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Flow and longform reading. Notes from an exploratory case study

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Abstract: The decline in deep, longform reading is increasingly recognized as an emerging social problem. This exploratory study investigates the possible conditions influencing flow during extended academic reading sessions, in particular the role of digital devices in these processes. We observed university students in two reading settings: one with digital tools present and the other with only printed texts available. Drawing on perspectives from embodied and distributed cognition, our findings suggest that, in contrast to established theories of flow in reading, readers are not consistently immersed in the reading task throughout a reading session but instead fluctuate between various reading modes: they seem to battle with an uneasy 'settling in-phase', only later to emerge as focused on the text, even as bodily positions are changed. Towards the end of a reading session, bodily restlessness increases once more. Observations from case studies also showed that participants' embodied engagement with the reading devices differ, as revealed during self-initiated interruptions: when reading in print, the reader would to a greater extent remain "on task" and continue reading during such interruptions. When reading digitally, the reader more often left the reading device idle on the desk. Our study contributes to the literature by suggesting that settling in requires time and effort, possibly especially in the presence of digital devices, and highlights the importance of addressing this process through more systematic training and focused attention. The settling-in phase is significant for how the reading unfolds. Further aspects of readers' bodily enactment with texts seem to differ between paper and screens. Finally, our results suggest the need for future research to systematically examine bodily shifts and reading trajectories of extended reading in natural settings.

Keywords: deep reading; distributed cognition; embodiment; flow; settling in

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1 Introduction

Recently, both international and country-specific survey studies indicate that students increasingly struggle with longform reading (Baron and Mangen 2021; Hakemulder and Mangen 2024; Mullis et al. 2023; OECD 2023). Many seem to find it difficult to engage with lengthy and complex texts, such as those required in academic courses. Commonly labeled "deep reading" (Wolf and Barzillai 2009) or "higher-level reading" (Schüller-Zwierlein et al. 2022), such reading goes beyond the simple task of decoding texts and retrieving explicitly stated information. It encompasses processes such as complex inference-making based on often implicit information, analogical reasoning, analytical and critical reflection, evaluation of opposing points of view, exercising sustained attention and what Maryanne Wolf has termed cognitive patience (2018) – a type of cognitive endurance and grit. Deep or higher-level reading skills are a cornerstone of many academic programs, but they are equally crucial for engaging with other types of texts, such as literary works, essays, political documents, biographies, policy papers, and historical or legal texts. More broadly, in an era of constant audiovisual stimuli and information overload, deep, longform reading serves as a powerful way to cultivate sustained focus and concentration (Schüller-Zwierlein et al. 2022). It also acts as a gateway to critical thinking, analytical reasoning, and perspective-taking (Wolf 2018).

Hence, if the decline in deep reading habits and skills is sustained in coming years, a wealth of cultural, academic, and other forms of knowledge that is inscribed in lengthy and complex texts will be lost to a growing number of people. Finding ways to facilitate and scaffold deep reading is therefore a key challenge in today's information society. A prerequisite is to map the conditions – in the environment, of the reader, and of texts – that are conducive to deep reading. One of these is flow, an experience of being fully engaged in an activity, theorized to depend on an optimal balance between individual challenge and individual skill levels, and associated with intrinsic motivation (Thissen et al. 2018). Deep reading requires the ability of the reader to "stay put" with textual information of various degrees and types of complexity, over an extended period of time. When successful, such sustained focus with a text may bring about a sense of deep and immersed engagement where elements of the surroundings recede to the background, time is entirely experiential, and the reading is automatic and more effortless than during moments when the reader is struggling, for instance, with comprehending the text, keeping distractions in the environment at bay, or countering boredom or restlessness.

