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New Cross
London SE14 6NW
United Kingdom

STRUCTURAL AIDS TO THE COGNITIVE PRACTICE OF MUSIC: GRAPHIC OR VERBAL ANALYSIS?

Reinhard KOPIEZ
Technische Universität Berlin

Two different methods of learning were compared in an experiment: group A, composed of 12 guitar students, learnt a piece by heart in a purely cognitive way, using a verbal analysis aid, and group B, likewise composed of 12 guitar students, learnt the piece cognitively with the help of a coloured graphic analysis. The findings show that the B group, using the non-verbal coloured graphic analysis reached a higher standard in the second of two consecutive learning phases. We therefore conclude that the traditional kind of verbal analysis does not effectively support the efficient learning of a piece of music by heart. This could open the way for musical theory to develop other kinds of analysis that promote better learning by musicians.

INTRODUCTION

The studies conducted by Oscar Raif in 1888 and first collected and published in 1901 as *Dexterity on the Piano (Über Fingerfertigkeit beim Clavierspiel)*, are still widely considered as the essential starting point for any excursion into the realms of instrumental teaching theory. But apart from the historical significance Raif's work has accrued, present research situates his experiments in a new and important context: Raif was probably the first person to question in print whether the limits of technical performance were in fact determined solely by the nimbleness and agility of a player's fingers, and the first person to highlight the importance of an overall mental grasp of the score in contributing to a better performance. His works' innovative approach lay in the stress it placed on dexterity of performance being primarily determined by internal, not directly perceivable, cognitive processes — a highly unusual idea for an époque when the "industrial work ethic" (Wehmeyer, 1983) had saturated all domains of life, including that of instrumental teaching practice. Raif discovered that there was no significant difference in manual dexterity between musicians and non-musicians, since both groups were capable of striking the same number of touches per second.

Thus for Raif (1901) blocks or inhibitions during a musical performance are the result of impaired cognitive processes which teaching practice should aim to correct: "[...] we aim to promote mental not

manual agility among the students of our piano class" (p. 68). The ultimate aim of such teaching practice was to facilitate the learning and performing of a piece by heart; in short, to strive for a true grasp of the music. But unfortunately he stops short of drawing practical conclusions for instrumental teaching practice from his theoretical considerations.

Boekelman (1895) is more concerned with the technical aspects of learning music in general and learning a piece by heart in particular than with the experimental side. He selected a number of fugues from J. S. Bach's *The Well-Tempered Clavier* and by the use of different colours and differentiated note forms rendered the theme structures graphically clear to the eye. The construction of each particular fugue was made apparent as follows: the leading theme (Dux) and its accompaniment (Comes) are coloured red, interludes are coloured black, the third theme is drawn in triangular notes, diminished themes are drawn with smaller notes, augmented themes with larger ones, and so on. Boekelman (1895) uses a total range of 12 different marking aids. (Unfortunately, for technical reasons, we are unable to provide an example.) Aimed at the enquiring amateur musician, his book is equally intended "for use in music academies and by the autodidact" (preface). Boekelman further indicates in the preface what he plainly considers to be the "proper" sequence of steps to be taken in order to learn one of these fugues: (a) a firm grasp of the construction, (b) practice on the actual instrument. First of all the composition should be read several times in the study, with the coloured markings of the individual parts serving as guides to the understanding of the structural organisation; only then may one safely turn to the "purely technical" (or "motoric") aspects. He predicts that his method for the cognitive learning of music will save a considerable amount of time when compared to that of mere repetitive motoric playing.

