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► **To cite this version:**

Michael Haverkamp. Light, Color and Motion as Crossmodal Elements of Baroque Music. Forum Acusticum, Dec 2020, Lyon, France. pp.2099-2106, <10.48465/fa.2020.0021>. <hal-03234165>

HAL Id: hal-03234165

<https://hal.science/hal-03234165v1>

Submitted on 26 May 2021

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LIGHT, COLOR AND MOTION AS CROSSMODAL ELEMENTS OF BAROQUE MUSIC

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ABSTRACT

During the eighteenth century, the expression of multisensory content by means of music has been very popular amongst composers and audiences. This way of musical painting has been mainly applied within vocal compositions, but has also been applied in instrumental works. Its plausibility was already being discussed during that time, with a focus on aesthetical criteria. Literature contains a variety of analytic approaches regarding visual references composed by Johann Sebastian Bach, Georg Philipp Telemann, Antonio Vivaldi, and many others. Visual references increase the stimulation of emotions within opera music and the intended clarity of religious lyrics. Furthermore, the audible imitation of nature has gained increasing importance.

In regards to the high frequency of visual references, it can be concluded that these multisensory connections were well accepted not only by the experts, but by the majority of the listeners. Today, it is suitable to approach this topic from the perspective of perceptual phenomenology. Beyond the field of music, multisensory references gain increasing importance for sound design, which requires configuration of meaningful and intuitive signals.

Light, color and movement exemplify the use of crossmodal elements within compositions of the Baroque era. In particular, the musical expressions of lightning and thunder are analyzed with a view on the various perceptual strategies connecting the senses. Movement is a parameter of auditory Gestalt perception, and movement curves help to visualize its role for composition and music performance.

1. PAINTING WITH MUSIC IN THE EIGHTEENTH CENTURY

References to visual perception are of special interest in regard to research for understanding perceptual processes of music and sound. In general, the full meaning of auditory events can only be captured if all multisensory implications are taken into consideration. To its full extent, auditory perception includes more than what can be described by pure psychoacoustic parameters. Gestalt forming processes are interspersed with content for the other senses. In particular, auditory perception usually refers to visual elements, which are included by means of cross-sensory correspondences, associations and semantic

cues [1, 2]. Those references are continuously configured by the perceptual system.

Assessment of sound and music thus needs to include estimations of multisensory references. These references are also essential for sound design in order to establish meaning of sound. As an example, the motion of an electrical vehicle can be expressed acoustically by means of specific sound features which are precisely correlated to its movement. Therefore, the study of visual references used in music compositions is also highly beneficial in regard of numerous sound applications for daily life.

During the eighteenth century, the expression of multisensory content by means of music was very popular amongst composers and audiences [3]. This method of painting with music was mainly applied within vocal compositions, but has also been applied in instrumental works. Its plausibility was already discussed during that time, with a focus on aesthetical criteria (e.g., by Mattheson [4]). Literature contains a variety of analytic approaches regarding visual references composed by Johann Sebastian Bach, Georg Philipp Telemann, Antonio Vivaldi, and many others. Visual references increased the stimulation of emotions within opera music and songs (e.g., "Oden"). The expression of affects was a major task to enhance empathy of the listeners. Furthermore, according to the philosopher Christian Wolff, religious lyrics required a specific clarity of expression and illustration of the words [5]. In addition to cantatas and oratorios, this was particularly important for passion music. It is exemplified within oratorio passions by J.S. Bach (e.g., St. Matthew and St. John Passion) and G.Ph. Telemann (e.g., Brockes Passion). This also applies to the many responsorial passions composed by Telemann, which are strictly based on Bible lyrics in contrast to the free text of oratorio passions. The approaches of both composers, however, are quite different: J.S. Bach applies a "mathematical momentum," whereas Telemann demonstrates a "sensualistic trait" [5].

Exemplification of God's working (divine providence) in sacred music gained particular importance in the context of physico-theology in the Age of Enlightenment. It required an audible imitation of nature. As a consequence, the expression of nature in music gained increasing importance during the eighteenth century [6]. In addition to church music, references towards nature were used to illustrate programmatic aspects of orchestral

works. Some examples can be found within overtures/suites by Georg Philipp Telemann, “Die Schöpfung” by Joseph Haydn or “Le portrait musical de la nature” by Justin Heinrich Knecht. Such references have also been included in chamber music, for instance, works by Heinrich Ignaz Franz Biber, Antoni Vivaldi, Jean-Philippe Rameau and many others. Overall, the naturalness of musical expression was seen as a significant criterion of aesthetic appearance.

