Designing a virtual reality environment for reading literature
Prelude to an experiment with *Alice's Adventures in Wonderland*
Federico Pianzola & Wayne de Fremery

[Pianzola, F., & de Fremery, W. (2020). Designing a virtual reality environment for reading literature: Prelude to an experiment with Alice's Adventures in Wonderland. In T. Schilhab & S. Walker (Eds.), The Materiality of Reading (pp. 67–93). Aarhus University Press.]

Abstract
This contribution presents the process of designing a virtual environment for reading using a VR headset. The aim is to set up an environment that invites readers to experience *Alice's Adventures in Wonderland* in a new way. Our VR literature concept explores the idea of books as worlds to enter. Its central questions concern how to design new media to enliven older media forms of literature. Decisions taken in the design process concern the shape given to the portions of text displayed, as well as their flow and localization in a virtual 3D space. The hypotheses to be tested in upcoming research are whether this kind of literary experience can attract new readers and help them to be more absorbed in the story – more focused and emotionally engaged – and establish a more vivid memory of what they read. This article is a description of hypotheses about how to design a VR reading environment so as to achieve these results.

Introduction

"In another moment down went Alice after it, never once considering how in the world she was to get out again" (Carroll 1866, 3).

New media present new opportunities to design literary experiences. This article is a description of hypotheses, opportunities and challenges when designing Lewis Carroll's classic *Alice's Adventures in Wonderland* for virtual reality (VR), with the aim of enhancing readers' narrative absorption – the state of being focused on and emotionally engaged with the story (Hakemulder et al. 2017) – and readers' recall of the reading experience. Carroll's Wonderland is an apt metaphor for the choices presented when designing literary texts in virtual reality, a 'book' format that is not yet common.

The very first chapter of the novel offers prompts for a reflection on books and reading: "'and what is the use of a book,' thought Alice, 'without pictures or conversations?'" (Carroll 1866, 1–2). Moreover, the way Alice dives down the rabbit-hole resembles the way in which readers can immerse themselves in books, but it could also be a way to imagine entering a virtual 3D space in which the story unfolds. A piece of fiction in VR can be designed to elicit the feeling of falling slowly down a deep well.

Readers can be made to face the text in front of them, but they can also "look down and make out what" they are "coming to", look at the sides and see what "maps and pictures" are hung there, and wonder many other things, including whether the fall might "never come to an end" (Carroll 1866, 3–4). VR presents the opportunity to experiment with the reification of old tropes related to reading experience, such as the sense of 'getting lost in a book'.

Working with *Alice* we explore how canonical texts might be redesigned for new media formats so as to increase readers' absorption into the story and ability to recall the aesthetic experience of reading. Our desire is to make the experience of literature engrossing for as many people as possible, including those generations for whom books are not the primary source of narratives, inasmuch as they are more attracted by audiovisual and interactive stories. We want people to be readers and "never once consider how in the world" they are "to get out" of literature presented in new media, once they have gone down the "rabbit hole" we have designed for them.

Digital technologies have been exploited in different ways in relation to literature – by literary artists to create new text forms, by digital humanists for curation and criticism – but no one has yet focused on designing literary texts in VR to enhance (rather than transform) traditional reading experiences, and better understand 'traditional' literary experiences. Over the last forty years many literary works augmented by digital technology have been released, including hypertexts, multimodal novels, interactive fiction, GPS location-specific narratives, installations in immersive virtual environments and so on (Hayles 2008). Two online catalogues collect artistic projects that go under the name of 'electronic literature' or 'digital fiction' (ELO; ELMCIP), covering many examples that aim at innovating how literature is created.

Work in the Digital Humanities has often been directed toward supporting literary history and criticism, creating digital editions of literary works conceived and born in more traditional media, like printed paper or manuscripts (for example Driscoll & Pierazzo 2016). However, in addition to authors and critics, there is great potential in thinking about a third agent in the world of literature: the reader. Reading in the age of digitization can be reconceptualized, for instance by designing the reading experience for a new medium: virtual reality. In the following sections we will present the design concept for such a reading experience.

Literature in a new medium

Exploring the affordances of a new medium means experimentation aimed at identifying the core elements that constitute experiences with 'old' media – in our case, the experience of reading literature on paper and screens – in order to understand the opportunities presented by the new media.

These experiments are made by attempting to assess the role that various design elements play in an experience, which is accomplished through iteration: prototyping, testing and redesign. In many cases, this experimental process necessitates that traditional features of a media be forgone, if only temporarily, in order to understand the role that

they have played traditionally, as well as the social history and technical conventions of that tradition.

For our VR Alice project, we started with the assumption, derived from cognitive narratology, that one core feature of literature is the enabling of the embodied resonance of experiences through the enactment of a story (Caracciolo 2014; Kukkonen 2020). That is, a reader's engagement with a story is prompted by the participation of their body in processes of meaning-making through the resonances evoked by motion verbs, indications of direction, bodily states, shift of perspective, rhythm, etc. With this in mind, we wished to explore how reading experiences in VR might be designed to foster the enactment of a story that will stay in readers' memories.

