AUTOMATIC READING (OBFUSCATION)

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Abstract

During reading, we rapidly construct meaning from sequences of rather cryptic symbols. A multitude of processes are involved in making meaning happen, however, most of them are conveniently tucked away from the reader's conscious experience allowing them to read effortlessly without having to worry about any of the practicalities such as where to place the gaze next and for how long. The present work reflects on the marvelous feat that is reading. In an experiment-like situation, we create a perceptual short-circuit that unlocks the otherwise unconscious processes involved in reading. To this end, the test subject is exposed to a written libretto while a computer tracks their eye movements and

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translates them to sound in real time. The artistic implementation is based on parametric synthesis ("mapping") and model-based sonification.

1. EYE MOVEMENTS IN READING

During reading we move our gaze rapidly from word to word, sometimes skipping a word when it is highly predictable or easy to recognize and sometimes returning to a previous word when it was misrecognized or difficult to understand (see Fig. 1 for an example). These eye movements are separated into *fixations* and *saccades* (Rayner, 1998). Fixations are periods when the eyes stand still (for approx. 250 ms) and during which visual information in sampled. Visual resolution is very high in a small area (2°) in the middle of the visual field (the *fovea*), and that leads to the need to move the eyes: to afford efficient and reliable recognition, the gaze has to be placed precisely on the word that is currently being processed (eye-mind hypothesis, Just, Carpenter, 1980).

Saccades are rapid eye movements whose purpose it is to bring the next word into the fovea when processing of the last word has finished. Saccades are called ballistic because once they are initiated their trajectory cannot be changed.

The recognition of a word can be rapid when the word is highly familiar or when it is short, or it can take considerably longer, when the word is long or unfamiliar. Further, the time it takes to process a word also depends on how it relates to other words in the sentence and the larger text. For instance, the pronoun "it" is easy to recognize but it can be difficult to decide to what "it" is referring to leading to a slowdown.

The sequence of individual saccades creates a complex trajectory through the text — the so-called scanpath. Since no two people understand a text in the exact same way, these scanpaths are characteristically different from person to person — not unlike signatures (von der Malsburg, Vasishth, 2011; von der Malsburg, Kliegl, Vasishth, 2015).

There are a lot more processes involved in making sense of a text and we're only scratching the surface here. However, one thing that is common to all these processes is that they are highly automatic and that we do not consciously experience them. In fact, our conscious experience of how we read a text is usually rather misleading. For example, we do not perceive the violent staccato of the fixations (3–5 per second), we do not perceive the rapid shifts when the gaze jumps from one word to the next, and we do not perceive the uneven resolution across the visual field. Instead, we perceive reading as gliding smoothly through a stable text while images and ideas emerge without any perceived effort. The subjective experience of the reading process is dramatically different, though, for readers with dyslexia which is estimated to affect 3–7% of the population. Finding treatments for dyslexia is an area of intense research.

2. PRESENT WORK

Automatic Reading (Obfuscation) is an artistic work as well as a research project in the spirit of Paul Feyerabend's text Science as an Art. It implements a real-time sonification of eye movements recorded while a test subject is reading a

composed *libretto*. The basis for this libretto is an essay by Jean-Luc Nancy titled *À l'écoute* which was adapted for for the present purpose. Nancy's work is concerned with philosophy, literature, current events, and questions related to aesthetic. It thus offers an interesting opportunity for a poetic extension of the present work. *Automatic Reading (Obfuscation)* is a longer-term undertaking and the current implementation serves as the foundation for a grant proposal that is currently being developed by Bernd Schurer.

The primary focus of this first incarnation is to uncover the hidden complexities of the reading process and to make them accessible to perception. We create an experimental setup, similar to those used in academic reading research. The test subject is exposed to the libretto while their eye movements are recorded with an eye-tracker. Eye movements are then translated to sound and immediately fed back to the reader. As mentioned above, readers have individual reading styles, and this will be reflected in the acoustic rendition. For outside observers, there will be a projection showing the text with the eye movements superimposed in real time. The sonification is expected to interact with the reading process in a feedback loop thus making the reader aware of how difficult reading would be if they had to deal consciously with the mechanics of reading. The system may therefore induce a state not entirely dissimilar to the subjective experience of dyslexic readers.

Fig. 1
Saccadic eye movements during reading
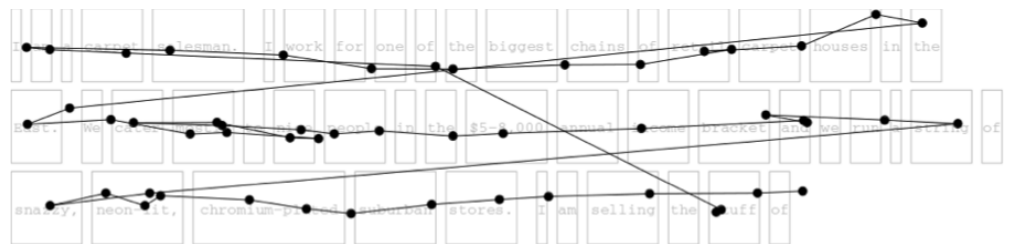
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