

On calligraphy

and the remediation of poor handwriting

Calligraphy is often seen as a skill that some people do as a hobby but is generally not associated with the ability to improve a poor handwriting. Yet the understanding of calligraphy and letter design can assist remedial teachers to cure handwriting problems.

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Calligraphy did not exist in the past. This seems like a strange statement, because now a calligrapher typically is occupied with "ancient script types". In the past a writer utilised other writing tools (like reed pen, quill, dip pen) that are applied again by nowadays calligraphers. Yet writing was not seen as calligraphy. There were of course "master writers" who were specialised in drawing flawless letter forms, but everyone else used to write in a way we today call calligraphy (the art of perfect lettering). For some calligraphy has become an loaded term. They regard it as something from the past, and trying to make children write like that is "an old hat". Meanwhile we are faced with an increasing number of particularly poor handwriting skills, especially in the upper primary school, and it may be effective to look back at times when demands on handwriting were still high. The authors believe that anyone involved in improving handwriting skills actually should be able to write at a calligraphic level. Only then somebody is able to demonstrate how to write properly. Because writing properly is like calligraphy. Moreover, what you cannot do yourself you cannot teach others. To provide appropriate training it is important that the teacher is better skilled than the student. Only a well skilled person can judge the shortcomings of a student and is able to give the correct instructions. This principle is confirmed by research that concluded that only professional athletes are able to provide an accurate prediction of the quality of an athletic performance. (Agliotti et al 2008). We understand that not everyone has the opportunity to obtain the full calligraphic knowledge and skills, therefore two important interfaces between calligraphic work and improving handwriting skills are explored in this article. Both affect the design of letters. First the "construction aspects" and secondly the "pen-tip velocity".

Understanding calligraphy and the shaping of characters support the remedial teacher in improving the handwriting of pupils.



Constructions aspects

First the construction aspects. Looking at below handwriting sample (Figure 1) you will see that the first letter "n" differs from the second one in some respects.

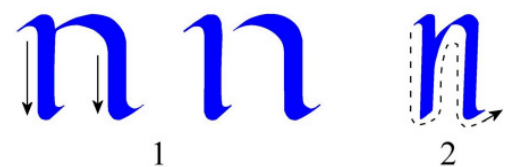


Figure 1

The first "n" consists of two separate stroke (both down-strokes), whilst the second "n" is made by a continuous motion (with an up-stroke between the first and second down-stroke).

The first "n" is wider than the second one (based on the circle as the basic shape).

In writing history, the first letter “n” is referred to as “formal script” and the second one is considered “informal”. Formal script is always “older”; informal script has been developed later as a more practical alternative. For instance: the second “n” takes less time to write, and takes up less space on paper. This also implies that writing it requires less hand movement. The formal script was used to write books (book script) and later to print books (F. van der Linden, 1983), the informal variant proved much more practical for normal correspondence (letter script) throughout the extensive ecclesiastical empire during the Renaissance. It is therefore logical that the informal script, using a single continuous movement, ultimately led to the handwriting script that most school children learn today. Both features, the continuous movement and the shape of the characters (being less wide than high) simplifies the writing by hand as is clearly shown from the handwriting of Elizabeth I of England, (Figure 2).

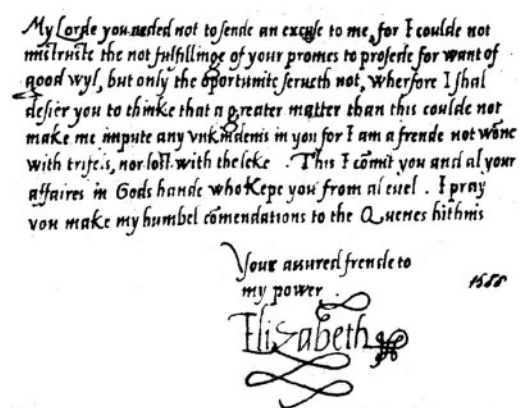


Figure 2
Letter written by Queen Elizabeth I of England (1566)

This script is also developed by the most skilled and professional writers of that time, those of the papal chancery, who each day filled many pages and had much insight into the economical use of the writing instrument. This script today is called the “italic” script referring to the country of origin, and is the most practiced script in today’s calligraphy. Because of the typical inclination of the characters, it is called “cursive” in the English language. The symbol “I” is used in text editors to indicate the inclined shape of characters.

