SYLEXIAD. A TYPEFACE FOR THE ADULT DYSLEXIC READER

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Abstract

The investigation concerns a series of typeface legibility and readability studies which have resulted in the creation of a number of new typefaces including Sylexiad. Sylexiad is grounded and informed from a dyslexic viewpoint and is a typeface for the adult dyslexic reader.

Sylexiad was developed by means of comparative typeface testing. This involved a series of formative and summative small-scale tests that accommodated two established word recognition models – word shape and parallel letter recognition. This novel method of measuring legibility and readability is called developmental typeface testing. The data was gathered by means of qualitative and quantitative techniques from dyslexic and non-dyslexic groups based at Norwich University College of the Arts and The University of East Anglia. These techniques included questionnaires, interviews and observations. The research was inductive and practice-based in approach.

The findings identify which typographic characteristics adult dyslexic and non-dyslexic readers preferred and why. For the majority of non-dyslexic readers tested, it was the combination of serif-style, lowercase forms, large x-heights, medium weight, variable strokes and normal inter-word spacing that was preferred. The non-dyslexic readers also favoured the form of Times New Roman. Conversely, for the majority of dyslexic readers tested it was the combination of handwritten style, uppercase forms, long ascenders and descenders, light weight, uniform strokes, perpendicular design and generous inter-word

spacing that was preferred. The dyslexic readers also favoured the form of Serif Sylexiad.

The conclusions have raised issues that confirm and contradict current typographic principles of legibility. In particular, from a dyslexic perspective, the word shape model has been challenged. The outcomes and issues that have been identified as a result of developmental typeface testing have therefore contributed to new knowledge within the field of dyslexia typographic research.

Keywords

sylexiad

dyslexic

developmental typeface testing

legibility

dine

Context

Sylexiad is an ongoing research investigation that began at Norwich University College of the Arts in January 2001.

During the late 1990s there was great interest within the Art and Design higher education sector concerning the condition of dyslexia. In 1999, Central St Martins College of Art and Design put forward the hypothesis that there would be ‘more dyslexia among art and design students than non-art students’ (Padgett 1999: 11). It was estimated that the figure could be as high as 15% (Surrey Institute of Art and Design, 1999) compared to a national figure of 4% with severe characteristics and a further 6% with mild dyslexic characteristics (Smythe 1999: 1).

As a result of this interest, I began to question the reasons for my own reading difficulties, especially my frequent misreading of texts. Therefore, as part of my pre-research process, an educational psychologist assessed me for dyslexia. The assessment indicated the presence of specific learning difficulties (dyslexia) due to 'slow speed of visual processing, and a slight weakness with working memory' (Smallwood 2000: 3).

At the time, the recommendation by dyslexia organisations was that preferred dyslexia typefaces should be exclusively for sans-serif fonts, particularly Arial (British Dyslexia Association 2000: 1) and Sassoon Primary (Dyslexic.com 2000:1, British Dyslexia Association 2000: 1). The only recommendation for serif fonts was sixteen years earlier by the International Dyslexia Centre, and that was for Times New Roman (Hornsby 1984: 71). None of the typefaces recommended by these dyslexia organisations were ever designed specifically for the dyslexic reader. The design of Helvetica (on which Arial was profoundly based) and Times New Roman were developed when there was little or no mainstream understanding of the condition of dyslexia. Indeed, these typographic forms were exclusively developed by non-dyslexic designers for a non-dyslexic audience.

The current typographic model for legible fonts is exclusively a non-dyslexic model, based on a theory of word shape which states that words are recognised as complete units by the outlines made by their shape (Cattell 1886: 9). Therefore, according to the word shape theory, lowercase letters are more legible than uppercase forms because ascenders and descenders provide greater word shape for the reader. As stated by McLean, and typical of mainstream typographic thinking, in order to provide good word shape the following three aesthetic principles should be observed:

1. ‘*Sans-serif type is intrinsically less legible than seriffed type.*’ (McLean 1980: 44)

2. ‘*Well-designed roman upper and lowercase is easier to read than any of its variants, e.g. italic, bold, caps, expanded or condensed versions.*’ (McLean 1980: 44)