The idea of learning a piece in a purely cognitive manner, without recourse to the actual instrument, gained further ground in the twentieth century with the publication in 1931 of *Modern Piano Playing* (*Modernes Klavierspiel*) by Leimer and Giesecking. However their approach to structural presentation stands in direct contrast to the graphic structuring method favoured by Boekelman. Although both methods posit the same aim — to memorise music before turning to the instrument — Leimer and Giesecking avoid any reference to graphic structuring methods and rely heavily instead on traditional methods of verbal analysis. Giesecking, who had been a pupil of Leimer's from

1912-1917, was largely responsible for promoting this method, since he was greatly admired during his lifetime for his exceptionally wide repertoire and phenomenal musical memory, which he readily attributed to the soundness of the method he had developed along with Leimer. The kernel of the method lay in "reflexion (systematic logical thought)" (Leimer/Giesecking 1931, p. 12) which is continuously exemplified throughout the book. For our purposes, however, let us restrict ourselves to the opening of their analysis of the *Two Part Invention in C Major* by J. S. Bach which gives a clear indication of how they conceived the process of cognitive learning:

First of all let us get our bearings on time and key: 4/4 and C Major. The motif begins at the second sixteenth and consists of 4 ascending scale-shaped bars, two ascending thirds, and terminates by a leap to the fifth. (...) The motif appears after the third crotchet in the lower register; simultaneously, in the upper register as counterpoint we have in quavers: c'' b' c'' d''. The motif is repeated in the second bar of the upper register from g' onwards — thus we have g' a' b' c'' — a' b' g' — leap to the fifth after d' (Leimer/Giesecking, 1931, p. 19)

Our own study is primarily geared to the practical perspective of a musician or music student who wishes to learn a piece a) in the shortest possible time, b) with the minimum number of mistakes. It forms part of a larger project which aims to examine various music-teaching methods in order to compare their effectiveness (see Kopiez, 1990).

Musicians have a vested — and keen — interest in the matter, as is shown by the many popular-scientific presentations of the question, notably by Bierach (1979) or by the recent reprint in Japan of Boekelman's Bach edition. But the question which is the most suitable method for structuring a piece for mental practice remains unanswered and is largely unanswerable. Even cognitive psychology which works from the premise that a successful teaching practice always implies the structuring of information from the environment is unable to supply a definite answer to our question whether a structured music-learning technique is better served with verbal or with graphic aids such as symbols or colours. Our study seeks to test the hypothesis that there are significant discrepancies between structural methods which address different senses for the player who wishes to learn an unknown piece by heart.

EXPERIMENT

Material

To test our hypothesis we selected a short musical exercise which was to be learnt cognitively by our groups of test-persons in two consecutive five minute periods. In principle the piece could have been taken from the literature of any instrument taught in any Academy of Music or Conservatory; we chose it, however, from the literature available to the guitar, as this instrument seemed particularly suitable to us, because it may be played in one or several parts, and because each of our test-persons could play on their own familiar instrument. The piece itself should present no specific motoric difficulties, be easy enough to be sight-read by any guitar student, and present the same degree of technical difficulty to all, so that those more advanced in the theory of harmony, for instance, should not gain an undue advantage. On the basis of these criteria we selected a slow atonal piece, the opening of the 4th movement from Ernst Krenek's *Suite für Gitarre*. The guitar teachers assured us that the piece was unknown to their students.






Subjects

The two participatory groups were each formed of 12 guitar students drawn from music academies. Since the 24 subjects had all successfully passed the academy's entrance exam, we assumed that they would have no motoric difficulties in the execution of the set piece.

Procedure

First of all, the 24 students from groups A and B heard the piece played over twice on a tape recorder. The groups then separated. Those from group A, who were to learn the piece using verbal analysis aids, were read once a short analysis of the piece and encouraged to make any notes they wished on the score while the piece was being read. Obviously the score, which is reproduced in Figure 1, contained none of the graphic indications available to group B. Below is the text of the analysis they heard:

Figure 1. The exercise shown in its colour-based notation. The colours are indicated by casing and shading. (From *Suite für Gitarre*, op. 164, E. Krenek, Opening of the 4th Movement). Note: The graphic notation shown in lines 1 and 2 of the figure is used to indicate the symmetrical relationship between rhythm and repeated motif (in the original colour was used to demonstrate the point).

1.  
2.  Superimposed fifths
3.  Second motif ascending or descending
4.  Third motif

The two lines of the piece — we are dealing with an extract from a longer work — are symmetrically arranged, with the first line characterised by ascending pitch, and the second line by descending pitch. The pivot for the change in pitch-direction is the falling second “f sharp” at the transition point from the first to the second line. This point is further accentuated by the dynamic marking “mf” and is the loudest point in the two lines.

