Consequently Positioning the Rhythm in Type Based on the Letters' Longest Continuous Black Mass

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Letters play a game of black and white. In that game, the continuous repetition of black and white creates a steadily progressing vertical and rhythmical stripe pattern, referred to as the rhythm in type. Readers conceiving the letters can perceive the rhythm as visually stressful. However, research into the rhythm in type is limited. The rhythm is only vaguely defined and there is no consequent way yet to exactly determine its position in letters.

In this article, I point to the less often discussed aspects of the rhythm. To advance research regarding the rhythm, I consequently position the rhythm with the new definition 'The rhythm in type is the sequence of the longest continuous black masses within the letters, in any direction.' This definition defines exactly where the rhythm in letters can be found and allows for more accurate comparisons of different rhythms within different letters, fonts and typefaces. This article provides an overview that summarizes how type designers can influence the shape of the rhythm.

K e y w o r d s **–**
letterform
stripe patterns
rhythm
font design
research methods
legibility
readability

The influence of the rhythm on reading

Letters alternate a stroke-rhythm and a white-rhythm (Lo Celso, 2005: 20) in a 'sequence of vertical elements' (Unger, 2019: 115; Bessemans, 2012: 155; Wilkins et al., 2007: 1788; Unger, 2006: 94; Majaj et al., 1998: 1165). Several parameters influence how this game of black and white is played. There are word spacing (Unger, 2006: 94), letter spacing (Unger, 2006: 94; Bessemans, 2012: 155), letter width (Unger, 2006: 94; Bessemans, 2012: 155), and I add the stroke width to this list. All letters apply these parameters in their own way, and it is only logical to say that the rhythm is different in each typeface and each font, being regular, bold, condensed, wide,… (Lo Celso, 2005: 21). The choice of the rhythm is one of the most fundamental decisions a type designer makes: how dark are the letters going to be (stroke thickness), and how wide are the letters going to be (spacing in-between the strokes: letter width and letter spacing)? Therefore, it is one of the most important elements of a Latin letter.

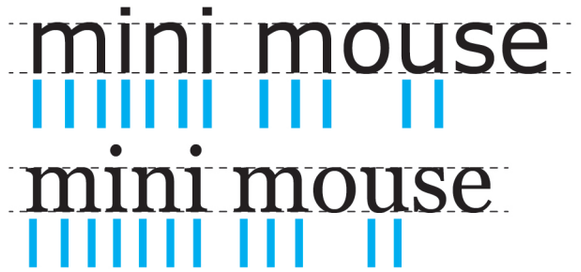
A legible typeface requires a balanced rhythm without unexpected interruptions in letter spacing, letter width, or stroke width (Smeijers, 2011: 27; Unger, 2006: 94) [Figure 1.]. Smeijers states that *"if we want to irritate the reader, we know what to do [with the rhythm: creating something like Figure 1. on top]."* However, a balanced rhythm does not necessarily mean a very rigid rhythm. Proof is found when serif and sans-serif typefaces are compared. Those two contain a different rhythm (Bessemans, 2012: 169; Lo Celso, 2005: 21). A serif typeface contains a more rigid rhythm than a sans-serif typeface [Figure 2.].

Figure 1.

A legible text requires a balanced rhythm without unexpected interruptions in stroke width, letter width, or letter spacing (the image is based on Smeijers, 2011: 27; also illustrated by Unger, 2006: 95).

Figure 2.

The rhythm in serif and sans-serif typefaces differs (Bessemans, 2012: 169; Lo Celso, 2005: 21). A serif typeface contains a much more regular rhythm than a sans-serif typeface.