Various debates regarding the extramusical content of compositions have focused on the question of whether painting with music should imitate nature or must be limited to an illustration of emotions. A connection of both aspects circumvents the debate. For example, a motif that sounds like a tempest is equally capable of reflecting a storm of emotions. Similarly, the motif of tears used by J.S. Bach within his St. Matthew Passion acts as both a physical description of falling tears *and* an expression of intense feelings, as shown in Figure 1. In analogy to the text, this motif is intended to stimulate the listener’s empathy with the suffering of Jesus.

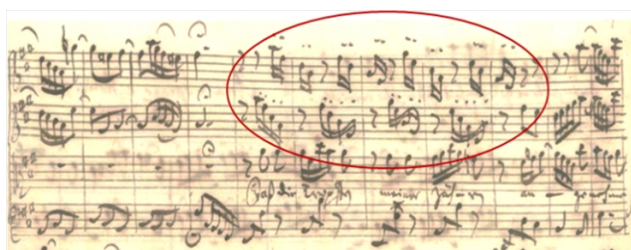


Figure 1. Motif of tears as a physical description of falling tears *and* expression of emotion. J.S. Bach, St. Matthew Passion BWV 244, Aria, Alto.

Regarding the high frequency of occurrence of visual references during that era, it can be concluded that such multisensory connections were well accepted not only by the experts, but by the majority of the listeners.

To find more clarification of the different processes of crossmodal connection within the perceptual system, a simplified model was introduced by the author in 2004 [7]. This schema is shown in Figure 2.

Note: In this paper the terms *sense* and *modality* are used as synonyms. The same applies for *cross-sensory* and *crossmodal*.

Common intuitive processes are shown as the three middle blocks of the diagram shown in Figure 2. Mathematical and physical connections are often used to intentionally configure relations between specific parameters of stimuli. This is beneficial for audio-visual applications and multisensory arts. It can either mean to correlate physical parameters like frequencies of sound and light, or to assign further visual parameters to parameters of sound. The last-mentioned requirement is typical for computer application software which

accompanies music with abstract visualizations (media players).

During the process of perception, involuntary, individual sensations of visual elements can be caused by auditory stimuli in the case of genuine synesthesia. Those phenomena are limited to a rather small number of persons, but show fixed relations of specific parameters—for example, pitch to color—and long-term constancy.

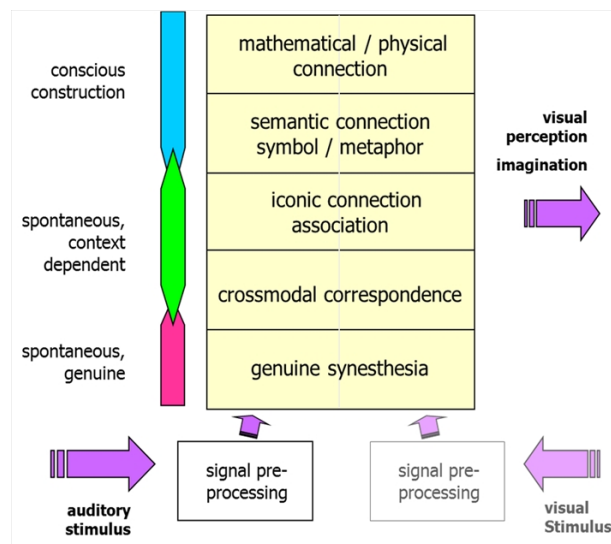


Figure 2. Layer model for taxonomy of cross-sensory connections within the perceptual system. An auditory stimulus can thus trigger visual sensation via five main processes. Main connections for visual aspects of music are based on correspondences, iconic references and semantic aspects [7].

In fact, the word synesthesia has already often been used with a somewhat extended meaning. In these cases, it covers all possibilities, as shown in the diagram. Primarily, painting with music makes use of cross-sensory correspondences and associative (iconic) content. This can be exemplified by the analysis of musical expressions of lightning and thunder, as explained below. The cross-motif that appears in passion music by J.S. Bach, however, shows that even symbolic content serves for interaction of the senses.

