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MONOCULAR RECOGNITION OF VERTICALLY-ORIENTED WORDS AND LANDOLT CS IN THE VISUAL HALF-FIELDS

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MONOCULAR RECOGNITION OF VERTICALLY-ORIENTED WORDS AND LANDOLT Cs IN THE VISUAL HALF-FIELDS

by

THEODORE F. D'AMICO

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

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ABSTRACT

MONOCULAR RECOGNITION OF VERTICALLY-ORIENTED WORDS AND LANDOLT Cs IN THE VISUAL HALF-FIELDS

by

Theodore F. D'Amico

Advisor: Professor William S. Battersby

All past tachistoscopic studies that have been conducted to investigate hemispheric asymmetries for the processing of alphabetical material can be criticized for using a verbal response indicator and/or failing to control simultaneously for directional reading habits and the influence of peripheral factors. In addition, many of these studies can be criticized for (a) their reliance on group data, (b) their failure to attend to differences in luminance in the two visual half-fields, and/or (c) their use of a single measure (e.g., per cent correct recognition) to evaluate functional hemispheric differences.

In the present study, an attempt was made to correct for the shortcomings of these past studies. Towards that end, five dextral and three sinistral observers (Os) were tested monocularly in four test sessions (one for each combination of eye and stimulus material). In each session, either vertically-mounted words (verbal condition) or Landolt Cs (acuity condition) were presented one at a time to either the left or right of fixation using a tachistoscope that illuminated the two visual half-fields equally. All stimuli were presented at a retinal eccentricity of 3^{o} at one of three

exposure durations. The exposure durations were selected at the beginning of each test session in an attempt to generate recognition rates ranging from approximately 10% to 80% correct so that estimates of threshold (50% correct) exposure duration could be calculated.

The task was a "go, no-go" RT discrimination: O was required to release a telegraph key with his index finger as rapidly as possible following the presentation of certain (positive) stimuli and not to release the key following the presentation of other (negative) stimuli. Responses to negative stimuli (false alarms) provided the basis for determining whether the criterion level of responding was comparable for left and right visual field presentations; responses to positive stimuli, and the latencies of these responses, provided the basis for measuring half-field differences in per cent correct recognition and reaction time, respectively. For each of these measures, as well as threshold exposure duration, half-field differences for the left and right eye viewing of words were evaluated on a group and individual basis in terms of their statistical significance after the data were adjusted for differences in hemiretinal acuity. These adjustments were accomplished by subtracting, for a given eye, RVF-LVF differences for the viewing of Landolt Cs from RVF-LVF differences for the viewing of words (acuity baseline comparisons). For each test session, positive and negative stimuli, field of presentation, and exposure duration were randomized within blocks of 45 trials, and the hand used in responding was counterbalanced across blocks. The type of stimulus material presented and the eye tested within a session were counterbalanced across the eight Os.

In general, the results indicated that the two cerebral hemispheres differ in their ability to process tachistoscopically presented alphabetical material. As a group, dextral Os showed a significant RVF superiority for per cent correct recognition and threshold exposure duration in both the left and right eye viewing conditions, and a significant RVF superiority for reaction time in the right eye viewing condition. In comparison, all half-field differences for the above three measures were not significant for the sinistral group.

Although in many cases the results failed to reach significance, the data for individual Os also indicated that the processing of alphabetical material is not performed equally well by the two hemispheres. For both left and right eye viewing, all five dextral Os showed a favoring of the RVF for per cent correct recognition and threshold exposure duration, and four of the five dextral Os showed a favoring of the RVF for reaction time. In comparison, all half-field recognition, threshold and reaction time differences for two of the three sinistral Os were nonsignificant and small relative to the half-field differences that obtained for the average dextral O.

The results were discussed in terms of (a) Kimura's hemispheric specialization hypothesis, (b) the correspondence between recognition and reaction time measures for evaluating half-field differences, and (c) previous half-field studies that have used a monocular viewing paradigm.