Consequently positioning the rhythm in type based on the letters' longest continuous black mass

The rhythm is not only an ornamental part of the letters. It influences the letters' effectiveness and the visual (dis)comfort while looking at letters during the reading process:

- The stripe pattern created by the rhythm can be uncomfortable to look at and can arouse illusions of color, shape, and motion (Wilkins, 2012: 64);
- The stripes interfere with reading. There even can be a difference in reading duration (Jainta et al., 2010): reading words such as "mum" takes longer than words such as "dad" (Wilkins et al., 2012);
- A less rigid rhythm improves the letters' legibility for children with a visual impairment (Bessemans, 2012: 336);
- A less rigid rhythm can increase the speed of word recognition (Wilkins, 2007: 1788);
- The stripes from the letter strokes correlate with spatial frequencies, which can be hindering for readers sensible to visual stress, particular readers suffering from migraine (Wilkins, 2007: 1801);

— Large letters are identified by the edges of their shapes, small letters by their strokes (Majaj et al., 1998: 1165).

— Designers are taught that the Oldstyle letter model from around 1450 contains an irregular rhythm due to wider round letters such as the letter 'o' (e.g. taught by Gerry Leonidas during the summer course TDi at Reading University, 2018). Letters gradually became more equal in width. In the contemporary early twenty-first-century letter model, round letters such as the 'o' are narrower (Unger, 2019: 116). Therefore, the contemporary letter model contains a more regular rhythm.

— The height of the rhythm increased over time because the x-height increased in the last five centuries, while ascenders and descenders lengths decreased.

A more accurate definition for the rhythm in letters

Despite knowing that the rhythm has an influence on the reading process, there is no exact definition of the rhythm yet. Defined as 'the sequence of black and white,' or as 'the sequence of strokes', the rhythm is easily found in letters with a straight vertical stroke. But these definitions leave open the rhythm's position for interpretation when letters have no straight vertical strokes such as in round shapes, and say nothing about the height of the rhythm. Only Bessemans (2012: 155) suggests a relation with the x-height but leaves open further refinement. A new definition should:

— Describe where in the letter the rhythm is positioned;

— Describe exactly the rhythm's height; independent from being uppercase or lowercase letters, or being ascenders (a stroke going higher than most letters) or descenders (a stroke going lower than most letters);

— Describe how round shapes should be treated;

— Describe how white spaces relate to the rhythm. These white spaces are present in, for example, round shapes or in shoulders (the rounding such as present in a letter 'n');

— Describe how serifs relate to the rhythm, as they are wider than strokes and thus form no part of those strokes.

— Be measurable by a computer. A 'stroke' is a concept that a computer does not understand, so a more exact concept is required. Additionally, a stroke can bend in several directions, an example is the shoulder, or a stroke can be drawn in overlap with other shapes such as the serifs. In those cases, which part of the stroke should be regarded as part of the rhythm ?

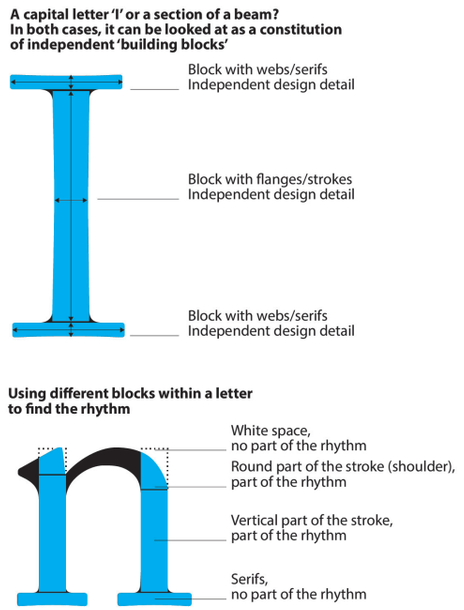
Inspiration for a more accurate definition is inspired by the field of engineering. Engineers play a similar game of black and white as letter designers, but in their case they do so with the section of beams. Such sections of beams often have the shape of a Roman capital letter 'I' or letter 'T'.

