Text Spacing Considerations for Children's On-Screen Reading

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Abstract: This investigation seeks to uncover the insights of three integral and inter-related parties in the creation and use of on-screen reading material for children's learning. This is an effort to discover what factors are perceived to influence children's comprehension. Through a design-analyse-refine methodology this researcher discusses a series of typographical considerations relating to space which bear further empirical investigation in the literature. This methodology involved discussion of ideas garnered from four experts. The results of each iteration of the experiment influenced further refinement of the ideas until suitable conclusions were able to be developed by the writer. Testing materials in this experiment adjusted variables for visual separation, including margins, separation of image and type, as well as line spacing, letter spacing and word spacing.

Introduction

Children encounter on-screen typography and learning opportunities in both formal education and in recreational pursuits, through reading in video games, television, and the computer. The quality of material used within the classroom and available within the school for children's on-screen reading requires careful consideration to ensure that it is of the highest standard to aid with children's learning and comprehension.

Much reading and typographic research has been performed over many years, in the areas of psychology, graphic design and the printing professions. It would appear from the research available today, that much of this research has been performed predominantly with adults. (Vanderschantz, 2008) Until recently, only assumptions were made regarding children's reading and typographic requirements. Theories and findings concerning adults, were often extrapolated and applied to children without specific empirical testing being performed. This also became the case with research and theory regarding typography and reading on screen. Theories and discoveries found in print, were initially extrapolated and then applied to type for the screen.

Background

It is clear from the body of work available in the areas of reading psychology that understanding eye movements during reading and the effects of typographic compositions is important in the visual presentation of text for children's on-screen reading. (Dyson, 2004)

In the introduction of *A Psychological Study of Typography,* Stanley Morison (1959) writes "spacing, in fact, is more important than choice of size or design of type". Spacing affects the ability for the eye to traverse successive lines of type with ease. The space between individual letters affects the ease with which letters can be identified and in turn, the ease of recognition of words. The space between words, affects successful transition from fixation to fixation, while the space between lines, affects the ability of the eye to navigate correctly from the end of one line to the beginning of a new line. For these reasons, we must carefully assess our spacing decisions when approaching a typographic layout, particularly that for children.

There are very few research outcomes able to inform a comprehensive design direction for the creation of well formed typography for children's on-screen reading material. Dyson (2004) states that there has been significant research into the legibility of print and the typographic considerations for effective reading in print. Dillon (1992) and Dyson & Kipping (1998) point out that the empirical investigations of typographical issues related to reading in print remain unduplicated for the screen. Dillon (1992), states that early studies of screen based reading compared and contrasted reading in print to reading on screen, and that typographic assumptions for print were carried forth. Dillon continues to discuss the work of Creed et al (1987) as indicating that when reading from screen compared to print, even when all variables are replicated, reading differences in each media can be found. The rapid development in technology and the large disparity in testing methods has rendered much of the early research into screen based reading both questionable and uncertain. It is however important for this knowledge to be discussed and future studies to be directed by these early studies.

Reynolds & Walker (2004), state that word and letter spacing has had very little investigation in the research of children's reading. Reynolds & Walker discuss type size, line spacing and line length, as having been examined as important factors, in the design of books for children. This, Reynolds & Walker claim is evident in the research of Huey (1908), Tinker (1965) and Watts & Nisbet (1974), who make no reference to investigation regarding either letter spacing or word spacing. In later studies of reading print, Walker (2005), states that in these studies, children identified tight letter, word and line spacing as being seemingly more difficult or confusing to read. This was often due to the children perceiving the size of the type to be smaller and harder to comprehend. From a motivational point of view, taking care not to set type overly tight, may therefore, assist with children's reading and comprehension.

It seems clear from the lack of current empirical evidence the roles of vertical and horizontal spacing in children's on-screen text require further investigation. Through the production of a design-analyse-refine methodology this investigator has shown a need for inter-disciplinary research crossing the boundaries of education, psychology, graphic design and computer science. The findings of this investigation offer insights for areas of importance for design of children's on-screen material; advice for the implementation of future reading studies with children; as well as design direction for designers whilst best practices are being developed.

