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Digitisation and Reading: What Do We Know, and What Do We Need to Know More About?

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Digitisation is affecting our modes of reading in many ways. We probably read more than ever before, but we also read very differently than, say, a decade ago. Our reading environment is becoming increasingly diverse:

- written text is becoming less predominant as audiovisual modalities are on the rise: for instance, we “read” more audiobooks and less novels in the form of written texts;
- reading is becoming more ad-hoc and mobile: something that is being done in-between or also concurrently with other activities;
- in education, digital learning materials are increasingly replacing print.

At the same time, recent results from large-scale reading tests such as PISA (2019)¹ found that performance in reading had declined in a large number of countries, and also that leisure reading (of books) is in stark decline (also found in PIRLS 2016).²

In this article, I will reflect on some of these issues in light of what we know from empirical research on the effect of the interface of screens on reading.

We are in the midst of a massive digitisation process, which is rapidly changing our modes of reading in numerous ways. Whether we talk about reading in schools and at universities, or leisure reading, digital devices are becoming the standard reading medium, rather than print books. (For leisure reading, the popularity of audio books seems to have risen at an even steeper rate, but this type of reading falls outside the scope of the present article.)

Despite decades of reading research, much is still unknown about the impact of screen devices on cognitive, affective, and emotional aspects of reading. Experiments vary with respect to theoretical frameworks, methodologies and measures, which makes it difficult to compare findings. Moreover, scholars from various disciplines and paradigms do not necessarily agree on the defini-

¹ Programme for International Student Assessment.

² Progress in International Reading Literacy Study.

tion of key terms such as “reading” and “digital reading”. A key tension in the field is between the understanding of a narrow and a broad conception of reading, where the definition of reading narrowly entails the reading of exclusively written text, whereas a broad understanding of reading includes engaging with semiotic modalities other than written text, such as sound, images/graphics and animation, as well as digital-only features such as hyperlinks and interactivity. Add to this complexity the fact that technological developments happen very quickly, with new digital devices, hardware and software (including those used for audiobooks) entering the market at an unprecedented rate. In comparison, it takes a long time—sometimes several years—to go from an experiment being designed and carried out, to the results being published and made available in a scientific journal. Hence, empirical research in this field may seem to be at a constant risk of becoming outdated almost before it is even started.

Nevertheless, there are so many studies available by now that we are beginning to see some trends that can be assumed to be less prone to obsolescence, at least when it comes to reading in the narrow sense of the term—viz., reading written texts. Notably, the recent emergence of meta-analyses—that is, studies that collect and synthesize results across a number of single, comparable experiments—allows us to paint a clearer picture of the effect of digitisation on reading, at least with respect to the reading of single texts. These meta-analyses—there are currently three³—indicate that there is a difference in comprehension when reading single, linear texts on paper versus on a screen (be it a laptop or a tablet). In light of recent results from large-scale reading assessments (e.g., PISA) as well as the abiding transition to digitizing textbooks and learning material in schools at all levels, it is about time we take stock: what do we know by now about the effects and implications of digitisation on reading? Is the print book important in the 21st century?

Digitization changes how we read and write, and in the process it also changes how we think. The increasing number of digital reading devices turns reading into an increasingly *diverse* activity. For adults as well as for younger readers, ad-hoc and intermittent reading is becoming the norm, whereas long-form, sustained reading of print texts—in the form of books—is in steady

3 V. Clinton, ‘Reading from paper compared to screens: A systematic review and meta-analysis’, *Journal of Research in Reading*, 42 (2019). P. Delgado, C. Vargas, R. Ackerman & L. Salmeron, ‘Don’t throw away your printed books: A meta-analysis on the effects of reading media on reading comprehension’, *Educational Research Review*, 25 (2018). Y. Kong, Y.S. Seo & L. Zhai, ‘Comparison of reading performance on screen and on paper: A meta-analysis’, *Computers & Education*, 123 (2018).

decline.⁴ For many people—and especially the younger generation—what is entailed in a day’s reading activities is tantamount to what is spent on the cell phone, the tablet or the laptop, computer. Typically, in such contexts, “reading” refers to engaging with short multimedia messages, and not—or not so often—with longer texts consisting merely of written text. It often also entails some version of writing, texting, sharing and communicating snippets of information—as in social media of various kinds. Also, differently from what would typically be considered “reading” just a couple of decades ago—reading (on screens) today is usually done in-between or concurrently with other activities, and often also as we are on our way from one place to another. Hence, reading has become mobile—not only in the sense of taking place on a smartphone, but also as an activity that is carried out when we ourselves are on the move.