With these stakes in mind, we wanted to explore the conditions that facilitate and inhibit flow during longform reading among university students, and, on the basis of such exploratory case study, design a pedagogical program to help students

improve their ability to engage in longform academic reading. Our study was in part motivated by the wish to explore the impact of having access to smartphones and other internet-connected devices during reading. Given that people constantly carry their smartphone with them, the mere option of checking an incoming text message may be seductive (cf. Gazzaley and Rosen 2016) and disturb the possibility for maintaining focus on reading. Switching between textbook reading and engaging with an app forces readers to constantly reorient their attention. This oscillation takes time and requires effort. This phenomenon, known as attention residue (Leroy 2009), where the mind remains in part preoccupied with the prior task, results in a delay of at least a minute or five. Attention residue is particularly prevalent when individuals switch between tasks without completing the initial one or when the tasks are complex and require significant cognitive resources. However, it does not occur with every mental activity; its likelihood increases with the complexity and emotional investment in the tasks involved. In addition, research has indicated that people involved in such task-switching take longer to complete their tasks than those who stayed focused on only the primary task (Rogers and Monsell 1995; Rubinstein et al. 2001).

Such challenges have only grown in recent decades, as the number of stimuli to which most people are exposed has increased exponentially, while the so-called attention economy is becoming more competitive (Bruineberg and Fabry 2022; Nelson-Field 2020). As part of our exploratory study, we therefore ask: What can we learn from observing how readers enact the optimal conditions for deep reading, involving immersion and flow, in natural settings, where readers read on an ordinary basis? And how do readers describe their subjective experiences of entering and sustaining flow-states while reading? By addressing these questions, we aim to uncover the interplay between observed behaviors and self-reported experiences, ultimately informing the design of practices that scaffold deep reading and foster optimal reading conditions. In the sections that follow, we (2) present the theoretical framework that informed our study, (3) outline the details of our methodology, (4) discuss our results and (5) limitations, and finally (6) we reflect on their implications for the scholarly literature, policy debates and future studies.

2 Theoretical framework: embodied cognition and flow in reading

In recent years, a new theoretical paradigm has emerged in reading research, converging on the understanding that reading is shaped by processes beyond the relation between a pair of eyes and a text (see e.g. Hillesund et al. 2022; Mc Laughlin

2015; Trasmundi et al. 2021). The distributed and embodied approach to reading suggests that reading is better understood as a dynamic task in which the whole body engages dynamically with the surrounding environment (Trasmundi 2024). Such a perspective reshapes the unit of analysis by taking into account how the experience of reading is defined by the wider context in which the activity occurs, including other people, the medium with which one reads, and the surrounding environment. When traditional cognitivist theories study flow processes in reading, the emphasis primarily falls on the psychological mechanisms that enable or constrain mental states conducive to reading (e.g. Nell 1988; Thissen et al. 2021). In this view, there is little need to consider the role and function of the body and its wider environment, because 'flow' is mainly considered a neurocognitive phenomenon. However, an embodied and distributed account of reading extends the unit of analysis to the *brain-body-environment system* (Hutchins 1995). Understanding reading as an embodied, contextual activity, requires investigations of relations and interaction between components in this wider system – in this case, how readers engage with texts and the broader reading ecology, encompassing prior experiences and expectations regarding the management of reading tasks, as well as reading aids, communication tools, food, and interactions with other people. The results, as we describe below, reveal the importance of studying the *brain-body-environment system* to better grasp how people get into the flow of reading, and what it may look like when they experience flow in reading.

But what, exactly, is 'flow'? The concept and theory of flow were originally applied to experiences involving specialized physical expertise and engagement with the immediate environment, whether through artifacts and technological devices, as people would become completely absorbed in activities like chess, computer games, painting, or playing musical instruments, or through the texture and materiality of the natural world, as in rock climbing or swimming (Beard 2015). However, flow has also been applied to activities with seemingly limited physical enactment, such as reading. McQuillan and Conde (1996) combined interviews with the administration of the established Flow Questionnaire (Csikszentmihalyi and Csikszentmihalyi 1988) to identify the conditions under which readers report being intensely engaged in a text, losing a sense of time and place. They found that texts most commonly prompting a sense of flow in readers were those read for pleasure, with fiction texts more likely to induce flow than non-fiction. More recently, Thissen et al. (2018) adapted the widely used Flow Short Scale (FSS; Rheinberg et al. 2003) to the context of fiction reading, developing the first reading-specific flow scale, the Reading Flow Short Scale (RFSS). Thissen et al. used the RFSS to measure what they termed "optimal reading experiences" of fiction texts. The RFSS is a significant contribution to research on flow in reading. However, because it is a self-reported measure administered after the event, it is subject to well-known biases related to social desirability and memory distortion. It

is also important to note an inherent limitation of self-report measures administered *after* the experience: since the very phenomenon under investigation is likely to be disrupted *by* investigating during the reading, it is necessarily always in hindsight that participants evaluate whether items like "I was completely immersed in what I was reading" (Thissen et al. 2018: 3) applied to their experience, and are only enabled to make their decision for their reading as a whole.

