



# **Cognition, Affect & Behavior Lab (CABLab)**

Department of Psychology, CHRIST (Deemed to be University)

## **Manual for Attentional Network Test (ANT)**

Location: PEBL 2.0/battery/ANT/ant.pbl

### **1.1 Background of the process**

Attention is usually defined as the allocation of limited processing resources to different stimuli and information in the environment (Anderson, 2004). The human attentional system consists of separate mechanisms, mediated by different brain areas. Posner and Petersen (1990) proposed that the attention system includes three attentional networks: alerting, orienting, and executive attention. The alerting network allows maintenance of a vigilant and alert state, the orienting network is responsible for the movement of attention through space in order to attend to sensory events, and the executive control network allows for the monitoring and resolution of conflict between expectation, stimulus, and response (MacLeod, 2009). These networks are regulated by different brain regions, and they involve separate neurochemical systems (Cohen, Henik, & Mor, 2010)

### **1.2 Description of the task**

The Attentional Network Task (ANT) is a combination of a flanker task (with arrows; Eriksen & Eriksen, 1974) and a cued reaction time task (Posner, 1980). The original Attention Network Test was developed by Fan et al. (2002) to measure three isolable attentional networks: alerting, orienting, and executive attention (Ishigami, & Klein, 2010). Participants indicate the direction of a central arrow that is flanked by four arrows (two per side) in three conditions. The four arrows point in the same direction as the central arrow (congruent condition), in the opposite direction (incongruent condition), or remains neutral where the central arrow is presented alone, depending on the study. The arrows are preceded by one of three types of cues (center cue, double cue, spatially informative cue; all of which are temporally informative) or no cue (a temporally uninformative condition). The center and double cues indicate that the arrow stimulus will occur soon, and the spatially informative cue is 100% predictive of target location (MacLeod, et al., 2010).

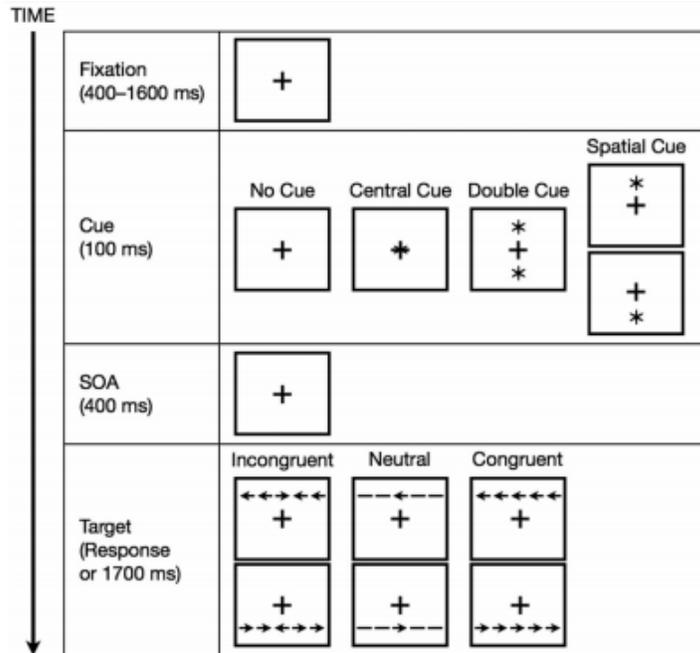


Figure 1.1a: The ideal ANT experimental procedure. Sequence of time is given in left column. All four cues are equally probable as well as the three flanker conditions. Targets appear above and below the fixation with equal probability (MacLeod, 2010)

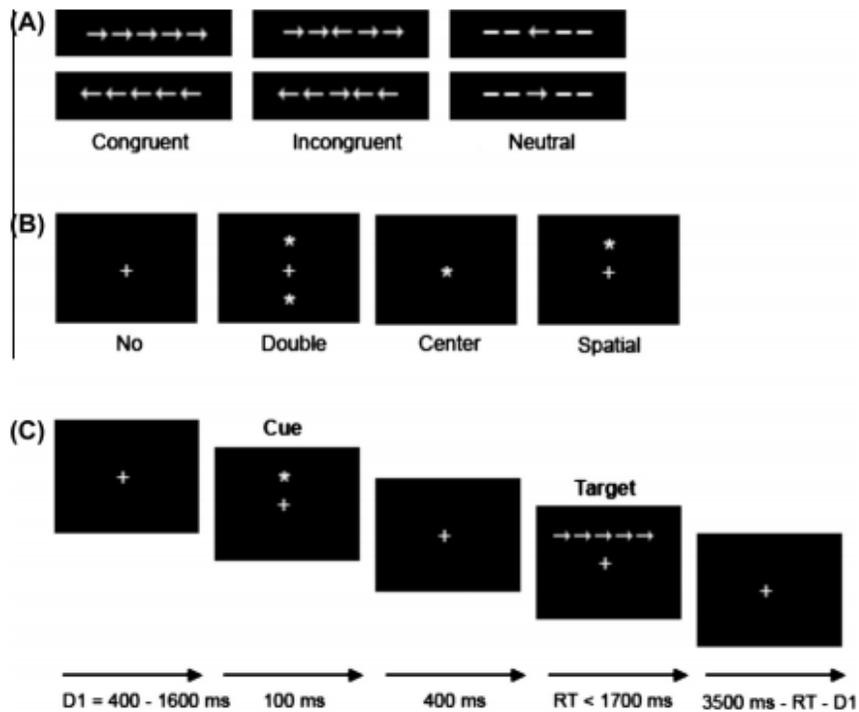
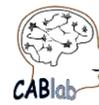


