Asymmetry of creative activity:  
Product-based iterative measurement procedure

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Abstract  
To measure the degree of left- or right-hemispheric processes involved both in creation of  
works of art and their perception, a procedure was derived based on calibrated expert  
estimations (of works or their authors). The resulting instrument for measurements consists of  
7-10 scales and two sets of ‘contrastive objects’ (each set containing 7-12 objects). The  
asymmetry is reflected by appropriate index which varies from –1 to +1 (‘pure’ right- and  
left-hemispheric dominance, respectively). It occurs possible to eliminate subjectivity both of  
experts and researchers (compilers of the instrument). The method was used in evolutionary  
studies concerning 102 composers, 240 painters, etc.; the error of measurement was usually 3- 
5%. Evolutionary curves built on these indices, permitted to observe periodical switching  
between left and right styles in music, painting, theatre staging, and poetry.

Keywords: Artistic creativity, hemisphericity, expert estimations, calibration, indices,  
evolutionary investigations, style of music

How to measure the degree of asymmetry of informational processes involved in the  
creation of art and its perception: prevalence of left- or right-hemispheric activity? – In many  
cases (especially in evolutionary studies) the only way is to use certain parameters of some  
objects – products (results) of appropriate kinds of mental activity: paintings, symphonies,  
poems, etc. Such measurements were realized by Maslov [1] in his studies of architectural  
styles. However, he dealt with subjective (expert) estimations. Our aim was to derive a  
method providing more objective measurements. So in the framework of the information  
approach a 7-step procedure was derived, resulting in objective quantitative indices [2 - 4].  

At the first step a group of 5-10 experts was compiled including both psychologists and  
specialists in the field studied (e.g., art historians, composers, etc.). They took part in two  
brain-attack sessions having the following aims:

a) To derive a preliminary list of hypothetical parameters characterizing the phenomenon  
in question. While this session, all proposals are welcome, and all are fixed in a special list.  
E.g., when measuring musical creativity, five experts proposed 16 hypothetical parameters,  
including:  
– Optimism – Pessimism;  
  – Rationality – Intuitivity;  
  – Timbre homogeneity – Timbre diversity, etc.

  Each parameter was presented in the form of a binary opposition, its first pole responding  
to left-hemispheric prevalence, the second pole to right-hemispheric one.

b) To compile two sets of hypothetical contrastive objects which would represent ‘gestalt  
images’ typical for both extreme poles of the phenomenon studied, i.e., ‘pure’ left-
hemispheric objects and ‘pure’ right-hemispheric ones. In case of musical creativity, the role of such objects was played by composers, and two sets were hypothesized:

- 10 typical left-hemispheric composers – J.S.Bach, A. Berg, G.Handel, F.Liszt, F.Mendelssohn, S.Prokofiev, J.Rameau, I.Stravinsky, P.Hindemith, & D.Shostakovich;

(In the case of poetry, the role of contrastive objects was played by concrete poetic texts which were presented to experts [5].)

While this session, the ‘veto rule’ was accepted: out of all proposals generated by the experts, only those objects were fixed in a special list, which were voted unanimously.

The second step dealt with another group of experts (desirably 7-15 persons): only specialists in the given field, e.g., eight musicologists. Each expert was given a set of forms (questionnaires); each blank was devoted to one of the above hypothetical contrastive objects (subjects). The expert was asked to estimate the given object on each of the above parameters. Each parameter was presented in the form of 6-point scale, responding to transitions from left-hemispheric prevalence – to right-hemispheric one. Then all the scores put by the given expert, were divided into two parts, proceeding from the median border on each given scale: 50% of scores to the left of the border were treated as evidences of left-hemispheric prevalence, 50% of scores to the right of the border being evidences of right-hemispheric prevalence. Due to such rough approximation, introducing ‘subjective calibration,’ – each score was interpreted as ‘true’ or ‘false,’ and the total percentage of ‘true’ scores was calculated for the entire matrix of estimations (over all experts). Usually this percentage was statistically higher than 60%, hence a certain ‘objective truth’ was inherent to the massif of the data, and further iterations were meaningful.