In a way, engineers regard a section as a composition of different 'building blocks' (the horizontal parts are named flanges, and the vertical parts are named the web). The amount of "mass" in a section determines the beam's resistance against bending, while larger white counters mean less material costs (Course at Provincial University College PHL, 2008; based on ir. E.O.E. van Rotterdam, 2000). The proportions of the blocks are changed independently from each other to optimize the beam's strength. [Figure 3, top] and engineers possess catalogs full of tables representing different 'I' and 'T'-shaped beams that are commercially available (e.g. ArcelorMittal, 2020).

Introducing a similar point of view into type design would mean looking at letters as different blocks of "black mass" which belong together [also Figure 3, top]. Each block can be changed mostly independently: if a serif changes, the stroke does not always need to change and vice versa. When looking to letters as blocks, the block which contributes most to the rhythm is the longest stroke. If a block has a rounding, then it can partly contribute to the rhythm [Figure 3, bottom]. What does not contribute to the rhythm are the blocks forming the serifs, nor does the white space. Serifs are wider than the vertical stroke, thus do not contribute to the (same) rhythm. The white space does not form a part of the black mass in a letter, so does not contribute to the rhythm.

Figure 3.

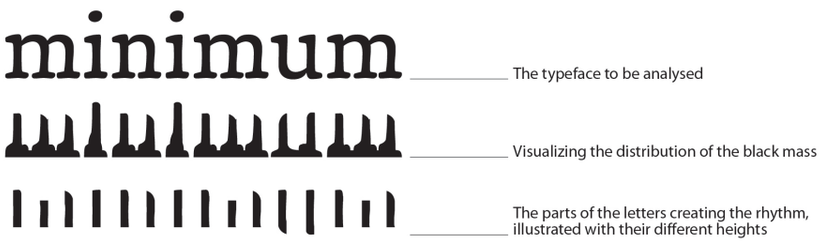
The top figure represents a capital I for a type designer, but also the section of a beam for an engineer. Engineers can regard each part as an individual block and change its dimensions to provide the beam enough resistance against bending. A type designer can look at a letter in a similar way: changing the block with the serifs does not always mean a change in the block with the stroke. Bottom: dividing letters in similar blocks allows for an analysis of each part differently.



With the different building blocks of letters and white spaces in mind, I propose the definition *'The rhythm in type is the sequence of the longest continuous black masses within the letters, in any direction.'* This definition groups blocks that have a similar appearance (or direction) while eliminating blocks that do not contribute to the rhythm (such as the serifs and white spaces).

A 'longest continuous black mass' can be determined by measuring it. One possible way to do so is drawing a graph and measuring the distribution of the mass over several points [Figure 4, middle]. After the position of the longest continuous black mass is found, it can be cut out in the letters [Figure 4, bottom].

Figure 4.



Drawing the vertical distribution of the black mass in a graph is a fast way to find the position of the longest continuous black mass. The graphs are created by "The Rhythm Influencer", a plugin that is able to determine the rhythm in several letters, aiming to support designers in their design process (Renckens, 2020a).

Note that, according to this definition, serif and sans-serif typefaces contain a different rhythm height [Figure 5]. Treating strokes and serifs separately is not yet done in earlier definitions of the rhythm, but the presence of serifs is a parameter that shortens the stroke length.

Figure 5.