Design aspects

Learning to write by means of a smooth, uninterrupted action of the pen is emphasised in group 3 of primary schools, whereby the focus generally is placed on the direction of writing (making sure that sentences are written horizontally). Another important aspect, the design of the individual characters, is given less attention. Therefore, this is one of the main causes of a poor handwriting. Although the direction of the handwriting is correct, differently shaped characters can be formed (Scholten/Hamerling 2007) (Figure 3).



Figure 3
Same writing direction but different characters

As described earlier, the formal script uses the circle as the basic form. Creating a perfect circle by hand is difficult, if not impossible. There is only one perfect circular shape, whilst many useful ellipses can be drawn. It is therefore easier for a child to write characters that are based on a narrower basic shape (Figure 4).



Figure 4
There is only one perfect circle. However, there are many useful ellipses.

The aspect ratio of the character body is preferably in the ratio 1:2, also because it is easier to explain this to children (Figure 5).

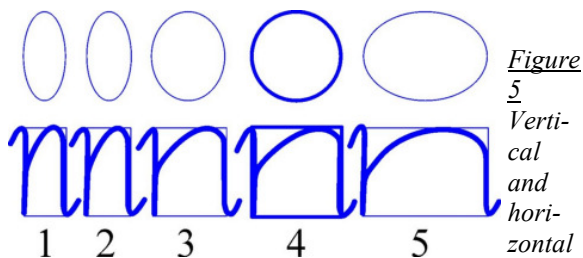


Figure 5
Vertical and horizontal shapes. The circle and the square (example No. 4) indicate the transition between both types. Example Nr. 2 indicates the correct width to height ratio.

Children are taught to apply vertical shapes as the basic form for their handwriting. Therefore, they must learn to consciously pay attention to this impor-

and effective execution of their handwriting. The fact is that in most primary schools the handwriting training in group 3 only focuses on the path of the pen tip, but neglects the design aspects of characters. When we teach children how to become aware of and influence the shape of characters, we can expect a substantial progress in the improvement of their handwriting.

The handwriting is also influenced positively, when the aspect (width to height) ratio of the character's body is made constant. It provides a certain tranquillity to the handwriting and also stimulates the use of identically shaped characters. Both aspects are important for good readability. Especially when the individual characters do not stand out it makes it easier to concentrate on the meaning of the written text. It is therefore important that all characters are created subject to the same design principles. Thus, 'invariance' is promoted: characters are increasingly formed out similar shapes. Of course, similar characters of a living handwriting will never be exactly equal. That is within the remit of computer and typography. But trying to apply the same basic shapes for character design and the same aspect ratio certainly helps. The earlier example of the two letters "n" focused to the differences. There is however an important form characteristic that is applied in both examples. It is the fact that pen strokes are made up by clearly distinguishable straight and curved line parts. Why is correctly executed print script legible? For a large part this is caused by a clear distinction between straight and curved line parts. The transition between a curved section and a straight one is obvious. One can identify exactly the point where a curved line becomes a straight line. Many poor handwriting examples suffer from this clarity as often all line parts are curved. This "lace loop" script, which is often taught by using musical motion methodologies, is the basis of many poor handwriting practices (Figure 6).



Figure 6
"Lace loop" handwriting and a well designed handwriting by using straight line parts.

Velocity of pen-tip

The second interface between normal handwriting and calligraphy concerns the behaviour of the pen-tip velocity. The Radboud University at Nijmegen examined this aspect for many years using a so-called xy-tablet that accurately measures the velocity at which the pen-tip travels during writing. We also referred to this in an earlier article "The World of the Young Child" [April 2002] in relation to "pen liftings" and "air tracks" formed by writing the unconnected script. The distance between dots on the curvature indicate equal time intervals (e.g. 1/100 second), which enables measuring the velocity of the pen-tip (Figure 7).