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I would first like to thank my advisor, Dr. William S. Battersby, whose guidance, warmth, and encouragement sustained me throughout my graduate career. I am most grateful to Drs. Jack Orbach and Mitchell Kietzman for their advice and continuous support. Their questions and critical analyses greatly enhanced my appreciation and understanding of this undertaking. I would also like to thank Drs. Sidney Weinstein and Max Pollack for their comments and suggestions for improving this manuscript. I would also like to express my gratitude to Robert Raino, Stanley Sham, and Larry Feldman for their technical advice and to my friends, Howard Cohen, Garry Nelson, Glenn Bauer, and Patricia Buttacavoli, for their constant support. Finally, I would like to dedicate this dissertation to my wife, Christine, whose understanding, encouragement, and love provided me with the confidence and motivation to see this task to its completion.

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INTRODUCTION

In recent years, numerous tachistoscopic studies have been conducted to investigate differences between the visual half-fields for the recognition of unilaterally presented alphabetical material, i.e., material that is presented in the left visual field (LVF) or right visual field (RVF) on a single exposure. The results of these studies have shown that, when alphabetical material composed of Latin letters (e.g., the letters used in English) is presented unilaterally, per cent correct recognition is generally greater in the RVF than in the LVF (e.g., Bryden, 1966a; Harcum & Finkel, 1963; Heron, 1957; Mishkin & Forgays, 1952; Orbach, 1952, 1967).

As discussed below, at least four factors have been suggested to account for this finding. These factors include directional reading habits, hemispheric specialization, acuity and sighting dominance (peripheral factors), and the use of a verbal response indicator. The primary purpose of the present study was to determine whether hemispheric specialization does, in fact, play a role in determining half-field differences in the recognition of unilaterally presented alphabetical material. Specifically, the primary purpose was to determine whether half-field recognition differences which are in accord with the concept of hemispheric specialization still occur when a nonverbal response indicator is used, and when the necessary controls are employed to rule out the the influence of other factors. Additional objectives of the present study were to determine if half-field recognition and RT measures are related, and the extent to which handedness (i.e., left handedness vs. right handedness) influences both these measures.

Directional Reading Habits

Heron (1957) has suggested that half-field differences in the recognition of alphabetical material are due primarily to a directional "post-exposural scanning process" (p. 46). This scanning process consists of a sequential analysis of the memory trace of the stimulus after its tachistoscopic exposure. The sequential analysis of the trace can occur without concomitant eye movements. This is because it consists presumably of central nervous system activity that precedes overt movements of the eyes in a manner similar to the phase sequence described by Hebb (1949). The sequence in which the memory trace is scanned and processed corresponds to the two types of eye movement that occur during reading, i.e., an initial shift to the beginning of the line of print and short saccades left to right. When alphabetical material composed of Latin letters is presented unilaterally, the tendency to move the eyes to the beginning of the line of print and the tendency to move the eyes across the line of print are in the same direction (towards the right) for RVF presentations, and are in opposite directions for LVF presentations. According to Heron (1957), the opposing eye movement tendencies that occur when alphabetical material is presented unilaterally in the LVF results in a less efficiently scanned memory trace and, consequently, in poorer recall of material presented in this half-field.

Although Heron's explanation is undeniably speculative, it seems to explain many of the findings in the half-field literature. For example, when aphabetical material is presented on both sides of fixation at the same time (bilateral method of stimulus presentation), the material presented in the LVF is better recognized (e.g., Bryden, 1966b; Bryden & Rainey, 1963; Harcum, 1964; Heron, 1957). To account for this finding, Heron suggested that although eye movement tendencies are directionally opposite in the bilateral condition, the dominant tendency is to move the eyes (from right to left) to the beginning of the line of print, while the secondary tendency is to scan the material from left to right. Since the leftmost elements of the memory trace are presumably scanned and processed first, a LVF superiority occurs in the bilateral condition.

The data pertaining to the characteristics of the stimulus material also lend support to Heron's explanation. For example, Harcum & Finkel (1963) found that mirror images of English words which are unilaterally presented are better recognized in the LVF. The authors' explanation of this finding was that mirror images of English words are read in a right to left direction. Consequently, when they are presented unilaterally, both eye movement tendecies are in the same direction (towards the left) for LVF presentations, and are in opposite directions for RVF presentations.

