

Cognitive placebo-effects in working memory and attention

Научный руководитель – Фаликман Мария Вячеславовна

Кривых Полина Олеговна

Студент (специалист)

Московский государственный университет имени М.В.Ломоносова, Факультет
психологии, Москва, Россия

E-mail: krivykh.polina@gmail.com

Introduction

Lately we have been facing a problem of estimating are there any real effects of drugs and computer programs that claim to improve memory and attention. It was shown that cognitive training can be interpreted as a placebo-effect and result into higher scores in intelligence tests [1]. Also, when comparing two groups undergoing NIBS (non-invasive brain stimulation) participants in sham stimulation group showed subjectively better results as compared with placebo group [7].

Method

Sample. 49 naïve participants (32 females, 17 males) with no neurological problems. We set the age limits from 18 to 48 y.o due to Salthouse's recommendations [4].

Hypothesis. Attention is crucially important for keeping information in the working memory [5]. This study tested the hypothesis that placebo intake can affect attention span and cause temporary improvement of working memory, if the participants are told they take a memory-improving pill.

Procedure. All participants were randomly assigned to experimental and control groups. Before starting the experiment, they had to sign the informed consent form. All test instructions were presented in written form on the computer screen. Participants were told they can ask any additional questions before starting the trial.

In general: participant read the instructions, completed Bourdon test, then 3-back test. Then they took a placebo pill in experimental group or tic-tac in control group followed by a short cartoon. The experimental group was instructed that during the cartoon active compounds of the pill entered the bloodstream. Then participants completed 3-back test and Bourdon test followed by a debriefing.

Bourdon test: participant had to find and mark with the cursor all the places where they saw a named number. Before starting the test every participant completed a short training session. Bourdon test was performed using Metodorf platform [8].

3-back test: participant saw letters on the screen, one at a time presented for 2 seconds. Participant had to answer whether the same letter was on the screen three letters back. The whole test included 20 trials. 3-back test was chosen as a working memory test due to its convergence with other working memory tests [2]. 3-back test was performed using PsyToolkit platform [9].

Placebo: Participants in the experimental group were given a placebo pill with an instruction to put the pill under the tongue. The pills were made via a manual press by direct pressing, 25-30 N. on the base of the department of pharmaceutical technology of the Institute of Pharmacy named after I.M. Sechenov. Pills composition: 3% calcium stearate, mannitol 97%. Participants in control group received tic-tac which was identical to placebo used in the experiment.

Debriefing: After the experiment was over, participants received full information about its purposes and could ask any questions. We paid special attention to make it clear for the participants in the experimental group that the pill couldn't result in any side effects.

Results

We couldn't use the data of 5 participants (2 males, 3 females) as they didn't understand the instructions. We analyzed Whipp's criteria in Bourdon test as well as hits and false alarms in 3-back test [3] - see table 1. Obtained data was analyzed using analysis of variance. Trend level differences were found at the repeated performance of Bourdon test: experimental group has a tendency for improvement while control group tends to deterioration. ($F=3,896$, $p = 0,055$, $\eta^2 = .018$). No significant differences were found for the 3-back test: neither for hits (probe 1: $F=0,2$, $p = 0,657$, $\eta^2 = .019$, probe 2: $F=0$, $p = 0,9$, $\eta^2 = 0$), nor for false alarms (probe 1: $F=0,998$, $p = 0,323$, $\eta^2 = .029$, probe 2: $F=2,680$, $p = 0,109$, $\eta^2 = 0,62$).

Discussion and conclusion

We only found trend level differences at the repeated performance of Bourdon test. This could happen due to participant's belief that placebo pill could increase concentration and, therefore, lead to higher results in the experimental group as compared with lower results in the control group due to tiredness.

Not so strong effect could be explained by small sample size, so it would be interesting to obtain data from more participants in the future research. No significant differences for the 3-back test could be explained by 3-back test being not sensitive enough to such small changes in the working memory. This is consistent with Tsai's [6] results - they found no improvement in n-back test completion after a cognitive training.

Источники и литература

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Иллюстрации

Table 1. Descriptive characteristics of Whipp's criteria after ANOVA

		N	Mean	Standard deviation
Bourdon test 1	Experimental group	24	0,9000	0,14856
	Control group	20	0,9120	0,09871
Bourdon test 2	Experimental group	24	0,9450	0,06101
	Control group	20	0,9045	0,07515

Рис. 1. Table 1. Descriptive characteristics of Whipp's criteria after ANOVA