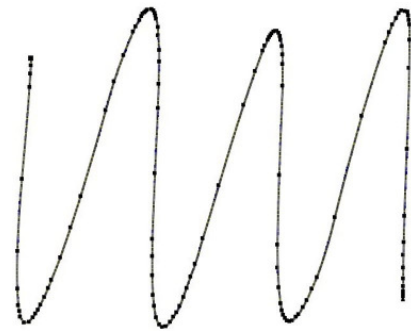


Figure 7
Time intervals (shown by the dots) of a ballistic movement are not equally spaced.

An uneven distribution of time intervals is most common. This phenomenon is called "ballistic movement". What does it mean exactly? A movement is ballistic when it is performed without any adjustment (FJ Maarse 1985). In relation to handwriting it refers to a non-uniform pen-tip velocity. Usually, moving a pen on paper consists of a certain starting speed followed by an increase of pen-tip velocity. The velocity of the pen-tip is at its peak when no changes in direction are required. It decreases very briefly at turning points, to speed-up again on the straight parts. The decrease and increase of the pen-tip velocity is clearly demonstrated in Figure 7, the lower velocity during curves is caused by the need to correct the direction of the pen-tip'. Usually the concept of ballistic movements assumes that "the motion is performed in its entirety". The word "ballistic" obviously refers to the term "ballistics", the science of mechanics that deals with the flight of bullets and missile. influenced anymore after the point of shooting or launching. s. The movement of the projectile cannot be influenced anymore after the point of shooting or launching.

1. <http://hwr.nici.kun.nl/%7Evvuurpijl/copywriter.gif> 3

2. Maarse, F. J. e.a. 1985 in Schrijfmotoriek in het hoofdstuk 'Computertechnieken in het schrijfontoerzoek en -onderwijs'.

More resources about graphic ballistic behaviour see the reference list at the end of this article. The books are marked with an *.

The energy has been consumed shortly after launching and during 'flight' no influence on the direction, size and speed can be exercised anymore. A clear example of graphic ballistic behaviour is placing one's signature. Gradually, the way signatures are placed has become an example of handwriting. Accepting this theory means that writing should be like placing a signature. During writing words should be created automatically. Placing a signature however has developed into a "motorial program", executed completely automatically. Bad handwriting is caused by an automatic execution of errors. Calligraphers, mastering a special kind of handwriting, also develop some automatic behaviour, but by controlling its execution correctly the pen-tip is moved at a constant speed. Next to the "formal calligraphy", utilising predetermined character shapes and forms, an informal calligraphy exists. The latter applies graphic ballistic behaviour. Writing is often paused between characters and, after a moment of concentration, the next character is placed rapidly and suddenly. This indicates a desire to control. However, this "ballistic calligraphy" usually is illegible or very difficult to read (Figure 8).



Figure 8

Ballistic calligraphy, the resemblance with placing a signature (and associated illegibility) is clear. This again shows the combination of ballistic writing and a lack of readability. For an eligible handwriting, effort must be concentrated on the management of the design process. This is not possible without a uniform velocity of the pen-tip. Children having a poor handwriting usually write ballistic. They therefore also have little or no control over the shaping of characters, because the movements of the writing hand are executed in an uncontrolled fashion. Earlier on the consequences of ballistic movement were demonstrated: the time intervals are concentrated at the curves, where speed is reduced, followed by acceleration on the straight parts. Hans-Leo Teulings (NICI 1988) therefore excludes calligraphy from the study of graphic ballistic movements for the following reason: "Calligraphy requires extensive visual feedback". This visual feedback (i.e. making adjustments) could only be obtained from a non-ballistic performance of the stroke.

Calligraphy in relation to the pen-tip velocity.

How does the calligrapher work, the master writer who resides on the far end of the skill spectrum? Calligraphers that produce the best designed characters, applying a regular form and aspect ratio and showing straight and curved line parts, move their pen as evenly as possible (Figure 9).