Moreover, reading takes substantial time, especially longform reading, which is the focus of the present study. It unfolds not as a smooth, linear process but often as a 'messy' activity of various embodied fluctuations and oscillations, such as pointing, moving, and regulating the reading pace (Trasmundi et al. 2022). During this process, experiential aspects such as absorption and flow will likely vary in response to shifts in the environment, whether from the text itself, the reader's own embodied experience (e.g., hunger, thirst, restlessness, or sleepiness), or external factors such as the presence of a mobile phone or other people's presence. Verbal self-report measures, whether prompted by researchers during reading (e.g., think-aloud protocols) or after reading (e.g., diary approaches), rely on the reader's ability to articulate cognitive and affective-emotional experiences. Many of these experiences, however, may be elusive to consciousness, such as subtle affective states. Additionally, verbal prompts administered during reading inevitably interrupt the very process they aim to measure.

The RFSS's focus on the text, the reader, and their interrelation also overlooks a central focus in our pilot case study, namely the role of the reading environment *beyond* the text-reader nexus. These elements may play a crucial role in facilitating flow during reading, whether for pleasure or study. Supplementing this text-reader focus, our study highlights how other factors in the reading environment, such as the reading device, other readers in the room, artifacts, and the reader's embodied dispositions, also need to be taken into consideration. Addressing these factors requires redefining reading to include the reader's embodied interaction with artifacts and people, and recognizing how cognition is distributed across texts, readers, and their environments. Our exploratory study seeks to capture the role of these additional, often overlooked, elements in the reading environment for the reader's experience of flow during extended study reading sessions. To do so, we employ a type of data largely untapped in the study of reading flow: video observations of real-time reading combined with focus group interviews conducted after the reading sessions.

3 Methodology

The study's participants (N = 13) were recruited from the MA program in Social Anthropology at the University of Oslo. The sample consisted of students aged 24 to 30. All participants were non-native English speakers reading in English; however,

they were enrolled in an MA program with English as the sole language of instruction. Upon signing up, participants committed to two five-hour reading sessions at the University Library. This design and duration was based on our decision to mirror an existing reading seminar at the university, called "the Deep Reading Seminar", which had been offered to undergraduate social anthropology students since 2019 (Wig and Naguib 2021). We set up our study as an exploratory case study to investigate reading behavior within this existing and naturally occurring reading setting.

The students were informed that the purpose of the study was to understand their experience with longform reading. Based on insights into the impact of digital devices on longform study reading (Baron and Mangen 2021) and the differences between screen and print reading (Delgado et al. 2018; Clinton 2019), we further designed our study to allow an in-depth exploration of the role of these devices in particular. Hence, on day 1, participants were allowed to use any device or technology they preferred during the reading session, with no restrictions on access to digital technologies. That is, they could use this technology both as a reading and/or entertainment device, whereas on day 2, they did not have access to any digital technologies, neither in the room nor during breaks. On this day 2, they were instructed to read the materials on print and leave phones and other devices turned off and out of reach.

Beyond this technology constraint, the same setup was maintained for both sessions. Each desk was numbered, and the students sat at the same desk in both sessions. They read for 5 h and could take breaks outside the room at will. They were assigned in total six scientific articles from the syllabus in their subject of study, three for each session. Two extra academic articles from the syllabus were provided as extra reading materials for those who finished the assigned readings. The decision to have them read texts from the syllabus was primarily pragmatic, allowing us to schedule the reading sessions as part of the students' own assumed reading plans and activities. We also assumed that this could be a way to motivate students to participate in the study.