At the third step the ‘refining’ of the set of parameters was fulfilled: excluding those ones which showed low percentage of ‘true’ scores. Thus, for musical creativity only 7 ‘reliable’ parameters were remained – see Table 1. (When choosing these parameters, also their correlation with other parameters was taken into account, in order to reflect various aspects of the phenomenon measured.)

Table 1. Example of stylistic (musical) parameters chosen for further measurements.

<table>
<thead>
<tr>
<th>Parameter (opposition)</th>
<th>Percentage of ‘true’ scores (at the third step)</th>
<th>Correlation with other parameters</th>
<th>Percentage of ‘true’ scores (final step)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimism – Pessimism</td>
<td>69</td>
<td>.37</td>
<td>84</td>
</tr>
<tr>
<td>Rationality – Intuitivity</td>
<td>76</td>
<td>.49</td>
<td>88</td>
</tr>
<tr>
<td>Timbre homogeneity – Timbre diversity</td>
<td>67</td>
<td>.50</td>
<td>82</td>
</tr>
<tr>
<td>Strict form – Free form</td>
<td>71</td>
<td>.56</td>
<td>90</td>
</tr>
<tr>
<td>Graphic type of music – Coloristic features of music</td>
<td>72</td>
<td>.49</td>
<td>82</td>
</tr>
<tr>
<td>Prevalence of middle and upper registers – Importance of lower register</td>
<td>64</td>
<td>.35</td>
<td>70</td>
</tr>
<tr>
<td>Strict logic of narration – Spontaneous, improvisational type of theme development</td>
<td>74</td>
<td>.53</td>
<td>89</td>
</tr>
<tr>
<td>In total (average value)</td>
<td>61</td>
<td>.47</td>
<td>84</td>
</tr>
</tbody>
</table>

The aim of the fourth step was to ‘refine’ the set of ‘contrastive objects’ – on the basis of the above ‘reliable’ parameters: those objects were excluded which showed not so high
percentage of ‘true’ scores. In the case of musical creativity only 7 ‘truly left’ composers remained, and 7 ‘truly right’ ones – see Table 2.

Table 2. ‘Truly contrastive’ left- and right-hemispheric composers: percentage of 'true scores,' over 7 ‘refined’ scales.

<table>
<thead>
<tr>
<th>Left-hemispheric composers</th>
<th>Right-hemispheric composers</th>
</tr>
</thead>
</table>

Calculations at the fifth step were aimed at proving the choice both of reliable parameters and reliable contrastive objects, by means of several computational procedures, including correlation analysis, extremal grouping method, principal component analysis, and experiments on ‘gestalt’ perception with processing their results by means of pairwise nonmetric multidimensional unfolding.

Results of one of such procedures are presented by Fig. 1: two-dimensional configuration of the above 14 ‘contrastive composers,’ which was built by means of ‘principal component analysis’ on the basis of averaged scores put by eight experts at the second step.

All other methods of calculations proved the choice both of parameters and ‘contrastive objects,’ so the strategy of ‘refining’ seems to be promising.
At the sixth step the ‘index of creative asymmetry’ was introduced, on the basis of the scores put by the given expert to the given object, over all the parameters chosen:

$$K = (n_L - n_R) / (n_L + n_R),$$

$n_L$ and $n_R$ being the number of ‘left’ and ‘right’ scores for a given object put by the given expert. This index varies in the range from −1 to +1, for ‘absolute’ right- and left-hemispheric prevalence, respectively. For instance, if an expert put to a certain composer 2 scores which were interpreted as ‘left’ (i.e., they are located to the left of this expert’s personal median points on the scales for these parameters), and 4 scores which were interpreted as ‘right’ (i.e., located to the right of this expert’s appropriate median points), and refused to estimate the given composer on 1 parameter, then the index of asymmetry for the creativity of the composer in question, according to the estimations of the given expert, equals $K = (2 − 4) / (2 + 4) = − .33$, that means slight prevalence of right-hemispheric activity in the creativity of this composer.

