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ABSTRACT

Both psychologists and reading specialists have been interested in whether words are processed letter by letter or in larger units. A reaction time paradigm was used to evaluate these options with interest focused on potential units of word recognition which might be functional within single syllable words. The basic paradigm involved presenting subjects with a five-letter word accompanied by a probe letter or letters (BLAST:BL). Subjects were to indicate if all letters in the probe were from the word. Reaction time for these decisions was measured for all probe types: single letter probes, all possible double letter probes, all triple letter probes, or the whole word as a probe. Several probe types were identified as being exceptionally easy to identify as members of the target word. The results were replicated in a second experiment under conditions where a visual match was not possible (BLAST:bl) and where a visual match was quite likely. A third experiment employed the same paradigm but with consonant strings which contained permissible spelling patterns or nonpermissible patterns. Permissible strings again showed a unit effect on the first and final consonant clusters. (Author/TO)

Units of Word Recognition

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Both psychologists and reading specialists have been interested in whether words are processed letter by letter or in larger units. A reaction time paradigm was used to evaluate these options, and interest was focused on potential units of word recognition which might be functional within single syllable words. Such units have been suggested by E. Gibson and have been loosely referred to as "spelling patterns".

The basic paradigm involved presenting Ss with a five letter word accompanied by a probe letter or letters e.g. BLAST:BL. Subjects were to indicate if all letters in the probe were from the word or not. Reaction time for these decisions was measured for all probe types which included single letters (BLAST:L); all possible double letter probes (BLAST:BL, BLAST:LA, BLAST:AS, BLAST:ST), all triple letter probes (BLAST:BLA, BLAST:LAS, BLAST:AST) or the whole word as a probe (BLAST:BLAST). On half the trials a single letter was changed to form the probe and the Ss were to respond "no" on these trials e.g. BLAST:BM.

In the first experiment, several probe types were identifed as being exceptionally easy to identify as members of the target word. The single letter probes were quite fast but not reliably faster than the initial consonant cluster or the initial and final consonant triplet or the whole word. All of these letter patterns were 200-300 misc. faster than other probe types such as BLAST:LA.

The results were replicated in Experiment II under conditions where a visual match was not possible (BLAST:bl); and where a visual match was quite likely $\frac{BL}{BLAST}$. In both replications responding to the whole word was even faster than to a single letter.

A third experiment employed the same paradigm but with consonant strings which contained permissible spelling patterns (BLCST) or non-permissible patterns (BZXFP). Permissible strings again showed a unit effect on the first and final consonant clusters.

There has been a great deal of recent interest in the processes and units which underlie perception of the written word. This interest stems from both psychologists interested in more theoretical questions and from reading teachers faced with teaching children how to decode words. One of the basic controversies about word recognition centers around the issue of whether words are processed letter by letter or in units larger than the single letter. Some of the candidates for the larger units involve the whole word, the syllable and syllable like units called the vocalic center group. An alternative to explanations centered around the syllable is a unit proposed by Elinor Gibson called the spelling pattern. The spelling pattern has not been adequately defined, but basically people seem to adopt certain units from prior experience such that frequent letter combinations come to be processed as a single unit. For example, initial consonant clusters such as ch, tr and st because of their frequent occurrence in English come to be processed as a perceptual unit within the word.

The present experiments were designed to explore the units of processing using single syllable words. The basic procedure involved a same different reaction time paradigm where subjects were simultaneously shown a whole word and various parts of the word or cues. The stimuli were presented in a tachistoscope and the subject was to decide whether the part which is on the right occurred in the prior words (see Table 1). In the first experiment we examined two word classes, CCVCC (BLAST) and CCVCE (FRAME). Nine cue types were used for both classes which included the single letters, all combinations of adjacent double letters, triple letters and the whole word. On half of the trials a single letter in the cue was changed so that it did not belong in the whole word e.g. BLAST:LI, BLAST;BLE. Each subject was given all possible cue patterns and both types in a completely repeated measures type of design.

Figure 1 shows the reaction times for the same judgments as a function of the nine different cue types for both the BLAST and FRAME patterns. As we can see in the figure, the single letters are quite fast, but they are not any faster than the initial double letters such as BL or FR. All of the other doublets are slow. The initial and final triplet are fast relative to the medial triple, and finally the whole word is fast.