Hemispheric Specialization

An alternative explanation has been offered by Kimura (1961, 1966) to account for the differential recognition of alphabetical material in the two visual half-fields. Like Heron, Kimura claimed that, when alphabetical material is presented bilaterally, directional reading habits overshadow other effects (e.g., hemispheric specialization) and produce a superior recognition in the LVF. However, unlike Heron, Kimura claimed that, when alphabetical material is presented unilaterally, the superior recognition in the RVF is due primarily to the effects of hemispheric specialization. Two basic assumptions underlie Kimura's explanation. The first is that there is a functional difference between the two cerebral hemispheres -- one hemisphere (typically the left) is thought to be responsible for speech and verbal information processing, the other (typically the right) is thought to be responsible for performing tasks requiring a high degree of visualspatial ability (e.g., DeRenzi, Scotti, & Spinnler, 1969; Kimura, 1963, 1966, 1973; Patterson & Zangwill, 1944; Sperry, 1968, 1973; Warrington & James, 1967). The second assumption is that half-field differences in recognition depend upon the nature of the stimulus (verbal vs. spatial) and the cerebral hemisphere activated. Specifically, it is assumed that, for most individuals, the presentation of verbal material in the RVF or of nonverbal material in the LVF results in better recognition because the material is projected directly to the hemisphere specialized for its processing. The poorer recognition of the same material presented in the opposite half-field is thought to be due to: (1) an inefficient processing of the material by the nonspecialized hemisphere; and/or (2) a loss of the informational value of the material as a result of the additional synaptic connections involved in transmission to the hemisphere specialized for its processing.

Evidence supporting Kimura's explanation comes from three related lines of inquiry. Firstly, numerous studies using the unilateral method of stimulus presentation have shown that the nature of the task or stimulus material (i.e., verbal vs. spatial) strongly influences half-field differences in recognition. For example, a LVF superiority has been found for dot and geometric form enumeration (Kimura, 1966), depth perception (Durnford & Kimura, 1971), and the recognition of random shapes (Dee & Fontenot, 1973), while a RVF superiority has been found for the recognition of English words (Harcum & Finkel, 1963; Mishkin & Forgays, 1952; Orbach, 1952, 1967; Terrace, 1959) and letter strings composed of Latin letters (Bryden, 1966a; Heron, 1957). Secondly, when the unilateral method of presentation is used and an attempt is made to control for directional reading habits by using either single Latin letters or vertically-mounted English words, a RVF superiority still occurs (Barton, Goodglass & Shai, 1965; Bryden, 1964, 1966a; Goodglass & Barton, 1963). Thus, in order to preserve an explanation based on directional reading habits, it must be assumed that Latin letters are scanned in a left to right direction. This assumption seems unlikely since a RVF superiority has been found for unilaterally presented mirror images of single Latin letters and vertically-mounted Hebrew words (Bryden, 1966a; Barton, Goodglass & Shai, 1965). Thirdly, researchers who have tried to control for directional reading habits by using either unilaterally presented single Latin letters or vertically-mounted letter strings have shown that half-field recognition differences are related to handedness (Bryden, 1964, 1965; Levy & Reid, 1976). As would be predicted based on the higher estimates of left hemispheric specialization for language in the right handed population (98%-99% vs. 53%-75%), dextral subjects showed a greater recognition differential favoring the RVF than did sinistral subjects (Goodglass & Quadfasel 1954; Milner, Branch, & Rasmussen, 1964; Penfield & Roberts 1959; Warrington & Pratt, 1973). When, however, horizontally-mounted letter strings were used, the favoring of the RVF was comparable for the two groups of subjects (Bryden, 1964). Presumably, in the latter case, directional reading habits overshadowed the effects of hemispheric specialization in producing half-field differences.

