Enhancing task solving efficiency by the stimulation of crystallized and/or fluid intelligence using environmental factors

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ABSTRACT

Aim. The study analyzes the influence of environmental factors on crystallized and/or fluid intelligence stimulation and their impact in increasing efficiency.

Material and method. Two groups of students were stimulated by environmental factors aiming to temporarily increase fluid intelligence, or both crystallized and fluid intelligence. The effects were evaluated using a special designed test.

Results and conclusion. For a task that requires attention, being under time pressure, fluid intelligence stimulation is crucial, improving the results by 21.88%. The benefit of supplementary stimulating crystallized intelligence, brought only an increase 10 times weaker, of 2.03%, up to 23.91% in performance improvement. This advantage was obtained by consuming a double time versus the group receiving only stimulated fluid intelligence.

We managed to reduce by over 20% the errors by stimulating fluid intelligence by environmental factors.

Keywords: fluid intelligence, crystallized intelligence, efficiency

INTRODUCTION

We started this study because an observation made during a research on fatigue. Some colleagues began working at the patient with high initial physical and especially mental fatigue levels, which of course affects work performance. Under these circumstances, we studied the possibilities of psychic level augmentation and removal of mental fatigue in order to increase work efficiency. Our attention was drawn to a new scientific branch of cognitive ergonomics (1), neuroergonomics (2) dealing with the interaction between the human mind and work process and human performance (3). A related field (with much discussed ethical aspects) cognitive enhancement, has exactly the activity ob-
ject needed in study. Much blamed (4) for the
dream to provide „intelligence in a pill”, it also
offers other methods, without risk, to increase
cognitive capacities.

One of these safe methods is the use of envi-
ronmental factors, which can stimulate the fluid
intelligence (dealing with reasoning, and new
problem solving).

MATERIALS AND METHOD

Among the environmental factors that in-
fluence the fluid intelligence, one is creating an
environment of „friendly competition” (5). The
competition actually stimulates creativity and
„friendship” is intended to combat the negative
aspects of competition.

We wanted to investigate the quantum of
additional benefit brought by the supplemen-
tary stimulation of the crystallized intelligence
(based on learning and previous experience).
For this purpose we selected two groups of stu-
dents who were motivated differently. We de-
signed a questionnaire in which students had to
count each of the letters: b, d, p and q present in
each box of a table with 36 boxes, and find out
how many times each letter repeats (Fig. 1).

\[
\begin{align*}
B &= ? ; D &= ? ; P &= ? ; Q &= ? \\
\begin{array}{cccccc}
  b & d & p & q & d & q \\
  q & d & q & b & p & p \\
\end{array}
\end{align*}
\]

FIGURE 1

We asked for the prior informed consent of
all participating students. To increase the crys-
tallized intelligence we used as method a dis-
cussion on a subject of immediate and intense
interest for the students: the next exam. All the
students were very attentive and active.

A. The first group was composed of 26 stu-
dents. The experimental protocol was as fol-
lows, for the group to which stimulated both
the fluid and crystallized intelligence.

a. We described this test to the students.
b. We have provided a set of tests similar to
those used in the real test, but with dif-
ferent frequency and positioning of the
four letters, so that students can com-
plete in order to familiarize them with the
type of test. We offered for this test about
2 minutes (afterwards letting the tests to
the students).
c. We had discussion on the themes for the
next exam for approximately 10 minutes
d. We administered the first test, for which
we offered 1½ minutes to solve.
e. We presented the perspicacity problem,
whose solution required approx. 9 minutes.
f. We administered the second test, for which
we offered also 1½ minutes to solve.

B. The second group was composed of 23 stu-
dents. The experimental protocol was as the same,
for the group to which only stimulated fluid intel-
ligence, excepting the point c which was omitted.
From point d on the test was similar.

1. The results of the group with stimulation
fluid intelligence tests 1 and 2 are pre
sented in Tables 1 and 2 and in Chart 1.

|   | NAME, GR. | TEST 1 | TEST 2 | RESULTS |
|---|-----------|--------|--------|---------|
| 1 | DA 10     | 0      | 1      | DECREASE|
| 2 | DCE 10    | 0      | 0      | THE SAME|
| 3 | DM 10     | 0      | 0      | THE SAME|
| 4 | CC 11     | 0      | 0      | THE SAME|
| 5 | VR 12     | 0      | 1      | DECREASE|
| 6 | CA 13     | 0      | 2      | DECREASE|
| 7 | BB 14     | 0      | 2      | DECREASE|
| 8 | BA 11     | 1      | 1      | THE SAME|
| 9 | CA 11     | 1      | 0      | INCREASE|
|10 | DA 11     | 1      | 3      | DECREASE|
|11 | CA 11     | 1      | 1      | THE SAME|
|12 | EJ 12     | 1      | 2      | DECREASE|
|13 | DDC 10    | 2      | 0      | INCREASE|
|14 | C C 12    | 2      | 2      | THE SAME|
|15 | GS 12     | 2      | 0      | INCREASE|
|16 | MCC 14    | 2      | 4      | DECREASE|
|17 | BM 14     | 2      | 0      | INCREASE|
|18 | TO 12     | 3      | 0      | INCREASE|
|19 | AC 13     | 3      | 2      | INCREASE|
|20 | AI 11     | 4      | 4      | THE SAME|
|21 | DAE 11    | 4      | 4      | THE SAME|
|22 | GM 12     | 4      | 1      | INCREASE|
|23 | AR 13     | 5      | 0      | INCREASE|
|24 | D D 13    | 5      | 2      | INCREASE|
|25 | GI 10     | 7      | 1      | INCREASE|
|26 | CI 11     | 7      | 2      | INCREASE|
|27 | TOTAL ERRORS | 57 | 35 |
Students who correctly solved the first test were 7 (27%), and those who correctly solved the second test were 9 (35%), an increase of 7%.