The aforementioned intentional and abstract way of connecting the senses, however, was not used for music painting during the eighteenth century; it became more popular in the beginning of the twentieth century. Since then, it has frequently been used in the other direction: painting images that express the auditory or formal content of music. In this manner, compositions by J.S. Bach were considered as to be especially suitable for visualizations based on mathematical schemes [8].

Note: Approaches to depicting music (auditory-to-visual) are often named *music painting*, or *musical graphics*. This proceeding shall not be mistaken for the *painting*

thunderstorms had to assume that lightning and thunder would appear independently from each other. This is in line with frequent experiences of daily life, when thunder can be perceived without lightning, and vice versa.

3. VISUAL COLOR VERSUS SOUND COLOR

The assignment of musical tones to visual color was intensively discussed during the Baroque era.



Figure 4. Georg Philipp Telemann: Description of the color organ of Louis-Bertrand Castel, cover page (top). Approach for reconstruction of Castel's color scale that he applied to one octave (bottom).

In Paris, the Jesuit Father Louis-Bertrand Castel developed a concept of a color organ, the "Clavicin Oculaire." Even at that time, this instrument attracted international interest, which is proven by the fact that G.Ph. Telemann published a euphoric report regarding Castel's approach [10]. Figure 4 shows the cover sheet and an attempted reconstruction of the color scale based on verbal descriptions. Telemann met Castel during his Paris journey in 1737-38. Nonetheless, it remains unclear whether or not he really had the opportunity to attend a demonstration of the famous instrument. Today, it has not been proven if Castel's approach was actually more than pure conceptual thinking and resulted in a playable device.

There appears to have been a wide assignment of tone pitch to visual color. It was intensively elaborated on during the nineteenth and beginning of the twentieth centuries. Detailed information can be found in Jörg

Jewanski's comprehensive study [11]. Even today, the fascination of the correlation of music and visual arts has not been lost [12].

The expressive timbre of music instruments is an essential base of colourfulness of music and thus a prerequisite of the Baroque "painting with music." During the eighteenth century, the expression of multisensory content by means of music has been very popular amongst composers and audiences. In vocal compositions, references to the other senses served to enhance the clarity of the message and to foster the emotional involvement of the audience. In instrumental works, key aspects are the *naturalness* of expression and the *language likeness* of musical phrases. The music had to transfer emotional content, the *affects*. References to the perception of color underlined the different types of emotion. In this manner, François Couperin explicitly defines a connection of color and music in his "Folies françaises, ou les dominos," included to his Troisième livre de pièces de clavecin, printed in 1722 [13]. The music of each piece refers to an imaginary persons camouflaged by a domino, but clearly characterized by its color.

More often, timbre itself was used to communicate mood and emotions. Timbre can be understood as the color of a tone. This *tone color* plays an important role in the music of the eighteenth century. It is conveyed via distinct timbres of solo instruments (German: "Spaltklang") or by coloring string instrument sound with wind instruments ("colla parte"). As an iconic reference to visual sensation, particularly to color, it is a very important factor in painting with music. For that purpose, instruments have intentionally been chosen according to the required expression. This results in a specific sound symbolism, which was well understood by contemporaries. Some examples of such symbolism in case of church music are listed below as applied by J.S. Bach for his cantatas [14, translated by the author from the German booklet text]:

- trumpet: symbol of majestic dignity and annunciation
- woodwinds: the divine in human point of view
- traverse flute: imitation of Christ
- oboe and oboe d'amore: domain of mankind
- violin: praying glance of mankind to God
- viola da gamba: lamentation

In order to enhance the potential of the instruments towards an expressivity which is comparable to that of the human voice, several ways of variation from tone to tone have been recommended. The irregular execution of tone series should include:

- rhythmic *inégalité* with variation of tone duration
- different sounds of intervals and chords, due to usage of different scales, which were not equally tempered
- variable articulation, such as 'd', 't', 'k', 'g', 'r', etc.

Baroque woodwind instruments show a high variability of timbres from tone to tone. This also contributes to the language-likeness of expressive performance. A subjective and an objective comparison of various flutes is the topic of an enhanced project. Results will be published soon. Figure 5 shows one of the instruments investigated.