Figuur 9

The calligrapher is only able to exercise sufficient control over the design process by a very regular pen-tip velocity.

It is obvious that the calligrapher cannot write according to ballistic principles without adjustment. Where ballistic writers show an accelerating movement at the end of placing a character (or signature), the calligrapher reduces speed at that point in order to complete the character even better. The following figure shows that all time intervals are spaced evenly over the up and down movements (Figure 10).

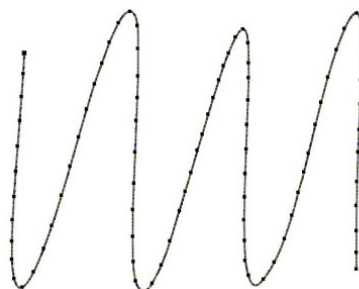


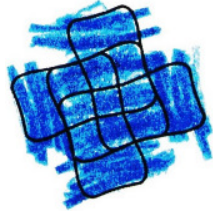
Figure 10

The time intervals (the space between the dots) of anti-ballistic movement are distributed evenly. The velocity now is continuous. This is called anti-ballistic writing, just to make it clear that this writing style is the opposite of the "involuntary" ballistic writing. Students have to be persuaded to adopt the anti-ballistic style through a process of awareness. It should now be clear that musical exercises cannot be used for this purpose, because these prompt a ballistic movement.

When we want to prepare children for writing by hand, alternatively for improving their handwriting, correctly executed colouring exercises provide excellent learning. In the article "Opportunities for distal graphomotor skills" (Journal of Remedial Teaching, October 2005) we wrote that these colouring exercises, using a colour-pencil, are very similar to writing.

Colouring the right way is a fantastic exercise for improving children's handwriting.

Provided that colouring is done by small circular movements, the size of the tip of a pencil. This way, the child is prepared to move its hand anti-ballistic, because of even movements of the pencil. This will also improve the technique of smooth colouring and also requires a better control of graphic skills. Without instruction children often tend to colour large areas by moving from the wrist, applying a ballistic windshield wiper motion. This makes it difficult for children to colour within the boundary of the drawing (Figure 11).



?????Figure 11
Ballistic colouring, 4 year old girl, the most common colouring style.

The up-and-down motion of the pencil is largely perpendicular to the boundaries of the drawing. Uncontrolled, ballistic movements cause the pencil-tip to cross these boundaries. However, when children move the pencil-tip in small circular motions they will cross the borders less often. This helps children to manage graphical techniques (Figure 12).



Figure 12
Anti-ballistic colouring, boy 3 years old, this way it is easier to colour within the boundaries of the drawing.

Analysis of the results of the anti-ballistic writing.

What is the result of anti-ballistic writing? Below are some results of adopting anti-ballistic writing by both children and adults. The exercise to achieve such a result will be describe later. All these examples show some remarkable and identical changes in the design of characters, words and lines.

de jonge beer loopt in het bos
de jonge beer loopt in het bos

Figure 13

1. This figure shows the result of practising the uniformity of pen-tip velocity. The first sentence represents the "normal" handwriting (boy 9 years). The second line represents the result after exercising the uniform pen-tip velocity, as described below.

ik zit lekker te schrijven
ik zit lekker te schrijven

Figure 14

2. This handwriting, belonging to an 11 years old girl, also shows a clear improvement of the design aspects. Interestingly, with the focus on a uniform pen-tip velocity, attention to the correct spelling deteriorates. For an explanation of this latter phenomenon see the article in JSW (Scholten/ Hamerling 2007)

Sint heeft een topje dat
Wat hij rij nu even zo schak
Sint heeft een lopen denken
Sint heeft een lopen denken

Figure 15

3. This figure shows the result of the same exercise executed by an adult, who was surprised to rediscover his original handwriting! Again, the line length is shortened, the size of the movements is smaller resulting in a more efficient action.

Dere pen schijft gewoon
Dere pen schijft gewoon

Figure 16

4. In this fourth example the director of a school first uses his normal handwriting and then writes anti-ballistic. Both the height of characters and the length of the sentence decrease. Also the width of the character body is less.

