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THE ANT IN A RUSSIAN SAMPLE: TESTING THE INDEPENDENCE OF ATTENTION NETWORKS

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THE ANT IN A RUSSIAN SAMPLE: TESTING THE INDEPENDENCE OF ATTENTION NETWORKS[2]

The Attention Network Test (ANT) is a measure that allows the assessment of three different attention networks postulated by Posner – alerting, orienting, and executive control. The alerting network is responsible for the maintenance of a vigilant and alert state; the orienting network allows the shift of attention to sensory events appearing in the perceptual field and is responsible for the selection of information from sensory input; the executive control network allows for resolving conflicts among responses. The ANT became a popular tool for assessing attention networks functioning thanks to its simplicity, relative briefness, and accessibility for researchers. This paper reports data obtained with the ANT in a Russian sample. The analysis was focused on the problem of the independence of the attention networks. No significant correlations between the attention networks were found. A repeated-measures analysis of variance yielded a significant interaction between the cue types and the flanker types. The character of this interaction indicates that the orienting and executive control networks are not independent.

Keywords: Attention Network Test, alerting, orienting, executive control

JEL Classification: Z

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Contemporary psychological and neuropsychological research on attention often uses the Attention Network Test (ANT), a measure that allows the assessment of three different attention networks. The ANT is based on the influential model suggested by Posner and Petersen (1990). They subdivided the human attentional system into three independent networks: alerting, orienting, and executive attention, also called executive control. These three attention networks are supposed to differ by their functions and underlying neuroanatomical structures. The alerting network is responsible for the maintenance of a vigilant and alert state; the orienting network allows the shift of attention to sensory events appearing in the perceptual field and is responsible for the selection of information from sensory input; and the executive control network allows for resolving conflicts among responses.

Fan and his colleagues (Fan et al., 2002) developed the ANT, a computerized task for measuring these three attention networks. The ANT became a popular tool thanks to its simplicity, relative briefness, and accessibility for researchers. This procedure integrates a classical flanker task (Eriksen & Eriksen, 1974) and Posner's cued reaction time task (Posner, 1980). The structure of a trial is presented in Figure 1. A trial starts with the presentation of a fixation cross (400 – 1600 ms) followed by one of four types of cues (100 ms). In the central cue condition, an asterisk appears right on the fixation cross. The double cue condition is the simultaneous appearance of two asterisks above and under the fixation cross. In the spatial cue condition, an asterisk appears either above or below the fixation cross and predicts the future target location. Finally, in the no cue condition, no asterisk appears. Then, after 400 ms, one of three types of targets is presented. A target consists of an arrow flanked either by four arrows pointing in the same direction as the central arrow (congruent condition), or by four arrows pointing in the opposite direction (incongruent condition), or by four straight lines (neutral condition). A target appears above or below the fixation cross. In general, there are twelve types of trials (four types of cues x three types of targets). A participant should respond to the direction of the central arrow by pressing the corresponding predefines keys.

A participant is informed that an asterisk location in the spatial cue condition predicts the target location and the appearance of asterisks in the central cue and double cue conditions indicates that the target will occur soon. The procedure contains a practice block of 24 trials and three experimental blocks of 96 trials each separated by short breaks for a rest. The whole experiment takes usually about twenty minutes.

Calculations based on the mean reaction time (RT) to different types of trials give the measures of efficiency for each attention network. RT in the double cue condition subtracted from RT in the no cue condition gives the alerting network score. RT in the spatial cue condition subtracted from RT in the central cue condition gives the orienting network score. RT in the congruent target condition subtracted from RT in the incongruent target condition gives the executive control network score. Noteworthy, the last index is inverted – the higher it is, the worse the executive control network functions.

