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Sidebearings analysis of alphabet letters with complex shape

ABSTRACT

Defining inter-letter space is important part of typeface designing process. The purpose of defining the letter space is to make them visually equally distant from each other within words, sentences and paragraphs creating an even value of grey, without darker or lighter areas. Different approaches for determining letter space were developed in order to facilitate this demanding process. Miguel Sousa (2006) and Walter Tracy (2003) proposes their spacing methods and in paper of De Melo Vargas (2007) and our previous work (Banjanin & Nedeljković, 2014) these methods were tested. The problems occur when defining space around letters a, f, g, s, t, z, and S, for which neither Sousa nor Tracy propose any kind of guidelines (except visual). The aim of this paper is to measure and analyse spacing values for these letters and to see if there is some kind of "formula" or some kind of guidelines which will broaden existing methods in more accurate way. We measured left and right sidebearings of these 7 problematic letters and established additional guidelines for defining letter space of those letters more accurately.

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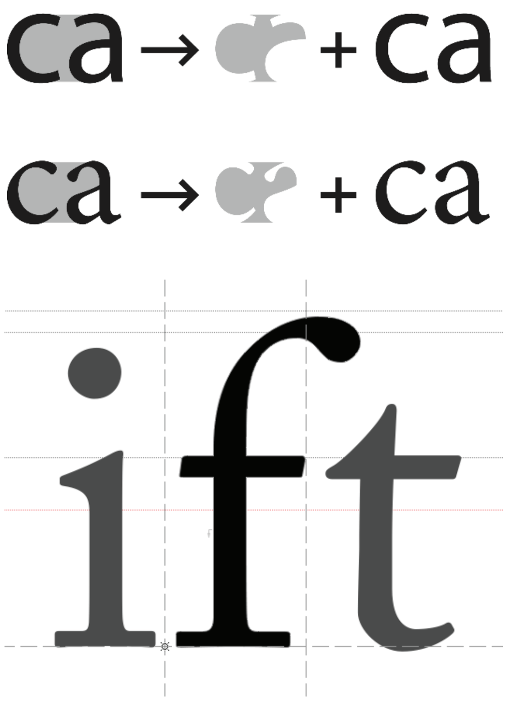
Introduction

Designing a typeface does not mean only defining the shape of letters, but also giving an appropriate amount of space around them. The purpose of defining the letter space is to make them visually equally distant from each other within words, sentences and paragraphs creating an even value of grey, without darker or lighter areas. Each letter is formed of black and white parts. The changes of these positive and negative letter elements throughout the text optically mix, creating a visual rhythm which assists the reader.

Inter-letter space varies from typeface to typeface and it certainly dictates the amount of space around the characters or their left and right side bearings (Cheng, 2006) (Figure 1b). Even though defining the letter space is in the final stages of design, depending on designer's eye and craftsmanship, there are some basic rules of spacing related to character shapes and counters that can be defined.

In the 1940s W. A. Dwiggins wrote in his letter to Rudolph Ruzicka that some rules for letter spacing can be established based on grouping the letters with similar shapes. For example, group with similar shape on one side of letters "n, m, h, b, d, q, k, i", both sides of the letter like "o" which defines amount of space for round shapes (c, e, a) and letters "f, g, s, t, z, S" which are hard to fit (Tracy, 2003). In the 1960s, David Kindersley presented a set of rules for spacing letters based on experiments involving transmitted light (Kindersley, 1966). Later on, guided by Dwiggins's hunch for existence of certain rules and with experience based on the principles that he learnt from Harry Smith of Linotype, Tracy developed a system for determining letter spacing for Roman alphabets.



a) b)

» **Figure 1:** *a) Letters and their inter letter spacing (counter). Sans serif font (above) and serif font (below); b) Letter "f" and its sidebearings*

Finding a proper rhythm between letters and their surrounding space is crucial to good inter-letter spacing. As Lo Celso (Lo Celso, 2005) said: "It seems an obvious assumption that rhythm is a constitutive element in type design, as understood under its sense of pattern and tendency to regularity".

Kaech (Kaech, 1956), proposed his method for letter spacing. He took letter "O" as reference letter for arranging the width of all other as well as for their inner spaces. He talks about "golden mean" and defines the quality of rhythm as a result of perfect relations between those measures. Kindersley also attempted several systems for spacing letters, by defining their "optical centres" through a photo-electric cell device, or by searching their "centre of gravity" by eye. He began with spacing capital letters "O" and "I" in string "OIIIO" and when satisfactory results was achieved, he placed all other characters into the place of second "I" and define their side bearings (Lo Ceslo, 2005).