Figure 1.1b: Schematic of the ANT; (A) three target conditions, (B) four cure conditions, (C) Sequence of events (Williams et al., 2016)



### 1.3 Procedure/Instructions

The Attentional Network Test (ANT) is available on the Psychology Experiment Building Language (PEBL 2.0) software and the instructions have been included in the default file. To access the ANT on PEBL, once you launch the PEBL.exe launcher, access battery/ANT/ant.pbl and press 'Run selected test'. The test begins with instructions which also include examples and demo runs. The instructions as given on the PEBL version is given below

“This study will test how you both use and ignore information in order to make a decision. In this task, you will be asked to determine the direction of the center arrow, in a set of five. If it is pointing left, press the 'Left Shift' key. If it is to the right, press the 'Right Shift' key. The heads of the arrows surrounding the center arrow will either be in same direction, the opposite direction; will be absent or only appear as lines. You will always ignore the surrounding symbols, and respond only to the central arrow. Some example stimuli are shown below. Press the spacebar to continue when you have seen enough examples.

In addition, the arrow stimuli will either occur slightly above the center of the screen, or slightly below the center of the screen. Prior to each stimulus, a '\*' symbol will sometimes cue you regarding the possible location of the new target.

If a single \* appears above or below the center of the screen, the stimulus will always happen at the location. Other times the cue will happen in the center, or two cues will happen (one on top and one on the bottom), or no cue will occur. In these cases, you will not know whether the stimulus will be on the top or bottom.

Press any key to see the sequence of stimuli.

You will start with a short block of practice trials. After each trial, you will be told whether you are correct, and told how long you took to make the response (in thousandths of a second). Make sure to respond as quickly and accurately as possible. Press the spacebar to start the test”

### 1.4 Scoring and interpretation

As a speeded choice task, the ANT provides two measures of performance, response time (RT) and error rate (ER), and the three network scores are calculable within each of these measures. In the case of RT, the measures of efficiency provided by the ANT for each attention network are calculated using three subtractions using RT data from accurate trials only (MacLeod, et al., 2010).

- i. To calculate the alerting network score, RT in the temporally informative double cue condition is subtracted from RT in the temporally uninformative no cue condition (averaging across all flanker conditions).
- ii. For the orienting network score, RT in the spatially informative cue condition is subtracted from RT in the spatially uninformative central cue condition (averaging across all flanker conditions).

- iii. The executive control network score is calculated by subtracting RT in the congruent flanker condition from RT in the incongruent flanker condition (averaging across all cue conditions)

### 1.5 Analysis of data

Once the participant has completed the ANT, access the data file from the source C://Documents/pebl-exp.2.0/battery/ANT/data/participant code. For each individual task, the consolidated data will appear in predetermined manner for easy access and analysis. For ANT, there are four data output files available given below

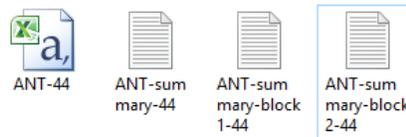
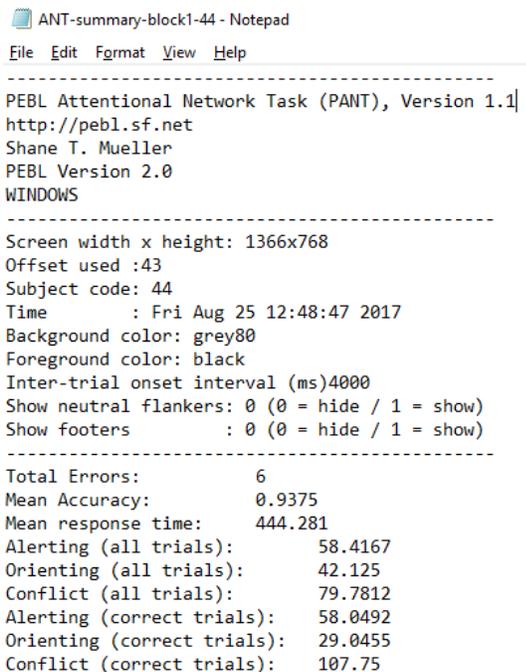