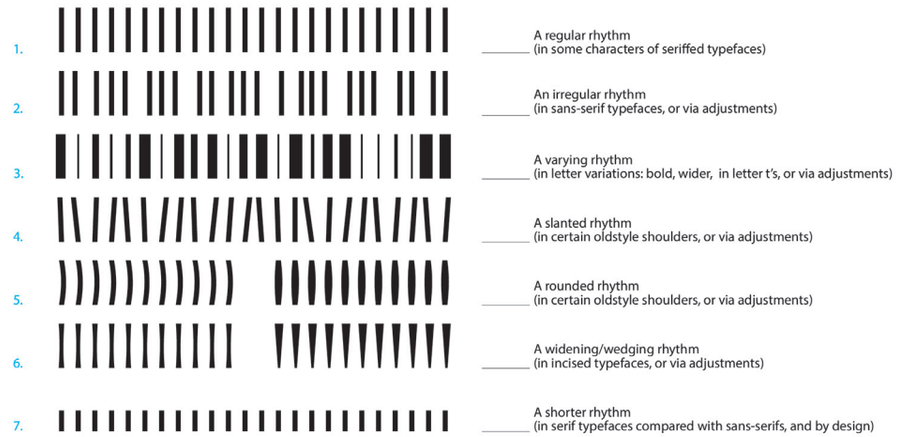
When the rhythm is defined as the 'longest continuous black mass,' Serifs become another design parameter that influences the total height of the rhythm. The presence of serifs becomes another way to compare the rhythm of serif and sans-serif typefaces. Typefaces: Verdana (sans-serif), Myriad Pro (sans-serif), Georgia (serif), Vivace (serif, designed to hide the rhythm by shortening and bending it).

Handling non-straight rhythms

But not only vertical stripe patterns are known to be possibly harmful to look at. Other patterns are known to have similar effects. Official regulations to avoid seizures mention "A potentially harmful regular pattern contains clearly discernible stripes when there are more than five light-dark pairs of stripes in any orientation. The stripes may be parallel or radial, curved or straight, and may be formed by rows of repetitive elements such as polka dots" (Harding & Wilkins, 2005; Harding et al., 2005; British Independent Television Commission, 2001).

Also in letters, the rhythm is not always straight, nor a sequence of identical forms, nor always vertical. The 'longest continuous mass' forming the rhythm can take on several shapes [Figure 6]. In all those occurrences, the different strokes still are one 'continuous black mass' [Figure 7], so the definition remains valid. Three different examples of occurrences will be discussed in more detail. Please note that there are more adjustments possible, which do not form a part of the type design. For example: (1) using gray instead of black/white is known to decrease the visual discomfort as well (Jainta, Jaschinski & Wilkins, 2010) and (2) making the type size larger decreases the number of stripes within the visual range.

Figure 6.



Formal features that the rhythm can contain (partly based on Renckens, 2018). The rhythm can contain several of those formal features at the same time.

Figure 7.

A curve still can be the longest continuous black mass within a letter.

Occurrence 1:
determining cut-offs for the rhythm within round strokes

When a stroke changes direction, such as in a shoulders or round letterforms, the new definition allows setting the cut-off for the rhythm [Figure 8, left]. The remaining cut-off (gray in the figure) determines which part of the round stroke contributes to the rhythm. If a letter contains no straight part, then it is recommended to look at the thickness of the rhythm found in the letter 'i' to determine the width of the cut-off.

Figure 8.

The rhythm in rounded forms according to this definition. First, determine the rhythm according to the longest continuous black mass. That determines the cut-offs. Then, include possible overshoots.

Renckens

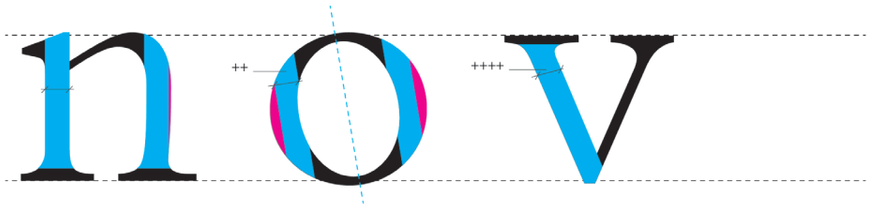
Consequently positioning the rhythm in type based on the letters' longest continuous black mass

It is seen that the position of the rhythm in round letterforms, such as the ones from the letter 'o' or in rounded shoulders, does not lie completely at the left/right sides of the letter [Figure 8, right, colored darker gray]. Round forms have an overshoot on the left/right sides, similar to the overshoots that round forms have below the baseline and above the x-height (meaning: round letters are a little bit higher than the other letters). If an overshoot is found, it should be incorporated within the rhythm to honor the fluid roundness of the original design.