3. ‘*Words should be set close to each other (about as far apart as the width of the letter “i”); and there should be more space between the lines than the words.*’ (McLean 1980: 45)

These recommendations (of which there are many) do not accommodate newer theories of word recognition from other fields. For example, the word shape model is no longer part of the dominant thinking within cognitive psychology (Watt 2003). The model currently accepted as the most accurate within this field is the parallel letter recognition model. This states that the letters within a word are identified simultaneously. The letter information is then used to recognize the word (Larson 2004: 74). The word is therefore recognized by the actual letters within the word – not by its shape. As a designer myself, with a particular interest in typography, and as a dyslexic reader, I found the recommendations by both the typographic establishment and the dyslexia organisations to be too prescriptive and contradictory. My investigation was therefore prompted by the need to bridge the gap between the fields of typographic design and cognitive psychology in order to identify the most appropriate recognition model for the adult dyslexic reader, and to allow for the possibility of developing new design paradigms.

Based on the outcomes of my investigation and my own views as a dyslexic designer and reader, the aims of the research was to:

- Test existing typefaces (Arial, Sassoon Primary and Times New Roman) in order to establish which of those fonts adult dyslexic readers prefer, and why.

- Test my own typeface designs (the Dine and Sylexiad fonts) in order to identify which typographic characteristics adult dyslexic readers prefer and why.

- Contribute new knowledge to the field of contemporary dyslexia typeface design.

Developmental typeface testing

My research involved the design, development and testing of five new typefaces that were specifically targeted at adult dyslexic readers as represented by my reader groups. Each typeface I designed was tested against those typefaces that, at the time, were recommended by dyslexia organisations. The outcomes from these tests, combined with reader comments, my own views as a dyslexic reader and my own views as a designer, helped to inform the development of each subsequent typeface design. The design/testing model that I originated involved a series of evaluative study tests that measure the legibility and readability of typefaces. The model has been grounded in the visual aspects of dyslexia and has incorporated Anisson's ideas concerning comparative typeface testing (Spencer 1968:13), Babbage's primacy of uniform letters (Spencer 1968: 13), Javel's primacy of the upper half of a word (Huot-Marchand 2004: 47), the testing of serif and sans-serif forms (Zachrisson 1965), aesthetic preference (Burt 1959) and reading rates (Wilkins 1996). It also combines elements of a literacy developmental stage, reading model (Frith 1985) and a comparative methodological approach to measuring legibility (Tinker 1963 and 1965) that allow for the testing of text formations concerning individual characters, individual words, individual sentences and individual paragraphs. The model has clear stages, is linear and flexible in structure and is referred to as 'developmental typeface testing'. It is the developmental typeface testing of my

typefaces Dine 1, Dine 2, Dine 3, Serif Sylexiad and Sylexiad Sans (Figures 1,2,3,4 and 5) which formed the basis of my research.

It is interesting to note that most legibility tests have been conducted by psychologists (rather than typographers). For that reason, those tests can be seen to be summative in that testing is conducted *after* the design process - never during or before that process. Developmental typeface testing is therefore unique within the field of typographic design research, in that it accommodates both a formative *and* summative aspect to the design, development and testing of fonts. It also uniquely accommodates both the word shape and parallel letter recognition models. Developmental typeface testing used a series of dyslexic and control reader groups involving 71 readers and consisted of seven study tests. The *formative stage* can be seen as experimental and exclusively dyslexic in terms of readership. The structure of this stage was fluid and evolved as each subsequent study informed the next. The *summative stage* was more fixed and comparative. It involved both dyslexic *and* control groups. The novel aspects of the formative and summative stages allow the design process to be developed in tandem with the testing process rather than being independent of it.

Arial, Sassoon Primary and Times New Roman were chosen as the test fonts and were used throughout the developmental typeface testing process for two reasons. Firstly, they were considered to be dyslexia friendly fonts. Secondly, due to their distinct and differing forms, they enabled me to categorize them into *archetypal* or, what I refer to as, *standard* font types. Therefore Arial, recommended by the British Dyslexia Association, was used as a '*standard sans-serif font*', Sassoon Primary, recommended by Dyslexic.com, was used as a '*standard handwritten-style font*' and Times New Roman, recommended by the International Dyslexia Centre, was used as a '*standard serif font*'.