Figure 1.2 Thumbnail of PEBL output files for ANT

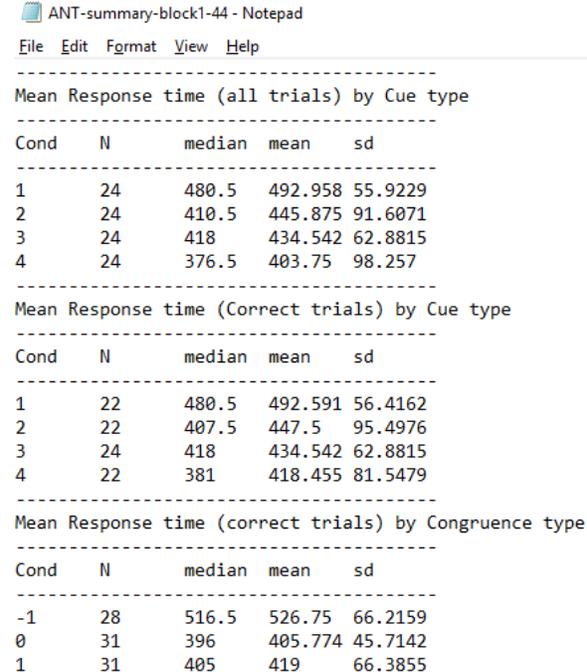
The text files hold summary of results for the separate blocks as well as a consolidated one. The measures of performance highlighted in these summaries are mostly mean response times and mean accuracy across the various congruency (3) and cue (4) conditions.



```

ANT-summary-block1-44 - Notepad
File Edit Format View Help
-----
PEBL Attentional Network Task (PANT), Version 1.1
http://pebl.sf.net
Shane T. Mueller
PEBL Version 2.0
WINDOWS
-----
Screen width x height: 1366x768
Offset used :43
Subject code: 44
Time       : Fri Aug 25 12:48:47 2017
Background color: grey80
Foreground color: black
Inter-trial onset interval (ms)4000
Show neutral flankers: 0 (0 = hide / 1 = show)
Show footers       : 0 (0 = hide / 1 = show)
-----
Total Errors:          6
Mean Accuracy:        0.9375
Mean response time:   444.281
Alerting (all trials): 58.4167
Orienting (all trials): 42.125
Conflict (all trials): 79.7812
Alerting (correct trials): 58.0492
Orienting (correct trials): 29.0455
Conflict (correct trials): 107.75

```



```

ANT-summary-block1-44 - Notepad
File Edit Format View Help
-----
Mean Response time (all trials) by Cue type
-----
Cond  N      median  mean   sd
-----
1     24     480.5   492.958 55.9229
2     24     410.5   445.875 91.6071
3     24     418     434.542 62.8815
4     24     376.5   403.75  98.257
-----
Mean Response time (Correct trials) by Cue type
-----
Cond  N      median  mean   sd
-----
1     22     480.5   492.591 56.4162
2     22     407.5   447.5   95.4976
3     24     418     434.542 62.8815
4     22     381     418.455 81.5479
-----
Mean Response time (correct trials) by Congruence type
-----
Cond  N      median  mean   sd
-----
-1    28     516.5   526.75  66.2159
0     31     396     405.774 45.7142
1     31     405     419     66.3855

```

Figure 1.3 Details of results provided on summary files on PEBL

The results provided in the summary text files are largely sufficient when ANT is used as a measure for attention within research studies. In most studies using the ANT paradigm, the alerting, orienting, and congruity effects are the most salient features of enquiry and can be easily judged through the summary tables. However, PEBL also provides scope for deeper

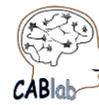
analysis as it provides a comprehensive trial wise data for the participants' responses. The data is obtained as a Microsoft Excel file (.csv), thus enabling easier analysis and formatting. A snapshot of the same has been given below