Digital technologies are an integral part of our everyday life, and they are an obvious asset to many educational objectives. However, recent empirical research comparing text reading on paper and screens should give us reason to pause and reflect on the ways in which increasing digitisation may also come at a (cognitive) cost, and that there are qualities of print books that we may want to make an effort to preserve. Keeping in mind the above-mentioned tension between the understanding of a narrow and a broad definition of reading, there are many indications that reading single, linear, written texts—i.e., reading in the narrow sense—is on its way to becoming an endangered species. Judging from the findings of recent empirical research, such trends can have some negative implications that we should be aware of.

Almost thirty years ago, Dillon reviewed the existing research comparing reading on paper with reading on screens. Much has happened since then, both in terms of technological advancements as well as theoretical and methodological developments in the field. Whereas Dillon’s main findings related to visual ergonomics and reading speed,⁵ more recent empirical research has looked primarily at cognitive aspects such as recall, comprehension and meta-cognition. When it comes to the reading of single texts, we now have enough research

4 N.S. Baron, *Words onscreen: the fate of reading in a digital world* (Oxford University Press, 2015). M. Kovač & A. van der Weel, ‘Reading in a post-textual era’, *First Monday*, 23 (2018). J.M. Twenge, G.N. Martin & B.H. Spitzberg, ‘Trends in US Adolescents’ media use, 1976–2016: The rise of digital media, the decline of TV, and the (near) demise of print’, *Psychology of Popular Media Culture*, 8 (2019).

5 A. Dillon, ‘Reading from paper versus screens: A critical review of the empirical literature’, *Ergonomics*, 35 (1992).

to say with a fair amount of certainty that there is a difference between reading on paper and reading on screens with respect to reading comprehension. Three meta-analyses⁶ and one literature review⁷ have revealed what Delgado et al. called a *screen inferiority effect* regarding the reading comprehension of linear texts. While also statistically controlling for a publication bias, the most comprehensive of the meta-analyses comprises 54 studies (n = 171,055 students) published between 2000 and 2017.⁸ The findings favored paper over digital reading (Hedge's $g = -0.21$ for between-participants designs; $d_c = -0.21$ for within-participant designs) concerning the reading of informational—but not of narrative—texts. Moreover, results revealed that the superiority of paper-based reading had in fact *increased* rather than decreased during the period of 2000–2017, casting doubt on claims about so-called digital natives displaying superior performance on screen.

Delgado et al. offer two hypotheses to explain the screen inferiority: the Shallowing Hypothesis and the Metacognitive Deficit Hypothesis. The Shallowing Hypothesis is related to the fact that the more we read on screens, the more we acquire a reading habit of quick and shallow skimming and scanning of texts.⁹ Eventually, this habit “bleeds over” to our modes of reading on paper as well.¹⁰ Hence, the ability to engage deeply and thoroughly with textual material is being affected by the sheer amount of skimming and scanning that we do when reading on screens. This tendency is closely related to the Metacognitive Deficit Hypothesis, which refers to the ability to monitor and control one's own comprehension when reading.¹¹ As we are facing challenges mobilizing what Maryanne Wolf has termed *cognitive patience*,¹² which is required for engaging deeply with complex texts, we also seem to have difficulties with gauging and calibrating our own reading when done on screens. More specifically,

