Nadine Chahine

Reading Arabic

Legibility Studies for the Arabic Script
What is the cost of visual complexity? This dissertation sets out to determine the effect of the complexity of word formation on the legibility of Arabic and the role that vocalization plays in reading. This is carried out via a holistic approach to legibility research that combines the visual culture with eye movement in reading and legibility studies.

To do this it looks at the transition of Arabic manuscript letterforms into typographic ones, the anatomy of the Arabic script, and the predominant typographic styles in use today. It presents the design process of the specially designed Afandem typeface family, a review of eye movement findings, and a new definition of legibility that is rooted in the models of eye movement. The experiment used eye tracking to test 72 subjects in Beirut to determine the effect of the complexity and vocalization on reading measures. These results are discussed within the scope of the Arab world today, its cultural and educational setup, and avenues for further research are explored.

Leiden University 2012
Reading Arabic
Legibility Studies for the Arabic Script

Proefschrift

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van Rector Magnificus Prof. Mr. P.F. van der Heijden,
volgens besluit van het College voor Promoties

te verdedigen op Donderdag 25 oktober 2012
klokke 11:15 uur

door

Nadine Chahine
geboren te Beiroet (Lebanon)
in 1978
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Acknowledgements

This research would not have been possible without the kind support of many individuals to whom I will always be in debt. I will be forever grateful to Prof. Gerard Unger who was the first to get me interested in legibility studies and who supervised this research; to Dr. Kevin Linson who made it possible for me to put a psycholinguist's hat on and take on experiment design and legibility research; to Dr. Keith Rayner who offered invaluable insights on eye movement data analysis and who also served on my reading committee; to Dr. Arnold Veltkamp and Dr. Petra Sijpsteijn for their helpful feedback; to my reading committee; to Prof. Frans de Wilter for the research support; to Samir Sayegh who inspired my love for Arabic typography in 1998 and who has been my mentor ever since; to Rawda High School and the Makkasid School Network (the schools: Khadija al-Kubra, Khalid bin al-Walid, Ali bin Abi Talib, Omar bin al-Khattab) and its faculty for giving access to their students, their support with the testing, and the advice on grammatical issues related to the test material; to Emile Yacoub for advice on test material selection; to my colleagues at Linotype and Monotype Imaging for all the support during these five years; to Frank Wildenberg for allowing me to switch to part-time work in order to start the PhD research; to Jörg Schweinsberg for giving me the space and time off needed to bring this research to an end and for agreeing to be my paronym; to Roswitha Ziegler for the support with flexible hours; to Attila Korap for his support in automated data compilation; to Jan Middendorp for the Dutch translation; to my family and friends without whom I could not have done this and especially to my dad and his wife Iman for all the support through the school testing period; to my sister Nataša for the editing of the dissertation; to my sister Tania for her support on the big day; to Giulia Conforti for her continuous support and for agreeing to be my paronym; to Samir Maakaron and Tarek Ariosi for the support and design feedback; to Ann Bovemsans who was a friend and a classmate to share the good and the bad with; to my friends and followers on Facebook and Twitter for the amazing and heartwarming messages of support; and finally to my late cat Mia, who sat by my side for every single hour of my studies, for 4 of my 5 PhD years.
Glossary

Design terms

Axis: The central axis around which letters are built.

Contrast: The difference between the thinnest and thickest parts of characters.

Leading: The space between two lines of text.

Modulation: The changing thickness of a letter stroke.

Naskh: It is a small script that is characterized by an even distribution of round and straight elements and is quite clear to read and fast to write. Naskh is Arabic for the word copy.

Optical size: How large the typeface appears. In Latin, this is usually indicated by the relation of the x-height to the capitals. The larger the x-height, the larger the optical size is perceived to be.

Spacing: How far or how close the letters sit in relation to one another.

Terminal treatment: How the ending of letter strokes are drawn.

Weight: How heavy the typeface is.

Width: The horizontal proportion of a typeface. This could vary from normal to condensed or extended.

Psychology terms

All definitions are taken from the Penguin Dictionary of Psychology (Reber, Allen, & Reber, 2009).

Analysis of variance: "A statistical method for making simultaneous comparisons between two or more means. An ANOVA yields a series of values (F values) which can be statistically tested to determine whether a significant relation exists between the experimental values."

