

# Generative Primes and Summaries for Reading in Distractive Environments

Tilman Dingler<sup>1</sup>, Namrata Srivastava<sup>2</sup> and Shaun Wallace<sup>3</sup>

<sup>1</sup>Delft University of Technology, Netherlands

<sup>2</sup>Monash University, Australia

<sup>3</sup>University of Rhode Island, USA

## Abstract

The proliferation of mobile phones has made reading on these devices increasingly common, but it has also exposed readers to a plethora of distractions, both internal (e.g., incoming SMS or phone calls) and external (e.g., navigating a footpath). Resuming a reading task after a distraction can be a daunting and time-consuming endeavour. To address this challenge, our research explores using automated text summaries and visualizations, powered by Large Language Models (LLMs), to aid readers in distractive environments. These summaries and visualizations can be triggered both before and after distractions occur, offering a flexible approach to mitigating interruptions. This paper delves into the concept of *generative primes* - text summaries and visualizations presented before a distraction happens - and post hoc text summaries and visualizations. We evaluate the effectiveness of these approaches in terms of their ability to faithfully represent the content and how effectively they assist readers in comprehending and recalling the text. Large Language Models open up new possibilities for developing reading interfaces that empower readers to seamlessly handle distractions and effortlessly pick up where they left off in their reading sessions as well as provide opportunities for memory consolidation. Our research sheds light on how these advances can positively impact the reading experience in today's increasingly distractive digital landscape.

## Keywords

Reading interfaces, attention management, priming, generative AI.

## 1. Introduction

The advent of mobile technology has transformed the way we engage with written content. From e-books and digital articles to social media feeds and messaging apps, our mobile devices have become the primary medium through which we access and consume written information. While this shift offers unprecedented convenience and accessibility, it has also introduced new challenges, particularly in environments where distractions abound [1, 2]. Reading on mobile phones in such distractive contexts presents a unique conundrum, as the constant influx of notifications, both internal (e.g., incoming SMS or phone calls) and external (e.g., navigating a busy street), disrupts the immersive reading experience. These distractions not only hinder the enjoyment of reading but also harm comprehension and memory retention [3, 4].

---

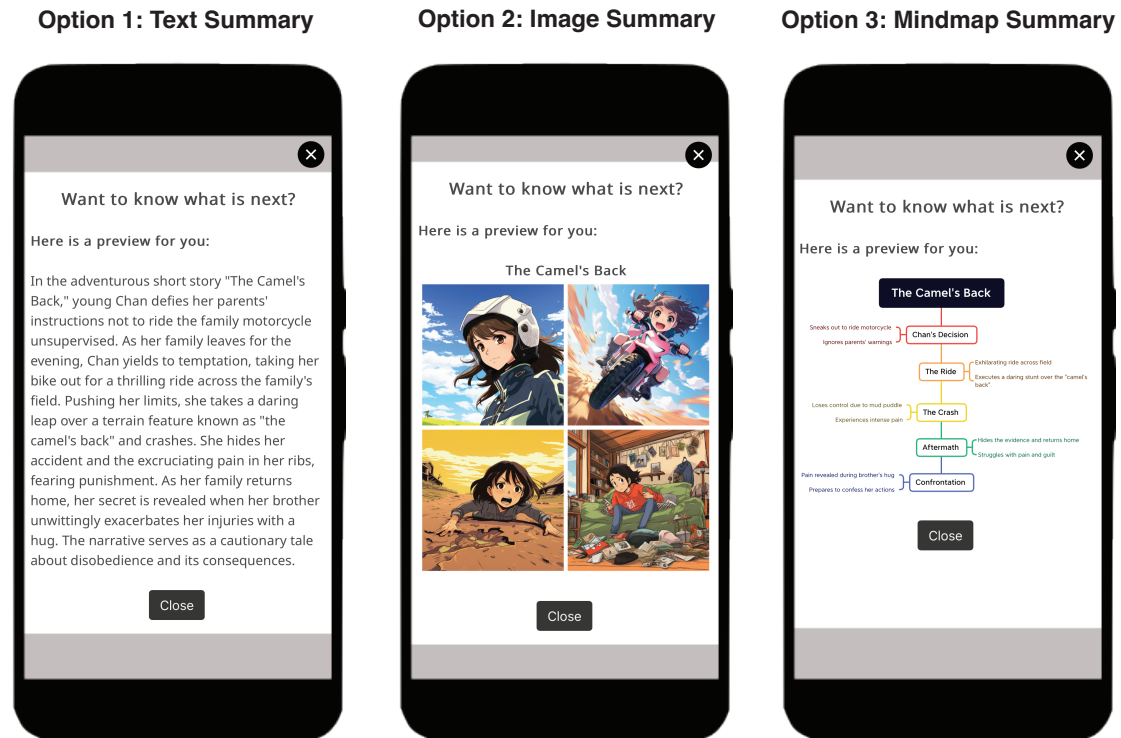
*MuM'23 Workshop on Interruptions and Attention Management: Exploring the Potential of Generative AI*

✉ t.dingler@tudelft.nl (T. Dingler); namrata.srivastava@monash.edu (N. Srivastava); shaun.wallace@uri.edu (S. Wallace)

🆔 0000-0001-6180-7033 (T. Dingler); 0000-0003-4194-318X (N. Srivastava); 0000-0001-5297-1659 (S. Wallace)

© 2024 Copyright for this paper by its authors. Use permitted under Creative Commons License Attribution 4.0 International (CC BY 4.0).