Acuity and Sighting Dominance

A third explanation to account for half-field differences in the recognition of unilaterally presented alphabetical material has been advanced by Hayashi and Bryden (1967), as well as Kershner and Gwan-Rong Jeng (1972). These authors have suggested that half-field recognition differences are the result of an interaction between hemispheric specialization and peripheral factors (e.g., acuity and sighting dominance). Evidence to support the assumption that acuity is a determinant of half-field differences is suggested by the finding that subjects with superior acuity in the right eye showed a significant favoring of the RVF for the recognition of unilaterally presented single Latin letters, whereas those with superior acuity in the left eye showed no significant half-field differences (Hayashi & Bryden, 1967). Hayashi and Bryden accounted for these findings in the following manner:

> Stimulation provided through the eye with better acuity is stonger or less distorted than provided through the other eye. In addition, there is considerable and physiological evidence indicating that the crossed optic pathways dominate the uncrossed pathways (Doty, 1958; Hubel & Wiesel, 1959; Polyak, 1957). This superiority of the crossed pathways would provide an advantage to the left visual field of the left eye and to the right visual field of the right eye. Taken in conjunction with the effects of acuity and cerebral dominance, it would lead us to expect a large right visual field superiority in the right acuity dominant subjects, for whom the right eye contributes the higher level of stimulation. On the other hand, little or no right field superiority would be expected in the left eye acuity dominant subjects, for whom the left eye is more important. (p. 611)

Evidence to suggest that sighting dominance is a determinant of half-field recognition differences comes from a study by Kershner and Gwan-Rong Jeng (1972). These authors found that unilaterally presented English and Chinese words are better recognized by (Chinese) subjects who sight with their right eye, whereas unilaterally presented forms are better recognized by subjects who sight with their left eye. Like Hayashi and Bryden, the authors interpreted their findings in terms of ocular dominance, hemispheric specialization and crossed optic fiber superiority.

Based on the above evidence, it may be inferred that the likelihood of obtaining a RVF superiority for the recognition of unilaterality presented alphabetical material is enhanced when right eye viewing is used. Unfortunately, this inference is only indirectly supported by the studies of Hayashi and Bryden and Kershner and Gwan-Rong Jeng, since both were conducted with binocular viewing. Moreover, this inference is further weakened by the findings of studies in which subjects were tested monocularly. In general, the results of monocular studies have shown that a RVF superiority is found only when left eye viewing is used (Markowitz & Weitzman, 1969, Nelson 1976; Overton & Wiener, 1966), or that the half-field differences that occur are independent of the eye tested (Barton <u>et al</u>. 1965; Goodglass & Barton, 1963).

<u>Verbal Response Indicators</u>

White (1972) claimed that both hemispheres are equally capable of processing verbal information. He maintained that, when directional reading habits are controlled for, the typical finding of a RVF superiority for unilaterally presented alphabetical material is due to the use of a verbal response indicator. White's argument is based on two assumptions. The first is that, in most individuals, only the left hemisphere is capable of initiating a verbal response. The second is that interhemispheric transfer of information results in an attenuation of the stimulus input. Thus, when alphabetical material is presented unilaterally and a spoken or written response is required (which is usually the case), a RVF superiority occurs only because LVF presentations would require an interhemispheric transfer of information for a verbal response to be initiated.

Evidence supporting White's contention comes from studies by Gazzaniga (1967, 1968). Gazzaniga has shown that, when alphabetical material and pictures are tachistoscopically exposed in the RVF, commissurotomized patients were able to identify the material using either the written or spoken word. The same material presented in the LVF could not be identified using the same response indicators. However, if the patients were permitted to use nonverbal responses, such as matching the exposed stimulus from among several alternatives, accuracy of identifaction was as good for stimuli presented in the LVF as for stimuli presented in the RVF.