Experiment Setup

This researcher has developed a series of testing materials based on the findings of a literature review performed during research towards an MCGD (Vanderschantz, 2007). The testing materials adjust variables for special separation; including margins, separation of image and type, as well as line spacing, letter spacing and word spacing. This experiment was performed in an effort to discover what factors are perceived to influence children's comprehension. This material was tested using the design-analyse-refine methodology. This methodology involved discussion of ideas garnered from four experts. The results influenced further refinement of the ideas until suitable conclusions were able to be developed by the researcher.

Methodology

Design-analyse-refine is a process driven, action research based methodology used commonly within graphic design research. This methodology parallels the traditional design process. It is most commonly used in experiments which seek to refine a visual problem through a series of cycles which analyse a visual solution at various stages. Initial concepts are garnered from a formal literature review and are presented to a panel of either field experts or target audience members. The feedback received during the analysis phase is used in refining and realising improved visual ideations. This refinement-analysis cycle is repeated, reducing the number of potential solutions and improving their visual effectiveness until conclusions are able to be drawn which answer the research question.

Testing Material

The testing materials were developed by this researcher, from an original printed, as yet unpublished book, written and illustrated by Tyrone Ohia. Ohia was a student at the Wanganui School of Design and studied Writing for Young People in 2007. Writing for Young People is an undergraduate paper delivered by Senior Lecturer, Vivien

Wake. In this paper, the students write and illustrate their own books and discuss these informally with young people within the book's target market. This book was very well received by the young audience.

The intended age group of this book was set by Ohia as being 5 - 10 years of age. This story was chosen for its simple use of colour, creative and engaging illustration style and rhythmic story telling nature. This book was also deemed suitable because of the positive feedback gained from discussions with the St Georges Preparatory School pupils, in early 2007.

This researcher sought to investigate three primary spacing factors of type used on screen which influence children's reading. Test round one, investigated the appropriate use of leading for children's on screen reading. Test round two, investigated letter spacing for children's reading. Test round three, investigated word spacing in children's reading. Each subsequent test round implemented an interpretation of the results of the previous testing variable. ie. Testing materials for round two implemented text with appropriate leading as discovered by test round one.

The objective of each experiment was to produce three or more different examples of the typographic factors being investigated. However, as Burt (1959), discussed, typographic variables cannot be altered without consideration of the many other variables which are affected by the changing of another variable. Thus, when the designer adjusted the variable being tested, other variables were adjusted in correlation with these adjustments. For example, when leading was increased in Experiment 1, for each of the testing materials, tracking, type size and image separation were adjusted where necessary in order to find a suitable presentation of the text for each individual testing piece.

The typeface *Trebuchet MS* was used as the base typeface for all testing materials. Trebuchet MS was originally designed for Microsoft as a screen-based typeface. *Trebuchet MS* and its Macintosh equivalent *Trebuchet* are freely available on both Windows and Macintosh based operating system platforms. The availability of this typeface enables it to be accessed easily and is chosen by teachers for in-class material and for web designers who rely on a typeface being present on an end-user's personal computer.

Characteristics of a typeface suitable for children's reading are discussed in depth by Burt (1959), Watts & Nisbet (1974) and Walker & Reynolds (2000). Following their findings, Trebuchet was chosen for its long ascenders which help with word and letter identification; the generous x-height and relative width of the typeface which assist with clear letter recognition and letter differentiation; the suitable bowls and counters which create open readable letter forms; and the soft, rounded, friendly and engaging nature identified as appealing to children.

The testing material was presented as a Stand Alone Flash Player sized 800 x 600 pixels. Three different examples were presented in each session. Each example was uniquely numbered for later reference and ease of discussion. This number appeared at the top of the screen outside of the 800 x 600 pixel interface area of the storybook.

Only three pages of the original story were presented within the interactive application. This was to ensure ease of use by the interviewee, and to minimise time required by the interviewee to explore each test material, thus, allowing for maximum discussion. The same three pages were used in all testing examples. This researcher chose to use the first three pages of the original book for the testing material.

Wherever possible, only minor alterations were made to Ohias' original illustrations. Layout considerations for the purposes of the testing material, entailed this researcher reworking position and size details to suit the onscreen environment, as well as providing useful space for typographic adjustments. The amount of content on the pages was not altered from Ohias' printed book. Ohias' original colour choices were not adjusted, other than those to do with the typography and where on-screen legibility was adversely affected.