Occurrence 2:
the longest continuous black mass under an angle

The longest continuous black mass is not always positioned vertically. That is, for example, very clear in letters 'o' with a slanted axis. If the axis of a letter is slanted, then the longest continuous mass is slanted as well [Figure 9, middle]. Other examples are letters containing diagonals, in which all letter strokes are drawn under an angle [Figure 9, right].

Figure 9.



The n, o, and v of the Bembo, illustrating that the longest continuous black mass is not always vertical. When the axis of a letter is slanted, then the longest continuous mass will probably be slanted as well. The rhythm under an angle is slightly thicker than the vertical strokes, according to Noordzij (2005).

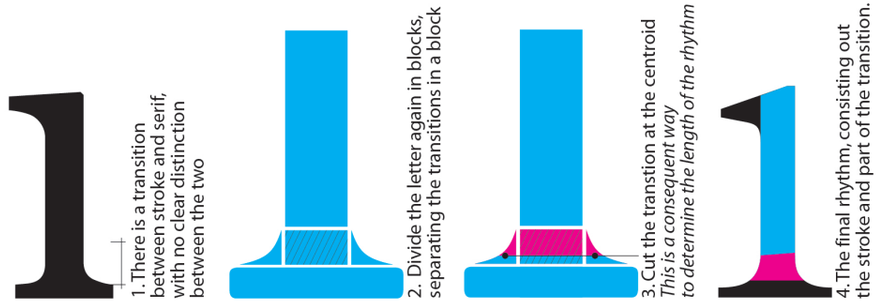
If the longest continuous black mass is positioned under an angle, the definition can be applied as before. But it is recommended to apply Noordzij's (2005) translation theory on the rhythm. Noordzij states that the width of a pen stroke differs depending on the angle you draw the line on. A stroke under an angle is thicker/thinner than a vertical pen stroke. When determining the rhythm under an angle, it is advisable to adjust the thickness of the rhythm according to the thickness of a calligraphic pen stroke.

Occurrence 3:
the end of the rhythm within non-demarcated crossings such as serifs

It often occurs that the transition between strokes and serifs is not clearly demarcated. In those cases, when the transition is unclear, the centroid (center of gravity) is the only mark that is present in any shape and engineers rely on this centroid for calculations on rounded/irregular shapes (Hibbeler, 2007: 10). It is positioned in the geometric center of the shape: if a shape is held by its centroid, it is in balance and will not turn around.

The centroid provides a consistent way to distinguish the end of the rhythm and the beginning of the serif. To define the centroid(s) within the transitions, divide the letterform again in blocks. Create separate blocks of the transitions between the stroke and the serif [Figure 10.]. Draw a dividing line between the two centroids.

Figure 10.