We collected data from three sources. First, four video cameras recorded both reading sessions from multiple angles. Two randomly selected participants, one male and one female, were recorded with cameras recording up-close video, approximately one meter from each reader, providing full-body shots. This gave the basis for the detailed case studies discussed below (Section 4.4). Given that the study is a pilot, we considered it sufficient for the present purposes to have close-up video recordings of only two participants. Second, we collected basic demographic information in a survey, completed before participants started reading. Third, following each session, we conducted approximately 70-min focus group interviews with all the participants, following an interview guide with open questions focusing on the chronology of the reading experience, practices of notetaking, experiences during breaks, and returns to the text.

As outlined, it is methodologically challenging to determine whether someone experiences flow during reading. Below we present and discuss our observations in the video data in light of the concept of flow in reading, focusing in particular on the observed transition time from a seemingly constrained behavior to a smooth task performance. As the reader enters a state of flow, the intervals between bodily adjustments become longer. Video observations reveal that more time passes between each time a reader takes their eyes off the text, reaches for their phone, takes a sip of water, etc. As will become clear, however, we do not associate flow in reading with complete bodily stillness. Part of what happens as readers "settle in" and experience flow, is that they move "with" the reading devices at hand, picking the papers up while often sitting back in the chair with materials in hand, as shown in the video material described below. Because of the methodological challenges of studying flow as it occurs among readers, part of our contribution to the literature is developing a research procedure and vocabulary with which to describe and understand conditions and experiences of flow in longform reading to be used in future studies.

4 Results and discussion

Our study was designed to explore if and how reaching a state of 'deep reading' is associated with the presence or absence of digital mediums, as well as looking for observational differences when reading for a longer period on paper and digital devices. However, parts of our results stand out by demonstrating similarities *across* the digital and analogue settings. Below, we begin by describing commonalities between participants reading with and without access to digital tools, before moving to their observed differences. Finally, we turn to a detailed study of the two participants who were filmed up-close with video-cameras, allowing us to further tease out the details of reading in context.

4.1 The sociality of reading

In both digital and analogue settings, students reported having read more than usual, feeling more effective, accomplished, and self-confident after the five-hour experience. In the focus group interviews, participants reported that they enjoyed entering an environment where choices had been made for them about when, where and what to read, resulting in a declared sense of accomplishment. Students noted that reading as much as they could for 5 h gave a sense of relief from having only one thing to do, and then having accomplished that one thing. Participants spoke about harnessing focus through the group dynamic, experiencing what they termed a form

of "support", "social control" or "nudging" that came from reading collectively. In the words of one student, "There is something about doing it all together, the atmosphere of calm and concentration, the shared commitment." While these responses were not prompted by the interviewers, who relied on open-ended questions about the stages of the reading experience, such statements of appreciation must be understood in the context of the group interview, which possibly reinforces one frame of interpretation. Nevertheless, the striking tendency to highlight the benefits of the group dynamic alludes to an important aspect of reading, namely the potentially positive effects of reading in the presence of others. Students spoke of how they would often succumb to frustration or self-judgment when unable to read sufficiently alone, viewing these moments as their own failure to concentrate. In contrast, by gathering all at once in the same room performing the same task, they seemed to create a momentarily drive toward social conformity, a dynamic that has been discussed based on classic experiments in social psychology (Hodges and Geyer 2006).

4.2 Common struggles of "settling in"

While our participants were highly skilled readers, working with a known and well-defined task, they also showed signs of struggling to get into flow, using various cognitive embodied strategies to arrange themselves to the task at hand, as seen in the video recordings. For instance, they would manipulate their environment by arranging e.g. pencils and bottles on their desk, arranging their hair and clothes, and adjusting the seating position. In the settling in-phase, such arrangements might signal readiness or hesitancy towards the cognitively effortful task of reading ahead of them. To achieve a state of flow appeared to take time and continual effort. When participants did reach a state of flow, it was not consistently smooth. They kept manipulating the surrounding environment to settle into reading. During the stage in which students set themselves up for focused reading, some searched their backpacks for different study necessities and set up their highlighters, pens, something to drink. They adjusted their bodily position and tried out different ways to settle within their environment, finding better ways to sit or arranging their clothing and their hair, potentially aiding readers in gaining an overview and establishing an organized starting point. Thus, they slowly inhabited the reading setting. Across both conditions, participants adjusted or changed their position to a higher degree during the first hour compared to the next 4 h. As time passed, they also took fewer pauses to drink, to scratch or look up from the text, indicating that they entered a state of flow in reading. This ebb and flow of concentration during reading was also reflected in the focus group interviews. Students noted that the experience of reading for 5 h was not characterized by a

stable or continuous focus, describing it more in terms of waves and a sense of flow that came and went, or as one participant put it, of entering and leaving "monkey brain mode". This dipping in and out of flow, positioning their bodies and manipulating artefacts in the environment to settle in, was common in both settings.