Between-subjects design: "A research design in which different groups of subjects are run under different conditions."

Confound: "In experimental work, to fail to separate two variables with the result that their effects cannot be independently ascertained. If in an experiment on memory and age all the older participants are female and all the young are male, then the sex and age are "confounded" and the memory data cannot be properly interpreted."

A Note Regarding Spelling and References

Parts of this dissertation are planned to be submitted to American psychology journals for publication. Because of that, the dissertation follows US English spelling and the reference guidelines and bibliography follow APA (American Psychological Association) guidelines.

About Transliterations

The Arabic names follow the ALA-LC method with the exception of 2 cases: Arabic words that have gone into mainstream English such as Quran, Naskh, and Kuf; and letter names where the Unicode Standard naming has been followed. The latter is due to this researcher's font development habits.
Counterbalancing: "An experimental procedure for controlling irrelevant factors. A good example is fatigue; if a subject is to perform two tasks, x and y, the order of running would be counterbalanced so that fatigue factors were spread equally across both x and y. To wit: one half of the subjects would perform task x first and one half task y first. If the experiment were run so that all subjects performed x first, it would not be possible to tell whether y was more difficult than x or merely that the subjects were getting tired."

Dependent variable: "Any variable the values of which are, in principle, the result of changes in the values of one or more independent variables. In mathematics this notion of dependence is readily represented by an expression of the kind y=f(x), where the values of y are dependent on the values of x. In psychology, the operative principle is that the behaviour of the subject under consideration is (like y) dependent upon the manipulation of some other factors (the analogue of x)."

Descriptive statistics: "A general label for statistical procedures used to describe, organize and summarize samples of data. Basically, a descriptive statistic is a number that represents some aspect of a sample of data."

Fixation (visual): "The orienting of the eyeball so that the projection of the viewed object falls on the fovea and is in focus. The object or location in space is called the fixation point and lies along the fixation line, which can be drawn from the fovea through the pupil to the object."

Greek-Latin square or Orthogonal Latin squares: "A balanced two-way classification scheme in which each condition occurs just once in each row and column. This balancing is often incorporated into experimental designs so that the order of administration of treatments is perfectly balanced across subjects. Two such Latin squares are orthogonal if, when combined, the same pair of symbols occurs only once in the combined square. This composite square is called a Greek-Latin square."

Independent variable: "Any variable the values of which are, in principle, independent of the changes in the values of other variables. In an experiment, any variable that is specifically manipulated so that its effects upon the dependent variables may be observed. Also called the experimental variable, the controlled variable and the treatment variable."

Inferential statistics: "Statistical procedures used to make inferences. Basically, they utilize the mathematics of probability theory to infer or induce generalizations about populations from sample data."

Interaction: Reciprocal effect or influence. In statistical interaction the effects of two (or more) variables are interdependent; e.g., task difficulty and arousal often interact so that increased arousal increases performance on easy tasks but decreases it on difficult tasks."

Main effect: "In statistical analysis of data, the basic relationship between a single independent variable and a single dependent variable."

Null hypothesis: "A hypothesis of no difference, no relationship. In the standard hypothesis-testing approach to science one attempts to demonstrate the falsity of the null hypothesis, leaving one with the implication that the alternative, mutually exclusive, hypothesis is the acceptable one."

Order effects: "Effects that are attributed to the order in which treatments are presented in an experiment. Order effects can confound an experiment and typically counter-balancing procedures are employed as a control."

Regression: "In reading, any eye movement back over material already read. The frequency of such regressions is related to the difficulty of the material and the reading skills of the individual."

Saccade: "A quick eye movement, a jump of the eyes from one fixation point to another. Saccadic movements are seen most clearly during reading and the scanning of visual displays."

Standard deviation: "A measure of the variability of a sample from the mean of the sample."

Standard error of the mean: "The standard deviation of the theoretical sampling distribution of the mean. In practice it is used as an estimate of the degree to which the obtained mean of a sample may be expected to deviate from the true population mean."

Statistical significance: "The degree to which an obtained result is sufficiently unlikely to have occurred under the assumption that only chance factors were operating, and therefore the degree to which it may be attributed to systematic manipulations. The degree itself is typically specified and denoted as probability, e.g., p<0.05 means that the results obtained (or more extreme results) could only have occurred by chance in fewer than 5 cases in 100. The smaller the p value, the more significant the results; that is, the less likely that they occurred by chance."

