G2/3

DIFFERENTIAL AUTOMATIZATION PROCESSES AS A FUNCTION OF THE TYPE OF STIMULI

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INTRODUCTION

Previous work on visual search (Schneider & Fisk 1982) has shown that subjects' performances vary as a function of whether stimuli and responses are consistently or variably mapped. For a consistently mapped (CM) condition is meant that across "trials the subject makes the same overt or covert response each time the stimulus occurs"; whereas a condition is classified as variably mapped (VM) when "responses changes across trials" (Schneider et al. 1984,pag.2). While CM conditions yield large practice effects, VM conditions do not show any improvement in subjects' performance "even after thousands of trials" (Schneider & Fisk 1982). These differential practice effects are attributed to the fact that stimuli and responses should be processed automatically in CM conditions, and under control in VM conditions. Automatic processing is thought as "fast, parallel, fairly effortless, and not under subjects' control". To the contrary controlled processing should be "slow, generally serial, effortful, capacity-limited, and subject-regulated" (Schneider et al. 1984). Finally, Fisk & Schneider (1981) suggested that vigilance decrements are expected when controlled rather than automatic processing takes place.

A large body of data has been collected favouring these views (see, Schneider et al. 1984 for a review). However, the most of the experiments reported does not pay much attention on how to disentangle parallel from serial processing. This distinction is crucial in distinguishing automatic from controlled processing. To take apart these two modes of processing in visual search tasks an experimental condition devised by Umiltà et al. (1979)

can be used. Three experiments having the same experimental conditions were carried out aiming at to establish whether: 1) The subjects changed their visual search strategy from a serial to a parallel one after practice in a CM condition; 2) The change in strategy varied as a function of the type of stimuli, though keeping experimental procedure and task requirements the same; 3) Vigilance decrement was restricted to serial processing.

EXPERIMENTS 1, 2, and 3

Subjects: 48 Ss took part in the experiments, 16 for each experiment.

Stimuli: In each experiment 288 positive and 192 negative stimuli were presented to a subject. A positive stimuli consisted of one target (a solid dot, an F, and an H, in Exp. 1, 2, and 3, respectively) and two or five non target (empty dots, Hs, and Fs, respectively). Target and non targets in a stimulus were arranged in one (three elements stimulus) or two rows (six elements stimulus). The target remained the same throughout an experiment and could be located in whichever position in a stimulus. Half of the stimuli comprised three, and half six elements. Each element in a stimulus subtended .5° in width and .6° in height of visual angle, and the distance between two adjacent or superimposed elements was .5°.

Procedure: Formal testing began after Ss confirmed to have well-understood the written instructions. The ISI was 5 sec, and a stimulus was presented for 100 msec. Ss performed a go - no go task, a response was required only when a positive target was presented.

RESULTS and DISCUSSION

Mean correct RTs were submitted to an ANOVA having one between-subject factor: Experiment (1, 2, 3); and three within-subject factors: Target location within a row (location 1, 2, 3 from left to right), Number of rows (1, 2), and Period (1, 2, 3, 4, 5, 6) obtained by dividing an experimental session in blocks of 80 trial each. The significant main effect of Target location and Number of rows indicated that a serial search strategy was used. These effects interacted both with Experiment and Period factors showing: a) Ss moved from a serial (from central to the right and then to the left location) to a parallel strategy when they had

to find a solid dot among empty dots, whereas they changed their serial strategy (from one identical to that employed early in a session in Exp.1, to a central-left-right search) when an F or an H were to be found; b) The difference in RT between one or two rows display reduced and actually disappeared with dots, while remained about the same with Fs and Hs. This suggest a change in the strategy used depending on the target/background relationship rather than on mapping conditions, which were held constant among the experiments. Practice had an effect throughout the experiments; but far larger when serial processing was more evident, that is when an H was to be found in a background of Fs. Finally, indications of a performance decrement appeared soon after a parallel or a very fast serial strategy was employed, such as in the case of Exp. 1 and 2.

It can be concluded that: 1) Changes from serial to parallel processing can be found when CM conditions are used; 2) Changes in strategy are determined by the type of the stimuli employed. It can be suggested that the background can play an important role in determining a "pop-out" effect (Francolini & Egeth 1979), possibly as a fuction of the degree of the lateral inhibition (Bjork & Murray 1977) or of its organizational structure, e.g., salience of symmetry (Bagnara et al. 1984); 3) Practice effects are found when serial processing is used; 4) Vigilance decrement appears earlier when parallel processing is apparently used, at variance with when a serial processing takes place.

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AIMS OF THE EXPERIMENTS:

1) DOES PRACTICE IN A CM CONDITION DETERMINE A CHANGE IN VISUAL SEARCH STRATEGY, I.E., FROM A SERIAL TO A PARALLEL SEARCH?