What can we conclude from the first experiment about spelling patterns? First, it is quite evident that a monotonic increase in processing time does not occur as a function of the number of letters that are processed. Single letters and the initial doublet are almost identical in processing time, and they are also not significantly different from the first and final triplet as well as the whole word. This is fairly strong evidence against a single letter approach to word recognition which would predict increases in reaction time as the number of letters increase. Second, it looks as if the initial consonant cluster functions as a unit. The initial consonant blend is a spelling pattern according to most definitions of spelling patterns and it is also normally taught by reading teachers as a very powerful word recognition cue. Third, spelling patterns seem to be more loosely structured than originally conceived by Elinor Gibson. Both the first and last triplet are fast, yet they overlap in that both involve the medial vowel. The medial vowel seems to float indicating that there is not a clear distinction in what a spelling pattern is. Fourth, the whole word itself, seems to be a unit of word recognition.

To see if these results transcen various modifications of the paradigm we ran two control experiments. The second experiment had the same cues and word types as those in the previous experiment. For the first condition the task was made more visual by placing the cues directly above the words. We were interested in whether the same effects would occur with a more visual matching task(See Table 2). For the second condition we worked in the opposite extreme by placing the cue to the right of the word but in lower case letters. This would insure that subjects could not use visual matching alone, but would have to translate into a higher order graphemic representation.

In looking at the results collapsed over word types(Figure 2), there is a main effect of task but there is no interaction between the two task types. The pattern of results for both conditions is essentially the same as the first experiment. The single letter is again fast, but it is also somewhat slower than the first consonant doublet. The first and last triplet as well as the whole word are fast. It is very clear that multiple letter units can be processed as quickly as single letters. These results also suggest that there are potential units of processing which seem to correspond to spelling pattern type units.

One problem with the present paradigm, particularly with respect to the double letter cues is that serial position effects may confound with spelling patterns. The serial position analysis simply indicates that letters are better processed near the ends of words. Consequently, one would expect the first two letters to be in a favorable processing position as well as the first and last triplets. So we ran another control experiment in which contrasts were made between permissible and non-permissible letter strings. The permissible strings were identical to the CCVCC words . he first and second studies, but the medial vowel was replaced with a consonant. The non-permissible strings were composed of letters not occurring together in English orthography(see Table 3). In this experiment we also gathered more single letter data so the first five cues involved the single letters with the remaining four probes containing double letter cues and the whole word.[1]

In looking at the results of this experiment presented in Figure 3, we see that all of the effects of spelling patterns do not disappear, which means that the units cannot be totally accounted for by serial position effects. For the permissible vs. non-permissible strings there is a strong and reliable interaction such that spelling patterns are even faster on the initial and final consonant clusters. The presence of a spelling pattern type unit must account for these gaps since the faster latencies occurred to the permisslbe letter pattern when the probe contained the spelling pattern units.

In summary, the experiments as a whole show clearly that there are units of processing larger than the single letter and within the syllable. Some of these units correspond to what Gibson defines as the spelling pattern. Furthermore, the units of processing seem to be somewhat flexible such that single letters, the initial doublet, some letter triplets and the whole word all seem to function as processing units.

[1] The single letter data was used as a control condition for another study which was not presented in this talk, due to a time factor.

Table I

Examples of Same and Different Judgment Stimuli for Word Types A & B for Experiment I

Probe	Type A Same*	Type A Different	Type B Same	Type B Different
1	FRAME:M	FRAME:T	BLAST:L	BLAST:R
2	FRAME:FR	FRAME:FL	BLAST:BL	BLAST:SL
3	FRAME:RA	FRAME:TA	BLAST:LA	BLAST:LO
4	FRAME:AM	FRAME:AL	BLAST:AS	BLAST:AN
5	FRAME:ME	FRAME:TE	BLAST:ST	BLAST:RT
6	FRAME:FRA	FRAME:FLA	BLAST:BLA	BLAST:CLA
7	FRAME:RAM	FRAME:RIM	BLAST:LAS	BLAST:LAN
8	FRAME:AME	FRAME:ATE	BLAST:AST	BLAST:ASH
9	FRAME:FRAME	FRAME:FROME	BLAST:BLAST	BLAST:BLANT

Table II

Examples of Same Judgment Stimuli for Conditions 1 and 2 for Experiment II

Probe	Condition 1 Type A	Condition 2 Type A	Condition 1 Type B	Condition 2 Type B
1	R FRAME	FRAME:e	S BLAST	BLAST:l
2	FR FRAME	FRAME:fr	BL BLAST	BLAST:bl
3	RA FRAME	FRAME:ra	LA BLAST	BLAST:la
4	AM FRAME	FRAME:am	AS BLAST	BLAST:as
5	ME FRAME	FRAME:me	ST BLAST	BLAST:st
6	FRA FRAME	FRAME:fra	BLA BLAST	BLAST:bla
7	RAM FRAME	FRAME:ram	LAS BLAST	BLAST:las
8	AME FRAME	FRAME:ame	AME BLAST	BLAST:ast
9	FRAME FRAME	FRAME:frame	BLAST BLAST	BLAST:blast