4.3 "Settling in" in the presence of digital devices

Beyond these commonalities, our findings indicate that the presence of digital devices, when they have no relation to the task at hand, is associated with longer time to settle into flow. As illustrated by the detailed case studies below (see Section 4.4), students reading on screens and in the presence of cellphones more frequently interrupted themselves, moving their eyes from the text, shifting their body positions, drinking from their water bottles, or checking their phones. The time it took readers to show signs of immersion decreased when phones and other digital devices were absent. One respondent in a focus group puts it as follows: "I felt good, I got a lot done. Last time [with digital devices] I took more small breaks using my phone. This time I had less breaks. The breaks also felt more meaningful."

Although it seems students were able to stay "switched on" for longer periods in the absence of digital devices, as we explore further below, some expressed this in practical terms, simply as having read more. Other participants described their brains not being able to "turn off" fully in the presence of digital devices, that breaks were more "meaningful" in the absence of phones and digital devices, or simply that they could not switch off as easily as opposed to breaks with phones present. To varying degrees, the specific environment in which they found themselves reading was conducive to this. Some explained how reading without any digital technology at hand kept them within a feeling of timelessness. "I lost track of time, every time that I checked the clock, I was so surprised, I had read so much," said one participant. "I felt I was in a timeless space," added another. Others reported time "slowing down" or "losing the sense of time passing". The distortion of time perception is one of the hallmarks of flow (Carr 2013: 61), hence we interpret such statements to signify an experience of flow. While the absence of digital technology appeared to have been a factor that gave a feeling of accelerated and rapid time passing, students reported they were also eventually able to feel immersed in the presence of digital devices. This self-reporting corresponds with the up-close video recordings of the two students selected for detailed case study, to which we now turn.

4.4 Case studies

In both reading conditions, we set up cameras to monitor the reading behavior of two randomly selected participants in detail. The case studies show differences in bodily reading techniques between the two readers, as well as systematic similarities, as both participants settled into reading flow faster and with fewer breaks when reading in the setting without digital devices.

4.4.1 Reading with digital devices

In the condition where students could read on digital devices, the female reader used her iPad to read the assigned materials. The male reader used a portable computer. As evident from the video material, both participants "settled in" by adjusting their bodies and manipulating the reading environment. During the first minutes of the reading session, the female reader took up her phone after 2 min into the reading, she put it down before picking it up again after a minute. She searched in her backpack and put in air pods, spending the first 10 min finding a stable position to sit in, leaning backwards, changing to sitting upright again, with smaller adjustments of legs or hair a total of seven times during this short period. Finally, she sat back, stretched, then put her legs up in the chair. After the first half hour, the frequency of these small bodily adjustments diminished, as she seemed to have found a good reading position. Progressively, her reading on the iPad became less interrupted by shifts in her position. Although she ever-so-often adjusted her legs or played with her hair, this was increasingly done while focusing her eyes on the text. Throughout the first 2 h, her reading was primarily interrupted by drinking from a water bottle. Although looking up while drinking, these were small pauses of only up to 5 s before resuming the reading, directing her eyes immediately back to the text. Gradually, the time passing between each time she drank decreased. For example, during the span of the first half an hour she drank eighteen times, sometimes with only one-minute intervals in between sips. But after the first 2 h, the female reader interrupted herself less and less in this way. She read continuously over longer periods of time before taking a break of 20 min at the three-hour-mark.