Harry Carter suggested a method for spacing letters in witch counters in letter "m" and ligature "ffi" define an interval between all other strokes. The letters with double upright strokes (n, u, h, fi) should have a wider interval than m, and similarly, the whites of d,o,p are a little wider than the white in "n". Spacing of "m", "n" and "o" are the key to provide a proper spacing for all the other characters (Carter, 1984). In his method, vertical stems, in their condition of acting as units of a pattern, actually are to build up rhythm across the text line (Lo Celso, 2005).

Walter Tracy suggests his method of defining letter spacing taking into consideration inner letter space (counter). He started with capital letter "H", measuring space between two vertical stems and then give the left and right side bearing around quarter of that value (half of counter on letter "H" between two letters with vertical stems; e.g. "HH"). He set value of right and left side bearing in word "HHHH" and then put letter "O" between them and adjust its side bearings. When these values are defined (these are called standards) other characters receive their side bearings according to values achieved from standard letters. For small letters he starts with letter "n" defining its left side bearing value as half of its counter and right side bearing value as little bit less than left (because of its rounded right corner). Then he adjusted side bearings for letter "o" in word "nnonn", "nnonon" and "nnoonn". Amount of white space for other characters in alphabet are calculated according to values achieved from standard letters.

In 2005, Miguel Sousa developed a reliable spacing method while creating his serif typeface Calouste (Sousa, 2005). Miguel Sousa starts with defining letter spacing similar as Tracy but he does not give any strict "formulas" or values for letter side bearings. He divides letters in three groups:

- First group: b,d,h,I,l,m,n,o,p,q,u- left and right side of these letters are related to at least one side of letters "n" and "o"
- Second group: a,c,e,f,j,k,r,t – letters in this group have one side with similar shapes (and) spaces to letters of the first group
- Third group: g,s,v,w,x,y,z – these letters have no direct relation to any other character thus making them hard to space

Consulting values for left and right side bearings of previously set letters "n" and "o" he applied these values to characters that share similar shapes with those in first group. Then he put every character one by one from the second group into first group and set their side bearings through series of testing using his own web based tool adesiontext (available at www.adhesiontext.com). Than he repeat this procedure with every letter from the third group until satisfactory results are achieved. Relying on the mentioned spacing methods, Fernando de Mello Vargas compared and applied those methods in determining the letter spacing for serif typeface Minion and sans-serif typeface Myriad (Vargas, 2007). However, Vargas only tested these methods on one serif and one sans-serif font.

None of above mentioned methods give solutions for letters with complex shape such as "a", "f", "g", "s", "t", "z", "S". The aim of this paper is to measure and analyse spacing values for these letters in ten different serif typefaces and to see if there can be established some kind of “formula” or some kind of guidelines which will broaden existing methods in more accurate way.

Methods

Defining letter spacing for certain letters in alphabet can be hard and time consuming. Existing methods only give recommended spacing values for letters that have some similarities with letters called “standards” (“n”, “o, “H” and “O”). For letters “a”, “f”, “g”, “s”, “t”, “z”, “S” these methods do not give any guidelines except to visually space them between “standards”.

Starting from assumption that there could be some kind of instructions how to space these characters, we measured their left (LSB) and right (RSB) sidebearing values in ten different serif fonts. Sidebearing values are measured using software tool Fontlab Studio 5. These values are represented in relative integer values (called font units). Negative value means that certain sidebearing is drawn near to the letter beyond its endpoint on contour, so it is called negative sidebearing. We calculate average values for both left and right sidebearing and compare these values with average values of their left and right sidebearing values for their “standards”.

For example, we measure average sidebearing values for letter “a” for ten different fonts, calculate their average values (in font units) and percentage of average sidebearings values from its standard (letter “n”). Standards are chosen according to their structural similarity at both sides of letter. For comparing values of sidebearings for letters “a, f, t and z” letter “n” was used as standard; for letter “g,s”, letter “o” was used as standard and for letter “S” letter “O” was used as standard. Obtained percentage values were used to calculate sidebearing values for complex letters in each of those ten fonts relative to standard reference letter for each character in that particular font. These ten fonts were: Adobe Caslon Pro, Adobe Garamond Pro, Bodoni MT, Bookman, Century, Constantia, Droid Serif, Minion Pro, Palatino, Times New Roman. All ten fonts were in regular style.