Within-subjects design: "An experimental design in which each subject is used in all conditions."
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 involved. The third paradox is that type designers have been successfully designing type for 5 centuries, 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 somewhat 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

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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 it is 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 turns 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 is the heart into which 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 comes 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 academicquisitiveness. Rather, it is driven by an earnest desire to promote reading as a culture. If people read more, would they think less?

Design is not merely a job. It is 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 as 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 test 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 text 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 concludes with the structural
of legibility testing. The typeface system is a family of three variants of the Nashik style in Simplified, Traditional, and Dynamic versions (Fig. 6.1). These are specifically designed to be used in the legibility studies, and are in direct reference to the styles of Nashik 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 advancements 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.
The Arabic Script

The Arabic script belongs to the group of Semitic scripts, which are descendants of the Aramaic offspring of the Phoenician alphabet. The Arabic script, like the Aramaic and Phoenician alphabets, is represented mainly by consonants in a system usually referred to as alajad.

The Arabic script was first used to write the Arabic language. With the spread of Muslim conquests, it grew to encompass many Semitic and non-Semitic languages such as New Persian, Turkish, several Berber languages in North Africa; Pashto, Kurdish, and Baluchi in Iran; Urdu, Sindhi and Kushtir; Dari/Sindhi Moghul; Sula, Malagasy and Malay as well as Swahili, Kanuri, Hausa, and Fula in central Africa, and Harari in Ethiopia. As such, the Arabic script today comes right after Latin as the most "widespread segmental script in the world" (Kaye, 2006, p. 133). It is estimated that there are around 1 billion users of the Arabic script worldwide (Anara & Boulama, 2003).

Characteristics

Like other Semitic scripts such as Hebrew and Syriac, Arabic is written from right to left and with the lines assembled from top to bottom. The numerals, usually referred to as Hindi, are written from left to right (Fig. 1.1).

Many Arabic words are written in a continuous pen stroke without lifting the pen, with the dots and marks added later. This means that the letters are connected to each other, and each letter can occur in four different possible scenarios depending on its position in the word: initial, middle, final, or isolated position. These positions usually affect the form that the each letter can take. For example, the letter Heh has four very distinct forms in its initial, middle, final, or isolated instances (Fig. 1.2a). Other letters usually retain a certain level of similarity across different positions where the initial form is similar to the middle, and the final is similar to the isolated one (Fig. 1.2b). The majority of Arabic calligraphic styles have variations for each one of the positions that a letter can fall in depending on the letters that come before and after it. These are sometimes expressed typographically via ligatures.

The classification of the contextual alternates into these four positions is a typographic interpretation of the Arabic script. Most typefaces will have only one shape per each of the positions. However, the forms of characters as evident in manuscripts are much more dynamic and variant than in the typographic norms that have been established till today. For example, the letter Jin can have a multitude of different
forms depending on its neighbouring characters (Fig. 1.4), but most typefaces will show only four different forms and perhaps a handful of ligatures. This is why the majority of typefaces available today look more stiff and repetitive in comparison to the manuscript calligraphic styles from which they have been derived.

Still, this division is a helpful way to analyze the script as it establishes a framework that can be later expanded as necessary. In some cases such as the styles referred to as Kufi, there are just those four forms to speak of in the first place. The transition of Arabic letterforms from calligraphic origins to typographic representations will be expanded on in the next chapter, when the anatomy of letterforms is discussed.

Of the basic twenty-eight letters, six do not join to the ones on their left. These letters only have two basic forms, a final and an isolated form (Fig. 1.5). As such, the Arabic script is partially connected and its words are characterized by an alternating rhythm of connected strings of letters where the break in connectivity can occur anywhere in the string. Though early examples of Arabic manuscripts showed an equal distance between strings within and outside of words, as well as the breaking of words over two lines, this practice fell out of common use very quickly and the typographic norm today is to cluster strings into words that are separated by a clear word space with no option for hyphenation.