**Figure 1:** An example of three AI-generated priming representations used in our study for mitigating the effects of reading interruption - textual (in the form of text summaries), visual (in the form of images), and conceptual (in the form of mind-maps).

As reading is increasingly becoming an activity that is performed on the go, it is vital to address the impact of distractive environments. Recent research highlights the prevalence of mobile phone usage for media consumption. According to a report by the World Economic Forum, people now spend over four hours a day reading, listening, and watching on their mobile phones [5]. This shift in media consumption, including reading habits, raises questions about the quality of information intake and the ability to maintain focus amid the constant barrage of distractions.

The interruptions experienced while reading on mobile devices are twofold. First, there are internal disruptions, such as incoming text messages, phone calls, or app notifications, which divert the reader's attention away from the text [1]. Second, external factors, like navigating a crowded sidewalk, further compound the challenge of maintaining reading continuity [1]. As a result, readers often find themselves in the unenviable position of having to navigate a maze of distractions before they can resume their reading [6]. This, in turn, can lead to frustration, diminished comprehension, and difficulties in recalling information from the text.

At the heart of interruptions lies the concept of switching costs, i.e., the time and mental resources it takes to shift focus from one activity to another (and potentially back). Workers have been shown to struggle to shift and resume their tasks after interruptions [7]. One potential

solution to this dilemma lies in integrating cues for task resumption [8]. In our work, we investigate in which ways keywords, text summaries, and visualizations can be used as cues to allow readers to resume reading activities and consolidate comprehension and memory. Here, we make use of the so-called *priming effect*, i.e., an effect from psychology where exposure to one stimulus influences the response to a subsequent stimulus. In essence, we investigate how textual and visual previews of passages affect reading comprehension [9] and help readers bridge interruptions [10].

In recent studies, we have further focused on whether such *text primes* should be administered after an interruption occurred or beforehand (e.g., by delaying an incoming call). The design of these cues, however, has so far been labour-intensive as interruptions can occur at arbitrary points during text reading and cues hence need to be generated for any number of text passages.

In our era, where Large Language Models (LLMs) have become increasingly sophisticated, these summaries and visualizations can be created in an automated fashion, however, and customized to the reader’s preferences. LLMs have significantly advanced the field of Natural Language Processing (NLP) and have been instrumental in tasks like text summarization, language translation, and information retrieval [11, 12]. GPT-3, for example, has demonstrated remarkable capabilities in understanding and generating human-like text, sparking interest in leveraging such models to enhance the reading experience [Brown et al., 2020]. These LLMs can be harnessed to power a new generation of reading interfaces that mitigate the negative effects of distractions. By providing readers with informative summaries and visualizations, these interfaces have the potential to facilitate smoother transitions between reading and interruptions.

This position paper delves into the concept of *generative primes*, i.e., content cues in the form of text, graphical and image visualizations that help readers preview and review text passages and mitigate the effects of interruptions. We investigate the benefits of presenting such primes before a distraction occurs and explore post-hoc summaries and visualizations, which help readers re-orient themselves after being interrupted. Our research evaluates how well these *generative primes* represent the content and how effectively they assist readers in comprehending and recalling the text.

Our research aims to contribute to a deeper understanding of how *generative primes*, empowered by LLMs, can revolutionize how we read in distractive environments. By offering insights into their effectiveness and applications, we hope to pave the way for a more seamless and enjoyable reading experience in the era of constant digital distractions.

## 2. The Concept of Generative Primes

The concept of “*generative primes*” represents an approach to address the challenges of reading in distractive environments. *Generative primes* are cues that provide readers with text summaries and visualizations either before a distraction occurs or after it has disrupted their reading. These elements act as cognitive aids, preparing the reader for the upcoming content or assisting in the resumption of the reading task after an interruption. By combining textual summaries and visualizations, *generative primes* create a holistic reading experience that can enhance comprehension, recall, and engagement.

In the past, we utilized the priming effect to facilitate text comprehension [13] and tested different visualizations, including text highlights, structured mind maps, and image galleries [9]. Primes had to be manually crafted, which limited this type of research to controlled lab studies with selected texts. By leveraging the power of LLMs to generate automated summaries and images from text, these *generative primes* can finally be scaled and deployed in the wild.