Additional evidence to support White's explanation comes from studies in which RT has been used to assess hemispheric specialization. Geffen, Bradshaw and Wallace (1971), for example, measured vocal RT and manual RT (counterbalanced across subjects and hands) to physiognomical material and found that when vocal RT was used, no significant half-field differences obtained. When, however, manual RT was used, stimuli were responded to faster when they were presented in the LVF. Based on the manual RT findings, the authors concluded that the right hemisphere is superior to the left in processing physiognomical material. This conclusion was based on the assumption that both hemispheres are equally capable of initiating a manual motor response. Thus, when a significant half-field difference is found for manual RT, the difference is interpreted as meaning that there is a hemispheric asymmetry in processing specific types of information. Half-field differences in RT have been explained in terms of interhemispheric transfer time (Filbey & Gazzaniga, 1969), an asymmetry between the hemispheres in the speed of processing specific information (Klatzky, 1970) or a combination of both these factors (Geffen et al. 1971). Geffen et al. attributed the failure to find a LVF superiority for vocal RT to the use of a verbal response indicator. Specifically, they claimed that, "when a vocal response to facial stimuli is required, this confers an advantage to the right hemisphere in stimulus analysis and aids the left hemisphere in speed of response initiation, so that the net result is a nonsignificant difference in RT beween the two visual fields" (Geffen et al., 1971, p. 421).

Studies which have used manual RT and have attempted to control for left to right reading habits also lend support to White's argument because they have not consistently reported a RVF superiority. For example, when single Latin letters are unilaterally presented, Klatzky and Atkinson (1971) found a LVF superiority, Rizzolatti, Umilta, and Berlucchi (1971) found a RVF superiority, and Umilta, Frost, and Hyman (1972) found no significant half-field differences. Based on the inconsistent findings of these RT studies, it is difficult to infer whether the two cerebral hemispheres differ in their ability to process alphabetical material. However, the failure to find a consistent RVF superiority in these studies may have been due to the choice of stimulus material. McKeever and Huling (1971) stated that "although letters are certainly language symbols, they are concrete stimuli with little connotative meaning compared to words (p. 15)." These authors contended that in order to test whether there is a hemispheric asymmetry in processing alphabetical or other types of verbal material it is necessary to employ words, as opposed to single letters or letter strings. Although there is no conclusive evidence to indicate that the likelihood of finding a RVF superiority is enhanced when words, as opposed to letter strings, are used, a study by Cohen (1972) suggests that single Latin letters may be analyzed either spatially or verbally, and that the half-field superiority that occurs is dependent upon the mode in which the letters are processed. Cohen measured manual RT to unilaterally presented Latin letters which were either physically identical (e.g., AA) or nominally identical (e.g., Aa). The subjects were required to respond by using the index finger of one hand when the two stimuli were physically identical and to respond with the index finger of the other hand when the stimuli were nominally identical. The results showed that, for dextral Os, name matches were performed more rapidly when the letters were presented in the RVF, while identity matches were performed more rapidly when the letters were presented in the LVF.

Still a second reason that may account for the failure to find a consistent RVF superiority for RT to unilaterally presented letters is that RT, <u>per se</u>, may tell us little about hemispheric specialization. Kimura and Durnford (1973) maintained that, in order to assess hemispheric asymmetries, recognition measures alone, or in conjunction with RT measures, should be used since the two measures may not be related. Furthermore, McKeever and Huling (1971) claimed that in order to evaluate functional differences between the cerebral hemispheres, the task has to be made difficult by presenting the stimuli at or near threshold level -- the assumption being that if the initial input is above a critical energy level, the attenuation as a result of transcollosal transfer will not be sufficient to produce half-field differences in recognition. In almost all the studies which have used RT to assess hemispheric asymmetries, stimulus energy levels well above threshold have been used and, consequently, the recognition rates have been between 90% and 100% in both the left and right visual fields.

Summary and Rationale for the Present Study

In summary, numerous half-field studies have been conducted and at least four factors have been suggested to account for the finding that unilaterally presented alphabetical material is better recognized in the RVF. The primary objective of the present study was to determine whether one of these factors -- hemispheric specialization for the processing of verbal information (Kimura's explanation) -- does, in fact, play a role in determining this finding. Although many past studies have had a similar objective, each of them can be criticized for their failure to control simultaneously for the influence of other factors. That is to say, all past studies which have investigated Kimura's explanation can be criticized for using a verbal response indicator and/or failing to control for directional reading habits and the influence of peripheral factors.