Results and discussion

Average sidebearing values of ten serif fonts for examined letters are shown in table 1. For standard letters average values of sidebearings are also shown. As a result we calculate percentage of examined letter’s sidebearings compared to average values of standard letter sidebearings.

The aim of this paper was to propose guidelines or rough formula how to calculate sidebearing values of complex letters for which neither Sousa nor Tracy gives any specific suggestions, so we can use these values and calculate new sidebearing values. Negative value for RSB of letter “f” is due to its structure and fact that it has a large amount of white space on left side (Cabarga, 2003).

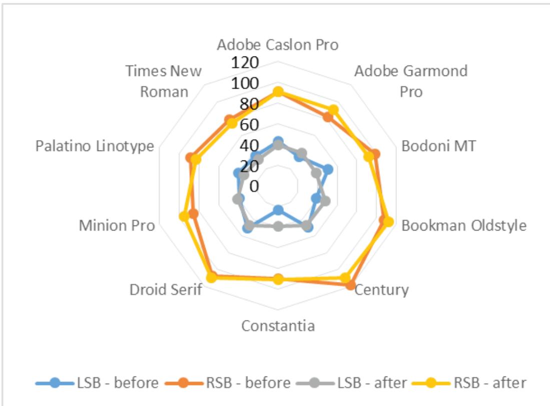
For example, RSB is indented to the left from right end point on outline for 81.1% of RSB values of left side on letter “n” in the specific typeface.

Table 1

Average sidebearing values for letters (a, f, g, s, t, z, s) from ten different fonts and calculated recommended sidebearing percentages

			Standards						Recommended sidebearing values	
	Avarage (from all ten fonts)		Avarage (for letter “n”)		Avarage (for letter “o”)		Avarage (for letter “O”)			
	LSB	RSB	LSB	RSB	LSB	RSB	LSB	RSB	LSB (% from standard)	RSB (% from standard)
a	40,5	95,1	102,1	90,7					39,67	93,14
f	28	-82,8	102,1	90,7					27,42	-81,10
g	31,4	6,6			38,5	38,7			81,56	17,05
s	42,4	37,1			38,5	38,7			110,13	95,87
t	21,8	12	102,1	90,7					21,35	11,75
z	28,5	23,2	102,1	90,7					27,91	22,72
s	51,6	44,1					45,7	46,1	112,91	96,50

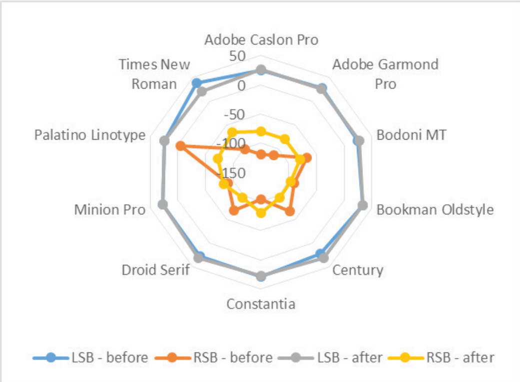
Applying these new percentage values for sidebearing values on tested fonts we manage to get results shown in Figure 2-8.



» **Figure 2:** *Sidebearing values for letter „a“*

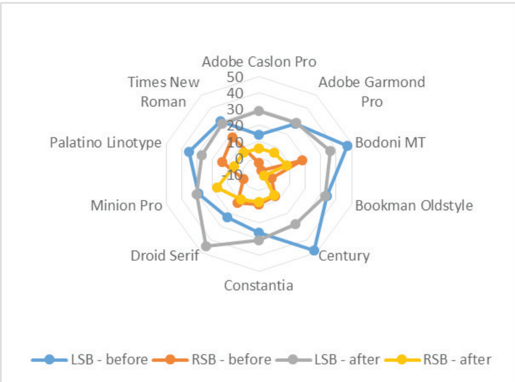
Here are shown differences in both sidebearing values (in font units) for these seven letters in all ten fonts. As we can see from Figure 2 new sidebearing values for letter “a” are similar to original ones. There are slightly more deviations for left sidebearing value in font Bodoni MT, Bookman Old Style and Constantia. Right sidebearing value is almost the same as original for all ten fonts.