2) DO CHANGES IN STRATEGY DEPEND FROM THE TYPE AND ORGANIZATION OF STIMULI?

3) IS VIGILANCE DECREMENT RESTRICTED TO SERIAL STRATEGIES?

Table 1: MEAN CORRECT REACTION TIMES (in msec.) and PERCENTAGE OF ERRORS AS A FUNCTION OF THE EXPERIMENTS.

EXPERIMENT	$\overline{RT}$	ERRORS (%)
1 (Dot)	405	2 (1.7)*
2 (F)	435	3.4 (2.8)*
3 (H)	549	3.6 (1.7)*

$p <= .001$

* = Percentage of False Alarms

Table 2: MEAN CORRECT REACTION TIMES (in msec.) and PERCENTAGE OF ERRORS AS A FUNCTION OF THE LOCATION OF THE TARGET

	$\overline{RT}$	ERRORS (%)
LOCATION		
LEFT	464	2
CENTER	460	1.4
RIGTH	464	1.8

$p <= .05$

Table 3: MEAN CORRECT REACTION TIMES (in msec.) and PERCENTAGE OF ERRORS AS A FUNCTION OF THE NUMBER OF ROWS

ROWS	$\overline{RT}$	ERRORS (%)
1	455	1.5
2	471	1.9

$p \leq .001$

Table 4: MEAN CORRECT REACTION TIMES (in msec.) and PERCENTAGE OF ERRORS AS A FUNCTION OF THE PRACTICE

PRACTICE	$\overline{RT}$	ERRORS (%)
1st Period	496	2.4
2nd "	470	1.6
3rd "	463	1.3
4th "	450	2.5
5th "	451	1.4
6th "	447	1.8

$p <= .001$

Table 5: MEAN CORRECT REACTION TIMES (in msec.) and PERCENTAGE OF ERRORS AS A FUNCTION OF THE EXPERIMENTS AND NUMBER OF ROWS

		EXPERIMENT					
		1 (Dot)		2 (F)		3 (H)	
		$\overline{RT}$	Errors	$\overline{RT}$	Errors	$\overline{RT}$	Errors
ROWS	1	402	0.3	425	1.2	537	3.0
	2	407	0.3	445	1.1	561	4.4

$p \leq .001$

Table 7: MEAN CORRECT REACTION TIMES (in msec.) and PERCENTAGE OF ERRORS AS A FUNCTION OF EXPERIMENTS, NUMBER OF ROWS, AND PRACTICE

	EXPERIMENT					
	1 (Dot)		2 (F)		3 (H)	
ROWS / PRACTICE	1	2	1	2	1	2
1st Period						
	*		**		**	
$\overline{RT}$	439 / 441	445	462	477	560	593
Err.	0.1	0.1	0.3	0.3	0.3	0.7
6th Period						
	n.s.		**		**	
$\overline{RT}$	386 / 391	390 / 385	419	435	511	540
Err.	/	0.1	0.3	0.3	0.3	0.8

p <= .001

* = p <= .05
** = p <= .01

Table 6: MEAN CORRECT REACTION TIMES (in msec.) and PERCENTAGE OF ERRORS AS A FUNCTION OF EXPERIMENTS, LOCATIONS, AND PRACTICE

	EXPERIMENT								
	1 (Dot)			2 (F)			3 (H)		
LOCATION / PRACTICE	1	2	3	1	2	3	1	2	3
1st Period									
	*	*		*	*		*	n.s.	
$\overline{RT}$	456	433	441	478	461	470	566	580	584
		*			*			*	
Err.	/	/	0.3	0.3	0.1	0.5	0.8	0.5	0.3
6th Period									
	n.s.	n.s.		*	*		*	*	
$\overline{RT}$	387	388	391	429	417	435	528	517	532
		n.s.			n.s.			n.s.	
Err.	/	/	/	0.4	0.2	0.3	0.5	0.6	0.5

$p <= .01$

* = $p <= .05$

Anelini 1° periodo

significativa interazione F * G

località significativa solo per i det

$F = 2.92$ $df = 4,90$ $p < .05$

Anelini 6° periodo

significativa LOCATION

$F = 5.60$ $df = 2,90$ $p < .005$

ANALISI DELLA VARIANZA. . . . DOTHF6

L° periodo

LIVELLI DEI FATTORI

E	3
C	2
S	16
G	3

MEDIA GENERALE 496.50000

FONTE DI VARIABILITA'	DEVIANZA	GDL.	VARIANZA	F	
E	3694.25400	2	1847.12700	n.s.	.
C	15738.33000	1	15738.33000		.
EC	3906.15700	2	1953.07900		.
S	570473.30000	15	38031.55000		.
ES	32587.51000	30	1086.25000		.
CS	14030.54000	15	935.36900		.
ECS	27331.53000	30	911.05100		.
G	957638.90000	2	478819.50000		.
EG	14359.64000	4	3589.91000	2.93	.
CG	17505.29000	2	8752.64300	10.27	.
ECG	3228.34600	4	807.08650		.
SG	861309.60000	30	28710.32000		.
ESG	77972.67000	60	1299.54500		.
CSG	24294.49000	30	809.81620		.
ECSG	45629.30000	60	760.48830		.
TOTALE	2669700.00000	287			