A second assumption is that writing systems are a primary stimulus offered by literature such as *Alice*. We have therefore focused our reflection on understanding how the conventions of writing systems might be modified for virtual environments. This focus on writing systems distinguishes our project from the growing body of work centred on interactivity and visual storytelling. Lastly, we assume that reading fiction stimulates an absorbed state and activates memory in ways that can be distinguished from other forms of media, such as films or video games (Green et al. 2008; Bálint, Kuijpers & Doicaru 2017). Starting from these assumptions, we have focused our work on attempts to understand how engagement with writing systems stimulates absorption as readers enact a story, and on the relationship between memory and this process of enacted embodiment.

Narrative absorption is an experiential state that can emerge while reading a narrative text, viewing an audiovisual narrative or using an interactive narrative artefact, such as a video game. This state is characterized by focused attention on the story world, perceived transportation into it, emotional engagement with characters and events, and vivid imagery (Green et al. 2008; Busselle & Bilandzic 2009; Kuijpers et al. 2014). Absorption and memory are intertwined inasmuch as operative memory is needed to remember anticipated and delayed information in stories (Gerrig & O'Brien 2005) – which brings about absorbing narrative effects like suspense and surprise (Sternberg 1992) – and absorbing stories are remembered longer by readers (McCabe & Peterson 1990; Cahill & McGaugh 1995).

Alice herself finds remembering stories a very useful thing to do and so she carefully checks whether the little bottle that she finds while looking for the White Rabbit is marked 'poison' or not, "for she had read several nice little stories about children who had got burnt, and eaten up by wild beasts, and other unpleasant things, all because they *would* not remember the simple rules their friends had taught them" (Carroll 1866, 10).

The stories we read add to our dictionary of experiences we can access during sense-making processes, especially when they involve understanding natural language (cf. the concept of 'bridging inferences' in McNamara 2007). This is why it is important to make written stories more accessible and engaging for contemporary users, because narratives are a constituent of our ability to understand the world and act in it.

In the following sections we present our ideas on how to design a VR experience aimed at fostering a thought-provoking and engaging encounter with a literary masterpiece.

Designing literature for VR

In human-centred design processes a crucial aspect to keep in mind is how the *user* will interact with the system that is being designed, "focusing on the users, their needs and requirements" (ISO 2019). In our case, we are designing a virtual reality environment for reading literature and are interested in the effects of literature on people; therefore we will focus only on the affordances of VR – i.e. what the technology offers to the user (Gibson 1979) – *for readers*. We are considering how VR may be used to make reading more appealing by prompting readers to imagine the story and its characters, and to remember the "story-driven experience" (Caracciolo 2014).

A central question for us is how to use VR to increase absorption and affect memory. However, before stating our design choices, it is worth briefly mentioning two contextual factors. First, as a technology, VR does not have some inherent quality that will enhance readers' ability to recall a literary experience. As with other technologies such as print, it is how literary materials are designed that affects memory and recall. Second, the novelty of the medium is likely to affect user experience, but initial research about reading in VR suggests novelty may only play a minor role, especially as the technology becomes more ubiquitous (de Fremery & Kim 2019; Pianzola et al. 2020). With the aim of enhancing readers' absorption and ability to recall specific passages from *Alice*, in our design concept we decided to work on the affordances of VR as a medium enabling interaction with text and other visual stimuli in a 3D space. Moreover, readers can move in the 3D space thanks to the use of controllers with which they can have their virtual avatars walk, fly or teletransport. As we will see, this combination of features is relevant for both absorption and memory.

Associating words or topics with visual references is an effective technique to retain them (Carruthers 2008; Clark & Mayer 2011). Carroll himself deploys this technique in *Alice*. When the reader encounters a tail-shaped text on the page – the tale told by the Mouse (Carroll 1866, 37) – it is a surprise that makes the reader visualize something unconventional: the overlapping of a *tale* and a *tail* (see Figure 1). This is an example of how a medium can be used to support readers' enactment of the story by complementing the verbal cues given by the written text with alternative visual stimuli. In other words, the text layout enacts the semantic content and also supports a reader's enactment of the story by complementing the verbal cues of the text (Moreno & Mayer 2002; Clark & Mayer 2011). The combination of language game, text organization on the page and the visual suggestion of a shape makes the episode memorable. This is an example driven by the author's creative need, but memory devices can also be embedded in the medium

independently from the story world suggested by the author.