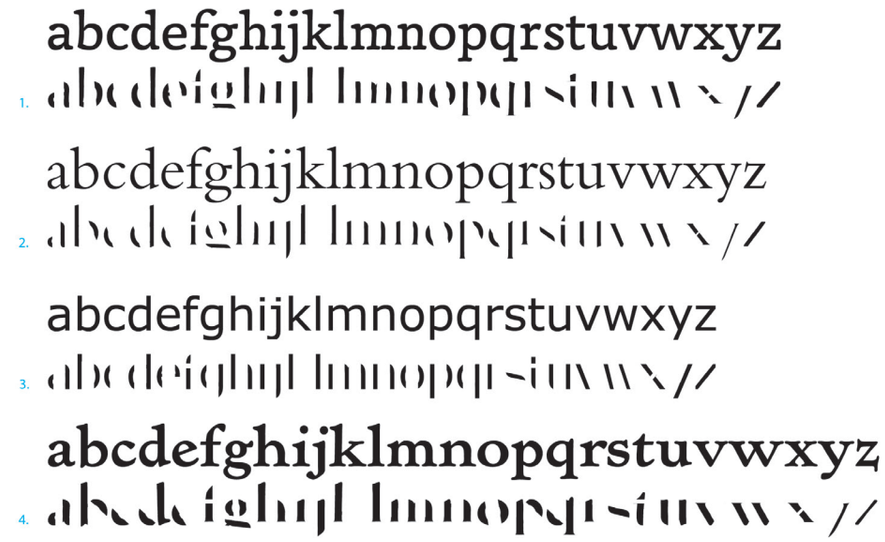


Drawing a line between the centroids on non-demarcated transitions enables the separation of serifs and strokes in a consistent way.

Figure 11 shows that the new definition fits on all letters. The only letters which for now behave as an exception are the letters 'y' and 'z'. In the letter y, the thinner stroke is always longer than the thicker stroke. In the letter z, that is sometimes the case, depending on the design. In these letters, the definition positions the rhythm in the thinner stroke, while the thicker stroke would be expected in accordance with the other 24 letters. At the moment, there is no information if the length of the stroke is more important than the thickness of the stroke; thus the letters 'y' and 'z' should remain treated this way till research provides more input.

Consequently positioning the rhythm in type based on the letters' longest continuous black mass

Figure 11.



The new definition of the rhythm is exemplified for several typefaces. The typefaces are shown with an equal x-height for comparison. Typefaces: Vivace (by Maarten Renckens), Bembo (Francesco Griffo), Verdana (Matthew Carter), AT Hariano (unknown designer).

The rhythm in future studies and designs

The new definition *'The rhythm in type is the sequence of the longest continuous black masses within the letters, in any direction'* provides a measurable position about the rhythm in all letters. With this knowledge, researchers are now able to evaluate the effect of the rhythm in type on the reading process more effectively:

- Accurately compare the possible formal features of the rhythm [Figure 6];
- And determine their influence on the reading process;
- Accurately compare the spacing, width, and height of the rhythm;
- And determine their influence on the reading process;
- And determine the minimal height of the rhythm before there is an effect on the reading process. A minimal height can be added as a threshold to the definition;
- Compare the rhythm of several typefaces, such as for example the evolution of the Old Style letter model with wider letters o's, versus the contemporary 21st-century letter model (as described by Gerard Unger).

Later, the results of these legibility studies should return to type designers in the form of guidelines explaining how the rhythm influences the reading process. Type designers generally assume that a regular rhythm is required for a visually balanced text but are often not aware that their design choices have an influence on the reading process. As long as the influence of the rhythm on the reading process is not fully studied, designers can only guess about the effectiveness of their designs.

Practical output of this definition is illustrated in the ongoing project *"Rhythm Influencer"* (Renckens, 2020a, Renckens, 2020b). This project aims to gradually implement knowledge about the rhythm in design tools. In its current iteration, this Glyphs plugin analyses the rhythm in letters via the black mass (at the moment of writing, it only supports vertical analysis). Based on the rhythm, the plugin is able to automatically sketch variations on a letter such as the regular, bold, extended, condensed,…

I invite other designers and researchers to challenge the ideas described in this article, to advance the knowledge about the rhythm in letters, and to develop more knowledge about the rhythm's influence on the reading process.

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Author

Maarten Renckens is a teacher and design researcher with a love for letters and a heart for people. Dealing with a reading difficulty himself, he is very interested in the reading process. His past projects include the typeface 'Schrijfmethode Bosch' (Writing Method Bosch) that learns children in how to write, and typefaces to encourage young readers and readers with hearing loss to read more expressively. With a background in architectural engineering, he is used to approach drawings mathematically. He applies this technical knowledge to unravel letterforms and to classify them in groups, in order to determine the effects of different letterforms on the reading process.

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