This simple classification of three key typographic styles seemed appropriate in providing the correct focus and continuity throughout the research. The use of more historical styles such as old style, transitional and modern serifs, and grotesque, geometric and humanist sans-serifs, within the testing process was rejected. Such inclusions would have over-complicated and unnecessarily broadened the investigation.

Research phases

The preliminary stage of the investigation included an analysis of my own reading difficulties, a literature search and review of potential test typefaces. With the exception of the Olsen typeface, designed by Olsen in 2001 (Gyllan 2002: 49) and the Read Regular typeface, produced by Frensch in 2003 at the Royal College of Art (Frensch 2003), I found no evidence of current research involving typefaces specifically designed for the dyslexic reader. There was also very little information concerning both dyslexia and typography as a single topic. With regards to dyslexia, my focus was on the visual aspects of the condition – specifically the visual anomalies associated with the alphabet system. As for typography, the search focused on legibility and legibility testing, as well as those typefaces recommended by dyslexia organizations. It also identified the two recognition models that were key to my investigation – word shape and parallel letter recognition. Although practice led, my investigation was theoretically informed by accommodating these two established models. In doing so, links were made between the distinct fields of typographic design and psychology.

The investigation itself can be summarized as four successive stages. Phase one of the research can be considered to be the formative stage of the developmental typeface testing process which resulted in the design, development and testing of a number of radical and experimental fonts called Dine. Dine 1 is a monocase font designed to provide each character with a distinct shape without compromising any meaning

associated with that shape. This initial concept would, in theory, maximize word shape and overcome problems of letter reversals in characters such as the lowercase c, n and u and uppercase N and Z. As part of the initial design process, which was based on word shape, in order to establish the similarities and differences between individual characters, a visual analysis of Helvetica (representative of a typical sans serif font – the style approved by most dyslexia organisations) was made (figures 6,7 and 8).
Dine 1 was also based on a diagnostic dyslexia handwriting checklist, which included unusual letter spacing, strange letter formations, a combination of upper and lowercase letters and an overall lack of letter fluidity (Silverman 2000). The form of Dine 1 can be viewed as being illegible. It was, however, an appropriate starting point for the investigation as it facilitated subsequent font development into less radical and more legible forms. Dine 2 is a duocase font, which evolved as a result of the testing of Dine 1, which in turn, led to the design of Dine 3. It is important to note at this point that the Dine fonts are not typefaces for the adult dyslexic reader, rather theoretical fonts which have been informed by the process of developmental typeface testing.

The formative stage of developmental typeface testing consisted of three study tests using a succession of dyslexic reader groups established at Norwich University College of the Arts. These groups comprised participants from undergraduate courses, all having undergone a psychological assessment conducted by educational psychologists from the Norfolk Psychological Service. Each version of the Dine font was tested against the various dyslexia organisations' recommended fonts of Arial, Sassoon Primary and Times New Roman; and on two occasions Tiresias InfoFont, a typeface recommended by the Royal National Institute for the Blind (RNIB, 2002). The outcomes and reader feedback gathered from each of the tests, coupled with my own experiences and views as a dyslexic reader, helped to inform the design and development of subsequent versions of the Dine font. Each study test focused on the reading of comparative text formations within four

distinct areas. The areas of investigation concerned individual characters (figure 9), individual words, individual sentences and individual paragraphs. Phase one of the research began in November 2001 and was completed in November 2003.

Phase two of the research involved a detailed evaluation of the formative developmental typeface testing outcomes from the three study tests. This appraisal included matters concerning dyslexic issues, text formation issues, general typographic design issues as well as issues regarding the Dine fonts. The evaluation attempted to highlight the differences experienced when reading different texts and to identify the significant factors required to develop a preferred typeface for the adult dyslexic reader. The outcomes of Phase two, coupled with my own experiences and views as a dyslexic reader, informed the design and development of Sylexiad – the first variant of a typeface for the adult dyslexic reader. Sylexiad has two forms, a serif version (Serif Sylexiad) and a sans-serif (Sylexiad Sans). Phase two began in December 2003 and was completed in April 2005.