In the first round of the experiment, emphasis and punctuation were kept as indicated by Ohia. Where possible, in the first experiment, line breaks were also set as was dictated by the book writer. Emphasis was also shown as Ohia had in print. Ohia used full capitalization of words for emphasis. In later experiments, emphasis, punctuation and line breaks were altered as suggested by the experts.

The test material was designed and edited using Adobe Photoshop in order to ensure correctly sized raster based images for testing. Images of the text and the background image were exported from Adobe Photoshop as *PNG* file

format. Exporting the type from Adobe Photoshop as an image, ensured that a consistent rendering engine was used for each experimental example across each testing environment used. Once imported, the images were not scaled or stretched within Adobe Flash in order to ensure that they would be the same size as those created in Adobe Photoshop. Images were placed on the Adobe Flash *stage* using whole pixel measurements. Whole point sizes were chosen for type sizes. Anti-aliasing was set to Adobe Photoshop *Sharp* anti-aliasing. Flash movies were shown at 100% and full screen with *AllowScale* disabled. In test round 2 and 3, Lossless Compression was set on the bitmap images within Adobe Flash.

Margin and padding were not specifically tested; however, the researcher feels strongly that suitable space around type and image at all times, is of great importance. The researcher thus ensured that at no time, did text closely abut an edge or image, nor did the researcher allow text to flow over an image or differentiated colour space. Navigation and interaction decisions were kept to a minimum in order to ensure that this did not create interference with the reading of the material.

Experts

As is customary with a design-analyse-refine methodology, the material was tested by a small group of four field experts. These included, one designer / typographer, two teacher / teacher educators and one children's librarian. These experts were chosen because of their level of knowledge and expertise in the fields of graphic design, education and children's book use.

Interview Structure

The interviews performed were semi-structured and did not rely on a core set of questions. Interviewees were asked to discuss the material with reference to children's reading and comprehension.

Due to geographic constraints, the educators interviews were performed in person, while the typographer and children's librarian were interviewed via teleconference.

Each expert viewed the material on a different computer because the constraints of geographic locality. The children's librarian viewed the experiments on a Windows XP PC, with a 15 inch LCD monitor and a screen resolution of 1024 x 768. The designer/typographer viewed the experiments on a Macintosh G5, running OSX 10.4.8, with a 19 inch CRT monitor and a screen resolution of 1024 x 768. The two educators/teachers viewed the experiments on the researcher's laptop. This laptop runs Windows XP and has a 15.4 inch widescreen monitor, with a resolution of 1680 X 1050.

Findings

Factors relating to typographic variables of line space, line length, letter and word spacing, padding and margin were discussed in detail by the experts who were interviewed during this experiment.

The way in which children use picture books and on-screen material, was discussed as a consideration to the design of this material. It was discovered that picture books and on-screen material, are often used by more than one young reader at a time, and often in reading aloud situations. Design considerations need to reflect this by utilization of additional space, and consideration of type size and colour and contrast. The children's librarian discussed reading aloud and reading from an angle in correlation to her preferences for the medium to loose settings of both vertical and horizontal spacing conditions. The educators also discussed the importance of creating text which was easily read from an angle, to cater for many young readers reading the same material. This also requires effective contrast for on-screen text, because viewing colour at an angle on a monitor is problematic.

It was thought by all of the interviewees, that the use of type and image must lead the eye of young readers. This was described as the way in which young readers read from top to bottom and left to right. One of the educators described the advertising principle of A.I.D.A (Attention. Interest. Desire. Action), as being used in this material to help develop reading patterns. These are the act of, attracting Attention, creating Interest, encouraging Desire and ensuring Action. It was also decided that images should support and enhance the text, and must not overpower or

overshadow the importance of the text. The image should both add informational value and perform a motivational mechanism in reading.

The amount of content on a page was also of interest to the experts interviewed in this investigation. They suggested, that pages 1 and 3 of this book contained a suitable amount of content for an on-screen illustrated children's book. However, the experts felt that page 2 appeared to contain too much content. It was suggested that this content be split over multiple pages.