Table III

Examples of Same and Different Judgment Stimuli for Word Types A & B for Experiment III

Probe	Type A Same	Type A Different	Type B Same	Type B Different
1	BLGST:B	BLGST:F	RQFPC:R	RQFPC:N
2	BLGST:L	BLGST:R	RQFPC:Q	RQFPC:L
3	BLGST:G	BLGST:K	RQFPC:F	RQFPC:T
4	BLGST:S	BLGST:N	RQFPC:P	RQFPC:X
5	BLGST:T	BLGST:P	RQFPC:C	RQFPC:Z
6	BLGST:LL	BLGST:BR	RQFPC:RQ	RQFPC:RL
7	BLGST:GS	BLGST:FS	RQFPC:FP	RQFPC:FN
8	BLGST:ST	BLGST:SP	RQFPC:PC	RQFPC:NC
9	BLGST:BLGST	BLGST:BLRST	RQFPC:RQFPC	RQFPC:RXFPC

Figure 1

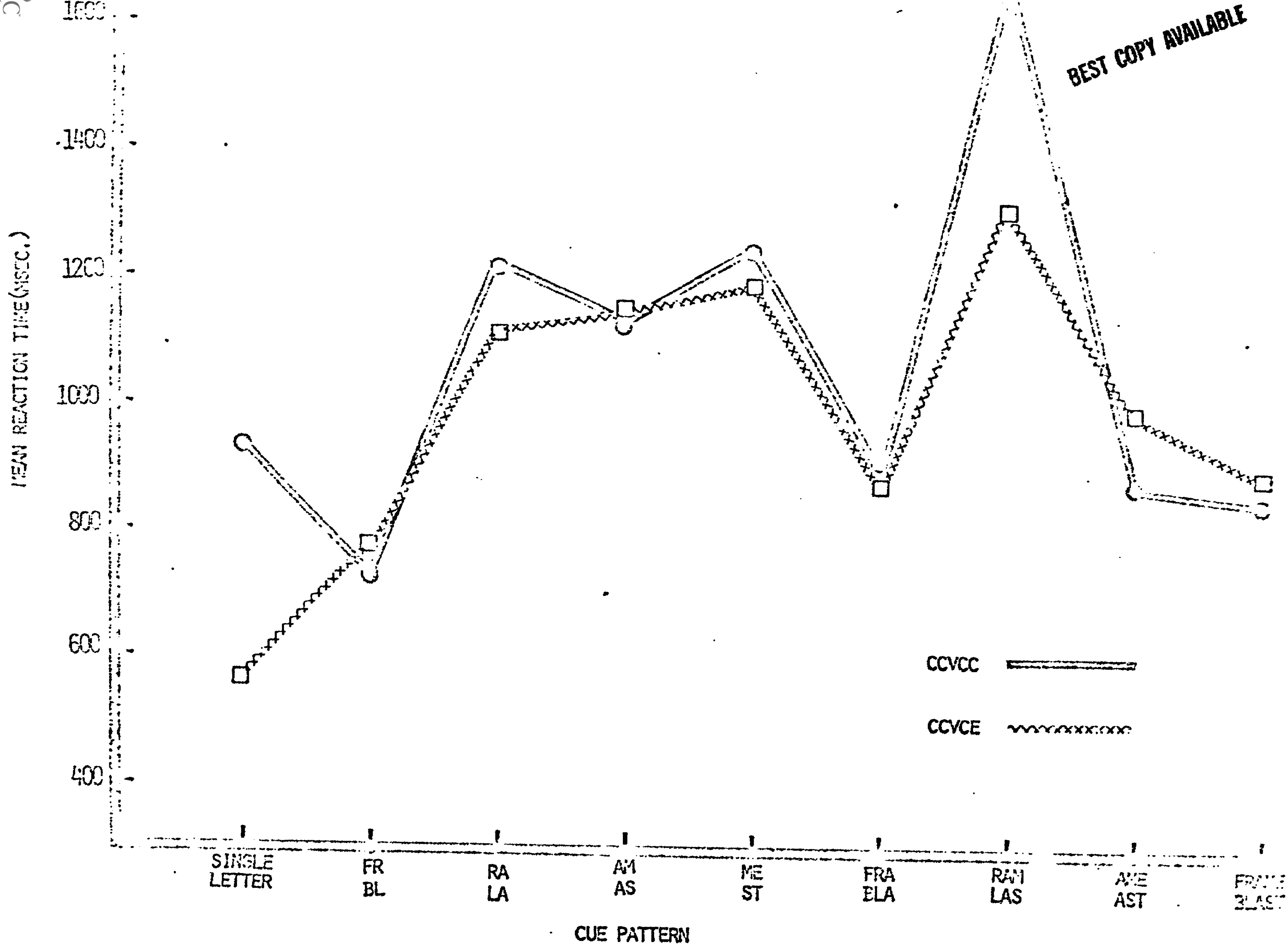

BEST COPY AVAILABLE
MEAN REACTION TIME (MSEC.)
1600
1400
1200
1000
800
600
400
CCVCC
CCVCE
SINGLE LETTER
FR BL
RA LA
AM AS
ME ST
FRA BLA
RAM LAS
AME AST
CUE PATTERN