To implement *generative primes*, Large Language Models (LLMs) like ChatGPT are invaluable for generating text summaries. ChatGPT is trained to understand and generate human-like text, making it ideal for creating concise, coherent, and informative textual overviews of longer passages. These summaries can serve as previews or reorientation tools, ensuring that readers stay connected to the content despite distractions.

Visualizations are essential components of *generative primes* that complement text summaries. Software tools like Midjourney and DALL-E have been revolutionary in this regard. Midjourney can create visualizations through image stories, distilling complex textual information into visually appealing and easily comprehensible narratives. Meanwhile, DALL-E can generate innovative visualizations, such as mind maps that visually represent the structure and connections within the text.

The synergy of text summaries from LLMs like ChatGPT and visualizations from software like Midjourney and DALL-E enables the creation of *generative primes* that cater to diverse learning and reading styles. These primes hold the potential to revolutionize the way we interact with written content in distractive environments, making the reading experience more engaging, informative, and resilient to interruptions.

### 3. Research Plan and Outlook

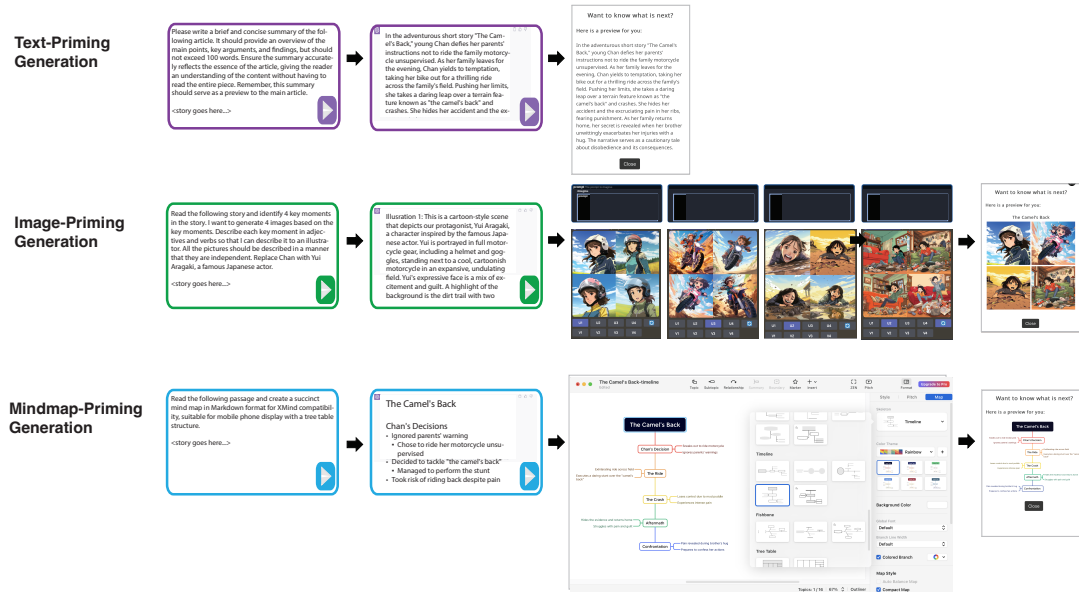
In our recent work, we explored the impact of interruptions on reading comprehension and how these effects can be mitigated using *reviews* (summaries of already read content) and *previews* (summaries of upcoming content) [10]. We conducted a series of pilot studies involving participants reading on mobile devices and being interrupted by various tasks. The studies aimed to determine whether presenting these summaries before or after interruptions could aid in re-engaging with the reading material and improving comprehension.

We found that previews shown after interruptions significantly enhanced reading comprehension compared to not showing any summaries. Reviews also helped, but to a lesser extent than previews. The effectiveness of these priming cues varied based on the type of reading material and the timing of the cue presentation.

Despite the effectiveness of previews in aiding comprehension, most participants expressed a preference for reviews. They found reviews more helpful in summarizing key points and aiding in answering comprehension questions. A significant number of participants (79.3%), however, preferred having some form of summary (either review or preview) compared to none.

These studies suggest that smart reading applications could incorporate text summaries, especially previews after interruptions, to facilitate better comprehension and re-engagement with reading tasks. Hence, we are now in the process of utilizing LLMs to generate text summaries and visualizations on the fly to create text primes. Figure 2 shows the process of creating three types of primes—text summary, image story, and a mindmap—from prompting to





**Figure 2:** A figure showing how text-priming, image-priming, and mindmap-priming cues were generated using Generative-AI tools.

feeding in the respective text passage and generating the output. The resulting *generative primes* are scalable and can be customized to readers' preferences. More research is needed on the quality and comprehensiveness of the text summaries and visualizations, as well as their ability to assist readers in maintaining focus, comprehension, and recall. Moving forward, experiments are needed with different types of distractions and reading contexts to further explore the benefits and limitations of *generative primes*. We will also investigate the customization options for these primes, allowing readers to tailor the summaries and visualizations to their preferences. Ultimately, we hope to contribute to the development of reading interfaces that effectively support readers in distractive environments and pave the way for a more seamless and enjoyable reading experience in the digital age.