Interestingly the 3 pages contained very similar word counts. Page 1 contained 24 words, page 2 displayed 24 words while page 3 had 25 words. These words were structured as sentences or tone groups, over 6, 7 and 5 lines respectively. The significant point of difference for page 2 compared to pages 1 and 3 was the use of very short single-word or double-word lines. 4 lines of text were presented approximately twice the height of other text on this page. This created a page with a greater saturation of visual space occupied by text or image compared to other pages tested. The increased text height of the first four lines of text resulted in a page with greater use of vertical space, while horizontal space was filled by slightly longer lines with larger word counts.

Line spacing was found to be most appropriate for children when generous leading was used. Set solid was not recommended by any of the experts and leading values of medium leading to loose leading were found to be most appropriate for young readers. The leading used in the second and third round of experiments was seen as appropriate. The results of this experiment indicated that for this material, interlinear space of between 15 and 20 pixels was appropriate for the material being tested. This measure was approximately 5 pixels smaller than the x-height of the letterforms being used on a particular line. The exact value of space used, depended upon the text size and use of capitalization. Increasing type size often also requires an increase in relative inter-linear space that is chosen. This was due to the increased visual weight of the text requiring more surrounding space to create a page with a similar visual colour. The apparent increase in size of type due to capitalization, also required additional inter-linear space, in order to create an open and approachable page for children's reading.

Generous use of letter spacing and word spacing was also judged important in children's reading material. It was clear from the discussions, however, that word spacing alone was not felt to be useful by the experts. A combination of letter spacing and word spacing was considered most appropriate. The fact that these two parameters lengthen the line was seen as advantageous in assisting with development of left to right eye movements.

It was considered by the educators that addition of letter spacing also assisted with the recognition and deciphering of difficult words; particularly, words with difficult or unusual letter forms. Word spacing was also discussed as being useful in creating suitable space around long and difficult words. However, word spacing appeared to have the disadvantage of creating emphasis on punctuation. It was of concern to the educators that emphasis on punctuation might lead to young readers pausing or becoming confused by the punctuation.

Letter spacing and word spacing were used in combination for the final round of experiments. A medium amount of both word spacing and letter spacing was used.

It would appear from this set of experiments that for this particular on-screen illustrated children's book the use of medium inter-linear space, and the combination of medium letter spacing and medium word spacing, was felt to be most appropriate by the experts interviewed.

The differences of type for the screen and type for print are outside the intended scope of this investigation. However, it was found by the children's librarian that the same experimental material when viewed in print, appeared differently to that viewed on screen. This would indicate support for the need for specific investigations into type for screen for children.

Discussion

It may be inferred from the interviews that careful consideration of type setting was of importance to the designer / typographer. This typesetting should ensure the encouragement of good reading practices, whilst, maintaining enjoyment in reading.

It may further be inferred, that of significance to the educators, was consideration of correct grammar, punctuation and consideration of tone groups, cadence and line structure. These would all ensure development of good reading practice and assistance with reading comprehension development.

Similarly, that of central importance to the librarian was consideration of reading situations and reading practices of children. Understanding children's use of media in groups and for reading aloud was a consideration that the librarian felt was of the utmost importance.

It would appear that a designer of reading materials for children would do well to understand fully the points of view of these three groups of experts. Designers would do well to present type in a manner that creates an enjoyable reading situation. Proper grammar and reading structure should also be considered in order to bring about good reading practice. This must be considered for both, group reading and reading aloud situations.

The responses to the interviews indicated that;

  ¶ spacing will assist in ensuring that correct eye movements are developed by young readers

  ¶ line spacing will ensure a page is approachable with lines clearly marked to ensure hierarchy & readability

  ¶ line length is such that it encourages eye movements

  ¶ letter spacing and word spacing are used to create clearly recognizable words and letter pairs

  ¶ padding and margins are of significance to ensure distraction is not caused by superfluous images, borders

  and interactive elements

The layout of the page must motivate the child to read. To bring about further engagement, the page structure must then be such, that it correctly enables the child to read and gather information successfully. A page must encourage the act of reading from top to bottom and left to right as is the tradition of written English. Type should be such that the child understands what the first piece of information to read is, and so on, down through the textual hierarchy. The act of creating a grammatically correct and structurally understandable set of hierarchies, is one of the most important jobs of a graphic designer or typographer of children's on-screen material.