**Basic Elements**

The claim that the Arabic script is made up of twenty-eight letters is indeed deceiving. In reality, there are several more letters that make up the repertoire needed to accurately represent the Arabic language as a start. Conspicuously missing from the count of twenty-eight is the All Makkura, which is the un-dotted version of Yeh ۴. Another absentee is the Teh Marbata ۴ which is written like the Teh ۴ but with two dots on top. Several other characters are also needed such as the isolated Hamza ۴, which denotes a glottal stop, as well as the different variations of the way it can be written in a word. When coupled with other base characters, the Hamza is treated as a combining mark. Other combining marks include the Matта ۴ and Hamza at-
word I. All of these letters and marks are necessary and play an important linguistic role and so it is more precise to speak of thirty-one letters in total (Fig. 1.5).

Arabic also employs a number of combining marks that serve as short vowels. These are the Fatha (ẹ as in ten), Damma (u as in put), Kasra (i as in pit), and Sukun (a lack of vowel). Another mark is the Shadda, which is used for doubling a consonant and is normally combined with a short vowel. Other marks are the muta’inn marks (addition of the final nun) referred to in Arabic as Tanween and these are: Fathatayn, Dammatayn, and Kasratayn (Fig. 1.3).

As mentioned at the beginning of this chapter, Arabic is a consonantal script. This means that words are represented by their consonants and the vowels are added in as marks. Three letters also double as long vowels and these are the Aalif, Waw, and Yeh. The short vowels are usually dropped out in everyday literature but are normally included in children or beginner books and in poetry and religious texts. Proficient readers are able to read un-vocalized text without any difficulty although the vowels are in certain cases indicated so to avoid confusion.

The earliest Arab manuscripts often did not include any vocalization. Indeed, during the early days in Islamic history, it was considered impolite to vocalize letters as this was a sign of lack of respect to the addressee who was deemed to be lacking in linguistic prowess and evidently in need of help with reading. It is also said that the vowel marks were first added to Arabic after the Arabs had started mixing with other nations and their knowledge of how to properly vocalize text was affected (Yacoub, 1966). The early vowels were written as coloured dots often in red above or below the characters. This is not to be confused with the dots as known today since early Arabic manuscripts at that period were also un-dotted.

The presence and abundance of dots in the Arabic script is one of its most striking features. Of the basic thirty-one letters, sixteen are dotted (Fig. 1.5). The dots vary in number and are positioned either above or below the main body of the character. Their role is to distinguish between characters that share the same basic form. This system of dotting came into further use when the Arabic script was expanded to support more languages. The extra letters needed were in most cases based on existing forms but with a different number and/or position of dots. The abundant use of dots is a testament to a major shortcoming of the Arabic script and that is that there are very few basic shapes to use in the first place. For example, the teeth (the initial or middle form seen in Beh) is used for six different letters and this is for the Arabic language only. This characteristic of the script is challenging for beginning readers who would have to memorize the different sounds that the position of the dot corresponds to. It is especially so when these letterforms start forming complex ligatures, and one has to guess which dot belongs to which character.

The Arabic script today includes hundreds of characters and extra combining marks that are used to represent the non-Arabic languages that it supports. The Unicode consortium also defines extra notations that are strictly for Quranic usage. Punctuation marks similar to those used in Latin have also been incorporated into the system with some degree of adaptation. The French guillemets are used for quotes; the question mark, comma, and semi-colon are the mirrored version of the Latin ones; the percent sign uses the Hindi zero; the period, ellipses, and exclamation mark remain the same.
Cultural Ties

The Arabs in pre-Islamic times relied on an oral tradition. Literary works such as poetry were memorised and passed on from one generation to the next. The rise and spread of Islam changed all that. The text of the Quran and the teachings of the Prophet had to be written down and saved for future generations. This heralded a new age in Arab culture where the skill to read and write became highly valued and respected. And so, the Arabic script sprang to maturity and became the vessel through which the holy words were manifested. Consequently, the art of calligraphy as a whole took on a spiritual role by association. Calligraphers were praised and supported by the rulers, and were known to even take on high posts in government such as the famed calligrapher Abū ʿAlī Muhammad ibn ʿAbīl Islamic (Abūl Islamic), who served as vizier three times during the Abbasid period between 928 and 936 AD (Blair, 2006, p. 157).

Another contributing factor to the rise of calligraphy in Arab culture was the ban on figurative representation in Muslim art. The role of calligraphy then expanded to encompass the writings of holy texts as well as the decoration of buildings, tapestry, metal, ceramics and many more artefacts that were used in everyday life. The inclusion of a decorative band of calligraphy on a household item or at the entrance of a building provided a blessing or barakah to the owners.

