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RESEARCH ARTICLE

TYPOGRAPHICAL OPTIMIZATION VIA THE RECORDING OF EYE MOVEMENTS DURING READING ARABIC IN PRIMARY SCHOOL

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ABSTRACT

The school learning requires initially, a visual strategy in the process of information treatment. However, the elements that make up writing are seldom consistent with the reader's optimal visual capabilities, which may interfere with vision or causing in the long run 'an vision problem'. The study consists in solving experimentally "the constraints that may arise by Arabic typography (orientation 'right to left). We assume that the quality of language comprehension is enhanced when the writing is best perceived in terms of graphics]. Thanks to the photoelectric method, eye movement recording was carried out on the sample of 160 pupils attending the second primary level. Four different tasks (body, spacing, space, justification) were applied to childrensubdivided into groups. The results demonstrate: the impact of typographical aspects of readability and the strong correlation existing between: ″changes in ocular parameters and typographic patterns″ during reading. They also detect optimal elements enabling efficient reading. Furthermore, they point to a ″progress in values according to school level and age. We consequently, suggest that the experiences object of the eye movement recording through the reading process: can constitute diagnostic to any attempt of standardization of "physical or semantic aspect" of the text that willimprove educational performance

INTRODUCTION

In view to approve the connection between the visual strategy performance and physical qualitative aspect of word processing, the emphasis is put on typographic display through the reading process. Dieter (1986) puts forward that text physical aspects have an impact on the functioning of the oculomotor system and undertake, hence, a fundamental role in legibility. The functional coherence go through page layout of a writing style that is easy to apprehend visually. After an overview on textbooks, it is determined that writing is not standardized on a rational basis adapted to visual communication (Hamm, 1975). This affects language processing mode, and causes discomfort while reading. The need to adjust the oculomotor responses according to appropriate typographical elements of writing will be our goal. We have conducted an experimental study on groups of children attending the second phase primary school, who had already have access to the rudimentary lexical factors known as' stability phase (Bensoltana and Asselah, 2005-2013). We attempt to examine the impact of changes in typographic elements in Arabic language on saccadic eye movements according to three school levels: Models of reading are closely connected to phases detected during the learning process (Murray and Al, 1988). There is an age control amongst children according to the different reached phases (Laving, 1997).

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The study aims to

1. Highlight the valuable role of the oculomotor system in the printing model, its role in detecting effects induced by the variables having a physical sensor motor interface and to detect, through a comparative study, values that allow maximum efficiency.
2. Determine, through a comparative study conducted amongst groups of pupils whose school level varies, the synchronic evolution of the mechanisms modulating the vision according to typographical grain.

The results reveal the inter-reliant correlation between the visual cognitive perception, the functioning of the oculomotor system and the medium containing the text, and thus validate that photoelectric method has a valuable utility for typographical standardization.

MATERIALS AND METHODS

Principle of photoelectric technique (corneal reflection)

The technique used in our work allows to clearly following the spatial and temporal waning of the gaze (Baccino, 1997). It is a tool permitting the capture of light variations (Fig.1). The projection on the border of the iris of a constant light beam enables us to track the behavior of the eye: the reflected intensity of light is in direct proportion to the angle of the eye rotation.

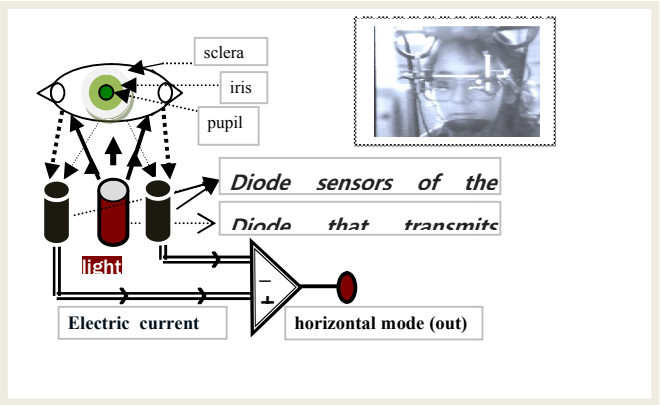

Figure 1. Device based on corneal reflection {method of light reflected}

Operating mode

The recording was carried out amongst a sample of 160 pupils (divided into 08 sub-groups of 10 persons each) enrolled in (the fourth, fifth, and sixth) school years and are, respectively, often, eleven, and twelve years old. The selection of the pupils was on the basis of two tests: the visual acuity test, and lateralization. Only children with good visual acuity [10/10] were selected. The test of lateralization enabled us to limit the sample to right-handed children in view to ensure certain homogeneity of the photoelectric recordings. Each group performs, randomly, a reading task according to the requested variation: [body - spacing - spacing - length (justification)] according to the flowchart (Fig. 2). The training text is read by all the pupils.