Phase three of the research can be considered to be the summative stage of the developmental typeface testing process. The subject of legibility is inherently visual and it was considered important to conduct tests outside the art college environment, in order to overcome any possible bias to the outcomes regarding the visual aspects of the typefaces tested. It also seemed appropriate to conduct both internal *and* external trials in order to compare data. Therefore, the internal trial continued to be based at Norwich University College of the Arts whilst the external trial was conducted at The University of East Anglia. Both internal and external trials comprised a dyslexic group and a control group (making a total of four reader groups, two dyslexic and two control). As in phase one, all dyslexic participants have undergone a psychological assessment by educational psychologists. The summative stage of developmental typeface testing consisted of four comparative study tests. Each version of Sylexiad was tested against Arial, Sassoon

Primary and Times New Roman. Each study test continued to focus on the reading of text formations within four distinct areas. The areas of investigation concerned individual characters (figure 10), individual words (figure 11), individual sentences and individual paragraphs (figure 12). Phase three of research began in April 2004 and was completed in June 2005.

Phase four began in April 2005 and was concluded in December 2005, and marked the final stage of research. It involved a further evaluation of the data produced from both the internal and external trials. As with the formative evaluation of outcomes, the appraisal included matters concerning dyslexic issues, text formation issues and typographic issues. The evidence gathered resulted in a comparative analysis between the dyslexic and control groups. Finally, the legibility and typographic preferences between the adult dyslexic readers and the non-dyslexic readers were analysed. The analysis focussed on issues concerning typographic styles, typographic form and typographic variables.

Findings

The development and evolution of the Dine fonts from the radical, illegible, monocase design of Dine 1 with extreme word shape, to the less radical, legible, duocase design of Dine 3 was informed by the outcomes of the formative developmental typeface testing process. These outcomes indicated that radical and unfamiliar design could be difficult and daunting for the dyslexic reader, which in turn can result in heightened visual disturbance, thus impairing readability. However, evidence indicated that the combination of light letterforms and large interspatial word qualities had a favourable effect in reducing these difficulties. As the subsequent versions of Dine evolved, the more familiar and conventional the form became, which resulted in more favourable

reader responses. This would indicate that familiarity of form is an important factor for dyslexic readers.

The other findings from the formative testing process highlighted three other areas of interest. They concerned dyslexic issues, text formation issues and typographic design issues. With regards to dyslexic issues, Dine 3 and Times New Roman were both favoured for readability, low visual stress and good comprehension. This outcome seems, on one level, to be contradictory as Dine 3 is an unfamiliar sans-serif, whilst Times New Roman is a familiar serif font. What links the two fonts would seem to be a relative lightness of stroke. The area concerning text formation issues showed that a sans-serif style (in the form of Arial) had the highest preference rating as a paragraph, whereas a serif style (in the form of Times New Roman) produced the most efficient read, with the highest word-per-minute rate. This would indicate no conclusive dominance of form towards either a serif or sans-serif style. Context was also identified as an issue and highlighted the need for letterforms to be as clear, distinctive and different from each other without losing the intrinsic meaning of the character. The outcomes concerning typographic design issues also indicated no evidence to suggest dominance either for or against serif or sans-serif styles. Dyslexic readers did however prefer lowercase forms when reading narrative texts. Qualities of cleanness and familiarity were also liked by the dyslexic readers, whilst compact, oblique and bold letterforms were disliked.

Much of the evidence concerning the formative developmental typeface testing was contradictory and inconclusive. Nonetheless, key outcomes were identified which, coupled with my own views as a dyslexic reader, were incorporated into the design of Sylexiad. The design of Sylexiad therefore included:

- a serif *and* sans-serif version

- A series of double-case alphabets
- The use of relatively light letter strokes
- The use of relatively long ascenders and descenders
- An attempt to make each character as clear and distinct from each other as possible without compromising the meaning of the character.
- A generous inter-word spatial quality

The design did not include:

- The use of relatively oblique letterforms
- The use of relatively compact letterforms
- The use of relatively bold letterforms
- The use of radical forms

The development of Sylexiad therefore resulted in two typefaces being designed. Sylexiad Sans is the sans-serif form and Serif Sylexiad the (very slight) serif form. Both fonts have a handwritten appearance and represent the first version of a typeface for the adult dyslexic reader. The Sylexiad fonts are perpendicular and rounded in appearance, and contain light uniform strokes. The findings of the summative testing process highlighted three areas of interest that concerned: dyslexic/reading issues, text formation issues and typographic design issues.