As such, the Arabic script is more than the sum of its characters. It has strong religious and cultural ties that have on the one hand propelled it into the highest level of art forms, and at other times have proved to be difficult to negotiate. The questions of script reform that had risen in the middle of the twentieth century, or any that could still arise today, have to be navigated through that focus. Given the fact that the Arabic script is the one in which the Quran is written, it would be almost impossible to try to change or reform anything in it.

Why would the script need to be reformed? As mentioned earlier, the Arabic script has just a handful of vowels. These are not enough to represent the vowel sounds present in the dialects spoken today. This means that if one were to attempt to write down the dialect of a certain region in the Arab world, one would not be able to fully represent it using the Arabic script. A simple example is the way the word bab (door) is pronounced in the Lebanese dialect. In Modern Standard Arabic, it rhymes with the English word "bad", but it Lebanese the All sound here is similar to the French o sound but is a bit more protracted. In the Syrian dialect, the All sound is more like the French a. This distinction between the pronunciations of the vowels is lost in writing. Given that there are numerous dialects spoken across the region, the ability to properly represent the spoken forms of Arabic is an important requirement for linguists, and possibly for the entire population.

Resulting Complexity

The implications of all these characteristics are manifold. The fact that the Arabic script is partially connected, that the vowels are usually left out, and the abundant use of dots as the distinguishing factor among letters, has resulted in a high level of complexity from both linguistic and typographic points of view. On the other hand, the combination of these characteristics has provided raw material for centuries of artistic manipulation and experimentation. The Arabic script has lent itself to a large variety of different calligraphic styles, and supported many different languages and cultures. It has crowned works of art and architecture for centuries, and has ingrained itself into the everyday life of its readers in ways that very few other art forms have. It has played a role in shaping a rich heritage and has been the vessel for great literary pieces. On the other hand, the complexity of the writing system has been often criticized by students, teachers, and linguists alike. The balancing of these two forces is a quite delicate task. For these reasons and many more, the Arabic script provides a very wide and interesting field of study.
Chapter 2
The Anatomy of the
Arabic Script

What do Arabic letterforms look like? What is constant and what is changing? The development of Arabic letterforms has been varied and rich, with many different styles and an abundance of regional variation. These styles form the basis for the collective visual memory of Arabs today. Some styles have gone out of use and as such are less familiar to contemporary readers. Others form the backbone of the text styles that Arabs are reading in today.

What kind of letterforms do Arabs see in public communication today? There are handwritten shop signs, invitations, street banners, and such forms of short occasional texts. These are usually penned by skilled calligraphers. Everything else is Arabic letters in their typographic form, either printed or on screen. This chapter will focus on the handwritten forms used in long texts and their transition into typographic ones. The aim is to examine the anatomy of Arabic letterforms and to dissect them into their essential parts. Why? Type designer Suzana Licko has said: people read best what they read most. The role of familiarity is crucial, and so we need to study and analyze what the readers are used to in reading.

The Aesthetics of Arabic Texts:
Manuscript Traditions

This section focuses on three calligraphic styles that were used primarily for long texts. These are the Early Kufi, Naskh, and Nasta‘liq. The rich variety of Arabic calligraphy encompasses many different styles, many more than what will be covered in the following paragraphs. These three styles were selected, as will be expanded on in the following paragraphs, because of the role they played in manuscripts, and for having later served as a major point of reference for typographic design.

Early Kufi: The Early Manuscripts, Simplicity, and Contemporary Design Inspiration