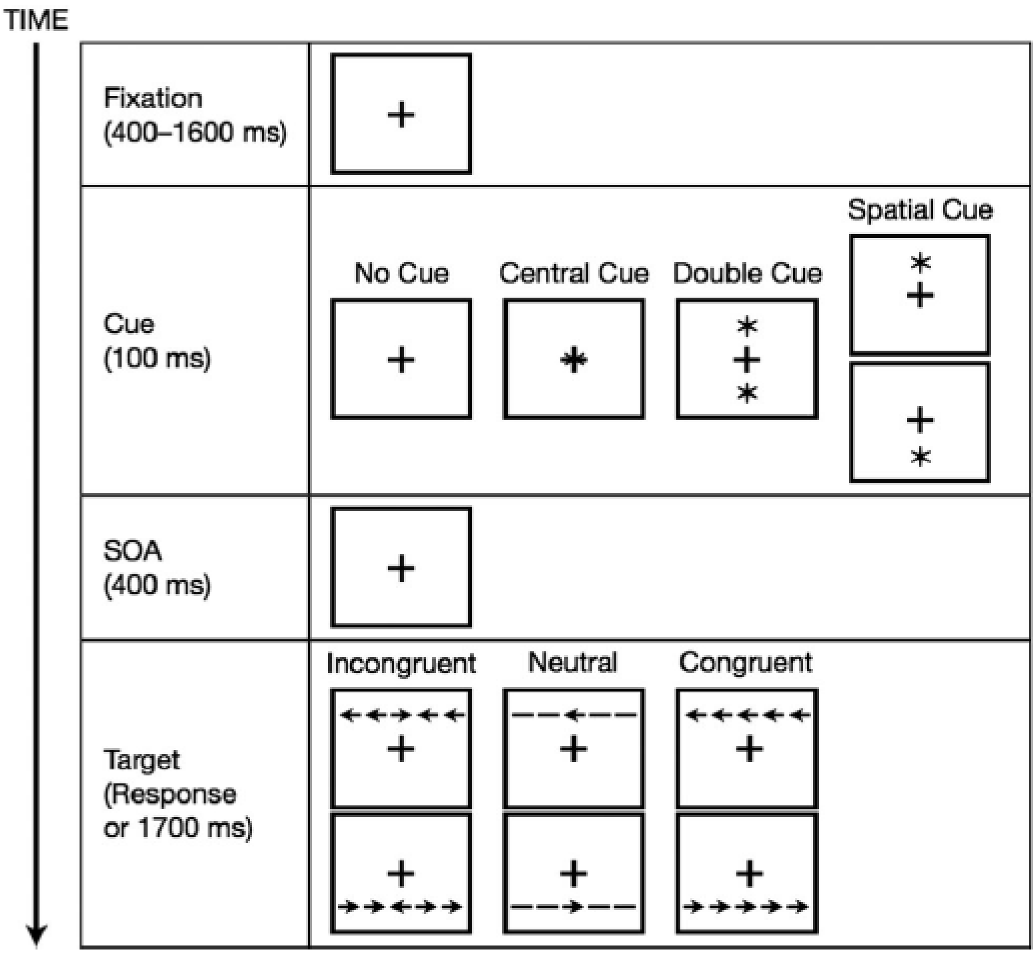

Fig. 1. The structure of a trial in the ANT (MacLeod et al., 2010).

According to Posner and Peterson's model, the three attention networks should be independent. Therefore, alerting, orienting, and executive control scores of the ANT should not correlate with each other. This is a key issue for testing both the validity of the ANT and Posner's theoretical ideas about attention networks. Fan and his colleagues analyzed the data of forty participants (Fan et al., 2002) and found no correlation between attention network scores. The only medium positive correlation was obtained between executive control and grand mean reaction time. It indicates that the participants with larger RTs are less efficient in inhibiting irrelevant responses. Of particular interest is the interaction obtained between cues and flankers. The character of this interaction showed a certain degree of dependence between orienting and executive control networks. Evidence obtained in other studies (see MacLeod et al., 2010) confirms that no stable pattern of correlation between attention network scores exists. However, some statistically significant correlations between the ANT scores have been found rather frequently. Moreover, the interaction between cues and flankers is regularly reported by various researchers.

To the best of my knowledge, there are no Russian publications on the ANT. The present study has two main goals: (1) to report the data obtained with the ANT in a Russian sample; these data could be regarded as normative for Russian samples, (2) to add to the literature about the independence of attention networks.

Method

Participants

A total of 82 participants volunteered to participate in the study. Three of them were excluded from the analysis because they made errors in more than 10% of trials in experimental blocks. The final sample consisted of 79 participants (26 men and 53 women) aged from 18 to 34 (mean age = 22.5, SD = 3.57).

Procedure

Since the data were collected in the framework of a larger research project, the participants were administered an array of other tasks that are not considered here. The ANT was administered in a standard way as described by its authors (see Fan et al., 2002).

Results and Discussion

The distributions of all scores were normal according to the Kolmogorov-Smirnov test. For this reason, parametric methods were used in the further statistical analysis.

Means and standard deviations of the attention network scores, and the grand mean RT are shown in Table 1. The mean orienting and executive control scores are very similar to those reported in a recent meta-analysis of ANT studies (MacLeod et al., 2010), where the mean orienting score was equal to 42 ms and the mean executive control score was equal to 109 ms. However, the mean alerting score in this meta-analysis was slightly higher, 48 ms. Unfortunately, the analysis of statistical differences between my mean scores and those obtained by MacLeod and his colleagues is not possible because they did not report any indices of variability.