The male reader showed similar embodied techniques of "settling in", using the first half hour to find a sustained reading position. During the first 90 min he looked at his phone six times, compared to only two for the next 90 min. During the first half hour, his hands were more restless than in the later stage, scratching itches and fiddling with his air pods. Towards the halftime mark, the male reader made fewer bodily adjustments, although the difference between the stages was less marked in his case compared to the female reader.

Notably, towards the end of the set reading period, the number of pauses among both participants increased once again. The female reader increasingly picked up her phone and put it down with shorter intervals. By comparison, she picked up her phone ten times in the last hour, while only four times in the first hour, and three times in the second hour. She also continued to take smaller pauses from reading where she looked up into the air. Equally, towards the last 2 h and until the end, the male reader took more breaks from reading. He got up from his chair six times, compared to only once in the first 2 h. In the last hour and a half, he reached for his phone more often, rubbed his eyes and increasingly stretched his back and fingers. Both participants displayed the same pattern: first seemingly struggling and adjusting to the environment, followed by a period of less interruptions and focus "on task", before a final period in which they displayed more restless behavior, taking more breaks. Both participants manipulated the surrounding environment to settle into reading, although notably, they did not move their digital reading devices, a point we explore further below.

Flow theory primarily focuses on the nature of the experience and how it arises from an optimal balance between an individual's challenge and skill. For instance, readers immersed in a text might resonate with statements such as, "I feel like I have the book stored in my mind" (Thissen et al. 2018: 3). However, our observational data suggest that this balance is often unstable. Readers' physical movements and gestures indicate that they are actively searching for this equilibrium rather than instantly achieving it. This observation raises the possibility that flow may depend on additional factors beyond those traditionally studied.

Existing research has explored preconditions for flow (e.g. McQuillan and Conde 1996), such as the reader's purpose (e.g., reading for work or pleasure), the genre (fiction or nonfiction), text selection, setting, interests, and background knowledge. While these factors are relevant, they do not explain how readers reach the optimal flow state. Other studies have focused on rich descriptions of the flow experience itself, emphasizing its characteristics at the peak moment. However, little attention has been given to the physical and behavioral processes readers undergo – the "hurdles" they navigate – to achieve this state. None of the conceptualizations we are aware of, including the 24 reviewed by Abuhamdeh (2020), address these aspects.

This oversight has implications for the operationalization of flow in reading. Existing self-report measures fail to capture the temporal dynamics of the experience. The items are often framed as if flow is constant throughout the activity. For example, Thissen et al. (2018: 3) include items like, "*During reading*", my body was in the room, but my mind was inside the world created by the story; or "I knew *on every page* that I was able to grasp the story" (our emphasis). Such measures, administered after the reading session, are necessarily retrospective. While this avoids disrupting the experience itself, it limits our understanding of how flow develops and fluctuates over time.

4.4.2 Reading without digital devices

In the setting without digital devices, participants were given print-outs of the articles they had to read. All digital devices were turned off and left out of reach. Under these conditions, the video material demonstrated how the "settling in" phase was quicker and more sustained compared to the session in which digital devices were allowed in the room. However, the analogue set-up also showed similarities with the digital, particularly in the case of the female reader. As in the presence of digital devices, she began her session by searching in her backpack during the first 15 min, as if making her environment ready for a deeper plunge. She removed her shoes and moved her body around to find a reading position in her chair, adjusting her legs and her hair. After this initial phase of "settling in" within the first 15 min, she grew focused on the reading task. She started taking notes and highlighting the paper after the first 15 min, which she continued to do regularly throughout the 5 h. The video material showed how she changed or adjusted her bodily position. Notably, however, these bodily adjustments and movements were temporally further apart than in the digital device condition, happening with five to 10 min intervals compared to two-five minutes intervals when reading on screen.

This reader's behavior continued to include instances of bodily dynamics such as adjusting her hair, her position, eating and drinking. However, she now managed to remain "on task" even during her own interruptions, in comparison with the digital set up. In the first 2 h in the digital condition, the female reader mainly drank from her water bottle while looking up. In contrast, during the same stage in the analogue set-up, she drank *while reading*, which can be interpreted as remaining "on task" during her own "interruptions". She also displayed traits indicating that she found herself in a more flexible state of reading, moving the papers with her when she changed positions, allowing her to pick up the papers and read while she drank, aligning her line of sight and the papers she read.