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- 6 Clinton, 'Reading from paper compared to screens: A systematic review and meta-analysis'. Delgado et al., 'Don't throw away your printed books: A meta-analysis on the effects of reading media on reading comprehension'. Kong et al., 'Comparison of reading performance on screen and on paper: A meta-analysis'.
- 7 L.M. Singer & P.A. Alexander, 'Reading on paper and digitally: What the past decades of empirical research reveal', *Review of educational research*, 87 (2017).
- 8 Delgado et al., 'Don't throw away your printed books: A meta-analysis on the effects of reading media on reading comprehension'.
- 9 Delgado et al., 'Don't throw away your printed books: A meta-analysis on the effects of reading media on reading comprehension'.
- 10 M. Wolf, *Reader, Come Home: The Reading Brain in a Digital World* (Harper, 2018).
- 11 Delgado et al., 'Don't throw away your printed books: A meta-analysis on the effects of reading media on reading comprehension'.
- 12 M. Wolf, *Reader, Come Home: The Reading Brain in a Digital World*.

empirical research has shown that we tend to overestimate our reading performance on screens, compared to paper. In a seminal study assessing the influence of text medium on metacognitive ability, university students worked with expository texts (1000–1200 words long) on paper and on screen and predicted how well they would perform on a subsequent comprehension task. Results showed superior performance in print when time was self-regulated. In addition, participants reading on screen were significantly more overconfident with respect to their subsequent performance compared to print readers.¹³ More recently, impoverished meta-comprehension on screen has also been found among younger readers.¹⁴

Given that schools and universities in many cases continue to replace books and other print materials with digital resources, this is a development that needs to be monitored closely over the next few years. Both in school and outside of school, children are increasingly engaging with shorter snippets of multimedia and multimodal texts, rather than engaging with longer stretches of written text, either on paper or on screen. Why should we worry about such a development? Because long-form reading—specifically that of written text—is assumed to yield cognitive and socio-emotional benefits that may be unique, and that we may want to make an extra effort to preserve in a future which will be increasingly digitized.

As for the socio-emotional benefits, research has indicated positive associations between literary reading and social cognition.¹⁵ Engaging with longer, more complex literary texts may hone interpersonal skills such as perspective taking and empathy, as literary fiction is replete with often complex models of the social world in which the reader can immerse. This immersive simulative experience may facilitate an understanding of others and of oneself, in the process augmenting readers' Theory of Mind.¹⁶ In light of the notable decline in leisure (fiction) reading, we need to ask if such trends may have negative implications for the development of social cognition and interpersonal skills.

13 R. Ackerman & M. Goldsmith, 'Metacognitive regulation of text learning: On screen versus on paper', *Journal of Experimental Psychology: Applied*, 17 (2011).

14 V. Halamish & E. Elbaz, 'Children's reading comprehension and metacomprehension on screen versus on paper', *Computers & Education*, 145 (2019).

15 D. Dodell-Feder & D.I. Tamir, 'Fiction reading has a small positive impact on social cognition: A meta-analysis', *Journal of Experimental Psychology: General*, 147 (2018). M.L. Mumper & R.J. Gerrig, 'Leisure reading and social cognition: A meta-analysis', *Psychology of Aesthetics, Creativity, and the Arts*, 11 (2017).

16 R.A. Mar & K. Oatley, 'The function of fiction is the abstraction and simulation of social experience', *Perspectives on psychological science*, 3 (2008). K. Oatley, K. 'Fiction: Simulation of social worlds', *Trends in cognitive sciences*, 20 (2016).

Moving to the cognitive benefits, an abundance of research shows that leisure reading of fiction predicts reading comprehension skills.¹⁷ There is a wealth of research documenting the associations between longform book reading (i.e., the reading of narratives, typically in book form) and reading comprehension.¹⁸ Including digital reading as a factor, a more recent longitudinal study found that the best readers read printed books frequently, while the poorest readers read little, but were frequent users of digital devices.¹⁹ In the same vein, Duncan et al. found that traditional (print, book) reading predicts reading comprehension ability whereas digital reading does not.²⁰ Extending this line of research and using the PISA 2009 database with data on more than 250,000 teenagers from across 35 OECD countries, Jerrim and Moss found evidence that teenagers who spend more time reading, *fiction texts* in particular (typically novels and stories in books) have significantly stronger reading skills than peers who do not read—or read less—fiction. The authors call it the “fiction effect”, since no associations were found between the frequency of reading non-fiction, news, magazines or comics and reading skill.²¹