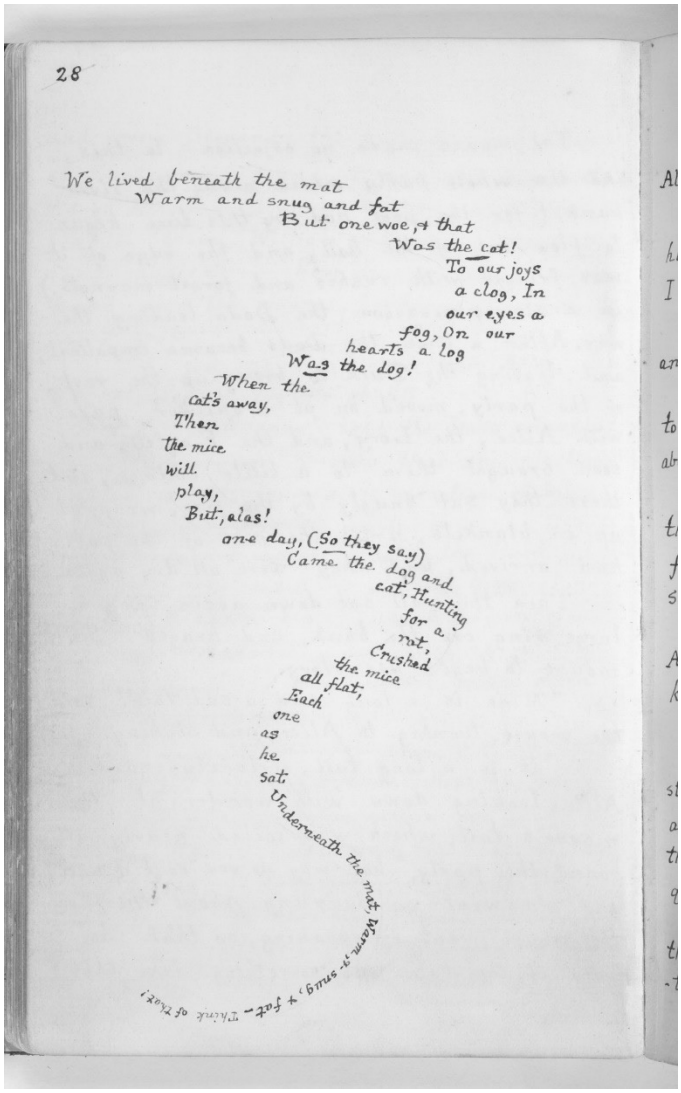

Figure 1. Page of the manuscript of *Alice's Adventures Under Ground*, the first book version of Alice's story (Carroll 1864)

A well-known example of the combination of text and visuals with the aim of aiding memory is a technique called 'architectural mnemonic' (also known as 'method of loci' and 'memory palace'), according to which words are associated with specific images and mentally placed in a familiar place. To remember them later, it is sufficient to imagine being in that place. This technique has been employed widely since ancient Greece and Rome, through the Middle and Modern Ages, up to recent TV series (*Sherlock*), even influencing the design of manuscripts and the creation of other artefacts (Figures 2[1] and

[1] This Gospel book, with richly painted evangelist portraits, canon tables and marginal illuminations, was made in Armenia in the early 17th century. We are used to thinking of printed books mainly as texts on a white page but drawings, decorations and colour have been an important part of how knowledge has been conveyed by documents. Manuscripts in many cases provide a rich multimodal

3[2]). The basic principle is that "images are retained more easily than abstract thoughts, but they 'require an abode,' for 'the embodied cannot be known without a place' ('corpus intelligi sine loco non potest')" (Carruthers 2008, 91 quoting Cicero, *De oratore*). And "'if we are not pleased with the real backgrounds available to us, we may create some in our imagination and obtain a most serviceable distribution of appropriate backgrounds' (III, 19, 32)" (Carruthers 2008, 90 quoting *Rhetorica ad Herennium*).

Figure 2. *Amida Gospels*, Canon table, Walters Manuscript W.541, fol. 5r. Walters Art Museum

experience, involving the processing of images and text together in order to understand and remember the content of the book. The use of memory techniques was very popular among scholars and sometimes the images crafted in manuscripts were inspired by the use of these techniques. In copying the Gospels, for instance, very often an architectural space was introduced, in which the text was schematically organized between pillars. This is known as the system of Canon Tables, a concordance device invented to identify passages that appear in more than one of the four Gospels.

[2] The technique known as architectural mnemonics influenced the design of manuscripts but also the creation of other artefacts, like this African memory board called *lukasa*, a "roughly hand-sized wooden object studded with beads and pins or covered with incised or raised ideograms. During Mbudye rituals, a lukasa is used to teach neophytes sacred lore about culture heroes, clan migrations, and the introduction of sacred rule" (Roberts & Roberts 1996, 31). The marks on the board are associated with different stories that a "man of memory" enacts and perform to the community while moving his finger on the board to "visit different places". Navigating a text in a 3D virtual space may resemble this process.

Figure 3. Luba. *Lukasa memory board*, late 19th or early 20th century

Architectural mnemonics, which facilitate embodied memory practices, inform our approach to the design of *Alice* for VR environments. Memory palaces are always specific to the individuals that create them. As such, it would be impossible to design a single environment that would facilitate every reader's ability to recall specific passages of *Alice* over the long term.

As many scholars have suggested, mnemonic processes rely on the activation of individual embodied agents (Dijkstra & Post 2015; Macken et al. 2016). Therefore, one way of approaching this issue is to allow readers to personalize the environment to some extent, so that they can become active users creating their own associations between text and 3D world. Another possibility is to prompt a reader's sense of being absorbed in their experience through the design of the virtual environment and the spatial organization of the text in a 3D world. Design choices affect a reader's embodied experience with the story; our task is to find design features that are likely to enable the formation of memories.