The Qurans of the first three centuries of Islam look decidedly different from what one can see today. The format was usually horizontal, the text was written in brown ink and certainly not on paper, and most relevant here: The style of calligraphy
was unlike any of the famed Six Pers as practiced by Ottoman calligraphers. To the
uninitiated and newcomers to the field of Arabic calligraphy, the visual language
of the Arabic script is often that of fluid undulating strokes that sway in a rhythmic
and elegant manner. This is true, but only of certain styles. The early Qur’ans were
written in styles that are elegant but not fluid, rhythmic but in a more restrained
manner. They were bold, monumental, and very powerful in visual impact. These
styles, and there is quite a variety in there, have been given many different names:
Some refer to an area of origin (such as Hijaj), to a visual characteristic
(as in Mu‘jam), to a period of time (the Abbasid styles), or as is most common, refer-
ing to the whole set of styles simply as Kufi (or Kufic). While the first two are used
quite specifically, the rest are broad terms that encompass a variety of styles that
share common broad characteristics. The Abbasid Styles, coined by Quranic paleo-
graphy expert François Deroche, is not very accurate since these styles came into
existence before the Abbasid period. The term Kufi is also problematic as it refers to
the city of Kufa in southern Iraq, and these styles are not only connected with that
city. However, this term has gone to mainstream usage, and so can be used with
cautions to refer to this group of styles, which are usually characterized by a strong
horizontal base line, strictly vertical ascenders, and squarish construction. This term
is also used to refer to later styles such as the Eastern Kufi and the Square Kufi so for
the sake of clarity, this section will use the term Early Kufi to refer to the styles used
to write the early manuscripts. This terminology is inspired by the name given to
these styles in Arabic, kufi al-masabiq al-‘ula or the kufi of the early manuscripts.

The key visual characteristics of the Early Kufi (Fig. 2.1 and 2.2) are as follows:
The letters are stacked side by side in a linear horizontal fashion. The ascenders
are strictly vertical strokes and the All ends in a curved outstroke to the right. Words
as a visual entity are not an integral unit. Rather the smallest unit is that of the con-
tinuous connected stroke and this is evident in the fact that words can be broken
along bases, and that the space between these units is equal to the space between
words. The letters, or the baseline stroke connecting them, can be stretched horizon-
tally and this gives a very distinct look to the page that ends up looking like an alter-
nating rhythm of vertical and horizontal strokes. It is not surprising then that this style
is part of what some authors call the squarish styles (Hecob, 1986). Conspicuously
abuse are the word connotations we know them today, and the colored dots one sometimes
sees in these manuscripts are in fact standing in for the vocalization marks.

There are four reasons why the Early Kufi is relevant to this dissertation. First, it is
the style in which the early Qur’ans were written, and so its link to long text is quite
strong. Second, there is a key visual characteristic that is relevant to Arabic and that is
the simplicity of word formation. As will be discussed in chapter 7, there is a con-
troversy within the field of Arabic type design that revolves around the question of
what authentic Arabic is and a key element of that is the adherence to the manner
in which letterforms connect to make words. In the more rounded styles, the word
formation is a complex process as will be discussed later on, but that is not the case
in the Early Kufi. There, the letters simply sit side by side to make words. The point
here is this: The complexity of word formation, which is the chief variable being
tested in the legibility experiment, is not a matter of being authentic to Arabic, but
rather, authentic to a specific calligraphic style of Arabic. Simplicity and complex-
ity in word formation are equally part of Arabic calligraphic tradition, and when

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1 The Six Pers are three sets of text and display pairs respectively: Nashí, Thuluth, Rayhán and Muhaqqaq, Kufic and Ta’lif.
2 The term does not refer to either the Hijaj or Mubtad, which had different visual characteristics.
going into legibility studies, it is important to note that both these approaches are grounded in the practical implementation of the script itself.

The third reason is a rather subjective one, and that is in this researcher’s affinity for this style and the great avenues of inspiration that it has offered for contemporary type design. Though the use of the Early Kufi went out of style for many centuries, today it offers the widest doors for typographic exploration and that is mainly due to the fact that its inherent characteristics are very similar to current trends in type design: uniform stroke width, large proportion of body size to ascender height, and the simplicity of construction. A look at these early manuscripts reveals a beauty of form and an elegance of design that is difficult to match. There is another lesson to be learned from these early manuscripts: simplicity can still be beautiful.

The fourth reason is one specifically related to legibility. The text in this style is undotted and often un-vocalized. Though the visual organization of letterforms is quite simple, the text is practically illegible to modern readers. The fact that the Arabic script needs the dots to differentiate letters is very clearly illustrated here. These early manuscripts offer a view of what Arabic is like when un-dotted, and quite easily reveal a basic shortcoming of the Arabic script.