Values of this index (averaged over estimations of eight experts of the second step) for the above 14 ‘contrastive composers’ are presented in Table 3.

Table 3. Indices of creative asymmetry for typical left- and right-hemispheric composers.

<table>
<thead>
<tr>
<th>Representatives of left-dominance</th>
<th>Representatives of right-dominance</th>
</tr>
</thead>
<tbody>
<tr>
<td>J.S.Bach (+ .71), G.Handel (+ .88), F.Mendelssohn (+ .46), S.Prokofiev (+ .68), J.Rameau (+ .94), I.Stravinsky (+ .39), P.Hindemith (+ .93)</td>
<td>H.Berlioz (− .59), R.Wagner (− .79), C.Debussy (− .57), G.Maler (− .82), A.Skriabin (− .75), P.Tchaikovsky (− .39), R.Schumann (− .61)</td>
</tr>
</tbody>
</table>

Finally, at the seventh step a certain ‘control expert group’ was involved (8 new experts in the case of music), to confirm the whole set of measurement tools: chosen parameters and contrastive objects. On the basis of these control experts’ scores, the probability of false identification of contrastive objects was estimated. The share of errors for composers was about 5%, which seems to be satisfactory for evolutionary measurements and other ones.

Quite similar procedures were derived for measurements of creative asymmetry in the field of painting, theatre staging, poetry, and so on. In all cases the error of false identification was in the range from 3 to 5%.

So, at the disposal of researchers there exist instruments for measurement, each consisting of a set of scales and two sets of contrastive objects. Of course, before mass measurements (i.e., investigation of numerous other objects), each new expert should pass through examination of his/her abilities – by estimating the above contrastive sets and personal ‘calibrating’ (determining his/her individual median points on the scales for all parameters). Moreover, new experts themselves can be estimated, meaning their professional competence in the field of each given investigation. (To do this, one can use the value of difference between the scores put by the given expert to left- and right-hemispheric contrastive objects: if this difference occurs small – then the given expert possesses low distinctive ability, i.e., he/she is not competent. and should be debarred from measurements.)

One of the principal peculiarities of such measurements consists in that they are almost free of subjectivity both of experts compiling the instrument and experts which use it. Firstly, when selecting scales and contrastive objects, the refining is realized irrespective of compilers’ intentions, and due to numerous control procedures, the final choice seems to be objective, i.e., providing maximal distinction between the two poles of the opposition in question. Secondly, the subjectivity of experts is eliminated by using their personal ‘reference points’ – medians based on the sets of ‘standard’ contrastive objects.

When practical applications of such instruments in evolutionary investigations, the researcher should compile a sample of objects representing the development of the creative field to be studied. (Thus, the evolution of West-European and Russian music during the 17th-
20th centuries, was reflected by a sample containing 102 composers.) Then it is necessary to estimate all these objects (subjects) by using a group of ‘calibrated’ experts (about 10-20 persons), each being presented forms (questionnaires) responding to these objects, together with a set of parameters (scales of the above instrument). After averaging (over all experts) the coefficients of asymmetry for all objects which belong to each given time unit (usually 3-year or 5-year time units were used), it is possible to build appropriate evolutionary dependence. Example of such evolutionary curve is shown by Fig. 2: alteration of left waves and right ones in the evolution of European music, against the background of long-range monotonic trend (in full agreement with theoretical predictions [1, 2, 4, 6]). Quite similar wave-like processes were found – by using the above instrument – in other kinds of art [2, 6].

![Fig. 2. Stylistic evolution of music (West European and Russian): periodic changes of the index of asymmetry (K) against the long-term monotonic trend. The long-range trend is designated by the dotted line. Some epochs of left- and right-hemispheric dominance are shown by shading.](image)

So, the instrument obtained occurred quite reliable and easy to work, providing measurements in such delicate sphere as stylistic changeability of artistic creativity.

**References**