When using architectural mnemonics, readers create a mental map of the text associating each part of it with a different *locus* in space. In virtual reality we can design that mnemonic space, helping readers to recall it later thanks to the more vivid perception of embodiment that they experienced in VR (Ragan 2010; Krokos et al. 2019). Indeed, software enabling architectural mnemonics already exists for VR (In Formation 2018). VR space can help people visualize the architecture of textual information, visually associating it to locations in space. However, we should note that there is both positive and negative evidence about the role of contextual cues in memory processes: on one hand, contextual visual stimuli help with memory only when we are actively prompted to make associations between text and context (Humphreys & Chalmers 2016; Wälti et al. 2019), as in the case

of architectural mnemonics. On the other hand, our internal states affect our ability to remember longer and more vividly (Ucros 1989). Architectural mnemonics is a very useful design concept that can lead to the design of various architectural spaces in VR – spaces that can be empirically evaluated for whether they seem to enable or disable readers' absorption and ability to recall the story-driven experience.

In the following sections we present initial designs for a VR reading experience for *Alice in Wonderland* with respect to two main aspects: the text and the 3D world in which reader and text are situated.

The text

In a semiotic sense the term 'text' should be used to refer to the whole VR artwork, but here we use it only with reference to the design of the typeset words, i.e. how the words are organized in the 3D space. In printed books the text is organized on pages which are ordered one after the other – with only one or two readable at a time – and modern readers navigate the text using page numbers, an abstract ordering system. In addition, they rely on *recto*/*verso* page orientations and book thickness to remember the location of a certain passage.

Conversely, e-books use position numbers and percentage to offer readers reference points. However, if the reader uses architectural mnemonics, these material features are disregarded, as she will imagine the text as located in places ('loci') that are normally not visually represented on the page – although the case of illustrated books is slightly different. In contrast to this, in VR a 3D world can be visually represented, and its spatial depth used as a reference for navigating the text. That is, if the background 3D world is a garden, we may read about the curious drink that makes Alice close up like a telescope from a paragraph located near the entrance of the garden, whereas the passage about the cake that makes her grow bigger may be located inside a pond. We will say more about the choice of the 3D background in the next section. Now we would like to focus on the disposition in space of the written words.

In terms of readers' embodied experience, VR present an opportunity to investigate questions about the materiality of printed books, such as how the linear sequences ordered in space by the stacking of pages affects memory and absorption. In principle, VR does not require the text to be linearly ordered in virtual space; different kinds of organization can be explored, also taking advantage of VR's 3D space, to bring forth the non-linear dimension of the reading experience. Strictly speaking, printed books and e-books do not enforce a linear reading – this is just one of its design affordances, one that is suggested by some cognitive and cultural schema about stories having a beginning, a middle and an end, and about our aesthetic habit of following the plot development. But reading is not only a linear process; it does not exclusively follow the unfolding of a linear sequence of events. We also sense the rhythm of the sentences, we go back and try to make sense of the words we previously read and connect different elements, refiguring what we learned (Ricoeur 1984). The non-linearity of reading is what allows the emergence of a story-driven experience, a process in which enaction and memory are strongly elicited (Caracciolo

2014). And since we want to prompt the interplay of embodiment and memory precisely to make the story-driven experience more engrossing, working on the non-linear patterns of reading is likely to be an appropriate strategy when designing a VR reading solution.

Placing the words in a 3D space enables forms of textual organization that can be very different from the typeset pages of printed books. It is also different from the interface of e-books read on smartphones and tablets, which enables one to see only small parts of text at a time. Reading on screen, however, allows a fluid typesetting that can be personalized by the reader, changing font and size, and even choosing between tapping and scrolling to see the next chunk of text. In VR, we can have an even more fluid typesetting, with the whole text distributed in space and present at all times, not just accessible through the framing of pages stacked one after the other. This affordance of VR can also aid memory. Seeing the whole text distributed in space enables a reader to associate passages with specific locations.

In a manner of speaking, the text distributed in three-dimensional space can be an opportunity to build the story articulated by the text and locations for particular memories. The ability to map text to more individually distinct locations using VR technologies promises to help readers make connections between different parts of the text, thereby activating inferential processes about story development (Gerrig & O'Brien 2005; Kukkonen 2019). It is also likely to help readers remember passages of the story, since the associations of text and places can trigger suspenseful absorption (Kuzmičová 2016). For instance, a reader at the entrance of the garden can anticipate with a quick look what is in the text, seeing that on her path she will encounter a "Pool of tears", a "Mad tea-party" and the "Queen's croquet-ground". Looking at the pond in the distance she may wonder what will happen when she reaches the text located in that place, and why the text she has in front of her is near a bush, but the text that she will eventually come to read is floating on water. How this affects the reading process and narrative effects more broadly will have to be determined with empirical testing. However, our choice is supported by evidence that maps are an effective tool for the purpose of remembering (Allen 2004) and that there is neurological relation between spatial navigation and episodic memory (Burgess et al. 2002; Solomon et al. 2019).