In Figure 3 sidebearing values for letter “f” are shown. We can see that for right sidebearing value there is major deviations in almost all ten fonts (except in Bodoni MT, Bookman Old Style and Minion Pro). LSB value is almost the same for all ten fonts. There are slight deviations in fonts Century and Times New Roman.



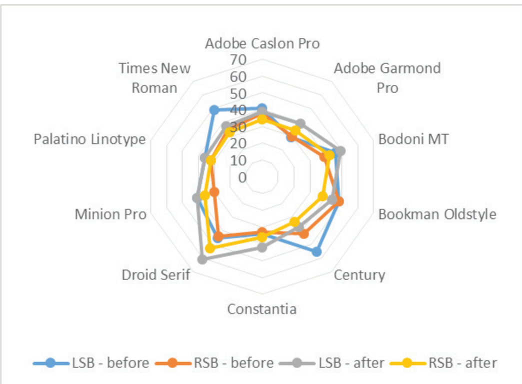
» **Figure 3:** *Sidebearing values for letter „f"*

In Figure 4 RSB values in only 4 fonts (Bookman Oldstyle, Century, Constantia and Droid Serif) are similar as original values. Other 6 fonts have major deviations from original ones. For LSB in half of tested fonts values are similar to original.



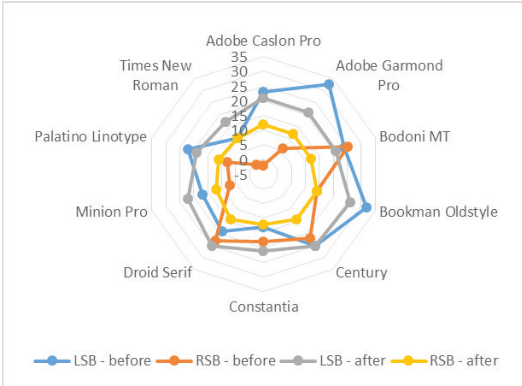
» **Figure 4:** *Sidebearing values for letter „g"*

For letter's "s" (figure 5) RSB values there are only slight deviations in Bookman Oldstyle, Century, Droid Serif and Minion Pro.



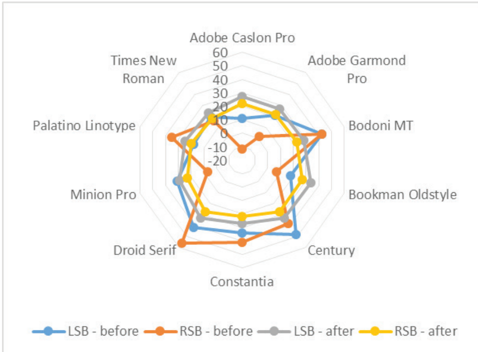
» **Figure 5:** *Sidebearing values for letter „s"*

Other 6 fonts have almost the same values as originals. For LSB values there are deviations in font Century, Constantia, Droid Serif and Times New Roman.



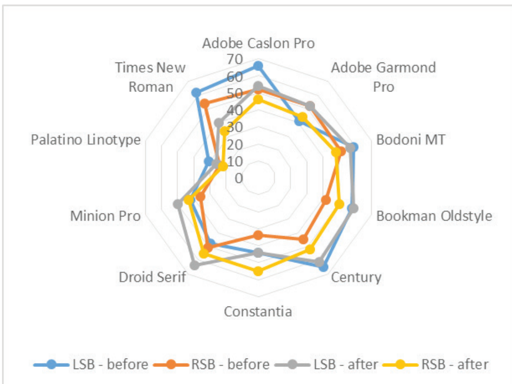
» **Figure 6:** *Sidebearing values for letter „t"*

In Figure 6 (letter "t") only for one font (Palatino), RSB value is similar to original. In all other cases there are major deviations. For LSB four fonts have similar values (Adobe Caslon, Bodoni MT, Century and Palatino).



» **Figure 7:** *Sidebearing values for letter „z"*

For small letter "z" (Figure 7) RSB values calculated are different in all cases except in font Times New Roman where this value is similar to original one. LSB value has major deviations in four fonts (Adobe Caslon Pro, Bodoni MT, Bookman Old Style and Century).



» **Figure 8:** *Sidebearing values for letter „S"*

For capital letter "S" (Figure 8) values for RSB are similar in all cases except in fonts Constantia and Times New Roman. For LSB values there are major deviations from original in three cases (Adobe Caslon Pro, Droid Serif, Times New Roman).