Following a brief instruction above results were obtained within a few minutes of training and doing a simple exercise. Also see the exercise described below.

What is the relationship between the above examples and a uniform pen-tip velocity? It is clear that the design of characters is more efficient :

1. The overall dimensions of the written sentence are smaller, both in length and height, with an almost constant body height; primarily the sticks and loops decrease in length.
2. The characters are designed more efficient shaped better.
The line length decreases. Therefore less hand movement.

Exercise in anti-ballistic writing.

How do you practice writing with a uniform pen-tip velocity and how can you experience this yourself to be able to better instruct students that need to improve their handwriting?

This is an example of an exercise. fig.17



Draw a circle with a radius of about 5 cm. Start drawing a curved line at the top of the circle:

1. without any flat parts
2. that does not touch itself nor the side of the circle
3. that changes direction continuously (clockwise or anti-clockwise)
4. that ends at the lower end of the circle.

Observe the pen-tip when drawing.

If you carry out this exercise carefully and not too fast, you will observe that the pen-tip velocity generally remains constant, because you are continuously anticipating the trajectory of the pen-tip. You must adhere to the "rules", the shape of the line is unknown in advance and this prevents you to move too fast. The result is a controlled, cautious movement that results in a much more uniform pen-tip velocity. This is exactly the only pen-tip velocity that gives control over the correct design of characters.

The goal of the calligrapher is an optimal control of the writing instrument, he/she knows intuitively that this can only be achieved by means of a regular pen-tip velocity. Therefore, a calligrapher writes anti-ballistic. Even when making private notes, the best results are achieved by applying a uniform pen-tip velocity. This is not necessarily a slow process. Gradually, the pace of writing is ac-

Writing is a delicate graphical skill that can only be applied successfully with sufficient practical control.



Figure 18

Even when chiselling characters in wood a uniform velocity of the chisel point is important to achieve properly designed shapes.

To get better handwriting results of your students, it is important to make them aware of the importance of a constant pen-tip velocity. Exercises, as described above may be very helpful.

At first you will find that writing this way will slow down the writing process. That is normal and also desirable to achieve the intended improvements. As more progress is made, it is possible to gradually increase the speed of writing such that the improvements of the design process remain. The speed of writing not necessarily needs to increase. Nowadays text editors are available to carry out fast and bulky writing needs. Children should first learn to shape characters properly. A well executed handwriting should concentrate on the correct design of characters, rather than focus on readability issues. If characters are designed well, the writing will always be legible.

Readability is a result and a bonus of correctly designed characters. No criteria are in place to judge "readability", but rules do exist for the correct design of characters. It is striking that CITO uses readability as an important key criterion in their research related to the Periodic Survey of the Educational Achievements (PPON), but they do not offer any standards for it. However, they use design criteria to assess the quality of handwriting (see "Less training, but a better handwriting" in January 2006 JSW page 18). Let us therefore be wiser than the CITO criteria, where only readability is used as a standard for good handwriting. To use readability as the sole standard for assessing handwriting results is similar to only concentrate on the correct results of arithmetic exercises. A school cannot develop a sound educational policy on this basis.

In addition to attention on the right trajectory, a handwriting may be improved greatly by focussing on the correct design of characters.



Conclusion

Apart from the attention on writing techniques, handwriting results can greatly improve when focussing on the correct design of characters. This has to do with the correct construction method of the lettering. Furthermore it also deals with issues such as straight and curved line parts, the width to height ratio of the character body, and the start and finish points within the individual characters. If improvement of handwriting is required the “ballistic” writing style certainly is undesirable and the “anti-ballistic” writing should be the goal. Two exercises for improving the awareness of anti-ballistic writing are available from the Script Development Foundation. Also a joint writing font as well as an un-joint writing font developed by the Foundation, requiring less hand movement, is freely available on request. This allows teachers to prepare acceptable didactic material for writing exercises.



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Literature

(Books marked with * discuss aspects of ballistic writing)

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