Figure 5: One of several instruments investigated for timbre variations. Baroque F-recorder after Pierre Jaillard Bressan (1663-1731), boxwood, build by Stephan Blezinger.

The methodology applied includes a shift of all tones of each instrument to a standard pitch. The timbre change caused by alteration of the spectral pattern can thus be compared subjectively. Attack and decay phases are removed from each tone. The frequency shift is processed in the time domain. Faulty distortions of timbre are thus minimized. Furthermore, the signal magnitude is normalized. In this manner, a *timbre profile* of all chromatic tones is prepared. It is used for both, subjective comparison and spectral analysis (Figure 6).

The spectral comparison from tone to tone shows a strong variation of the patterns of partial tones, which is clearly audible as a variation of timbres. This can be further understood with view at the various types of spectra which occur. In case of the Late Baroque recorder, four principle types can be distinguished. Some tones show a dominant f_1 , e.g. the lowest tone of this recorder. The fundamental f_1 , however, is present at each tone, but is usually supported by a variety of harmonics which clearly differentiate the flute timbre from a pure sinusoidal tone.

Some spectra show a wide spread of seven or more strong partial tones. This behaviour generates a smooth, string-like timbre. As an example, the spectrum of a violin tone is characterized by a high number of harmonics with slightly decreasing magnitude towards the higher partials [15, p.74]. Typical examples are here observed at $f_{is'}/F_4^{\#}$ and c''/C_5 .

The most typical behaviour of a Baroque recorder with its inverted conical bore, however, is characterized by protruding uneven-numbered harmonics f_1, f_3, f_5 and f_7 . This spectral feature is well known from organ pipes with closed tube, named "gedackt" or "gedeckt" (German for "covered") [16, p.252].