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	subi	block	trial	practic	cue	topbott	targdir	flkrcoh	flkrdir	time	delay	resp	corr	rt
2	44	0	1	1	4	lo	-1	-1	1	126753	965.18	<lshift>	1	522
3	44	0	2	1	2	lo	-1	-1	1	130757	1442	<lshift>	1	617
4	44	0	3	1	4	hi	-1	-1	1	134758	743.54	<lshift>	1	492
5	44	0	4	1	4	hi	1	1	1	138755	1357.3	<rshift>	1	408
6	44	0	5	1	2	lo	-1	0	0	142758	1428.7	<lshift>	1	514
7	44	0	6	1	3	hi	1	1	1	146758	1414.4	<rshift>	1	396
8	44	0	7	1	3	lo	1	-1	-1	150758	466.82	<lshift>	0	374
9	44	0	8	1	2	hi	1	0	0	154759	1521.2	<rshift>	1	398
10	44	0	9	1	1	hi	1	1	1	158757	1565.6	<rshift>	1	575
11	44	0	10	1	3	hi	1	0	0	162758	1497.5	<rshift>	1	348
12	44	0	11	1	2	lo	-1	1	-1	166760	1276.1	<lshift>	1	627
13	44	0	12	1	2	lo	1	1	1	170759	638.57	<rshift>	1	415
14	44	0	13	1	3	lo	-1	1	-1	174760	1011.4	<lshift>	1	526
15	44	0	14	1	1	lo	1	-1	-1	178759	1256.8	<rshift>	1	488
16	44	0	15	1	4	lo	1	0	0	182757	859.48	<rshift>	1	362
17	44	0	16	1	3	lo	1	1	1	186757	1487.1	<rshift>	1	399
18	44	0	17	1	2	lo	1	-1	-1	190759	703.58	<rshift>	1	481
19	44	0	18	1	4	hi	-1	1	-1	194759	884.89	<lshift>	1	459
20	44	0	19	1	3	hi	-1	-1	1	198759	1332.7	<rshift>	0	351
21	44	0	20	1	2	hi	-1	0	0	202759	598.84	<lshift>	1	388
22	44	0	21	1	4	lo	-1	1	-1	206759	418.06	<lshift>	1	460
23	44	0	22	1	3	hi	1	-1	-1	210759	1076.6	<rshift>	1	494
24	44	0	23	1	2	hi	-1	1	-1	214758	1198.5	<lshift>	1	465

Figure 1.4 Detailed participant results obtained on Excel for ANT in PEBL

In the output files above, the columns indicate different parameters, whereas the rows indicate individual trials. In the PEBL 2.0 version of the ANT, there are a total of 312 trials which includes the practice block of 24 trials. In the example above, the columns labelled between A and N represent various details of each trial. Columns A to I provide information about each trial in terms of position of arrows, flankers, cues, etc., whereas columns J to N provide details of the response by the participant in terms of reaction time, button click, accuracy, etc. A brief legend has been prepared to elaborate the information on the excel output above.

<b>(A) sub-</b> Participant code (unique)	<b>(H) flkrcoh-</b> Coherence of Flanker arrows to central arrow (-1: Opposing arrows, 1: Consistent arrows, 0: No arrows)
<b>(B) block-</b> Experimental block number(0,1,2)	<b>(I) flkrdir-</b> Direction of flanker arrows (-1: Left, 0: No arrows, 1: Right)
<b>(C) trial-</b> Trial order number	<b>(J) time-</b> Experiment clock; cumulative
<b>(D) practice-</b> Practice or experimental (0,1)	<b>(K) delay-</b> Delay of the target after cue
<b>(E) cue-</b> Cue condition (1: Uncued, 2: Center cued, 3: Top-bottom cued, 4: Direction Cued)	<b>(L) resp-</b> Keyboard input (L-shift, R-shift)
<b>(F) topbottom-</b> Position of arrows (hi:	



above +, lo: below +)	<b>(M) corr-</b> Accuracy of response (1: Correct, 0: Incorrect)
<b>(G) targdir-</b> Direction of central arrow (- 1: Left, 1: Right)	<b>(N) rt-</b> Reaction time

## 1.6 Use and scope

The typical three main effects found in this test across different studies include alerting, orienting, and congruity effects. The alerting effect involves faster responses to trials containing an alerting cue, as compared to trials without such a cue. The orienting effect involves faster responses to spatially cued trials, as compared to trials in which there is no spatial cue. Finally, the executive effect involves faster responses to congruent trials than to incongruent trials. The ANT has been widely used to assess attention functions and dysfunctions in diverse populations, and has been demonstrated to be reliable and suitable for assessing the link between attentional networks and different psychological aspects such as psychopathology, development, and individual differences Cohen, et al., 2010).

## 1.7 References

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