Figure 2

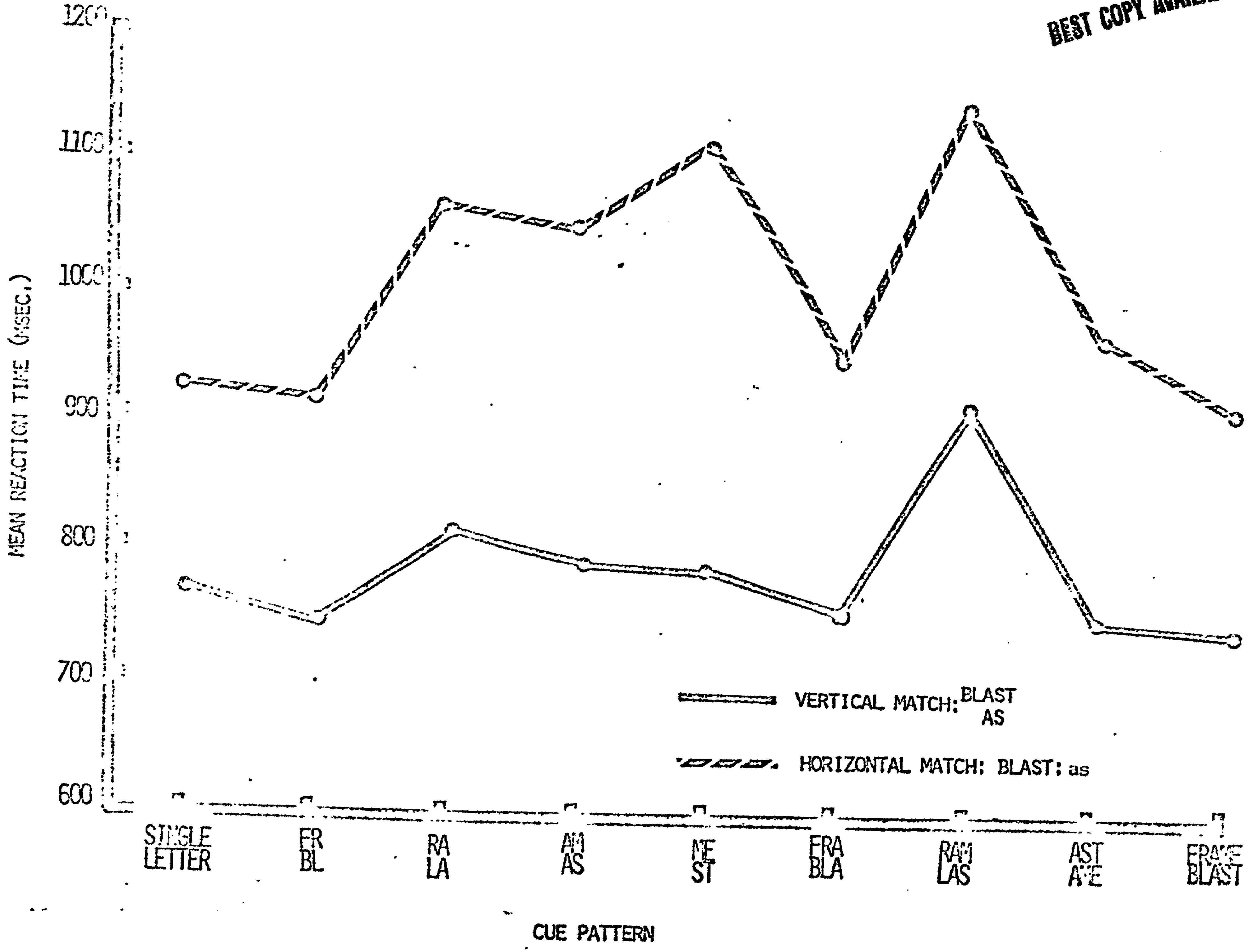
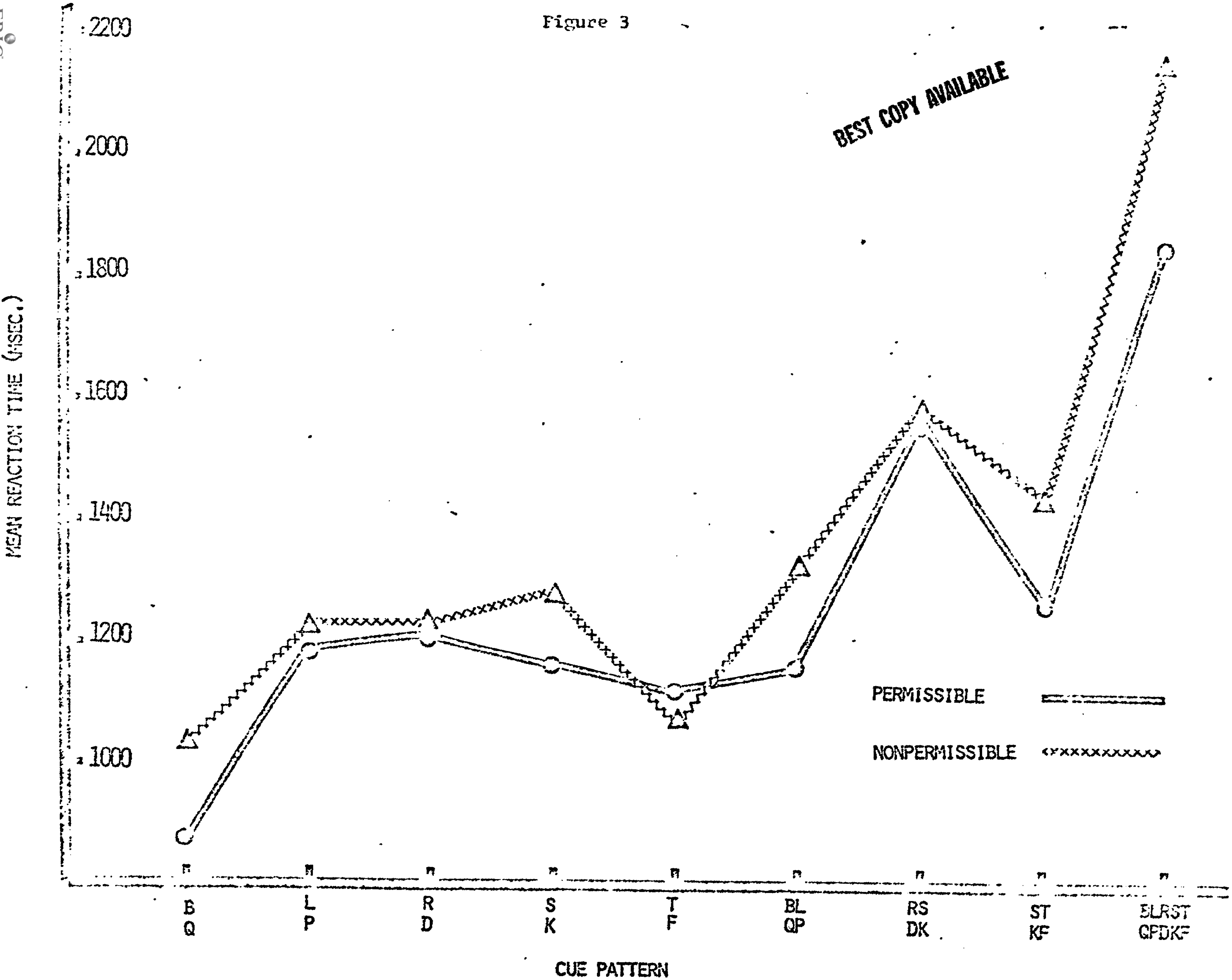

MEAN REACTION TIME (MSEC.)
1200
1100
1000
900
800
700
600
SINGLE LETTER
FR BL
RA LA
AM AS
ME ST
FRA BLA
RAM LAS
AST AME
FRAME BLAST
CUE PATTERN
VERTICAL MATCH: BLAST AS
HORIZONTAL MATCH: BLAST: as

Figure 3


BEST COPY AVAILABLE
MEAN REACTION TIME (MSEC.)
2200
2000
1800
1600
1400
1200
1000
B Q
L P
R D
S K
T F
BL QP
RS DK
ST KF
BLRST QPDKF
CUE PATTERN
PERMISSIBLE
NONPERMISSIBLE