The results of the group “with both the crystallized intelligence and fluid intelligence stimulation – tests 1 and 2 are shown in Tables 3 and 4, as well as in the Chart 2.

### Table 2

| Nr. mistaken points | Nr. students | Percentage test 1 | Nr. mistaken points | Nr. students | Percentage test 2 |
|---------------------|--------------|--------------------|---------------------|--------------|--------------------|
| 0                   | 7            | 27%                | 0                   | 9            | 35%                |
| 1                   | 5            | 19%                | 1                   | 7            | 23%                |
| 2                   | 5            | 19%                | 2                   | 6            | 27%                |
| 3                   | 3            | 8%                 | 3                   | 1            | 4%                 |
| 4                   | 3            | 11%                | 4                   | 3            | 11%                |
| 5                   | 2            | 8%                 |                      |              | Results of the group with fluid intelligence stimulation |
| 7                   | 2            | 8%                 |                      |              |                    |

**Table 3**

| NUME GR. | TEST 1 | TEST 2 | RESULTS |
|----------|--------|--------|---------|
| 1        | RAI 25 | 0      | 1       | DECREASE |
| 2        | TFA 25 | 0      | 0       | THE SAME |
| 3        | SCM 28 | 0      | 0       | THE SAME |
| 4        | TG 28  | 0      | 0       | THE SAME |
| 5        | SR 29  | 0      | 0       | THE SAME |
| 6        | SV 29  | 0      | 0       | THE SAME |
| 7        | TIA 29 | 0      | 1       | DECREASE |
| 8        | VAE 30 | 0      | 4       | DECREASE |
| 9        | RRA 25 | 1      | 0       | INCREASE |
| 10       | FG 30  | 1      | 0       | INCREASE |
| 11       | VII 30 | 1      | 0       | INCREASE |
| 12       | ZB 30  | 1      | 2       | DECREASE |

| NUME GR. | TEST 1 | TEST 2 | RESULTS |
|----------|--------|--------|---------|
| 13       | RCM 25 | 2      | 0       | INCREASE |
| 14       | SC 25  | 2      | 4       | DECREASE |
| 15       | CD 28  | 2      | 1       | INCREASE |
| 16       | MAS 27 | 3      | 2       | INCREASE |
| 17       | MIA 28 | 3      | 2       | INCREASE |
| 18       | SM 28  | 3      | 1       | INCREASE |
| 19       | PI 29  | 3      | 0       | INCREASE |
| 20       | SI 28  | 4      | 2       | INCREASE |
| 21       | TIM 28 | 4      | 2       | INCREASE |
| 22       | VB 30  | 4      | 2       | INCREASE |
| 23       | UDR 29 | 5      | 1       | INCREASE |

Total errors 39 35
The students who correctly solved the first test, 8, 35%, as in the case of the first group (1/3). The second test correctly solved 10 students, 42%, an increase of 7.

**DISCUSSION OF RESULTS**

The essential is the number of points each measurement differs from the correct answer. Total errors (in points of difference) for each group and for each of the two tests, are presented in Charts 3 and 4.

In test 2 to for the group with stimulation fluid intelligence were wrong in just 35 points total to 57 in the first test, the error is reduced with 22 points, in the group with stimulation of fluid and crystallized intelligence, were wrong in the second test only 25 points total to 39 in the first test, the error reduction with 14 points (21.88% from total errors of this group).

**CHART 2. The number of errors – group with both the crystallized intelligence and fluid intelligence stimulation – tests 1 and 2**

**CHART 3. Number total of errors – group with crystallized + fluid intelligence stimulation**

**CHART 4. Number total of errors – group with fluid intelligence stimulation**
CONCLUSIONS

Stimulation of the two types of intelligence is a proven fact in psychological research. The factors involved in the two processes are different. Our results indicate that for a task that requires attention, being under time pressure, fluid intelligence stimulation is crucial, improving the results by n21.88%. The benefit of supplementary stimulating crystallized intelligence, one that is based on prior learning and experiences brought only an increase 10 times weaker 2.03%, up to 23.91% in performance improvement. This advantage is obtained by consuming a double time versus the group receiving only stimulated fluid intelligence.

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