Interhemispheric differences in divided attention

Jacques Paty, Bernard Claverie, Jean Berthomieu

8th Event-Related Potentials International Congress
E.P.I.C.IV - University of Stanford California - June 22-28 - 1986

INTERHEMISPHERIC DIFFERENCES IN DIVIDED ATTENTION

J. PATY, B. CLAVERIE, J. BERTHOMIEU.

Groupe de Psychophysiologie Cognitive
UNIVERSITE DE BORDEAUX II
146 Rue Léo Saignat - 33076 BORDEAUX CEDEX - FRANCE

this work was supported by a grant of
Ministère Français de l'Environnement n° 82-186

The division of attention between several sensory modalities, and several tasks is frequent in natural environnement. According to the TREISMAN model interferences between visual and auditory informations are quite different in bimodal or unimodal conditions. KINSBOURNE has proposed a model of an assymmetrical brain activation in competition for attention related to a cognitive assymmetry.

Our aim is to precise what topographical changes - as studied by electrocerebral activities - are reliable to the modality or to the task.

Two tasks were performed at the same time . a Reaction time according to usual CNV - RT paradigm as first task, and a detection signal with increasing complexity task at the second one.

METHODS .

At each record session there were five degrees of complexity

1 * neutral = single (S1 - S2) - CNV - RT paradigm

2 * CNV-RT second stimulus without task

3 * CNV-RT second stimulus with counting signals defined on 1 item

4 * CNV-RT second stimulus with counting signals defined on 2 items

5 * CNV-RT second stimulus with counting signals defined on 3 items

- Stimulus for CNV-RT were brief tones of 65 dB (a = auditory condition) or flashes (v = visual condition).

- The second stimulation was series of figures or synthetic sounds,

with 27 combinations of three parameters with equiprobability of presentations

in V = visual condition ; color ; size ; shape.

In A = auditory condition : frequency ; modulation (increasing decreasing, shift); shape (single, double, triple bursts).

- E.E.G. was monopolarly recorded with pasted silver electrodes located à Fz, Cz, P3, P4, with linked ear lobes reference.

- 24 non-paid voluntar subjects , 20 to 26 years old ,were studied, in 48 total record sessions.

Four groups with 12 sessions each were performed for each combination of modalities. (Vv, Va, Av, Aa).

Analysis of performances (R.T., Detection Error : D.E.) and 13 E.E.G. parameters by each electrode location were automatically computed on an interconnected system between an INTERTECHNIC Plurimat'S and a Digital (PDP11/34) computers. Averaging, superaveraging of each group, and two ways variance analysis (situation/ topography) were studied in condition 2 to 4 which may be compared in given informations.

RESULTS.

1 - Performances : reaction times and error detection are increased in relation to the complexity. This is more important in A conditions (Av and Aa) than in V conditions (Vv and Va).

Aa	RT	ED	Av	RT	ED
2	260.56 ± 71.43	31.33 ± 38.13	2	246.79 ± 59.26	17.16 ± 37.22
3	257.39 ± 62.80	34.50 ± 52.03	3	275.83 ± 67.48	18.25 ± 27.20
4	266.18 ± 64.28	15.02 ± 17.03	4	295.29 ± 66.45	8.86 ± 23.00

Va			Vv		
2	198.68 ± 38.76	-1.25 ± 04.88	2	199.27 ± 40.29	0.83 ± 07.10
3	203.10 ± 44.87	0.33 ± 06.99	3	198.66 ± 35.43	-5.66 ± 07.65
4	202.07 ± 40.07	-1.08 ± 10.94	4	205.97 ± 42.94	-3.25 ± 09.12

2 - Electrocortical parameters : Several kinds of changes are observed which are related to complexity changes : decreased N1 - P2 amplitudes at (S1) and at (S2) ; stability of P3 latencies at (S1) and at (S2); diphasic changes of slow potentials in the interstimulus interval (Na, Nb) and the post imperative time (Pb Pc). there is a decreased amplitude with an A (auditive) second stimulus and an increased amplitude with a V (visual) second stimulus.

Differences between linked modality groups are shown in the figures (thick line 2nd cond., thin line 3rd cond., dotted line 4th cond.).

Two main indications are given :

- there is a decreasing of amplitudes, related to the complexity of the second task in bimodal conditions (Va and Av) and no important changes are observed in unimodal conditions (Aa et Vv)

- An assymmetry of parietal responses in A conditions, is more important in Av than in Aa. There is a symmetry in V conditions.

DISCUSSION.

There is some evidence that the "second detection task" may disturb performances of the "first CNV - RT task" (and its electrocortical indicants which are synchronized on it). Topographical changes of brain ERPs show that parietal areas are mainly affected, with interhemispheric differences which may be related to sensory modality interaction and/or to the characteristics of the tasks.

As SCHNEIDER and SCHIFFRIN described them, automatic and controlled cognitive processes seems to be involved in interhemispheric relations. Greater difficulty of auditory signal detection (A) is related to increased assymmetry of evoked potentials. This suggest that there is a brain level an assymmetrical distribution for attention in agreement with KINSBOURNE assessment. Our data may support the theory, as reported by GUIARD, of a interactive model of interhemispheric relations, better than an integrative one.

BIBLIOGRAPHY.

- GUIARD. Y. Interhemispheric relations and selective attention in J. REQUIN (Edt.) "Anticipation and Behaviour" Ed. du CNRS 1980, 491-520.

- KINSBOURNE. M. The mechanism of hemispheric control of the lateral gradient of attention in Attention and Performance V ; (LONDON) Academic Press. 1975

- PATY. J., CLAVERIE. B., BRUN. A. , and al. Interférences émotionnelles et attentives et potentiels lents cérébraux. E.E.G. Neurophysiol. 1979, 9, 4, 408-417.

- TREISMAN. A. M. and DAVIES. A. Divided attention to ear and eye; in "Attention and Performance III", 1973, Academic Press, 1973, 4, 101-117.

- SCHNEIDER.W., SCHIFFRIN. R.W. Controlled and automatic human information processing : I : Detection search and attention. Psychol. Rev. 1977, 84, 1-88.