$SF = S + ES = 1$

CS

$SE/G = ES + ESG = 1128$

PG

$SC/G = 851.66$

45

ANALISI DELLA VARIANZA. . . . DOTHF6

6°

Tutti < 3 gli coefficienti

LIVELLI DEI FATTORI

E	3
C	2
S	16
G	3

MEDIA GENERALE 447.06420

FONTE DI VARIABILITA'	DEVIANZA	GDL	VARIANZA	F	
E	7042.72700	2	3521.36400	5.60	.
C	20474.45000	1	20474.45000		.
EC	1481.84700	2	740.92330		.
S	346084.30000	15	23072.29000		.
ES	24412.58000	30	813.75260		.
CS	11586.08000	15	772.40560		.
ECS	17194.60000	30	573.15320		.
G	966789.80000	2	483394.90000		.
EG	2387.27400	4	596.81860		.
CG	6341.30800	2	3170.65400	4.61	.025
ECG	1762.59300	4	440.64830		.
SG	746034.40000	30	24867.81000		.
ESG	32134.43000	60	535.57390		.
CSG	18067.25000	30	602.24150		.
ECSG	31099.69000	60	518.32810		.
TOTALE	2232894.00000	287			

$SE/G = \frac{SE + SEG}{SG} = 624.29$

$SC/G = \frac{\cancel{648}\ 702}{48}$

Table A: MEAN CORRECT REACTION TIMES (in msec.) and PERCENTAGE OF ERRORS AS A FUNCTION OF EXPERIMENTS, LOCATIONS, AND PRACTICE

	EXPERIMENT								
	1 (Dot)			2 (F)			3 (H)		
LOCATION / PRACTICE	1	2	3	1	2	3	1	2	3
1st Period									
RT	456	433	441	478	461	470	566	580	584
Err.	/	/	0.3	0.2	0.1	0.5	0.7	0.4	0.2
6th Period									
RT	387	388	391	429	417	435	528	517	532
Err.	/	/	/	0.4	0.2	0.3	0.4	0.6	0.5

$p <= .01$

EFFETTI DIFFERENZIALI NELLA LATENZA DI RISPOSTA IN RAPPORTO AL TARGET E AL BACKGROUND

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Precedenti lavori (Umilta' et al., 1979) hanno dimostrato che i soggetti adottano una strategia seriale in compiti di ricerca visiva per rilevare un elemento diverso in pattern di 3 o 6 elementi. E' stato suggerito che una strategia seriale deve essere caratterizzata come un processo controllato e che i processi controllati possono modificarsi con la pratica (Schneider et al, 1984). Una conseguenza della pratica puo' essere il passaggio da una strategia seriale ad una parallela.

Al fine di verificare tale ipotesi sono stati condotti 3 esperimenti. Ai soggetti veniva chiesto di premere un pulsante ogniqualvolta un elemento diverso era presente all'interno del pattern visivo. Il target era costituito rispettivamente da: un cerchio pieno all'interno di corone circolari (esp 1); una F tra H (esp 2); una H tra le F (esp 3). Ogni condizione era studiata con un rilevante numero di prove al fine di rilevare cambiamenti di strategia. I risultati mostrano: 1) che vi sono differenze significative in funzione della condizione sperimentale con risposte piu' rapide nella rilevazione di un cerchio pieno rispetto ad una

F e ancor di piu' rispetto ad una H; 2) che i soggetti usano una strategia di tipo seriale in ciascun esperimento indipendentemente dal tipo di pattern, come rilevato da un significativo effetto del numero di elementi (3/6); 3) che sono presenti effetti differenziali tra esperimenti in rapporto alla posizione del target (sopra/sotto; sn/dx); 4) che l'effetto della pratica e' funzione del livello di complessita' del pattern visivo con una maggior evidenza quanto piu' marcato e' l'effetto della ricerca seriale.

Complessivamente i risultati fanno ritenere che la ricerca visiva di un target sia dipendente dal tipo di background in cui il target e' inserito attraverso o un fenomeno di pop-out (Francolini & Egeth, 1979) o attraverso l'inibizione laterale (Bjork & Murray, 1977) o grazie al prevalere di caratteristiche salienti (ad es. simmetria) (Bagnara et al., 1984). Gli effetti di pratica e/o di vigilanza legati alla ricerca visiva sembrano essere correlati alle caratteristiche di segmentazione visiva del campo sulla base degli aspetti precedentemente citati.

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