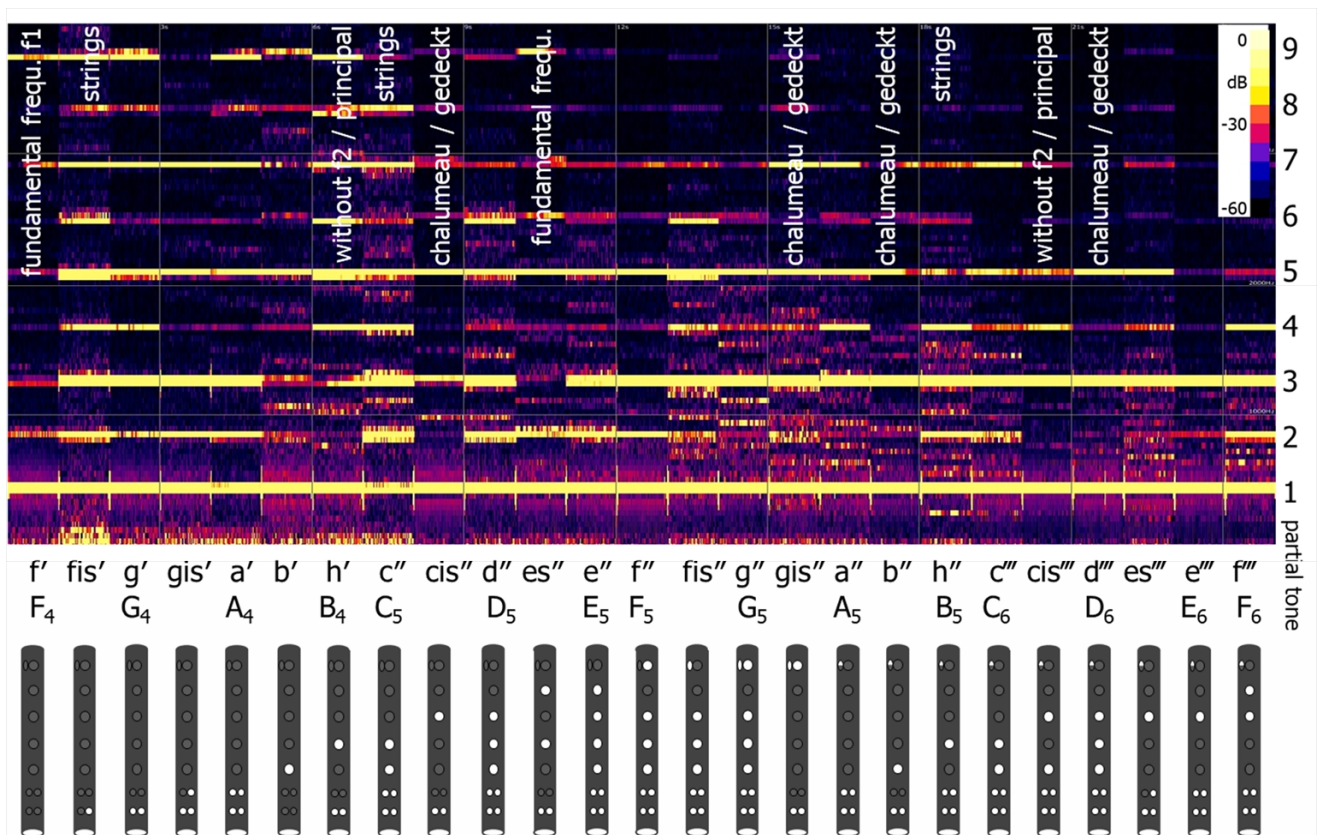


Figure 6. Timbre profile of the baroque recorder after Bressan ($a^1=415$ Hz) shown in Figure 5.

This is also typical for the lowest register of the clarinet [15, p.65] and for its Baroque variant, the chalumeau. The chalumeau-like behaviour occurs at many tones of various instruments which have been studied. It can be concluded that it is a determining feature of Baroque recorders.

At some tones, the spectrum shows a homogenous group of partials, but without f_2 . This type is known from the open organ pipes of the “principal” stop [16 p. 252]. The principal manifests the typical sound of the acoustic organ.

The observed timbre variations are not only a result of period limitations of instrument making. A variation of timbre from tone to tone seem to especially fit to the overall aesthetics of the music. It is beneficial to make the performance more colourful and expressive with view at the required language-likeness and naturalness of Baroque music.

4. MOTION AND BODY MOVEMENT

In addition to visual features like brightness and color, sounds correlate well to motion. On the one hand, this includes imagined or performed body movement. Such body movement can be dance, handling of musical instruments or gestures used for conducting. On the other hand, movement is a parameter of the perceived auditory Gestalt. This enables numerous prospects for musical performance, which were widely used during the Baroque era. Musical expression thus comprised both real body movement *and* the affective movement of the mind. The connection of auditory perception and emotion is triggered by crossmodal connections between hearing and vision, furthermore supported by interoceptive gut feeling and sense of balance.

As an example, an illustration of the circular movement of a sword can be found in Johann Heinrich Schmelzer’s Balletto a 4 *Fechtschule* ("fencing school") G-dur, composed in 1668. It is remarkable that the revolution of arm and sword is intuitively understood by listening to the music. Interestingly, this circular movement is expressed by the music, which in general is understood as to develop on a linear time axis, without any possibility to “move back,” like the arm of the swordsman.

Many more examples of visual expressions can be found within the music of the seventeenth and eighteenth centuries:

Georg Friedrich Haendel’s alto air no. 6 from the oratorio *Messiah* (“But who may abide the day of His coming ... ?” HWV 56, 1741) illustrates the movement of blazing flames, according to the lyrics: “For he is like a refiner’s fire.” The related metaphor refers to a blacksmith

working on the refinement of metal, representing that God is suspected to refine the soul.

Music is also capable of supporting the imagination of invisible processes. G.Ph. Telemann plausibly proves this thesis by composing the movement of planets for his Oratorio on New Year’s Day, TVWV 1:745. The “celestial mechanics” are envisioned by the bassoon, which accompanies the bass singer with a continuous sequence of rotational elements. The lyrics directly refer to this movement and to its presumed originator: “Who whirls the fiery race of the sun? Who drives the stars sometimes forth, sometimes back?” (original in German).

A similar approach for expression of high dynamics of movement is used in the aria presented by the deity of shepherds Pales in the “Jagdkantate,” by J.S. Bach: “Was mir behagt ist nur die muntere Jagd” (Hunting cantata, “The lively hunt is all my heart’s desire” BWV 208). An excerpt of the autograph is shown in Figure 7. Here, semiquaver figures and wide tone jumps of the solo cello indicate the clopping of a sheep flock. The music thus illustrates the metaphor of industrious people working for the well-being of the sovereign Christian von Sachsen-Weißenfels, the addressee of the composition.