Naskh: The Text Style Par Excellence

The second style to be discussed in this section is Naskh. The name derives from the Arabic verb to copy. It is a style meant for small text sizes and is one of the fastest to write, hence its popularity. The term, some write, “is used as a generic name for a variety of Arabic scripts used for many centuries, mostly for the copying of books and later for printing” (Gacek, 2006, p. 339). The following paragraphs are concerned with the various leading scribes connected with this style. However, of importance to this dissertation is the Naskh style as practiced during the Ottoman period for that was the period in which printing was introduced and the transition to typographic forms started.

Though the name Naskh has also been used to denote the styles used in papyri in either the first, second, or third centuries of Islamic records to denote a rounded script that is in contrast to the squarish styles of contemporary manuscripts, some authors find this terminology to be undesirable due to its overly generalized description (Khan, 1993, p. 21).

The earliest known Quran written in Naskh is from Baghdad in 1000-01 (Khallili, 2008, p. 51) though this style was not only confined to the Quran but also had a much wider usage (James, 1992b, p. 15). This first manuscript was penned by the master calligrapher Abul-Hassan ‘Ali ibn Hithil, usually referred to as Ibn al-Bawwab. His style of Naskh was characterized by angular qualities that proclaimed it to be part of the dry or “yabis” set of styles (Fig. 2.3).

The Naskh style, however, evolved into a rounder and more cursive form with the hand of the master calligrapher Yaqub al-Musta’sim who lived in Baghdad in the thirteenth century. He is credited with bringing the Six Pens, or al-Aqlam Asisba, to perfection. Yaqub is attributed with a reform of Naskh via a new way of trimming the reed (James, 1992b, p. 56). By the 15th century his style of Naskh was the “universal model” for this style (James, 1992a, p. 14). In the Ra`i`i tradition, Naskh is part of the curvilinear “murrattab” or dampened styles (Gacek, 2006, p. 340).

The Naskh style, as penned by Shukri (Seyh) Handullah (1429-1520), was based on the style of Yaqub al-Musta’sim and became the standard Quranic text style during the Ottoman period (James, 1992a, p. 69). He was the calligraphy master of Prince Bayezid, son of Sultan Mehmed the Conqueror, and accompanied him to Istanbul when he came to power (James, 1992a, p. 69). When Beyazid ascended the throne, Shukri Handullah became master calligrapher at the Ottoman Palace. It is said that the Sultan had great appreciation for his teacher and that he asked him to develop the styles of Yaqub and provided him with the best specimens. These he studied in great detail and proceeded to sculpt a style of his own (Fig. 2.4) and thus earning the title Qibla al-Khatib (the calligraphers’ soderina) (Derman, 2002). He continued to work for the Sultan in the late fifteenth and early sixteenth century, and in his role on Naskh proved to be a reference model for future generations (Blair, 2006). So,
what was it exactly that Shaykh Hamadallah did? This quote by Mohammed Zakariya (1998) sheds some light on his contribution:

“Studying the work of older masters, he sifted and tested to find the best letter shapes and invented a system of imaginary slanted horizon lines along which to arrange each letter, imparting motion, tension, and energy to the writing. He also refined the measurements of the letters and regularized the spacing between letters and words, giving the text a more open, regular feel.”

Continuing in those footsteps, Hafiz Osman (1642-1698) further refined this style and reintroduced the Six Pesas after they had fallen out of use in the 16th century (Khalil, 2008, p. 44). He was appointed as the calligraphy teacher to Sultan Mustapha II and the future sultan Ahmed III. Like Shaykh Hamadallah, he was greatly honored by the Sultans, to the extent that he was awarded a special sofa to sit on in the presence of the Sultan who would hold his inkwell while he was preparing the calligraphic exercises (Derman, 2002).

Hafiz Osman’s contribution to Arabic calligraphy came through his study of Shaykh Hamadallah’s style and the process of mixing it with his own individual flair. Fig. 2.4 His new style of Naskh, Thuluth, and Kufic is still in use today, though later calligraphers have also left their mark (Derman, 2002, p. 86). These two calligraphers were two of the most important figures in Ottoman calligraphy (Khalil, 2008, p. 44). Looking beyond the Ottoman traditions, the earliest known Manuelcu Qurans (dated from the first 2 decades of the 14th century) were also set in Naskh through that was replaced by Muhajirin in the large scale Qurans of the later period (James, 1992b, p. 150). Iranian Qurans in the 15th century also saw a dominance of Naskh as the main hand. Nastaliq, as will be covered next, was quickly developing in the region but it was mainly used for literary and diplomatic purposes (James, 1992a, p. 12).