The individual lines are likewise symmetrically arranged. Thus the rhythm bar 1 is literally repeated in bar 2, and the transposed motif at the beginning of the second line is repeated at the end an octave lower. The treble repeat in the upper register of the first bar is also repeated in bar 2.

Bar 1 comprises of superimposed fifths — with the tone “g” initially missing from the fifth “c — g” and appearing to fill the gap on the third crotchet. The transition to bar 2 is thus marked by three layered fifths. The fifths from bar 1 are slightly dampened by the altered bass tone “c sharp” which appears somewhat out of place here. The small leap to the second “c — c sharp” from the bass represents, along with the superimposed fifths, a further important motif in bar 1, and is repeated in bar 2 as a major second “g sharp — a sharp”. In general we may say that bar 2 is a transposed repetition of bar 1. The relationship of fifths from bar 1 is prolonged in the lower register of bar 2 in the line “c sharp” (last bass tone in bar 1) “g sharp — f sharp”. At the opening of the second line we now find, for the first time, that a third motif in the upper register joins the

second motif we are already familiar with. As we have mentioned this motif is transposed an octave lower and is repeated at the end of the line.

The second motif, which we know from bar 1, now lies in the upper register “d — c sharp” with reversed dynamic direction. Moreover, the syncopated “g” at the end of bar 3 marks the beginning of the gradual dissolution of rhythmic stability, which continues beyond the 5/4 bar. This “g” note connects bar 3 with bar 4 as a leading note would do. The major second motif from bar 2 reappears in bar 4 but now diminished. The bass continues from bar 3 to bar 4 but now not as a fifth, but as a fourth “f — a sharp (= b flat)”. The piece leaves us with an overall tranquil and measured impression.

After hearing this analysis the test-persons set to work to learn the piece, using their notes, but of course without their instruments. It was a purely cognitive exercise. The experiment consisted of 2 consecutive learning phases of 5 minutes each. In the second phase of the experiment each subject had the opportunity to improve his or her performance by repeating the memorising process. Group A only heard the analysis once, before the start of the first learning phase. After each of the two 5 minutes learning periods they then played the piece on their instruments — as far as they had learnt it — and a recording was made of each individual performance. Group B — those who were to learn the piece using graphic colouring aids — were presented with the score shown in Figure 1, so marked that similar motifs appeared in the same colours. No analysis was read to them, instead they began immediately to memorise the coloured structures of the music. (For technical reasons the coloured score cannot be reproduced here — we show it using casing and shading to represent the colours.) In all other aspects the experiment ran identically to that of group A.

Evaluation

When all the recordings were complete, they were judged according to a specially developed evaluation system (see Figure 2), which gave a maximum of 72 points to the categories “correct pitch” and “correct rhythm” from the two respective learning periods. One point was awarded for each correctly reproduced note, and one point for the correct rhythm of each note. By using this evaluation system we were enabled to distinguish between correct notes with incongruous rhythms and correct rhythms with incongruous notes. The evaluation was carried out by two assessors listening to the recordings bar by bar and working independently from one another. The evaluation system (see Figure 2) proved so reliable that there was 97 % agreement between the assessors’ evaluations.