In addition to the above shortcoming, almost all studies that have investigated Kimura's explanation or, for that matter, alternative explanations of half-field differences, can be criticized on three additional grounds. Firstly, almost all past studies have relied upon averaging statistics and have totally ignored differences in individual performance. Although the use of averaging statistics enables one to generalize the findings, their use often obscures individual variations in performance. Morevover, significant half-field differences may be found for group scores, while half-field differences for individual subjects may fail to reach significance. Secondly, almost all past studies can be criticized for using a single exposure duration and measuring half-field differences solely on the basis of per cent correct recognition. While such a procedure is easy to implement, it suffers from several drawbacks. The primary drawback is that it does not permit one to generate psychophysical functions so that estimates of threshold (i.e., 50% correct recognition) exposure duration can be made for both left and right visual field presentations. Moreover, such a procedure does not permit one to evaluate directly the correspondence between recognition and other measures (e.g., RT) that have been used to evaluate half-field differences. Thirdly, many past studies can be criticized for their failure to equate for luminance in the two visual half-fields. Obviously, the importance of hemispheric specialization or other possible determinants of half-field differences can not be assessed when the results may be due, in part, to the structural or physical characteristics of the viewing apparatus (White, 1972).

In the present study, an attempt was made to correct for the shortcomings of past studies that have investigated Kimura's explanation of half-field differences in the recognition of unilaterally presented alphabetical material. The primary objective was to determine whether dextral subjects (subjects for whom the left hemisphere is presumably specialized for processing verbal information) display half-field recognition and thresholds differences which are in accord with Kimura's explanation when the necessary controls are implemented to rule out the influence of other factors. Additional objectives of the present study were to determine whether half-field recognition and RT measures are related, and the extent to which both these measures are influenced by the handedness of subjects.

METHOD

Observers. Five male (HC, TY, TS, HM, RC) and three female (CD, WG, BK) observers (*O*s) with normal or corrected vision served in this experiment. Based on tests developed by Crovitz and Zener (1962), five *O*s were right handed (CD, HC, WG, TY, BK), three were left handed (TS, HM, RC) and, excepting WG, BK, and RC, all sighted with their right eye (see Appendix C, Tables C_1 and C_2). Each *O* was given one or more practice sessions to become familiar with the experimental procedure and to provide an estimate of the exposure durations to be used in the experiment. All *O*s were paid $2.00 per hour and were individually in four test sessions, each lasting approximately 120 minutes.

Apparatus. A three-channel tachistoscope (Scientific Prototype, model GA) was employed. Adapting field and fixation targets were presented through the blank channel; stimuli were delivered through Channel 1. Since there were found to be unacceptable differences in luminance between the left and right visual fields, both channels were modified by affixing tin foil and black cardboard to the white reflecting plates so that, for each channel, the luminance levels of the two visual half-fields did not differ by more than 1%.[1] Both channels measured 7 inches horizontally by 4 inches vertically and had identical luminances (.56 ft. L) as measured by a Pritchard photometer (Photo Research Co.) at the viewing point. A viewing distance of 50 inches produced a visual field of 7° 58′ horizontally by 4° 54′ vertically.

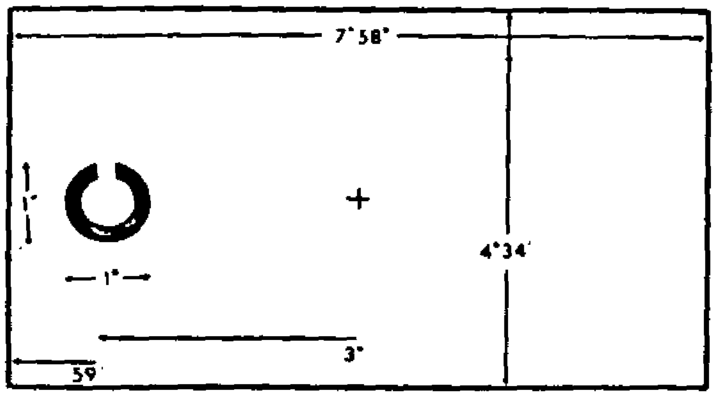
To help stabilize viewing and to ensure that the viewing eye was at 90° to the midpoint of the fixation and stimulus channels, a chin rest was provided and a wooden insert with a centrally placed round aperture 1 and 1/4 inches in diameter was placed in the viewing hood. The chin rest was offset approximately 1 and 1/2 inches to the left or to the right of the center of the field (for right and left eye viewing, respectively) so that the left and right visual fields appeared to be of comparable size.[2]

