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Introduction

There are three curious little facts about design and reading research. Reading is one of the most complex skills that humans acquire, and yet in time it becomes automatic and so deeply ingrained that one cannot turn it off, except maybe if one is a type designer. The first paradox is that the people in charge of designing what everyone reads are the ones who are more likely to judge the serifs on a newspaper headline than to actually read what the text says.

The second paradox is that the research work related to reading and legibility is one where type designers are usually not involved¹. The third paradox is that type designers have been successfully designing type for 5 centuries², and yet the striking majority has had no contact with reading research.

So, when a designer embarks on reading and legibility research, the approach is somehow different. Designers research not only because they want to know, but also because they need to know. Because design is what they are and what they do all day.

The world of Arabic typography has been a rocky one with very uneven terrain. The script is complex and technology was no friend. The transition of manuscript to typographic forms has resulted in what calligraphers see as misshapen forms. Now that technology has taken a favorable turn, and it is possible to go back to manuscript forms, what will the type designer do?

To be an Arabic type designer is to know very little about reading in Arabic or about the legibility of Arabic typefaces. The subjective instincts are there, but the science is not. It is not enough to rely on instinct, for many type designers today have very different opinions on what makes a more legible Arabic typeface. One needs to be able to answer questions, with full conviction, and based on objective results rather than subjective preferences. It is possible to design aesthetically pleasing typefaces in any of the styles in use today, so this is not an issue of beauty of form, but is one of function. Which style is making the reading of long text easier? That is the main consideration.

Dissertation Aims

This dissertation adopts a holistic approach to the question of typeface legibility that takes in the process of reading, the role of the reader, the visual characteristics of text, as well as the typographic visual culture within which reading takes place. Though there is a tendency by both designers and linguists to approach the question

¹ This situation starts to change, and the recent years have seen a shift towards more collaboration between designers and psychologists.

² This is more applicable to Latin rather than Arabic type design.

of reading from their own angle of specialty and to isolate variables, and one really needs to do that in order to test their influence, there is much to be gained in studying the dynamics of the relationships of these different factors.

To that extent, this paper will look at the Arabic script in context, its cultural ties, its anatomy, and the many styles of Arabic calligraphy. It will explore the typographic repertoire today to try to come to an understanding as to why Arabic typefaces look the way they do, and why is it that there are these varying degrees of complexity in typefaces meant for long reading. It questions what has shaped the evolution of Arabic typography, and how these factors changed over time.

And to examine the other side of the coin, the paper moves on to review the studies exploring how reading works, how the eyes move during reading, and the different models of the mechanisms that control this. From this base, a new definition of legibility is proposed, one that marries the reader and the visual. It offers evidence of what constitutes a more legible design, as well as the time frame through which legibility effects come to play. To complete the background picture, it continues with a review of Arabic reading and legibility studies. Whether it is eye movement or which part of the brain is active, reading Arabic is special.

With that picture in the background, we then move to the foreground to investigate the characteristics of eye movement while reading Arabic and the marks of a legible design. This in turn brings us into the heart of this research.

Key Questions

Building on a research base that encompasses design, language, and education, the dissertation is concerned with these key questions:

**How does the complexity of word formation affect reading speed in Arabic?
What role do the short vowels play?**

Their Significance

The issue of complexity is one that comes up when addressing the transition of manuscript to typographic forms of Naskh, the style that is most commonly used for long text. It also comes up under the name of orthographic complexity when linguists research the process of reading Arabic. It even shows up when neurologists investigate brain activity during the reading of Arabic text. The issue of vowels is related to the way Arabic text is written, and the fact that the short vowels are not usually displayed. This leads to a situation where one needs to know what one is reading, in order to be able to read. When seen against the background of low literacy rates, the absence of reading as a national pastime, and within a larger frame of a region in continuous turmoil, it is, then, an issue worth exploring.

The whole point of the exercise is to come to design and educational recommendations that enable the presentation of Arabic long texts, as in books, magazines, and newspapers, in the easiest way to read possible. The research is not only born out of curiosity and academic inquisitiveness. Rather, it is driven by an earnest desire to promote reading as a culture. If people read more, would they fight less?