All these variations and evolutions of this style or group of styles aside, the Naskh style is relevant to this dissertation for many reasons: It is the most commonly used style for the setting of long texts. It was used in both religious and secular settings. Finally, it is also the style after which the majority of Arabic typefaces are built. In fact, the thesis question regarding the complexity of word formation is very much connected to the Naskh style given its predominance in both handwritten and printed texts.

The Naskh style is one used for small sizes and is usually neat and balanced between round and flat elements. It often has a forward tilt and the overall look is clean and legible, hence its popularity among modern text. And within that last sentence one encounters an apparent contradiction: The manuscript Naskh style is used for long texts because of its high legibility—and this is true—and yet the whole premise of this dissertation is the questioning of the legibility of this style. To clarify that one has to look at the visual characteristics of two other parties: the other popular calligraphic styles and the simplified typographic styles that the modern reader is accustomed to. The first group is characterized by calligraphic abundance and a busy representation that is visually compelling but with an often hectic rhythm. The second group is a flattened-out simplified version of the manuscript style. So, yes, the Naskh manuscript style is more legible than the other more hectic calligraphic styles, and the relative legibility to the simpler typographic variants is what this dissertation will try to investigate.

As to word formation and the structural characteristics of this style of calligraphy, and to avoid repetition, this will be covered in the Structural Analysis and the Different Interpretation of Typographic Naskh sections.

Nastaliq: A companion style?

This is the ultimate Persian style, which came to life in Iran in the late 14th century as either a direct derivative of Naskh, or as a mix of Naskh and Thuluth (Gacek, 2006a, p. 337). Both Thuluth and Nastaliq are of the hanging styles, so named because of their round and connected strokes that slant and hang in a diagonal and downward fashion. They have quite strong contrast in their thick and thin strokes. The rhythm alternates between strong compression to great expansion of strokes. The hanging scripts are well suited for Persian, which lacks the vertical accent achieved by the repetition of the Allahu-lam combination in Arabic and has a different proportion of round and vertical elements (Bliss, 2006a). Nastaliq (Fig. 2.5) is characterized by words that descend on the baseline, long elongations where possible, and the final letter or word is often tucked up as a superscript (Gacek, 2006a, p. 337).

This style is interesting to this paper in a purely tangential way. It is not a style that is common for the setting of long Arabic texts. However, that is not the case for Persian or Urdu where newspapers in Pakistan today are still being read in this style. As will be discussed in the structural analysis, Nastaliq to Naskh is similar in structure to the relation of Italic to Roman in the Latin typographic spectrum. The question of an Italic Arabic comes up on a regular basis, and the legibility of this style is very much still an open question. So, its place in this dissertation is not to answer a question, but rather to pose one for the future. Is it possible to have an “italic” Arabic, and would such a combination be legible?

The Aesthetics of Arabic Texts: Typographic Traditions

The story of Arabic typography is intimately intertwined with the development of typesetting technology. Given the complexity of the Arabic script and its many differences from Latin in its structure and aesthetics, the typesetting technology developed for the setting Latin had to be adapted to support Arabic. At the heart of the struggle is the complexity of word formation, which so happens to be the chief variable to be investigated in this dissertation. This complexity and the challenges it poses run as unifying themes throughout the five centuries of printing Arabic.

To put it simply: to print the 26 Latin letters, a typesetter needs a total of 52 metal types for the upper case and lowercase versions. To print the 28 or 31 Arabic letters in the Naskh style that is true to manuscript traditions, a typesetter would need hundreds if not thousands of different metal types. Not only is the problem one of time and logistics but it is also one of alignments. The organic forms of manuscript Naskh do not subscribe to linear horizontal stacking. So how was this problem resolved? There were three different solutions:

The Rule of Four Plus Extras: Traditional Naskh

There is a common element that unites the works of Granjon in the late 16th century (Fig. 2.6), seen to be the best of the early European attempts to print Arabic, the printing types used in Istanbul in the first Ottoman backed printing press set up by Ibrahim Müneferizä in the late 16th century (Fig. 2.7), with the printing types used