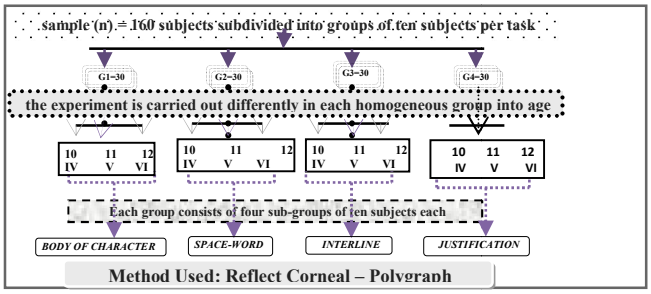

Figure 2. (flowchart): distribution of the typographic tasks – school level

Analysis of Oculogramm

While reading, our gaze achieves a fast but efficient exploration throughout the text. Passage from one line to another does not disturb the process of interpreting graphic symbols or that allow the understanding of their meaning. This is a high proprioceptive motor performance (Levy-Schoen, 1969). The visual motor responses during a text processing are translated by saccades. The qualitative aspect of oculogramms is characteristic of a horizontal text scan from right to left (Fig. 3) an extract our the study and oculogram compared in reverse (Fig. 4).

RESULT

Amongst the studied parameters, we shall prove one parameter only, namely: reading duration per line, and establish a comparison of the obtained averages. Values by school level of each group according to each task are collected in each table and represented in graphs.

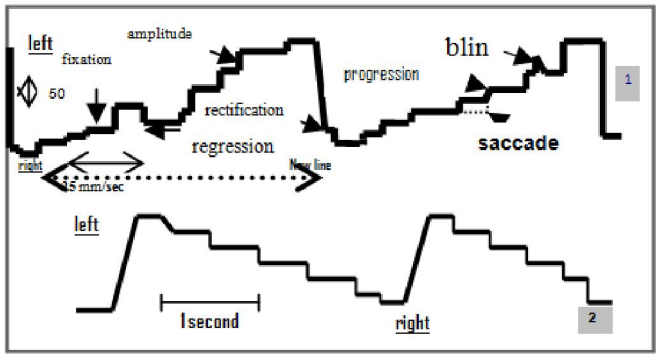

Figure 3. Oculograms models: 1 - reading a text in Arabic 2 - reading a text in Latin

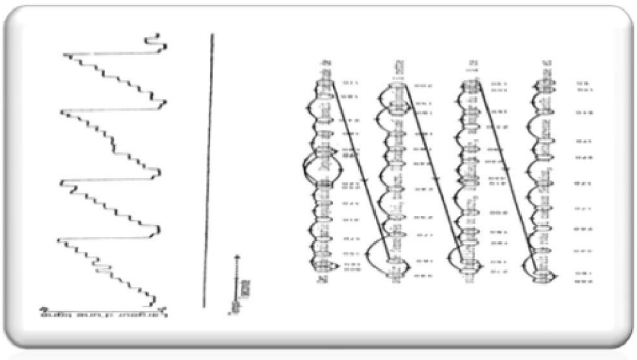

Figure 4. Oculogram in Latin progressing in opposite direction (O'Regan and Levy-Schoen 1983)

2.1- Tables (1, 2, 3, 4) combining the averages depending of the four typographical factors:

2.2 - Graphical (Fig.5(a,b,c,d)) representation of the averages, from the influence of the four typographical variables on the ocular parameter duration of reading per line (second / line s/l).
Observation: The important feature noticed in all diagrams is the rising shape of the four curves that are those are stacked according to the school level (validated in our study).

Table 5. Optimum obtained in three school levels depending on typographical factor (value/reference)

Parameters level /Year	body		space		Interligne		Lenght	
	value	norm	value	norm	value	norm	value	norm
IV/(10)	6.52	25	7.45	0.3	5.82	1.4	4.36	10
V/ (11)	4.39	25	5.84	0.9	5.05	1.4	2.95	10
VI/(12)	4.23	25	4.19	0.9	4.86	1	2.64	10

Table 6. Comparison and decision over optimums of model of three levels

Variable Optimum	Body	Space	Interline	Lenght
	point	cm	cm	cm
optimum obtened	25	0.9	1.4	10
optimum suggested	22	0.5	1.4	12.5

Values Optimization

A- Selection and elaboration of optimums: We have detected the optimal values, with a maximum efficiency, for each