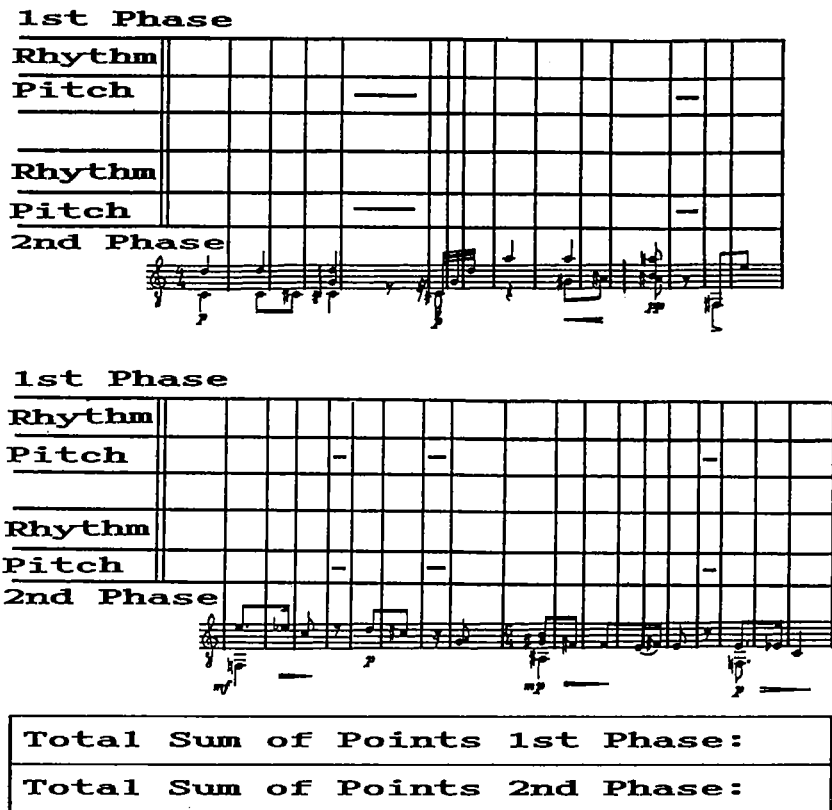


Figure 2. Evaluation diagram for the tape recordings.

RESULTS

T-tests were used for the statistical evaluation for each of the two learning periods as follows:

Table 1. — Performance Evaluation for the Two Cognitive Learning Groups

Form of analysis	First phase			Second phase		
	\bar{X}	S ₁	n	\bar{X}	S ₂	n
Verbal	48.66	13.60	12	61.50	9.53	12
Graphic	53.91	13.00	12	68.16	3.99	12

Note. Verbal/graphic difference in the first phase of learning: $t = .97$; $df = 22$; $p = .34$. Verbal/graphic difference in the second phase of learning: $t = 2.33$; $df = 22$; $p = .042$.

As may be seen from the t-test of the first phase, there is no significant difference in achievement between the verbal and graphic-oriented groups ($p = .34$). Thus the findings of the first phase may neither validate nor invalidate our hypothesis. But in the evaluation of the second phase an effect becomes clearly apparent that was already discernible in the first phase — namely that those who learn by the graphic colouring method tend to higher performance achievement. If this discrepancy between the two groups were extended over a longer period, we would arrive at a statistically important performance differential between them ($p = .042$). At the same time the group learning with graphic colouring aids also displayed a greater homogeneity of performance achievement. A supplementary U-test gave even more definite results for the second learning period: $U = 32.5$, $p = .02$.

DISCUSSION

The only explanation we can put forward to explain this effect is to suppose that retention of analytic information was impeded during the reading of the verbal analysis, probably by an interference effect. If we further assume that music lends itself to relational coding then the structuring of a piece with graphic colouring aids has the advantage over verbal analysis that as a mental exercise it may be the more easily remembered. The fact that although both modes of structuring address different sensory modalities, they both lead to permanent retention, highlights, in our opinion, the multi-modal coding possibilities inherent in music. This view is corroborated by Paivio's model of "dual coding" (1978).

Information, he states, may be stored either in a pictorial-analogous or in a relational manner. Relational storage means that the object to be stored is first processed and transformed into a series of verbal statements. The inter-relation of these two coding practices in music-teaching theory has still not been sufficiently elucidated, but Nauck-Börner points out (1987, pp. 20-22) that both kinds of coding are inherent in musical notation.

CONCLUSIONS AND PERSPECTIVES

Our findings indicate that pictorial-analogous coding is also possible with music. Traditional teaching patterns, oriented to the verbal analysis

of the score, may indeed furnish information essential for an improved interpretation but — at least according to our findings — they contribute little to learning a piece of by heart. This should be understood finally as an encouragement to those forms of musical research that seek a more practice-oriented theory for musician's use and seek to develop new representational techniques so that analysis and instrumental practice no longer stand in splendid isolation from one another.

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Strasse des 17. Juni 135
1000 Berlin 12
Germany