader’s eye: pull-out quotes, oversized headings and often color. Other examples include the gamification of classic works of literature when adapted for iPad users: readers can choose options for the characters to follow. These changes suggest the differences between paper and digital reading are minimal, and yet researchers find that more information is retained when students read paper texts rather than digital texts (Mangen, Walgermo & Brønnick, 2013). Proposed explanations for this finding include visual ergonomics, haptic differences, meta-cognitive differences and navigation. We do not yet know enough to understand all the implications for education, but we do know that the brain does not process hyperlinked digital text in the same way that it processes paper and ink texts.

The hyperlink creates a very different reading experience from traditional paper reading experiences. Digital texts typically contain numerous links to other texts, images, film-clips and so on, all of which can be accessed with a single click. We are always just a click or two away from knowing more about the topic or finding the right piece of information. The hyperlink can also take us to other people – we are always just a click away from knowing what other people are thinking or saying about a topic. During the brief history of the internet, these connections to other texts and other people have become more animated, so that we are constantly alerted to the presence of other media as we read. This instant access to information is, of course, one of the greatest advantages of digital technology. Using these links, we can independently build our own informational world, an option which is normally highly praised.

Karen Bromley’s advice on how to use Smartphones to supplement classroom reading celebrates this activity (2012). She describes how she used her Smartphone to supplement her reading of an informational text about a type of parrot – the kakapo – that is facing extinction. She looked up terms and compared measurements. She also followed up her reading in a variety of ways, and sums up the classroom implications for other literacy teachers. One of the key points she makes (pulled out in an oversize quote which mimics on-line texts) was that “Using my smartphone, I synthesized what I read in the book, and extended my connections to the world beyond the book” (Bromley 2012, 341). She pities readers in classrooms who were not free to pursue their interests in this way and proffers a powerful argument for augmenting traditional literacy education with Smartphone technology.

Bromley’s searches do indeed seem to have enabled her to gain more from the book she was reading. But as we use tools such as the hyperlink and Smartphones to navigate away from the original text we were reading, so our commitment to that original text decreases (Carr 2010, 103). We have doubtless all had the experience of going to check something and wandering off, click by click, until half an hour has gone by and we have forgotten what we originally went into the digital world to look for. Part of Bromley’s point is that this is no bad thing: instead of being passive consumers, we become active creators of worlds of our own choosing. For information searches such as store opening times, this lack of commitment to a text is hardly problematic, but digital technology is increasingly used to enable real time connections during events. For instance, the use of twitter to comment on musical performances and films whilst as they are happening. From a content point of view, this is deeply problematic. Sometimes we need to commit to a text, a film, a piece of music and

endeavour to understand it on its own terms. We need to be able to focus, to concentrate, to allow our own feelings and thoughts to mature without the interruption of hearing about other people's thoughts and feelings. It is wonderful that we have technology that enables us to follow our own interests, but we also need to learn to pay attention to the interests of others expressed through lengthy texts, films, music and so on. Digital technology has made the total immersion in another world increasingly difficult. And the neuroscientific evidence of synaptic pruning alerts us to the fact that if we do not learn to do this by our late teens, our brains will have difficulty acquiring the skill thereafter.

Although narrative fiction typically contains a wealth of the social information about how other people think that appeals so strongly, digital media, especially social media proffers even greater access to the minds of real people. Twitter and facebook enable us to surround ourselves with the social information we are designed to seek out. No wonder youngsters sit transfixed in front of their screens. When we watch someone texting or playing a video game, "What you see is a mind consumed with a medium. When we're on-line we're oblivious to everything else going on around us" (Carr, 2010, 118). Outwardly, this looks the same as the reader immersed in a novel. Both freeze the reader in a way that creates a mind-out-of-body experience. Internally, however, the brain forming rapid decisions about whether or not to follow a distraction such as a hyperlink or checking an email is actually firing in a different way from the empathetic reading brain. As Nicholas Carr explains

[I]f, knowing what we know today about the brain's plasticity, you were to set out to invent a medium that would rewire our mental circuits as quickly and as thoroughly as possible, you would probably end up designing something that looks and works a lot like the Internet. It's not just that we tend to use the Net regularly, even obsessively. It's that the Net delivers precisely the kind of sensory and cognitive stimuli – repetitive, intensive, interactive, addictive – that have been shown to result in strong and rapid alterations in brain circuits and functions.

(Carr, 2010, 116)

The key neurological difference between on-line reading and the reading of novels that Carr draws our attention to lies in the greatly increased activity taking place in the frontal lobes where decision-making takes place. Where the fluent reader of the book processed the text primarily through the ventral route in the left hemisphere, inadvertently supporting empathy with fictional beings promoted during deep reading, fluent Internet users use a specific network in the dorsolateral prefrontal cortex – an area associated with decision-making, especially decisions involving trust in relationships – which they do not use when reading print. A team of researchers looking for ways to stimulate the brains of the elderly examined what happens when they used Internet search engine such as google using fMRI techniques (Small et al 2010). They found that internet use stimulated a more than two-fold increase in signal intensity in the frontal pole, anterior temporal region, anterior and posterior cingulate, and hippocampus. Novice Internet users do not use these areas of the brain, but after just an hour a day for five days, they begin to do so (Small and Vorgan, 2008). Our brains are changed by what and how we read. Small et al's study was concerned with much older readers, and we should exercise caution in applying their findings to children who are still developing their neural pathways for reading. Nevertheless, there is sufficient evidence available to claim that following hyperlinks and other link-click-link literacies do forge different neural pathways from traditional print narratives.

The conventional response to such information about how media affect the way we think, feel and behave, as Marshall McLuhan warned us in the pre-Internet world, is to argue that it is not so much the media as “how they are used that counts” which, McLuhan bluntly observes, “is the numb stance of the technological idiot” (McLuhan [1964] 2003, 31). The MIT neuroscientist Robert Desimone observes that “It takes a lot of prefrontal brain power to force yourself not to process a strong [distracting] input” (in Carr 2010, 232, fn 232). Once the flag announcing an email has popped up on your screen, it is hard not to at least acknowledge its presence, and so lose concentration at least momentarily. When the neurons respond to distractors such as hyperlinks, they wire together forming neural pathways that expect distraction. The activity of clicking from link to link means that the reader is engaged and active in ways that continuous prose cannot offer. The downside, as Carr also points out, is that “neurons that don’t fire together don’t wire together”(120). The repeated action of clicking from link to link also means we literally train our brains to expect such stimulation which, in turn, makes it increasingly difficult to engage with longer texts, to read deeply. “Reading changes our lives, and our lives change our reading” (Wolf 2008, 158). I would add that “reading changes our brains, and our brains change our reading”.

I am not a Luddite who thinks we can (or should) prevent our children from taking advantage of the digital world. As educators, our job is most definitely to enable children to take advantage of digital print and the environments in which it is produced. For gleaning information, digital media have so many advantages over traditional books. Nevertheless, we must take the risk to deep reading posed by digital media seriously, and I think the way forward is to complement such reading with books that hone in on our desire for social information. This, I think, is where the appeal of novels foregrounding mind-reading are central, including fantasy series and other disparaged works such as *Gossip Girl*, which, with its connection to the blogging world overtly displays the social appeal of digital media and provides the wealth of insight into the private thoughts of fictional characters that promotes theory of mind. Oddly enough, magic and gossip seem to be the very things which can counterbalance the demands of click-link-click on-line reading and so proffer choice between deep reading and skimming in later life.

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