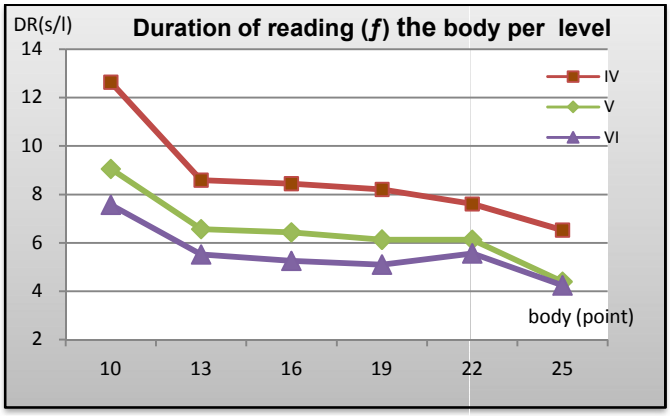

Figure 5a. Variation of the reading time depending on body

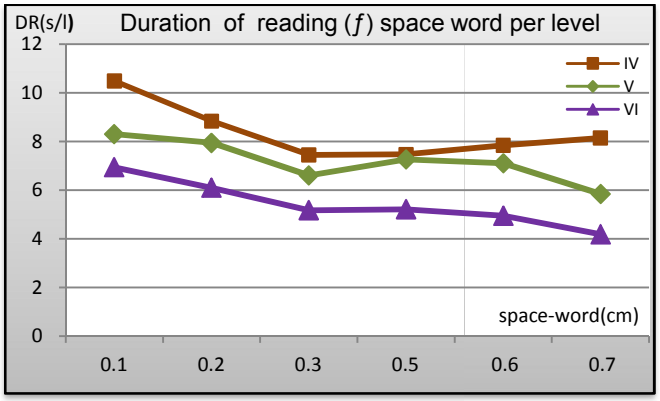

Figure 5b. Variation of the reading time depending on inter-word space

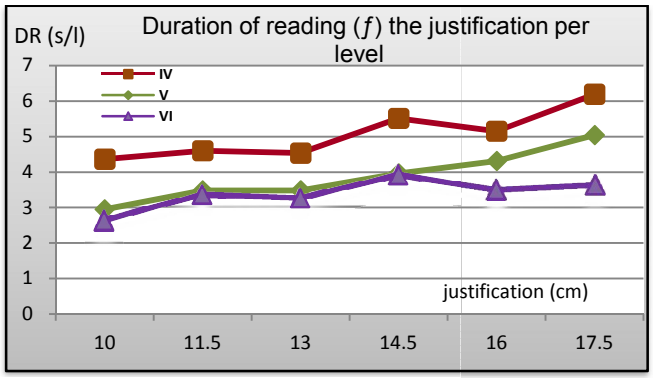

Figure 5c. Variation of the time of reading on justification

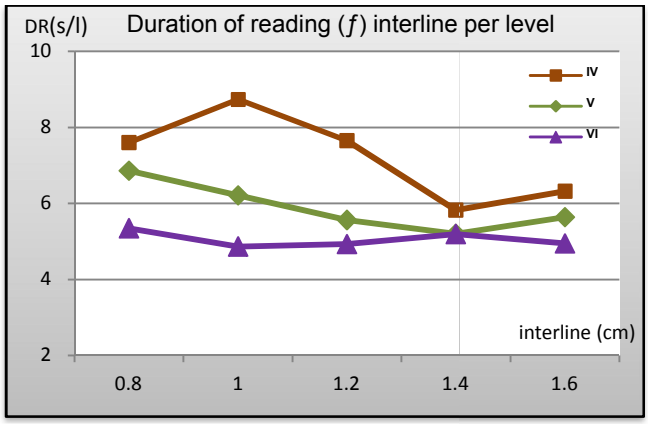

Figure 5d. Variation of the time of reading depending on interline

variable and are illustrated in (Table 5). Moreover; after comparison and reflection down minimum values selected: our choice fell on the optimum identified (Table 6). Comment: the Table (6) below illustrates the optimums: progress recorded from a class to another is demonstrated, alongside with the decrease in typographical grain and the progress in reading. That convinces of the fact that the oculomotor system is modeled according to the standardization of writing. In effect; we have created of a model as a test "suitable {for the three levels}, from sélectionned standards and applying the values suggested.