By emphasizing 3D space as a design element that can aid readers' recall of their experience with *Alice* in VR, we do not want to displace the linearity needed by the plot development altogether; our aim is rather to valorise non-linear reading patterns because they are crucial for the embodied engagement involved in absorbed reading and mnemonic processes. For this reason, we propose a design solution that involves arranging blocks of text grouped in various locations of the 3D space (Figure 4[3]). In this way it is possible to

[3] The paragraphs are arranged in blocks of text located in the 3D world so that the reader is able to see the whole book organized around her. Some parts of the book are not visible in this figure because they are located outside the reader's field of view. This text distribution allows the reader to follow the linear progression of the story one paragraph after the other, as a journey from the lake to the top of the hill, but it also enables non-linear exploration, since it is possible to see the whole text and move to a specific location at will. (Original picture by Ian Dick, CC BY 2.0, flic.kr/p/2hEsPqH)

implement both a linear and a non-linear pattern at the same time: blocks of text that follow each other in the story are arranged in contiguous zones of the 3D space.

The reader will access the VR edition entering the 3D space from a point of view that allows them to see the text distributed in the world all around herself. This choice allows the reader to look at the overall 'architecture' of text and world – getting a sense of their current location in the textual space – and encourages them to remember the blocks of text not just as coming one after the other but also as associated with various locations of the environment. Thus, mnemonic processes can be activated both by the progression of the story (such as emotionally intense events, which are more memorable) and by their relationship with elements of the environment. We hypothesise that seeing oneself situated inside a world with a text will mean the reader is more likely to activate embodied cognitive and affective responses – a sense of presence (Lombard et al. 2015) – that will help to create more intense absorption and consequently stronger memories of the reading experience (cf. Krokos et al. 2019).

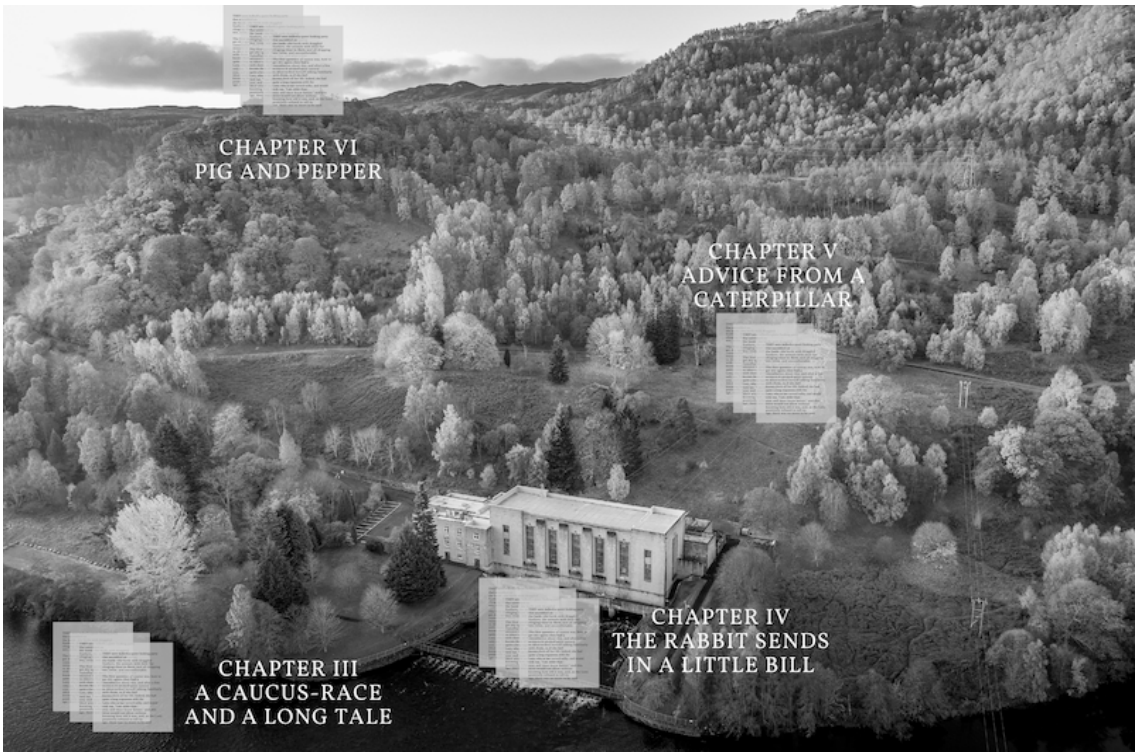

Figure 4. Image representing the reader's initial position when accessing the VR edition of the story

Since in VR the typesetting is no longer bounded by the material structure of the book, the page no longer needs to be the organisational unit of the text: a surface of smaller extent – the paragraph, for instance – will probably be a better fit for the VR medium. There are two main reasons supporting this choice. First, smaller text units are nowadays more familiar for many people, since they are the most common format on social media; thus, having a less intimidating text extension may be more user-friendly for occasional readers (cf. Baron 2015). A second more technical reason concerns VR headsets. Their lenses are

curved and, consequently, only small segments of text displayed in the centre of the field of view remain in focus. To see the text placed outside the focus point clearly, the reader has to move her head (not just her eyes), so that the required part will be seen through the centre of the lens. Accordingly, the best solution seems to be displaying a portion of text on a surface of limited extension, placing it at the appropriate distance to be seen in focus without discomfort (Kreylos 2016).