A recent longitudinal study from Finland corroborates these findings. Torppa et al. looked at associations between leisure reading (of books, magazines, newspapers, and digital reading) and reading skills of 2,525 students aged 7 to 16. They found that book reading in particular predicted better reading comprehension, whereas digital reading was negatively correlated with reading skills.²² Hence, the role of longform reading of books continues to play an important role in the development of reading skills, whereas it seems reasonable to question the contributions of digital reading in this context.

17 S.E. Mol & A.G. Bus, ‘To read or not to read: A meta-analysis of print exposure from infancy to early adulthood’, *Psychological Bulletin*, 137 (2011).

18 A.E. Cunningham & K.E. Stanovich, ‘Early reading acquisition and its relation to reading experience and ability 10 years later’, *Developmental psychology*, 33 (1997). A.E. Cunningham & K.E. Stanovich, ‘What Reading Does for the Mind’, *Journal of Direct Instruction*, 1 (2001).

19 M. Pfof, T. Dörfler & C. Artelt, ‘Students’ extracurricular reading behaviour and the development of vocabulary and reading comprehension’, *Learning and Individual Differences*, 26 (2013).

20 L.G. Duncan, S.P. McGeown, Y.M. Griffiths, S.E. Stothard & A. Dobai, ‘Adolescent reading skill and engagement with digital literacies as predictors of reading comprehension’, *British Journal of Psychology*, 107 (2016).

21 J. Jerrim & G. Moss, ‘The link between fiction and teenagers’ reading skills: International evidence from the OECD PISA study’, *British Educational Research Journal*, 45 (2019).

22 M. Torppa, P. Niemi, K. Vasalampi, M.K. Lerkkanen, A. Tolvanen & A.M. Poikkeus, ‘Leisure reading (but not any kind) and reading comprehension support each other—A longitudinal study across grades 1 and 9’ *Child development* (Online first).

In light of such findings, results from recent large-scale reading assessments such as PISA are worthy of increased attention. In several countries, reading performance as measured in PISA has declined since 2009 (when reading was the main domain, like in 2018) and this decline is accompanied by a significant drop in the number of teenagers reporting that they enjoy reading for pleasure (OECD, 2019). Long-form reading of fiction (in particular, novels) is in steady decline, whereas reading short-form, multimodal and multimedia texts on screens, as in social media, is equally starkly increasing.

Digital technologies continue to offer unprecedented possibilities with respect to information access, personalization, and individual tailoring of teaching and learning. However, while certain cognitive skills such as spatial cognition and task switching may be enhanced, there is a cognitive cost to frequent digital technology use that is related to deep processing, mindfulness, critical thinking, imagination and reflection.²³ Development of such higher order skills require cognitive patience and the ability to persist in cognitively challenging tasks that require deep, sustained engagement, skills for which digital technologies have yet to show their suitability.

“Digital technologies are here to stay,” is an argument often heard when critical issues are raised concerning the adequacy and usefulness of laptops and tablets in schools. Without there being solid research backing such claims, digital technologies are often associated with “future skills” and innovative teaching and learning processes. There are certainly numerous advantages to digital learning material, and digital technologies have their obvious place in today’s classrooms. At the same time, we should remember that print books have proven strengths that may in fact become even more important as digitalisation continues to progress. There are qualities and affordances of paper and print that seem to better support sustained, long-form reading. Given the extremely important role that this type of reading in particular plays in the development of cognitive and socio-emotional skills, we may want to think twice about abandoning paper and print books in classrooms as well as in our own leisure reading.

23 P.M. Greenfield, “Technology and informal education: What is taught, what is learned,” *Science*, 323 (2009).

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