For the internal and external dyslexic groups the relationship between dyslexic issues and reading indicated a clear preference for the Serif Sylexiad font, especially with regards to reading, visual stress and comprehension difficulties. The least favoured font was Times New Roman. With regards to text formation issues, the dyslexic groups favoured the handwritten, light and uniform strokes of the Sylexiad fonts and Sassoon

Primary. They also favoured the serif quality of Serif Sylexiad and Times New Roman. The uppercase forms of both Sylexiad fonts were favoured during the character, sentence and paragraph studies, and both fonts accounted for the quickest sentence reading times. The readers considered Serif Sylexiad to be the preferred typeface with regards to text formation issues. The anecdotal evidence concerning typographic design issues indicated no dominance towards either a serif or sans-serif style. Despite this outcome the quality of cleanness was liked in sans-serif, handwritten styles. There was a preference indicated by the dyslexic readers for uppercase forms and the lighter weight and generous spatial qualities of the Sylexiad fonts.

For the internal and external controls, there were no dyslexic or reading issues identified. With regards to text formation issues, the serif qualities of Times New Roman and Serif Sylexiad were preferred when reading individual words, and also resulted in the best comprehension rates during the paragraph studies. The sans-serif quality and relatively heavy weights of Arial and Sassoon Primary were favoured during the sentence studies and accounted for the fastest reading times. The Sylexiad fonts were the least favoured during the sentence and paragraph studies, the preferred font being Times New Roman. The anecdotal evidence concerning typographic design issues indicated no dominance towards either a serif or sans-serif style, or upper or lowercase forms. This may however have been due to testing anomalies (see critique). The controls did however favour the lowercase and spatial qualities and medium weight of Times New Roman.

The comparisons between the dyslexic groups and the controls indicate similarities and differences. Both groups favoured serifs (Serif Sylexiad for the dyslexic readers and Times New Roman for the non-dyslexic readers). Both groups also identified individual characters more effectively in uppercase rather than lowercase forms. The familiarity of a typeface may also have been an important legibility factor, which affects *all* readers.

As for the differences, the evidence suggests that the majority of dyslexic readers preferred the relatively light and uniform strokes, the handwritten style and the spacious quality of the Sylexiad fonts. They also preferred the uppercase forms of those fonts when reading individual sentences and paragraphs. For the non-dyslexic readers, lowercase rather than uppercase forms were preferred when reading individual sentences and paragraphs. The normal spatial qualities, medium weight and less uniform strokes of Times New Roman were liked. For the non-dyslexic readers, Times New Roman was the preferred font, whereas for the dyslexic readers it was Serif Sylexiad.

Analysis and arguments

Based on the extrapolation of the outcomes of developmental typeface testing, generic conclusions were made concerning adult dyslexic readers as exemplified by my reader groups. In comparing and contrasting the evidence-based outcomes between the non-dyslexic and dyslexic readers, a number of key ideas emerge which both confirm and challenge current typographic legibility principles.

The research has conclusively shown that for the majority of non-dyslexic readers, serif styles (particularly in the form of Times New Roman) were more readable as extended texts; lowercase typefaces resulted in good legibility and faster reading rates compared to uppercase forms*; typefaces with medium weights were preferred, and normal inter-word spatial relationships were preferred. These findings confirm current typographic maxims concerning legibility. The research has also conclusively shown that for *all* readers condensed-looking typefaces were not favoured, which also supports current typographic doctrine. The evidence also indicates that for *all* readers, the familiarity of a font facilitated effective reading.

*This applied to the internal control only (see critique).

Conversely, the research has shown that for the majority of dyslexic readers: the handwritten and perpendicular styles of both Sylexiad fonts were more readable as extended texts compared to the other test fonts; uppercase typefaces *often* resulted in good legibility and faster reading rates compared to lowercase forms; typefaces with light weights were preferred; and a more generous than normal inter-word spatial relationship was preferred. The issue of long ascenders and descenders improving legibility was inconclusive. However, as a dyslexic reader myself, I agree with Sassoon and some of the participants of this research in advocating that they can indeed facilitate effective reading (Sassoon 2004), especially for dyslexic readers.