Reading in VR will require head movements and gestures that are different from those we commonly make when reading printed books. When seated the user will be able to read the block of texts in front of her, moving between paragraphs by swiping with a hand controller. Then she can virtually move to the block of text located in a different zone of the 3D space by pointing at it with the controller. This is not too different from reading a text on a computer monitor or scrolling through a novel on a smartphone. The evolution of the materiality of and our interaction with books is part of our cultural history: in the past, reading scrolls gave way to turning the pages of a printed book.

The 3D world

We designed text distribution in a 3D space with the aim of fostering memory. The 3D world in which the text is placed contributes to such functions as well, but it is also designed to sustain the activation of absorbed reading by providing visual stimuli.

With respect to memory, we presented the process of mental enrichment elicited by the text distribution in space. However, in our concept readers can also add objects and signs of their choice to the 3D world, to make the background more familiar to them, just as they would annotate on paper or use different coloured post-its to bookmark interesting parts of a book. Giving readers the chance to personalize the 3D world is a way of enabling active reading, but another issue has to be also considered, namely deciding what kind of background should be provided in order to further prompt absorption and memory.

In her exploration of the possible benefits of VR for narrative, Marie-Laure Ryan assumes that the 3D world should represent the narrative world, thus concluding that "stories in which landscape and setting feature prominently … benefit from the … increase in spatial immersion" (Ryan 2015, 255). We disagree and think that the 3D world should not represent the story world, because this would provide visual elements that have a strong impact on the reader's attention, making them less engaged with the verbal component of the story (Green et al. 2008). On the other hand, making it completely unrelated to the story does not seem a fruitful option either. Preliminary tests with users revealed that they enjoyed some kind of connection between the background and the story (Pianzola et al. 2019). Therefore, we propose using a 3D background that has some relevant connection with the text.

For *Alice*, a garden may be a good option, since there is a thematic affinity with the story setting. For other kinds of stories, with scenes in very different geographical places or more focused on the psychological processes of the characters, the challenge is to find a suitable 3D world that can valorise the thematic, stylistic and narrative features of the literary work. For instance, for Primo Levi's *The Truce* – recounting a long journey from

Auschwitz to Turin through post-World War II Europe – we could choose to use either a map on which the reader can follow the character's movements, like the one Levi himself had at the beginning of his book, or a more abstract background with different isolated places floating like islands in a dark void. In general, the duty to create an appropriate 3D world in which to place the text will be part of the creative and editorial process of VR literature.

Beside designing the 3D world for increasing readers' absorption, if we are also going to consider the role of embodiment for remembering, in the *Rhetorica ad Herennium* there are some suggestions for how to pick an appropriate background when building an architectural mnemonic. These are suggestions that can be also tested in VR:

> Background *loci* should be well lighted but not glaring; they must not be too much alike but differ enough in form to be clearly distinguishable one from the next; they should be of moderate size and extent, "for when excessively large they render the images vague, and when too small often seem incapable of receiving an arrangement of images" … These backgrounds should be viewed from about thirty feet [nine meters] away, "for, like the external eye, so the inner eye of thought is less powerful when you have moved the object of sight too near or too far away" (III, 19, 32). (Carruthers 2008, 90)

This may be a valuable suggestion for memorizing in general, but we are here concerned with memory in relation to the aesthetic experience of reading literature. In the design process, when making choices concerning the position of the reader in the 3D world, we have to consider their effect on both absorption and memory. One issue to be addressed is whether the distance between the background and the reader's point of view should be the one suggested by the ancient masters of rhetoric, or whether the evolution of narrative forms should be made manifest, thus allowing the reader's point of view in virtual reality to follow the perspective of the characters. The sensorimotor enactment prompted by the way the story is told is very important for narrative absorption: for instance, action verbs and textual cues about characters' perception are more effective than impersonal narration (Speer et al. 2009).

Consider the case of a third-person narrator commenting on the story events (cf. Hühn et al. 2013): "[Alice was saying] 'I shall have to ask them what the name of the country is, you know. Please, Ma'am, is this New Zealand or Australia?' (and she tried to curtsey as she spoke – fancy *curtseying* as you're falling through the air! Do you think you could manage it?)" (Carroll 1866, 5). The background matched with this passage should take into account the style and narrative effects of the text, because they contribute significantly to the story-driven experience that we want readers to remember.

Since the humorous effect relies on the ideological distance between the character and the reader – who is led to acknowledge that Alice is being portrayed as a very playful and unique girl – it may be odd to have a background seen from a short distance, bringing the reader too close to what might be the character's perspective. Hence, in this case, the nine

metre's distance suggested in the *Rhetorica ad Herennium* may be a good option, since it reflects the detachment needed to appreciate the narrator's humour. But consider when the same narrator shifts to the character's focalization: "Alice was not a bit hurt, and she jumped up on to her feet in a moment: she looked up, but it was all dark overhead; before her was another long passage, and the White Rabbit was still in sight, hurrying down it. There was not a moment to be lost: away went Alice like the wind" (Carroll 1866, 7). In this scene the narrator focuses on Alice's self-perception of her own body and adopts her perspective to describe the narrative space around her. Likewise, the sentence "There was not a moment to be lost" is a cue strongly attached to Alice's perspective; it is not just a represented thought – it is unlikely someone would explicitly think this – rather it is the verbalization of the character's perception of urgency and her concurrent bodily activation. In this case, a background seen from a nine-metre distance is not very appropriate, since it may counteract the focalization effect triggered by textual cues.