In the digital set-up, she would disengage with the reading device, an iPad, gazing away and leaving it on the table when drinking. This bodily difference between the digital and the analogue condition suggests the impact of media for immersion and flow. While reading on paper, she interacted dynamically with the materials, often picking them up and leaning back in her chair with the papers in hand. The video recordings further reveal how she continuously engaged with the papers, frequently handling them by turning pages both forwards and backwards at various points during the reading exercise. This may be an example of what has been termed "sensuous tinkering" (Trasmundi et al. 2021: 6), that is, engaging in haptic and tactile manipulation with the material substrate to support cognition or pleasure during reading. Such tinkering may be an indication of immersion in the text, and it would be interesting in future studies to explore in more detail whether and how

such an observable phenomenon may be associated with other indicators of immersion, for instance as measured by physiological data.

This type of "sensuous tinkering" with the reading device during reading was not seen in the presence of digital devices, as her iPad was never picked up and remained on the table. In other words, it seems the two different reading artifacts – the physically amenable paper stack, on the one hand, and the digital device, on the other – had different capacity to aid, enhance, or improve cognition (cf. Hutchins 1999: 126).

The "settling in" phase was also shorter in the case of the male reader in absence of digital devices. Both in terms of time spent, and frequency of bodily adjustments, the displays of restless behavior diminished faster in the absence of digital devices. The male reader began to highlight areas in the text after 10 min, but in his case, it was difficult to compare note-taking across the two conditions given that the screen he worked on during the digital setting was not visible to the camera. But like the case of the female reader in the absence of digital devices, the male reader also moved his papers and picked them up repeatedly, in sync with his physical position, as well as "handling" the papers, turning the pages forwards and backwards several times.

5 Limitations

Before discussing the implications of these results, it is helpful to first acknowledge the methodological constraints of this study – including its small scale, and our reliance on rather few observations and self-reports. The nature of our data does not allow robust conclusions with respect to questions such as how long the readers actually spent "on task" during the overall 5 h of the dedicated session. Based on the video observations, we can show the frequency and the duration of breaks and pauses during reading, and whether these breaks and pauses seemed to be self-initiated or prompted by disturbances in the surrounding environment. Findings from our focus group interviews indicate that participants perceived their reading as more successful in the paper condition compared to the digital condition. However, since we did not measure their actual reading time or performance, our conclusions are limited to the participants' self-reported experiences following the reading session, as well as our coding and analysis of the video material.

Such limitations show the importance and necessity of supplementing observational studies and self-report data with additional measures. To provide insights into what occurs during reading and allow for analysis of the effects of various types of interruptions or breaks on outcomes, such as comprehension. In order to shed more light on what goes on during reading, and to what extent readers are in fact reading or doing something unrelated, a more robust research design would

supplement video data with physiological measures such as eye tracking, allowing more accurate identification of time "on task". Recent advances in eye tracking equipment such as lightweight eye tracking glasses make it possible to track eye movements during reading with sufficient precision in natural settings. In addition, exploratory observational studies such as this current study could benefit from the inclusion of some performance-measure administered at the end of a reading session or an entire seminar, assessing students' comprehension or recall of the assigned texts. In this way, we would be able to further specify the role of the reading devices, the quality of flow, and the embodied reading trajectories and how they contribute positively and negatively in study reading beyond the readers' subjective experiences.

Another central question is whether or to what extent our findings relating to the fluctuations of flow are specific to reading, as compared to other tasks of the same duration, for instance, physical exercise, writing and drawing, playing various games and instruments, or relaxation practices such as yoga and meditation or even listening to storytelling. Granted, flow has been studied in many such activities (Høffding et al. 2024), and it would be interesting to compare reading-specific flow in comparison.