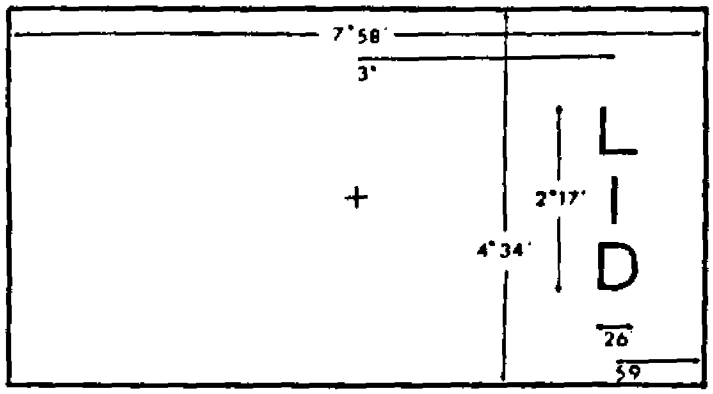
Trials were initiated by _O_ depressing a foot switch which simultaneously triggered a stimulus and a digital counter (Hewlett Packard, model 1672) 1.2 sec. later. Reaction times were measured from stimulus onset to the release of a telegraph key which was depressed by _O_'s index finger prior to each trial.

Procedure. The experiment was conducted in a dimly lit room with ambient light provided by a 10 watt bulb so that _E_ could carry out the tasks of changing the stimuli and recording the data. A wooden partitition was attached to the front of the tachistoscope to reduce the ambient light at the point of viewing and to prevent _O_ from observing the stimuli to be presented.

Each _O_ was tested monocularly in four test sessions. During each session, an eye patch was used to occlude the nonviewing eye and either Landolt Cs (acuity condition) or vertically-mounted, three letter words (verbal condition) were presented one at a time to the left or right of fixation in an unpredictable order. Figure 1 shows the size and retinal eccentricity of these stimuli in degrees of visual angle. In the two acuity sessions, Landolt Cs with a gap in a 3, 6, 9, or 12 o'clock position or without a gap were used to test for differences in ocular and hemiretinal acuity. The gap in the Landolt C subtended a visual angle of 13'. The 6 and 12 o'clock gaps were presented at a retinal eccentricity of 3°, but because the Landolt Cs were

Figure 1. Diagram of representative stimuli used in the present study (Landolt C in the 12 o'clock position in the left visual field for the acuity condition and the word "LID" in the right visual field for the verbal condition). Retinal eccentricity and dimensions of field and stimulus material are indicated in degrees of visual angle subtended.


7"58"
1"
1"
4"34'
3"
59'


7"58'
3"
L
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2"17'
4"34'
26
59

always centered at this eccentricity, the 3 and 9 o'clock gap positions were 22′ closer or farther from fixation depending on the field of presentation.

Eight vertically-mounted, three letter words (LID, LED, LET, LIT, BID, BED, BET, BIT) comprised of upper case letters (Prestype #1248) and blank white cards were used as stimuli in the verbal condition. The words had letters in common to ensure that O was forced to attend to all three letters in order to identify each word correctly. The words subtended a visual angle of 26′ horizontally and 2° 17′ vertically and, like the Landolt Cs, were centered at a retinal eccentricity of 3°. Each letter was of identical height, subtending 34′ in the vertical extent and from 4′ to 26′ in the horizontal extent. The spaces between letters subtended a visual angle of 17′.