Having considered the implications of two very different examples, our concept for the virtual 3D space focuses on assessing how VR can help intensify readers' absorption and enhance their ability to recall literary language and the experience elicited by it. The idea that the background should be seen from a distance matching the perspective given by narrative voice and focalization comes from the need not to create cognitive dissonance between the enactment suggested by the words and the physical location of the reader in the 3D world.

It is significant for the activation of absorption to have a variable perspectival distance, so that readers can be prompted to follow the modulation of narrative focalization, sometimes seeing the background from afar and sometimes enacting the character's point of view. This could be achieved by placing the various blocks of text at different distances from the 3D background, based on the main focalization employed in each block of text (Figure 5[4]). This architectural choice enables the reader to see the background world with an aerial perspective (the nine metres suggested by the ancient rhetoricians) when reading some parts of the story. In other cases, she will be able to see the 3D world more closely, alongside the part of text she is reading. This solution allows the deployment of the architectural mnemonic technique with a variable perspectival distance from the background.

[4] On top, the default position, with the background seen from afar (original picture by stillwellmike, CC BY 2.0, flic.kr/p/tzRLMB). On the bottom, the position for those paragraphs in which the narrator adopts character's focalization. The movements of the reader's point of view in VR aim at visually supporting the story enactment elicited by verbal cues focused on the character's perception. To avoid distortions, the distance between the reader and the text will be always the same, so that for the reader there is no perceived change in text size (original picture by Tristan Ferris, CC BY 2.0, flic.kr/p/y3jPyx).

Figure 5. Two frames representing the variable reader's point of view

Conclusion

With the hope of making the experience of reading literature more engrossing for 21st century readers, we have proposed some initial design concepts to be tested in future empirical research. Our choices have been guided by a desire to enhance the embodiment of readers interacting with texts so that the story-driven experience will be better remembered. They have also been guided by a desire to take advantage of the affordances provided by VR to engender more memorable textual experiences. Architectural mnemonics influenced our decisions conceptually and lead to the following choices:

- display paragraphs as basic text unit

- organise paragraphs in blocks of text that are situated in different locations of the 3D world
- place the reader's initial point of view in a position allowing them to see the entirety of the 3D world and the blocks of text distributed in it
- choose a 3D background world not mimetically representing the story setting but having a thematic affinity to it
- place the blocks of text closer to or farther from the background world, according to narrative focalization

We made these choices in order to shape *Alice* into a literary experience in virtual reality that enhances the imaginative and mnemonic experience of those that encounter Carroll's story in virtual space. We hope that our description of how we came to make these choices might be useful to broader discussions about methods for reiterating literary classics in virtual reality and other emerging media, taking advantage of the affordances of technology.

We chose to focus on two very specific aspects – narrative absorption and memory – which do not exemplify the variety of effects that literature can achieve. We provided arguments supporting our decisions and explained the motivations behind the design process. However, we are aware that this is just one of the possibilities offered by VR. In the future, we will proceed in this direction but we will also experiment with alternative solutions to find the best design to boost the power of reading in the era of digital technology.

References

Allen, G. L. (ed.) (2004). *Human Spatial Memory: Remembering Where*, Mahwah: Lawrence Erlbaum Associates.

Amida Gospels. 17th Century. Walters Art Museum. Accessed 7 January 2019. thedigitalwalters.org/Data/WaltersManuscripts/W541/data/W.541/sap/W541_000011_sap.jpg.

Baron, N. S. (2015). *Words Onscreen: The Fate of Reading in a Digital World*, New York: Oxford University Press.

Burgess, N., E. A. Maguire & J. O'Keefe (2002). The human hippocampus and spatial and episodic memory. *Neuron*, 35(4), 625–641.

Busselle, R. & H. Bilandzic (2009). Measuring narrative engagement. *Media Psychology* 12(4), 321–347.

Cahill, L. & J. L. McGaugh (1995). A novel demonstration of enhanced memory associated with emotional arousal. *Consciousness and Cognition* 4(4), 410–421.

Caracciolo, M. (2014). *The Experientiality of Narrative: An Enactivist Approach*, Berlin: de Gruyter.

Carroll, L. (1864). *Alice's Adventures Under Ground*, Manuscript. Oxford. bl.uk/manuscripts/FullDisplay.aspx?ref=Add_MS_46700. Accessed 7 January 2019.