## 4. Conclusion

Our work defines and highlights the potential of *generative primes*, which include text summaries and visualizations, to mitigate the challenges of reading in distractive environments. By providing readers with informative cues before and after distractions occur, these *generative primes* have the ability to enhance comprehension, recall, and engagement. Further research may focus on the customization options and evaluate the effectiveness of these primes in different reading contexts. Ultimately, we aim to contribute to the development of reading interfaces that empower readers to navigate distractions and seamlessly continue their reading tasks.

## Acknowledgements

We thank the participants of our studies as well as the continuous support by Adobe Research and the team at the Documents Intelligence Lab, foremost Rajiv Jain and Jennifer Healey.

## References

- [1] L. Leiva, M. Böhmer, S. Gehring, A. Krüger, Back to the app: The costs of mobile application interruptions, in: Proceedings of the 14th International Conference on Human-Computer Interaction with Mobile Devices and Services, MobileHCI '12, Association for Computing Machinery, New York, NY, USA, 2012, p. 291–294. URL: <https://doi.org/10.1145/2371574.2371617>. doi:10.1145/2371574.2371617.
- [2] A. Oulasvirta, S. Tamminen, V. Roto, J. Kuorelahti, Interaction in 4-second bursts: the fragmented nature of attentional resources in mobile hci, in: Proceedings of the SIGCHI conference on Human factors in computing systems, 2005, pp. 919–928.
- [3] C. K. Foroughi, N. E. Werner, D. Barragán, D. A. Boehm-Davis, Interruptions disrupt reading comprehension., *Journal of Experimental Psychology: General* 144 (2015) 704.
- [4] S. T. Iqbal, B. P. Bailey, Investigating the effectiveness of mental workload as a predictor of opportune moments for interruption, in: CHI '05 Extended Abstracts on Human Factors in Computing Systems, CHI EA '05, Association for Computing Machinery, New York, NY, USA, 2005, p. 1489–1492. URL: <https://doi.org/10.1145/1056808.1056948>. doi:10.1145/1056808.1056948.
- [5] World Economic Forum, The rise and rise of media on your mobile phone - in one chart, Available online at: <https://www.weforum.org/agenda/2021/02/media-consumption-mobile-phone/>, 2021. Accessed: 10.11.2023.
- [6] D. P. Brumby, A. L. Cox, J. Back, S. J. Gould, Recovering from an interruption: Investigating speed- accuracy trade-offs in task resumption behavior., *Journal of Experimental Psychology: Applied* 19 (2013) 95.
- [7] G. Mark, V. M. Gonzalez, J. Harris, No task left behind? examining the nature of fragmented work, in: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI '05, Association for Computing Machinery, New York, NY, USA, 2005, p. 321–330. URL: <https://doi.org/10.1145/1054972.1055017>. doi:10.1145/1054972.1055017.
- [8] C. Schneegass, F. Draxler, Designing task resumption cues for interruptions in mobile learning scenarios, in: *Technology-Augmented Perception and Cognition*, Springer, 2021, pp. 125–181.
- [9] T. Dingler, D. Kern, K. Angerbauer, A. Schmidt, Text priming - effects of text visualizations on readers prior to reading, in: R. Bernhaupt, G. Dalvi, A. Joshi, D. K. Balkrishan, J. O'Neill, M. Winckler (Eds.), *Human-Computer Interaction – INTERACT 2017*, Springer International Publishing, Cham, 2017, pp. 345–365.
- [10] N. Srivastava, R. Jain, J. Healey, Z. Bylinskii, T. Dingler, Mitigating the effects of reading interruptions by providing reviews and previews, in: *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems, CHI EA '21*, Association for Computing Machinery, New York, NY, USA, 2021. URL: <https://doi.org/10.1145/3411763.3451610>. doi:10.1145/3411763.3451610.

- [11] OpenAI, Chatgpt: Optimizing language models for dialogue, 2020.
- [12] OpenAI, Gpt-4 technical report, 2023. [arXiv:2303.08774](https://arxiv.org/abs/2303.08774).
- [13] K. Angerbauer, T. Dingler, D. Kern, A. Schmidt, Utilizing the effects of priming to facilitate text comprehension, in: Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems, CHI EA '15, Association for Computing Machinery, New York, NY, USA, 2015, p. 1043–1048. URL: <https://doi.org/10.1145/2702613.2732914>. doi:10.1145/2702613.2732914.