Table 1

Descriptive statistics and Pearson correlation coefficients between the ANT scores.

	M (ms)	SD	Alerting	Orienting	Executive control
Alerting	39	23			
Orienting	41	26	.05		
Executive control	113	33	–.02	.29**	
Grand mean RT	580	76	–.06	.30**	.41**

Note. ** p < .01.

Inter-network correlation analyses (see Table 1) showed a low but statistically significant correlation between orienting network scores and executive control network scores. These two network scores also correlate positively with the grand mean RT. Therefore, better functioning of the orienting network is associated with worse functioning of the executive control network; slower participants are better in orienting and worse in executive control.

These results correspond to those of other studies in the sense that the attention networks may provide various correlation patterns and the correlations are never high. Presumably, the unsteady correlations between the attention networks depend on the physical conditions of the experiment or other situational factors.

A 4 x 3 (4 cue types x 3 flanker types) repeated-measures analysis of variance (ANOVA) was conducted as another method for testing the independence of attention networks. The results are presented in Figure 2. There were main effects of the cue types ($F(3, 234) = 197.317$, $p < .001$, $\eta^2 = .10$) and flanker types ($F(2, 156) = 484.114$, $p < .001$, $\eta^2 = .75$). Critically, there was a significant interaction between the cue types and flanker types ($F(6, 468) = 9.585$, $p < .001$, $\eta^2 = .01$) such that incongruent flankers increased RTs for any cue conditions. This interaction was stronger for the central and double cues.

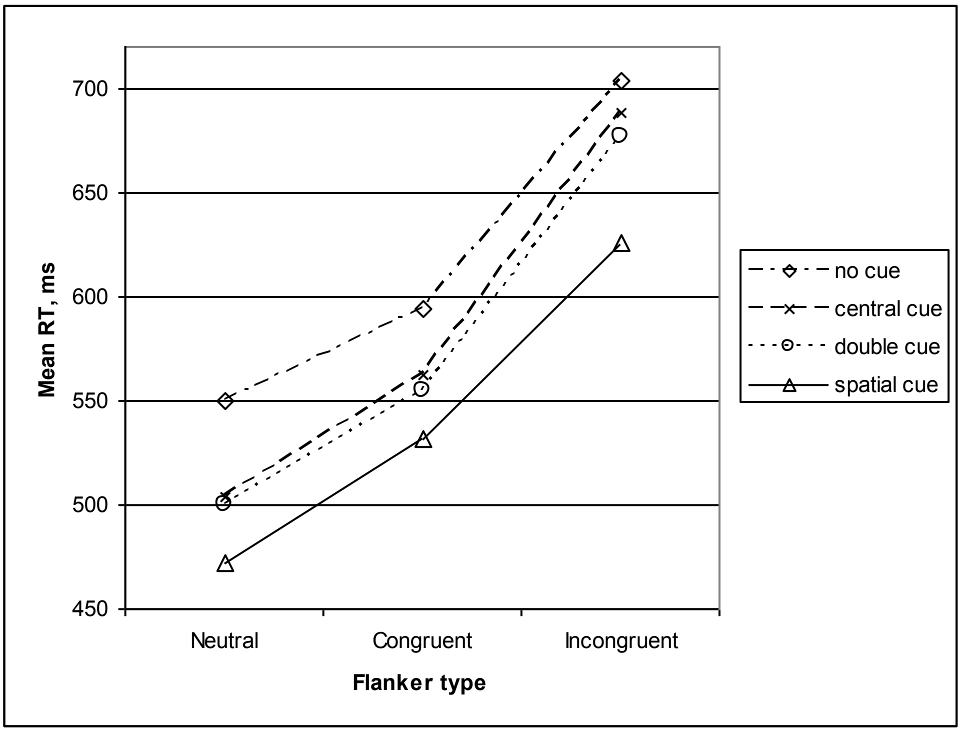

Fig. 2. Mean reaction time for each combination of cue and flanker type.

The ANOVA results correspond completely to the evidence obtained by other researchers (Fan et al., 2002; MacLeod et al., 2010) and indicate that the orienting and executive control networks are interrelated. The same type of interaction between cues and flankers is replicated in most studies. This allows us to claim that the orienting and executive control networks are not independent, at least, when they are measured by the ANT.

Another important result of the ANOVA concerns the significant difference in RTs to the targets with neutral and congruent flankers. The authors of the ANT did not obtain these differences and claimed the executive control scores can be calculated by using RT either in the congruent or in the neutral target conditions interchangeably. However, it makes sense to calculate two separate executive control scores for the congruent and neutral target condition, because these two indices will allow a more diverse and rich analysis of attention network functioning.

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