1. INTRODUCTION

The viewing position effect (VPE) consists of a systematic variation of word recognition performance as a function of fixation location in the word: with only one fixation in the word, performance is maximal when fixating slightly left from the word centre and decreases when the eyes deviates from this optimal position, producing an inverted U-shaped function (O'Regan, Lévy-Schoen et al. 1984).

Nazir et al. (Nazir, O'Regan et al., 1991; Nazir, Heller et al., 1992; Nazir, Jacobs et al., 1998) have proposed a mathematical model of the VPE function. In this model, word recognition is letter-based. The probability of recognising a word is a function of the independent probabilities of recognising letters. The VPE curve is explained by the process in parallel of letters for which the visibility decreases with retinal eccentricity.

In this model, the presence of a VPE is interpreted as indicating a parallel treatment of the letters in the word. In fact, the VPE is present after a few month of learning to read (Aghababian and Nazir, 2000). However, although the VPE curve is present after a few month of learning to read, the height of the curves is affected by the length of the words in young children. This length effect disappears in the 4th or 5th grade and is interpreted in terms of a progressive coupling between visual information and lexical knowledge.

VPE function estimation seems thus to be a powerful tool to evaluate visual word recognition, the links with lexical knowledge, and its deficits (yet used in single case studies with a deaf beginning reader, see Aghababian, Nazir et al. 2001 and a pure alexic patient, see Montant, Nazir et al. 1998).
2. **Case Report**

MT is a right-handed French-speaking boy, who was 13;8 years old at the time of the testing. His IQ was above normal (Total IQ : 130). His reading level corresponds to a 5th grade.

**Reading and writing:**

His reading and writing performance are typical of developmental surface dyslexia/dysgraphia:

- significant deficit in reading/writing irregular words compared to pseudowords ;
- majority of regularisation errors in reading, but also visual confusions ;
- majority of phonologically plausible errors in writing ;
- rejection of irregular words and acceptance of pseudo-homophones in a lexical decision task.

All the data converge to a deficit in developping an orthographical lexicon.

**Other cognitive components:**

Neither metaphonological (assessed by means of acronyms, rhyme judgement ...) nor phonological working memory (assessed by means of words, pseudowords and digits spans) deficit were found.

Also, his performance was normal in visual and verbal long term memory.
3. **Viewing Position Effect**

Visual word recognition performance of MT was investigated using an experimental technique known to elicit the VPE in normal readers.

The viewing position effect is elicited with a simple experimental paradigm. After a fixation point, words are briefly displayed (with a maximum presentation time of 200 ms to avoid ocular movements), with the different letters positions in the word having the same probability to be presented at the fixation point (see Fig. 1).

**Subjects** – 15 chronological age matched control subjects

**Materials** - The experimental stimuli were 192 French words (80 of 5 letters and 112 words of 7 letters).

**Design** – Each letter of the word was designated as a potential initial fixation position. In consequence, 5 groups of 16 five-letters words and 7 groups of seven-letters words were constituted. Each group was randomly assigned to one initial fixation position.

**Procedure** – The time of presentation was adapted for each subject and each length in repeated sessions of practice trials in order to have correct responses percentage above 50%. Words were preceded by a fixation point and followed by a mask.

![Figure 1. Viewing Position effect paradigm](From O'Regan, Lévy-Schoen *et al.*, 1984)
**Results**

Presentation time:
- 5 letters: 166 ms; control mean: 69.67 (±20)
- 7 letters: 199 ms; control mean: 72.93 (±24.14)

- **VPE**: Both control subjects and MT present a VPE.

- **Length Effect**: Contrary to control subjects, MT presents a clear length effect, both in word accuracy and presentation time. This effect is interpreting as showing *a difficulty to link visual information with lexical knowledge*. It is coherent with MT surface dyslexia pattern.

- **Shape**: MT don’t show the classical inverted-U shaped curve, but a more narrowed curve (inverted V shaped curve). This type of curve was observed only for poor beginning readers and interpreted as reflecting *a reduced visual span* (Aghababian and Nazir 2000): i.e. the region around the point of fixation within which characters are resolved.

MT seems to process letters in parallel. However, this processing takes more time than chronologically age-matched controls. His performance don’t benefit from lexical knowledge, as attended with a deficit in creating orthographical representations. Also, his visual span seems to be narrowed, which causes limitations in the number of letters processed in parallel.
4. **VISUAL SPAN**

The visual span is defined as the region around the point of fixation within which characters of a given size can be resolved (Legge, Mansfield *et al.*, 2001). The boundary of the visual span indicates the horizontal retinal eccentricity at which letters are no longer recognizable in reading. In order to test more directly the visual span and to avoid the impact of lexical knowledge, MT was assessed with paradigm adapted from Legge, Mansfield *et al.* (2001).

**Subjects** – 3 chronological age-matched control subjects.

**Design** – 270 trigrams were presented, at 15 different horizontal eccentricities. Two times of presentation were used: 83 and 166 ms. One control subject realised the experiment with the two times of presentation, the two others with only one. Trigrams were preceded by a central fixation point and followed by a mask.

In order to characterise the span, plots of letter-recognition accuracy versus horizontal letter position were fitted with split Gaussians (see figure 3), with three parameters: amplitude, and the standard deviations of the left and right sides. All the curve fits accounted for 83-96% of the variance.

**Results** – MT shows a significant reduction of both sides for both presentation times. His visual span is well narrowed.

![Figure 3. Effect of eccentricity. Trigram recognition data for group average. Letter recognition accuracy is plotted as a function of letter position left or right of the midline.](image-url)
5. **LINKING VISUAL SPAN AND VIEWING POSITION EFFECT CURVE**

The classical explanation of MT inverted-V-shaped VPE curve is a reduction in visual span. By consequence, the visual span estimation for MT at 166 ms (the 5 letter words presentation mean time for MT in VPE experiment) should be significantly reduced in comparison with the control subjects span at 83 ms (approximatively corresponding to the 5 letter words mean presentation time for the control group in VPE experiment). It is not the case. There is no significant difference between MT and control subjects visual span.

![Excentricity curves](image)

**Conclusion**

In contrary to Nazir's predictions (Aghababian and Nazir, 2000), the reduced visual span of MT can not account for his abnormal VPE performance.