Design is not merely a job. It is not something that one can stop doing because it is a state of being rather than a task to be done. It is the way one processes visual

information, of any kind. It is a filter that is very hard to turn off. The only question that remains then, is the designer willing to be actively engaged within his or her larger context? To be a citizen as well as a designer?

These are questions related to the motivation of individual designers, but this paper still functions just as well when viewed from a pure academic angle. The significance in the study stems from several factors. One, it offers a new holistic definition of legibility that unites reading research with typographic features. Two, this is the first comprehensive study dealing with Arabic typeface legibility. Three, it reports statistically significant results that can form the basis for design recommendations for setting Arabic texts. Finally, it brings a new approach to legibility studies.

The fourth factor adds a layer of importance to the study that is of a more subtle nature. This is one of the few studies into legibility that has been carried out by a type designer. It is also one where the actual testing did not take place inside the walls of a lab, but rather in the schoolrooms of Beirut. It is then an instance where a designer crosses over into the realm of psycholinguistics, and takes the research questions on site to readers in their daily context. In that respect, it is hoped that such an approach would encourage other designers to collaborate with psycholinguists in order to create research environments that are fully comprehensive in the way they address the question of reading.

Thesis Statement

In terms of expectations, the dissertation lays the theoretical framework followed by practical research to defend the thesis statement that the complexity of word formation in the Arabic script (as can be seen in the different typographic interpretations of the Naskh style) increases the cognitive load needed for word processing and therefore has a negative effect on legibility.

The presence of vocalization marks removes ambiguity and therefore can be expected to decrease the number of regressions. The research is interested in what sort of effect the presence or omission of vowels has on reading measures, but the thesis does not make a predictive statement as to the value of that effect.

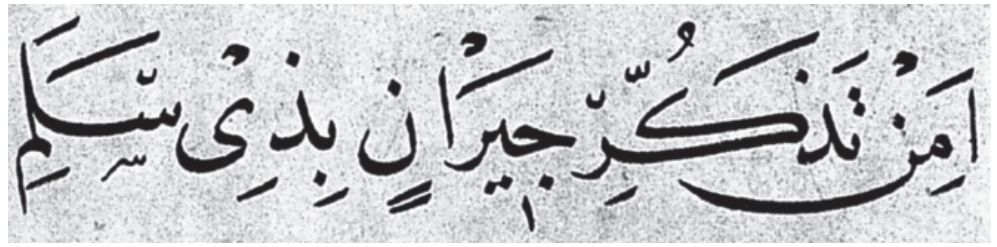
Brief Outline of the Dissertation's Structure

This dissertation is based on a spiral form. It draws a painting with an overarching narrative that starts at the outer extremes and loops in to culminate at the heart of the paper. It paints with large brushstrokes, and the details get finer as it goes into the center. The overall structure is quite simple to follow.

Chapter 1 is an introductory text to the Arabic script, its origins, and its characteristics. It analyzes its basic elements and ties it in with its larger cultural setting. As one will read often in this paper and in other sources, the Arabic script is quite complex. This chapter tries to demystify it.

Chapter 2 dives into the anatomy of the Arabic script. It starts with a brief overview of the Arabic calligraphic styles used in the setting of long texts and then on to printing and the transition of manuscript forms into typographic ones. The chapter then expands into a study of the different alignment zones that one can find in manuscript Naskh styles and moves on to investigate the different typographic interpretations of the Naskh style. The anatomical study continues with the structural

Fig. 0.1 An Ottoman manuscript (1) served as the point of reference for the design of Afandem (2), which was designed in 3 different styles: Simplified (3), Traditional (4), and Dynamic (5).