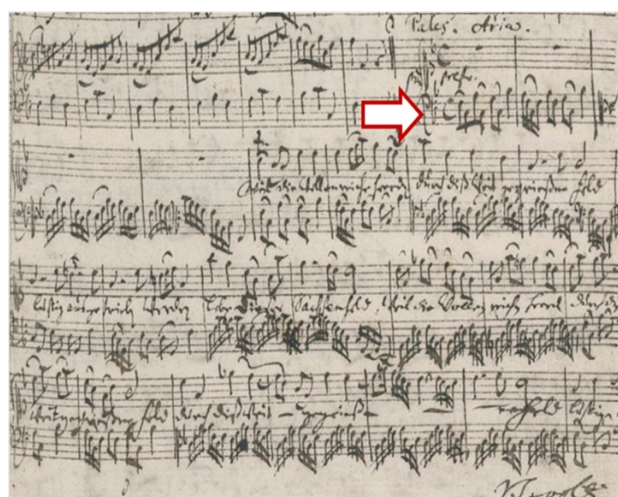


Figure 7. J.S. Bach: Hunting Cantata “Was mir behagt ist nur die muntere Jagd” BWV 208, Aria no. 13, with the lyrics “Weil die wollenreichen Herden durch dies weitgepriesene Feld lustig ausgetrieben werden, lebe dieser Sachsenheld; ...” (“While the flocks rich in wool through this widely honoured field are joyfully driven, long live this hero of Saxony!; ...”) The arrow marks the beginning of the cello solo.

In contrast to the aforementioned illustration of the celestial mechanics by G.Ph. Telemann, however, Bach’s composition includes onomatopoeia as a reference to associations of former hearing experiences of the listener. Telemann needs to base his approach exclusively on

visual references, because his task is to illustrate a process of absolute silence.

After the Baroque era, throughout the nineteenth and twentieth centuries, the relation of music and body motion gained great popularity. From a view of music practice, this is plausible due to the fact that performance has always been closely connected to body movement. It occurs while playing instruments, using gestures while singing or conducting, and with regard to dance. During the last decades of the nineteenth century, however, in the course of developing music psychology, it became clear that music furthermore communicates the aforementioned Gestalt parameters of movement. These parameters are not necessarily correlated to real physiological motor activity, but they contribute to the Gestalt formation and emotional effect. Such aspects of motion are thus of specific interest for processes of musical perception as well as for interpretation of musical scores, because they support a "natural" phrasing and expression. Aspects of naturalism gained major importance during the eighteenth century because nature provided the ideal for and was seen as a benchmark of aesthetic quality [6].

The musicologist and educator, Alexander Truslit (1889-1971), provided important contributions to the search for relations between body movement and music interpretation/perception.

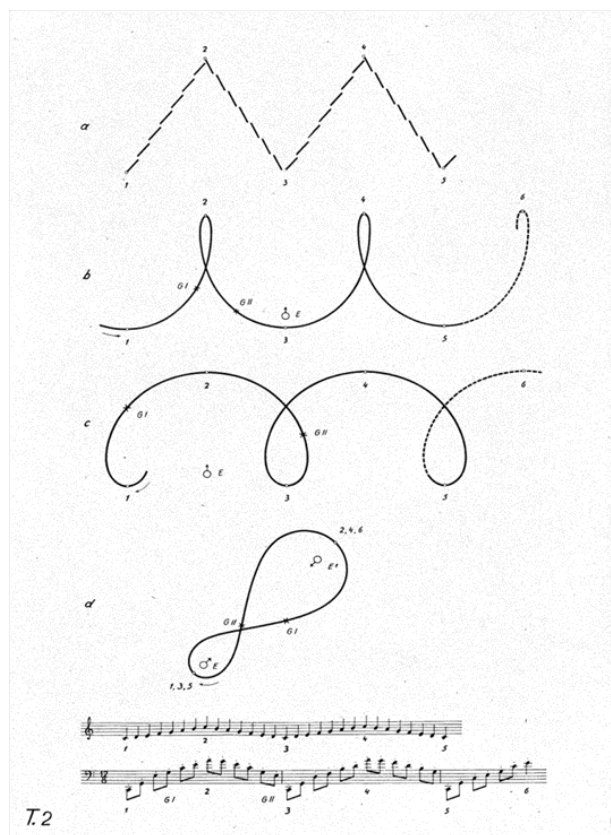


Figure 8. Basic forms of movement curves by Alexander Truslit with one "unnatural" (a) and three "natural" shapes of movement (b-d) [17, plate 2, inverted to black lines on white background].