Carroll, L. (1866). *Alice's Adventures in Wonderland*, New York: Appleton.
Carroll, L. (1872). *Through the Looking Glass: And What Alice Found There*, London: Macmillan.
Carruthers, M. (2008). *The Book of Memory: A Study of Memory in Medieval Culture*, Cambridge: Cambridge University Press.
Clark, R. C. & R. E. Mayer (2011). *E-learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*, San Francisco: Pfeiffer.
Dijkstra, K. & L. Post (2015). Mechanisms of embodiment. *Frontiers in Psychology*, 6: 1525.
de Fremery, W. & J. Kim (2019). *To teach, delight, and inspire: Experiences with Kim So-wŏl's Chindallaekkot (Azaleas) as a printed facsimile, printed scholarly edition, web-based reading text, and virtual reality experience*. Unpublished.
ELMCIP (2019). *Electronic literature knowledge base*. Accessed 7 January 2019. elmcip.net/knowledgebase.
ELO (2019). *Electronic literature directory*. Accessed 7 January 2019. directory.eliterature.org.
Gerrig, R. J. & E. J. O'Brien (2005). The scope of memory-based processing. *Discourse Processes*, 39(2–3), 225–242.
Gibson, J. J. (1979). *The Ecological Approach to Visual Perception*, Boston: Houghton Mifflin Harcourt.
Green, M. C., S. Kass, J. Carrey, B. Herzig, R. Feeney & J. Sabini (2008). Transportation across media: Repeated exposure to print and film. *Media Psychology*, 11(4), 512–539.
Hakemulder, F., M. M. Kuijpers, E. S. Tan, K. Bálint & M. M. Doicaru (eds.) (2017). *Narrative Absorption*, Amsterdam: John Benjamins.
Hayles, K. (2008). *Electronic Literature: New Horizons for the Literary*, Notre Dame, IN: University of Notre Dame Press.
Hühn, P., J. C. Meister, J. Pier & W. Schmid (eds.) (2013). *The Living Handbook of Narratology*, Hamburg: Hamburg University Press. Accessed 7 January 2019. lhn.uni-hamburg.de.
In Formation, Inc. (2018). *Loci memory palace*. Accessed 7 January 2019. iform.us/ssite/2018/07/13/loci-memory-palace.
ISO (2019). *Ergonomics of human-system interaction — Part 210: human-centred design for interactive systems (ISO 9241-210:2019)*. Accessed 22 November 2019. iso.org/standard/77520.html.
Kreylos, O. (2016). *Head-mounted displays and lenses*. Accessed 7 January 2019. doc-ok.org/?p=1360.
Krokos, E., C. Plaisant & A. Varshney (2019). Virtual memory palaces: Immersion aids recall. *Virtual Reality*, 23(1), 1–15.
Kuijpers, M. M., F. Hakemulder, E. S. Tan & M. M. Doicaru (2014). Exploring absorbing reading experiences: developing and validating a self-report scale to measure story world absorption. *Scientific Study of Literature*, 4(1), 89–122.
Kukkonen, K. 2020. *Probability Designs: Literature and Predictive Processing*, Oxford:

Oxford University Press.
Kuzmičová, A. (2016). Does it matter where you read? Situating narrative in physical environment. *Communication Theory*, 26(3), 290–308.
Lombard, M., F. Biocca, J. Freeman, W. Ijsselsteijn & R. J. Schaevitz (eds.) (2015). *Immersed in Media: Telepresence Theory, Measurement & Technology*, Cham: Springer.
Macken, B., J. C. Taylor, M. D. Kozlov, R. W. Hughes & D. M. Jones (2016). Memory as embodiment: The case of modality and serial short-term memory. *Cognition*, 155, 113–124.
McCabe, A. & C. Peterson (1990). What makes a narrative memorable? *Applied Psycholinguistics*, 11(1), 73–82.
McNamara, D. S. (ed.) (2007). *Reading Comprehension Strategies: Theories, Interventions, and Technologies*, New York: Lawrence Erlbaum Associates.
Moreno, R. & R. E. Mayer (2002). Learning science in virtual reality multimedia environments: role of methods and media. *Journal of Educational Psychology* 94(3), 598–610.
Pianzola, F., J. Weller & K. Balint (2019). Virtual reality as a tool for promoting reading via enhanced narrative absorption and empathy. *Scientific Study of Literature*, 9(2), 162–193.
Ragan, E. D. (2010). The effects of higher levels of immersion on procedure memorization performance and implications for educational virtual environments. *Presence: Teleoperators and Virtual Environments*, 19(6), 527–543.
Ricoeur, P. (1984). *Time and Narrative*, Chicago: University of Chicago Press.
Roberts, M. N. & A. F. Roberts (1996). Luba art and the making of history. *African Arts*, 29(1), 22–35.
Ryan, M.-L. (2015). *Narrative as Virtual Reality 2: Revisiting Immersion and Interactivity in Literature and Electronic Media*, Baltimore: Johns Hopkins University Press.
Sherlock (2007–2010). TV series. Created by Mark Gatiss and Steven Moffat. BBC.
Solomon, E. A., B. C. Lega, M. R. Sperling & M. J. Kahana (2019). Hippocampal theta codes for distances in semantic and temporal spaces. *Proceedings of the National Academy of Sciences*, November. doi.org/10.1073/pnas.1906729116.
Speer, N. K., J. R. Reynolds, K. M. Swallow & J. M. Zacks (2009). Reading stories activates neural representations of visual and motor experiences. *Psychological Science*, 20(8), 989–999.
Sternberg, M. (1992). Telling in time (II): Chronology, teleology, narrativity. *Poetics Today*, 13(3), 463–541.