1

امِنْ تَذَكُّرٍ جِرَانٍ بِذِي سَلَمٍ

2

زَعَمُوا أَنْ غَدِيرًا كَانَ فِيهِ ثَلَاثُ سَمَكَاتٍ

3

زَعَمُوا أَنْ غَدِيرًا كَانَ فِيهِ ثَلَاثُ سَمَكَاتٍ

4

زَعَمُوا أَنْ غَدِيرًا كَانَ فِيهِ ثَلَاثُ سَمَكَاتٍ

5

comparisons of the popular typographic styles and then zooms in on the details of letter anatomy and the relationship of body parts across the different letterforms.

Moreover, to understand how all of these elements affect the rhythm of Arabic texts, we look at how letters change their shape within different positions in a any given word, as well as the frequency of letter usage in the Arabic language. The aim here is to dissect the Arabic script in order to understand how it is built, and what set of rules govern its internal relationships.

Chapter 3 goes more in detail into the state of Arabic typography today. It is an exploration of the predominant typographic styles that one finds in the Middle East today. The point to make by this point is why Arabic typefaces look the way they do, and how this forms the visual culture in which this study takes place. For how can we investigate reading and legibility, if we do not look at what people are used to reading in the first place?

Chapter 4 continues that thread with the documentation of the design process of Afandem, a typeface system designed by this researcher for the express purposes

of legibility testing. The typeface system is a family of three variants of the Naskh style in Simplified, Traditional, and Dynamic versions (Fig. 0.1). These are specifically designed to be used in the legibility studies, and are in direct reference to the styles of Naskh typefaces available on the market today.

Chapter 5 marks a break in the narrative. Up to this point, the focus had been on Arabic typographic design and its evolution. This chapter marks the cross over into psycholinguistics. It is a literature review of eye movement research and typeface legibility studies. It starts with a look at the mechanics of eye movement in reading: the stops, the jumps, and what characterizes them. It explores questions of how much text the eyes can see with every new jump, both in overt and covert attention. The chapter then moves on to different factors that can affect reading: the age and reading skill of the reader, and the many facets of the language that the text is in. It also tackles the question of eye movement control, which is in essence the question of where and when to move the eyes. This leads to the discussion of the various reading models proposed.

Chapter 5 then moves on to the effects of the visual characteristics of text on reading, and an examination of text as a pattern and the features in letter identification. This then brings us finally to the effects of the legibility of type. For this, the dissertation offers a new definition of legibility, as well as a review of how to measure it. To be able to offer a holistic definition what legibility is, the chapter expands into the realms of letter and word identification, crowding, and letter vs. word superiority. It builds on to address how typographic variables affect legibility and to review some of the findings related to that effect.

Chapter 5 is possibly the most important one in this dissertation. Would one be able to design a car without knowing how a car works? Type designers have been designing typefaces for centuries with very little exposure to reading research. Still, at this day and age, and given all the advancement in neuropsychology and psycholinguistic research, it seems only natural for design to meet science. The interaction can only benefit both domains. This is the reason why the proposed legibility definition, which deals mainly with the visual characteristics of text, is built on the foundations of reading research.

Chapter 6 is concerned with the Arabic reading and legibility studies. To understand how the Arabic language works, one has to study its morphology and orthography. This chapter expands on that and also offers a review of the findings related to the reading of Arabic. To that effect, it deals with the nature of spoken and written Arabic, the process of learning to read Arabic, and the effect of morphology, orthography, and vowels on reading. This chapter also expands into eye movement and brain activity during the reading of Arabic. The review of studies dealing with the legibility of Arabic typefaces is short as there are so few to go over, but this only highlights the importance of this research.

Chapter 7 is the beating heart of this dissertation. It is dedicated to the experiment, its set up, hypothesis, method and design, and the variables being tested. The results are presented and descriptive and inferential statistics are reported. These are cited per independent variable: reading time, average fixation durations, total number of fixations, total number of regressions, and the averages of forward and regressive saccades. The discussion revolves around the effects of text style, age of reader, and presence of vocalization on the reading measures listed above.

As it is with the living organisms in possession of a beating heart, take that away and the organism dies. However, the heart alone does not make a living organism. The value of design and research is best viewed within the larger context they aim to serve and within which they actively operate.

This is how the spiral loops in.