My findings have often contradicted current typographic legibility maxims. For the majority of dyslexic readers tested, generous word spacing allied to the (light) weight and slightly condensed form (due to long ascenders and descenders) of the Sylexiad fonts was important. This would suggest that for subjects with reading difficulties it is the combination of spacing, weight and overall form of a typeface that is important rather than individual letterform design.

The outcomes of developmental typeface testing have raised issues that challenge the word shape model. From the formative stage, the testing of the Dine fonts have shown that as each subsequent design became less radical than previous versions, the word shape became less distinct yet more preferred. From the summative stage the testing outcomes indicated a preference by dyslexic readers for the uppercase rather than lowercase Sylexiad forms. The internal dyslexic group also had a higher reading rate in uppercase forms. There was also a low preference rating for Times New Roman (and its 'shaped' serifs). All of this evidence (coupled by the fact that all letter reversals occur in

lowercase forms), although far from conclusive, highlights a general trend, from a dyslexic perspective, away from word shape as a viable recognition model.

At the start of this investigation my research aims were to:

- Test existing typefaces (Arial, Sassoon Primary and Times New Roman) in order to establish which of those fonts adult dyslexic readers prefer and why.

This aim has been achieved. Arial was found to be the preferred *existing* font. This, I would argue, is as a result of a practice effect. Arial is a ubiquitous and familiar font, and the evidence (taken as a whole) would support Licko's theory that we read best what we read most (Unger 1992: 100-101).

- Test my own typeface designs (the Dine and Sylexiad fonts) in order to establish which typographic characteristics adult dyslexic readers prefer and why.

This aim has been achieved. The typographic characteristics that the majority of adult dyslexic readers preferred were: a handwritten style, uppercase (especially Sylexiad) forms rather than lowercase forms, long ascenders and descenders*, light weight, uniform strokes, perpendicular design, generous inter-word spacing and familiarity.

- Contribute new knowledge to the field of contemporary dyslexia typeface design.

*The evidence for this preferred characteristic was inconclusive.

This aim has been achieved in three ways. Firstly, for the first time a series of fonts have been designed *and* tested for a specific dyslexic audience. For the majority of adult dyslexic readers who were tested, Serif Sylexiad was considered to be the preferred typeface. Secondly, a new technique of developmental typeface testing has been established in order to measure legibility and readability. It includes a formative and summative element and therefore allows for a design to be modified *during* the testing process. Previously all legibility studies have been conducted retrospectively as the design process always came before the testing process and was never conducted in tandem. Thirdly, by accommodating the word shape model and parallel letter recognition model within the developmental typeface testing process, the previously distinct and distant fields of typographic design and cognitive psychology have been brought together. As a result, the existing word shape model favoured by most typographic designers has been challenged.

For some dyslexic readers it seems clear that certain current typographic legibility principles may not be appropriate. They were established by non-dyslexic typographers for a non-dyslexic audience. The current advice by dyslexic organisations for dyslexic readers is often confused as it both supports and contradicts these principles. The British Dyslexic Association, for example, offers advice supporting a current maxim by recommending that dyslexic readers use lowercase rather than capital letters (British Dyslexic Association 2005: 1). As my research has shown, this is not necessarily the case. Conversely the organisation contradicts another current maxim by advocating the use of sans-serif (rather than serif) fonts, particularly Arial (British Dyslexic Association 2005: 1). This advice, I would argue, is because of a practice effect associated with familiar fonts. These recommendations are too specific and unhelpful. I think that broader recommendations concerning typographic characteristics would be more appropriate for dyslexic readers than simply specific fonts. As the research has shown

there are fonts that are more legible than Arial. With this in mind, new typographic rules concerning legibility for dyslexic readers will need to be considered.

Critique

Looking back at the research with hindsight, there are a number of aspects that I would have possibly changed. With regards to the test typefaces, Sassoon Primary was chosen because it was recommended by both Dyslexic.com and the British Dyslexia Association (Dyslexic.com 2000: 1) (British Dyslexia Association 2000: 1). The typeface was specifically designed for children and, therefore, because I was testing on adults, perhaps the adult form of Sassoon Sans would have been more appropriate. It was also unfortunate that Read Regular was designed by Frensch during the latter stages of this research in 2003 and that it was not available earlier in order to test the font against the other typefaces.