Lastly, it can be questioned how and to what extent our choice of text in the present study had a bearing on the results. Given that flow has been found to be more easily facilitated by fiction reading (McQuillan and Conde 1996), it is an interesting empirical question whether we would observe different patterns and reading trajectories if the participants were provided fictional texts instead of, as in our study, texts on their curriculum. Several textual parameters may be of interest in this respect. The fact that our participants read scholarly articles and not one long text, adds to the difficulty of comparing flow across the two reading sessions. Results from the focus group interviews also revealed that the preferences and perceptions of the students varied with respect to the different articles. Future studies exploring embodied reading trajectories and flow with paper versus digital texts should compare the reading of longer texts, with due scholarly attention to questions of genre and other textual parameters that may be important to flow (e.g., narrative or stylistic complexity; layout; information density; action-based or character-based stories).

6 Implications

While the recognition of the limitations of our study helps point in the direction of new questions, our results also suggest some possible answers that are relevant to reading researchers and policy makers alike. The results of our exploratory pilot study contribute to exploring our conceptual understanding of readers' practice of

concentrated engagement with longer texts. Based on our observations, we have discussed the importance of "settling in" as a prerequisite for achieving flow– an amalgamation of various factors related to the text, the reader, and the reading environment. We advocate considering a perspective that views reading performance as a process of bodily engagement with the environment, in which individuals adjust and modulate their bodily positions, aligning themselves with the task-environment and preparing the body as well as the mind to concentrate and engage. This process is partly facilitated by what the environment offers, be it the presence of other people engaged in long-form reading, or the accessibility of digital devices.

Encouraging or facilitating this process whether as individual readers or educators might enhance reading experiences. For instance, raising awareness of the phenomena discussed here, or providing opportunities for deep reading sessions in university libraries could improve the flow of reading, increase reading enjoyment, and ultimately lead to more pages being read within a given time. Such awareness could also facilitate access to longer and complex texts, both within and beyond academic circles, whether these are fiction or nonfiction. These implications align with findings from OECD studies mentioned in the introduction. They underscore the importance of deep reading skills in fostering comprehension, critical thinking, and the ability to engage with complex materials across academic and professional domains. Building on these results, policy makers, educational practitioners and scholars could consider how pedagogical practices and institutional settings might better support the development of these skills.

Beyond these potential implications for pedagogy and policy, our findings also lead to new research questions. Building on the insights from our pilot study, we suggest a broader research agenda aimed at systematically investigating the factors that positively enable deep reading and flow. This ambition could entail explorations of the interplay between physical and digital reading environments, examine the role of interruptions or breaks, and evaluate how these factors impact the subjective experience of flow and further measurable outcomes like comprehension and retention. By integrating these insights, future research could further inform embodied strategies to support deep reading in diverse contexts.

Two areas of future empirical research immediately strike us as particularly promising. First, building on the present pilot study, empirical studies could be carried out within educational settings to further investigate the effects of digital access and reading substrate on students' flow. A sound research design would seek to control for confounds related to, for instance, differences in the content or type of the reading materials, the difference made by types of reading device (screen vs. print, screens with access to the internet vs. disconnected), as well as identifying relevant personality variables among participants, by establishing reader profiles to

determine who benefits from digital device removal and who, potentially, does not. This empirical investigation could also seek to discern what constitutes the optimal length span of a deep reading session. Will readers adjust the timing of their manipulations and arrangements with artefacts, adjusting postures, hair etc. to settle into the length of the sessions?

Secondly, our study raises questions about the role of social facilitation in reading, and in particular, in challenging long-form reading. In focus group interviews, participants spoke enthusiastically about how social facilitation entailed by the group dynamic helped harness a sense of flow and task progress by providing a form of social support, an unspoken, mutual assistance. This topic merits further research. What effect does social facilitation have on reading flow? Does an individual reading experience lend itself to similar experiences of flow and focused reading as does reading as a collective experience?

In our view, collective deep reading holds potential not only as a subject of research but ultimately also as a form of pedagogy for students in higher education, if scaled correctly. Many students succumb to frustration or self-judgment when unable to read sufficiently, viewing these moments as their own failure to concentrate. However, the perspective we have developed in this article locates the "problem", and hence also possible solutions, beyond the individual reader. An embodied and distributed cognitive perspective on reading reveals the significance of reading as a fully integrated, whole-bodied activity, where flow and immersion emerge when body, text, reading medium, and environment are harmoniously aligned. This alignment enables readers to engage deeply during reading, unlocking the transformative joy of getting lost in a text.

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