After obtaining numeric values we generate strings of text to see if there are visual inconsistences between original and calculated sidebearings. Some larger differences in letter spacing were detected and marked in Table 2. Greater inconsistences in LSB and RSB values are for letters "f" (right sidebearings), "g", "t" and "z" (right sidebearings) but when applied in text they are merely visible.

Conclusions

Due to absence of more accurate way to define sidebearing values for letters with complex shape (a, f, g, s, t, z, S) (Tracy, 2003) it was necessary to establish additional guidelines for defining letter space of those letters more accurately. We measured sidebearing values (LSB and RSB) for these seven letters in ten serif typefaces and assume that there is some kind of pattern for defining these values as it was case with other letters in alphabet (Tracy, 2003). Because Latin alphabet has uniform letter structure (skeleton) we assume that letters like these rely on their structure when defining sidebearing values in case of every typeface (e.g. letter "f" has the same structure (skeleton) in all Latin typefaces).

Table 2
Pangram sentence with all alphabet letters with original metrics values and calculated metrics values.

Adobe Caslon Pro	Original metrics	Sixty zippers were quickly picked from the woven jute bag.
	Calculated metrics	Sixty zippers were quickly picked from the woven jute bag.
Adobe Garmond Pro	Original metrics	Sixty zippers were quickly picked from the woven jute bag.
	Calculated metrics	Sixty zippers were quickly picked from the woven jute bag.
Bodoni MT	Original metrics	Sixty zippers were quickly picked from the woven jute bag.
	Calculated metrics	Sixty zippers were quickly picked from the woven jute bag.
Bookman	Original metrics	Sixty zippers were quickly picked from the woven jute bag.
	Calculated metrics	Sixty zippers were quickly picked from the woven jute bag.
Century	Original metrics	Sixty zippers were quickly picked from the woven jute bag.
	Calculated metrics	Sixty zippers were quickly picked from the woven jute bag.
Constantia	Original metrics	Sixty zippers were quickly picked from the woven jute bag.
	Calculated metrics	Sixty zippers were quickly picked from the woven jute bag.
Droid Serif	Original metrics	Sixty zippers were quickly picked from the woven jute bag.
	Calculated metrics	Sixty zippers were quickly picked from the woven jute bag.
Minion Pro	Original metrics	Sixty zippers were quickly picked from the woven jute bag.
	Calculated metrics	Sixty zippers were quickly picked from the woven jute bag.
Palatino	Original metrics	Sixty zippers were quickly picked from the woven jute bag.
	Calculated metrics	Sixty zippers were quickly picked from the woven jute bag.
Times New Roman	Original metrics	Sixty zippers were quickly picked from the woven jute bag.
	Calculated metrics	Sixty zippers were quickly picked from the woven jute bag.

This was a starting point for this research. These seven letters are defined as “letters with complex shape” or “problematic letters” because of their large amounts of white space (counters) around and inside of them. With defining proper inter-letter space, these large amounts of space can be reduced in order to achieve better visual rhythm of letter shape and their blank space. Analysing numeric values and figures 2-8 shown in previous chapter it can be concluded that only in cases of letters “a”, “s”, “z” and “S” our approach gave satisfactory results. Letters “g”, “f” and “t” appeared to have shape that is more liable to changes in some part of their structure (e.g. in terminals) throughout different typefaces. Letters “f” and “t” are also more opened and have larger amount of blank space on their right side. This varies from typeface to typeface in different length of upper terminal (letter “f”) and lower terminal (letter “t”). This is the main reason why these letters are hard to fit. For the letter “g” we did not except such differences in sidebearing values because of its closed structure. But one thing that was probably the cause of RSB inconsistence in values is also a terminal stroke in the upper right side of its structure. Length and shape of this terminal are different throughout typefaces and we assume that this had a great impact on our results.

But when values calculated in this paper are applied on letter sidebearings and shown in string of text only small amount of these inconsistences becomes visible. In pangram sentence (sentence with all characters of alphabet) in Table 2 only in certain letter pairs problematic inter letter space was detected.

So we can conclude that this method of defining guidelines for determining sidebearing values for these seven problematic letters can be a good start for further work on letter spacing and maybe a beginning of calculations and implementations of these calculations in automatic algorithm for defining font metrics. This calculations and suggestions can be added to existing methods in order to broaden them and to help typeface designer to speed up this process of defining inter-letter space.

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