He focused on the evaluation of general principles of music perception, composition and performance. A specific system of visualization of music movement has been developed and is based on drawn movement curves. This system is of specific interest to the description of motion elements incorporated into the music and will now be further explored.

In 1938, Truslit published a book that describes the essentials of his approach [17]. Numerous visualisations on separate plates and music examples on shellac-discs illustrate the practical application of his findings. All types of movement that are appropriate for interpretation can be reduced to three basic forms: *open*, *close* and *winding* ("offene, geschlossene, gewundene Bewegung," Figure 8 b-d). If tones are simply strung together without any specific phrasing, as instrumental beginners often do, there is neither a smooth movement curve nor a performance worth listening to.

As an example for by Truslit's approach, Figure 9 shows a movement curve with an *open* shape of movement for interpretation of a piano piece by Carl Philipp Emanuel Bach. This movement curve is meant as an instruction for the player to apply optimum phrasing. The curve should be evaluated by practical experiments with real body motion in order to find the most appropriate method of movement. Subsequently, this optimum movement shall be applied to the interpretation during the performance. This requires imagination of the music movement, but is not necessarily connected to real body movement.

Movement is thus transformed from real body movement to virtual movement as an essential feature of auditory Gestalt perception and imagination.

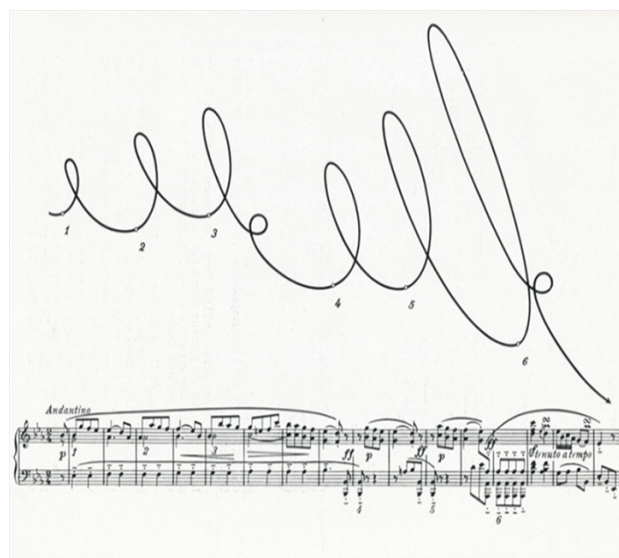


Figure 9. Movement curve by Alexander Truslit with "open shape of movement" for performance of the Rondo Eb major Wq.61/1 by Carl Philipp Emanuel Bach (1714-1788). [17, p.149]

5. CONCLUSION

From the Baroque era to today, the inclusion of multisensory references into music has been and still is very popular, and the expression of affects and natural phenomena still play an important role. The possibilities to achieve a music performance which is intuitive to the listener can be understood with the various strategies of the perceptual system to connect perceptual content of the different senses. Recently, individual phenomena like genuine synesthesia have become a topic of research.

In order to enable a broad acceptance of painting with music by the listeners, it is not sufficient to refer to the visual field during the process of composition by means of those individual connections. Instead, an expanded term of synesthesia needs to include common forms of perceptual connections between the modalities, such as crossmodal correspondences, associations (iconicity) and semantic cues.

During the Baroque era, correspondences of light, color, and motion to the music were frequently used. Additionally, onomatopoeia were included to establish connections of music to sounds known from daily life. Specific attention was paid to natural sounds, because nature was recognized as an ideal for aesthetic quality.

Multisensory analysis is beneficial to better understand the effects of music on the listeners. Furthermore, it provides essential tools to find new approaches for sound design.

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