The formative developmental typeface testing process in many ways acted as a dry run for the summative process and, as such, the first study test was not particularly comprehensive or expansive. However, this situation improved as the formative process developed. Many procedures were trialled in order to measure reading times and many techniques were tested before employing the most effective method for the summative process. This sampling of various techniques resulted in the first three study tests being somewhat inconsistent, which in turn, occasionally made the comparison of data difficult. The situation may have been alleviated had controls been used during this stage.

The summative developmental typeface testing process was much more consistent, and due to the inclusion of the controls, allowed for data comparisons to be made between the two groups. The summative process did, however, produce an outcome that was difficult to explain and that concerned the reading rate of the external control being higher

in uppercase forms compared to lowercase forms. This outcome was unexpected as it contradicted current typographic legibility maxims and the internal control outcomes. As a consequence, this would suggest some sort of testing anomaly. However, these issues did not affect the overall validity or reliability of the developmental typeface testing model. The developmental typeface testing procedure will allow other typeface designers interested in legibility and readability to use the process and expect to achieve similar outcomes.

Conclusion

This investigation has continued a long tradition of legibility studies, most of which have been conducted by psychologists. What makes my investigation distinctive is that a designer rather than a psychologist developed it. This has resulted in the inclusion of a formative and summative element within the developmental typeface testing framework. These elements enabled the design process to be conducted in tandem with the testing process rather than being separate. My developmental typeface testing model allows the process of legibility study to be more organic than in previous studies. In an attempt to connect the worlds of typographic design and cognitive science, which have previously been separate, the two distinct and different word recognition models favoured by both fields were incorporated into the design process. This has resulted, for the majority of dyslexic readers tested, (as exemplified by the reader groups) in the word shape model to be challenged.

The objective of my research was to design a typeface for the adult dyslexic reader and, in doing so, develop a new typeface testing model. This has been achieved through developmental typeface testing and has resulted in Serif Sylexiad being the favoured typeface for the majority of dyslexic readers tested. Although all of my research

questions have been answered, many other questions have yet to be asked and my developmental typeface testing model, and initial Sylexiad fonts, may provide a template for future investigations, questions and subsequent answers regarding the subject of dyslexia and legibility.

Postscript

Since completing this stage of my research Sylexiad has been expanded, refined and appropriately digitised with the help of the typographer Adrian Williams. There is now a complete range of Sylexiad fonts commercially available on http://www.robsfonts.com/ The first independent practical application of Sylexiad was for the Serpentine Gallery Project *NEVERODDOREVEN*. As part of the project the design group åbäke and artist Abigail Reynolds have used Sylexiad Sans Medium as the sole font for a pack of playing cards developed to exploit a dyslexic's ability to think divergently. The project involved a conference, 'Playful Experiments : Dyslexia and the Arts', at the Goethe-Institut as well as an exhibition at the Serpentine Gallery.

My research findings have been presented at the 5th Annual Friends of St Bride Library Conference 'Fast Type, Slow Type' in Birmingham, UK and have also been featured in the design magazines Novum, Ultrabold (The Journal of St Bride) and Étapes.

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Captions

Figure 1: Dine 1.

Figure 2: Dine 2.

Figure 3: Dine 3.

Figure 4: Serif Sylexiad.

Figure 5: Sylexiad Sans.

Figure 6: Visual analysis of a sans-serif font (Helvetica) containing diagonal strokes.

Figure 7: Visual analysis of a sans-serif font (Helvetica) containing strokes with curves.

Figure 8: Visual analysis of a sans-serif font (Helvetica) containing strokes at right angles to the baseline.

Figure 9: Individual character reading materials from the formative stage of developmental typeface testing.

Figure 10: Individual character reading materials from the summative stage of developmental typeface testing.

Figure 11: Individual word reading materials from the summative stage of developmental typeface testing.

Figure 12: Individual paragraph reading materials from the summative stage of developmental typeface testing.

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