Design for the screen at present, relies on resolution restrictions and monitor size constraints. The material in this investigation was designed at 800 x 600 pixels to allow for monitor resolutions which, from the researcher's understanding, are still common in school environments today. This small interface size resulted in pages that contained a significant amount of information in a small amount of screen real-estate. As improved technology makes its way into schools, much higher resolutions will be available. Larger monitor sizes, allowing more screen real-estate, will also be available to designers, allowing more space for presentation of information.

Consideration of reading conditions was a reflection which repeatedly arose from the discussions with the educators and librarian. Designers must note that illustrated children's books are often used by many young readers at one time and often in reading aloud situations. These two factors, will therefore, require careful consideration during design decision making. Studies have shown that eye movements are affected differently in reading aloud situations than for silent reading. Rayner (1998), suggested that eye movements are slower in reading aloud situations and fixations appear to be longer. Use of exaggerated space or increased space in the design of materials which are to be read aloud therefore, will not adversely impact reading or eye movements. The findings of this investigation must clearly relate to the design of materials which will be read aloud or in groups. Continuation of this research with resources designed and intended for single reader use and silent reading situations, would prove of interest to both the education and graphic design communities.

As the children's librarian discovered by accident, the reading material does, in fact, appear differently in print, from the way it appears on screen. Difficulties found in reading the text on screen, were not present in reading the text in print, and vice versa. For this reason, it was shown that design considerations for the screen are clearly different from design considerations for print.

Conclusions

In summation, key considerations raised in these interviews support the hypothesis that considered use of typography in the form of padding or margin, separation of image and type, as well as line spacing, line length and word and letter spacing, will assist with children's comprehension.

The results of these experiments helped this researcher to develop a list of considerations which he suggests should be applied when designing on-screen material for children. Considerations include; page structure to facilitate eye movements and scanning of the page; use of motivational techniques such as text presentation and illustration; use of the norms of written language including structure, grammar, tone groups and cadence; vertical spacing in terms of top and bottom margins and inter-linear spacing; as well as horizontal spacing from the point of view of letter and word spacing and line length.

It was found that page structure can motivate and encourage a child, as well as ensure enthusiasm and enjoyment in reading. Perhaps more importantly, in the early stages of learning, page structure can help teach a child to effectively use a page for reading and information gathering. In order to motivate the reader, page structure, including use of text and image, should incorporate the A.I.D.A techniques most commonly discussed in advertising. Should a graphic designer or typographer do their job well, children's on-screen reading material would effectively attract a young reader to the reading material. This, in turn, should create interest and desire, resulting in the successful reading and comprehension of the material set.

Vertical structure is achieved through consideration of top and bottom margins, as well as suitable interlinear spacing. Use of generous line spacing will aid with children's reading by ensuring that the eye remains on the line being read, without impeding the ability to find the next line on a return sweep. Extra line space is required when full-word-capitalization is in use on a line, because of the relative height of a word set in full capitalization. In this situation, both the capitalized word and the line of text, subsequently appears larger than a line of text which is set lowercase.

Margins at the top and bottom of a text block, ensure that the edges of the monitor or between the text block and other elements of the screen or interface, do not cause a cramping or distraction from the text to be read. The amount of content on a page will also affect the margins at the top and bottom of a page, and will also become a factor in line length and horizontal padding considerations.

Horizontal spacing is achieved through the use of letter and word spacing, as well as line length. Generous letter spacing and word spacing is useful in creating easily read words and lines of text. This is achieved by creating lines which are open and breathable, with clearly defined letters and words for easy recognition. This horizontal spacing also creates a longer line length which aids with training the young readers' eyes to read along the text in a left to right motion. It is most important that should line length increase, the text block should not become too close to illustrations or to edges, which would cause distraction.

Although no single solution or golden key has been generated by this investigation, it is clear that the hypothesis holds true. Educated use of typography for children's on-screen reading, in the form of large or loose padding and margin; and clear or marked separation of image and type; and generous line spacing, line length, word and letter spacing is considered by this representative group of experts to assist with children's comprehension.

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