DISCUSSION

The four variables carried up should be considered as physical aspects influencing the "visual strategy". Their standardization for the obtained optimal values facilitates the acquisition of the vocabulary. Nevertheless, in view of the complexity of the aspects involved in reading and the high visual accuracy, it is necessary to make a variety of combinations in order to achieve the conforming standards that create conventional models. We shall define and comment respectively factors typographical used in the study:

Role of body character

Amongst children, "the mistakes made during reading disappeared in the texts of large size". Children therefore opt to large sizes (Association, 2001). The child has certainly a "powerful visual acuity," yet the problem is "the lack of education of the sensor motor system ", which does develop as training is underway. The body has little influence on eye movements (Richaudeau, 1976). While, Dieter (1986) determines the opposite. Javel (1905), for his part, links typographical factors to visibility instead of readability and suggests that a better lighting with a strong intensity on the part of reading compensates for the lack of visibility. We offer to solve the problem upon our theory: normalization of the body combined to the visual response. This points out, in particular, a long-term critical anomaly that threatens any intellectual:"the presbyopia".

Role of spaces between words

Spaces between words are certainly critical index of word position, the beginning and the end of 'sentences and paragraphs' (Abrams and Zuber, 1972). Reading speed numbered in words/min is lower by about 20% for filleds paces and 90% for texts without spacing (Spragins and Al. 1976). Changing the space between word scan, however, affect the readability surrounding these spaces and this may complicate more or less their knowledge (Dieter, 1986). The variation of the space does not change the typographic grain but rather affects the amplitude (O'Regan and Levy-Schoen, 1983).

Role of the line-spacing

The spaces between lines are highly variable in their relating proportions. In Arabic exclusively, spacing obeys two versions: - If the text is not vocalized: Interline is reduced and the processing occurs at high level (memory).

- If the text is vocalized: interline is compact which results in a visual perceptual load in the visual field because of the diacritical points, the 'vowels and the tanwin' superimposed to the consonants from above and below "and set between lines. According to western researchers (Richaudeau, 1976), (O'Regan and Levy-Schoen, 1983), (Tinker and Paterson, 1955) there is a negative effect for compact line-spacing.

Role of Justification

When the lines are long, it is not possible to neglect the difference between the length of the perpendicular drawn from the eye to the paper and the oblique ones that go from the eye, at the beginning and end of lines (Lamare, 1982). The accommodations resulting from reading are all the more important that the lines are long. It is likely that changes in accommodation occur synchronically with the jerks in the interest of the myopic. The use of books with large justification (harmful for myopic) canal so be detrimental to the farsighted, predisposing them to squint. The line length has a significant influence on the characteristics of eye movements (Richaudeau, 1976). Thus, and according to the results we obtained, optimizing the lines reduces ocular fatigue. Our results suggest that "the structural aspects (sensory stimuli) like the word size, the location of spaces between words, spacing, and justification" are the causes of the effects on eye movements and require, on the typographic plan, a normalization of the graphitic aspects. The recording of eye movements is a valuable option to address typographical variability (Dieter, 1986). This confirms the hypothesis called "immediate control" according to which the gaze doesn't not leaves a word only when its processing is achieved, cited in (Kapoula, 1986). Reading difficulties in language are found in the way it is presented. We assume, in fact, that conventional models should be determined from typographical elements adapted to the perception that best meet the visual activity given that it is the basis of the collection of information. Hamm (1975) insists to persuade that the function of typography is that it is "an important tool for visual communication". Any changes that have been developed in printing in view to solving the problems facing the typography of Arabic language have not highlighted "experiences related to the study of eye movement recording to verify and validate their suggestions ". This seems to be an opportunistic approach to consolidate the results.

Conclusion

Despite the high plasticity of the oculomotor system, poor conditions of processing can lead in, more or less, short term to a lesser efficiency, even without apparent manifestation of a perceptual discomfort. To avoid this anomaly, our study aims, with the various factors involved in the experiment, at achieving an overall harmony of the processing. If the eyes perform fast uncoordinated movements; they would have a particular tiredness "asthenopia" (Lamare, 1982). Efforts should therefore be focused on the writing method that is the aim of the school exercise, and this one must be conducted in conjunction with the text comprehension". We, consequently, managed to detect the resulting optimal values of the comparison between the three school levels, and have confirmed that: "Typography plays a major role in readability and proves to be a significant perceptual aspect of the educational plan". The Typographical elements adapted to visual capacity support lexical access and increases visual performance. We suggest that corrections can be tested and validated on the basis of visual experimental data: given the precious role of eyes in the information processing. We, hence, introduce an important argument for the study of improving the typography of the Arabic language (Meynet, 1971) «the technical study on recording oculomotor responses». The need to inform the academic side to looks into this rational point is requested.

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