The task was a "go, no-go" RT discrimination: O was required to release a telegraph key as rapidly as possible following the appearance of certain (positive) stimuli and not to release the key following the appearance of other (negative) stimuli. Responses to negative stimuli (false alarms) provided the basis for determining whether the criterion level for responding was comparable for left and right visual field presentations; responses to positive stimuli, and the latencies of these responses, provided the basis for measuring half-field differences in per cent correct recognition and RT, respectively. The positive stimuli in the acuity condition were Landolt Cs in the 6 and 12 o'clock gap positions; the positive stimuli in the verbal condition were the words LID and BET. Reaction times in excess of an arbitrary limit of 1,000 msec. were counted as misses when positive stimuli were presented and as correct rejections when negative stimuli were presented.

For each test session, the positive and negative stimuli were presented at three exposure durations. The three exposure durations were selected at the beginning of the test session in an effort to obtain recognition rates ranging from approximately 10% to 80%. Based on the findings of <u>O</u>'s practice session(s), a subthreshold exposure duration was selected and increased in one msec. steps until <u>O</u> verbally identified six stimuli in succession. From the exposure duration which yielded six correct responses, 2 and 4 msec. were subtracted producing three exposure durations with a range of 4 msec. To verify that the exposure durations selected would generate recognition rates ranging from approximately 10% to 80%, 60 additional stimuli were presented, 20 at each of the three exposure durations. Based on the results of the 60 trial presentation, the magnitude of the values and the intervals between exposure durations were increased, decreased, <u>or</u> maintained.

During each test session, 360 stimuli were presented one at a time. Each stimulus had an equal likelihood of being presented at a specific exposure duration in either the left or right visual field. The combined probability of presentation was .5 for positive stimuli (.25 for each of the two positive stimuli) and .5 for negative stimuli. Thus, at each of the three exposure durations, 30 positive and 30 negative stimuli were presented in each visual half-field. The session was subdivided into 8 blocks of 45 trials. Within each block, positive and negative stimuli, field of presentation, and exposure duration were randomized. Two or three minute rest periods were given between blocks to permit <u>E</u> to reorder the stimulus material. On half the trials, <u>O</u> initiated the trial by depressing a foot switch with his right foot and responded by releasing a telegraph key with his right index finger. On the other half of the trials, the left foot and left index finger were used.

Prior to the test session, _O_ was told the stimulus choices, probability of presentation of the positive and negative stimuli, and to initiate a trial only when he was maintaining fixation. In an effort to maintain a strict criterion, _O_ was also told prior to the session that accuracy of responding was more important than speed of responding. When _O_ committed a false alarm (a response to a negative stimulus) during the test session, he was further cautioned to release the telegraph key only when he was certain that a positive stimulus had been presented.

For the first two sessions, half the _O_s were tested using the acuity stimuli, and the other half were tested using the verbal stimuli. The order of testing eyes and the initiation-response sequence were counterbalanced across the eight _O_s.

In summary, five dextral and three sinistral _O_s were tested monocularly in four sessions. Within each session, either vertically-mounted words or Landolt Cs were presented individually in either the left or right visual field at one of three exposure durations. The _O_'s task was to release a telegraph key as rapidly as possible when a positive stimulus was presented and not to release the key when a negative stimulus was presented. A total of 90 positive and 90 negative stimuli were presented in each visual half-field in each session.

Data Analysis. The data for the dextral and sinistral _O_s were analyzed separately on a group and individual basis with respect to the number of responses to the presentation of negative stimuli (false alarm data), and the number of responses and the latency of responses to the presentation of positive stimuli (recognition and RT data, respectively). For each of these measures, half-field differences for the left and right eye viewing of words were evaluated in terms of their statistical significance after the data were adjusted to take into account differences in hemiretinal acuity. These adjustments were accomplished by subtracting, for a given eye, RVF - LVF differences for the viewing of Landolt Cs from RVF - LVF differences for the viewing of words (acuity baseline comparisons). For the false alarm and recognition data, half-field differences were evaluated over the entire dynamic range. For the RT data, however, half-field differences were evaluated over the intermediate and longest exposure durations (D_2 and D_3, respectively) because the response frequency at the shortest exposure duration (D_1) was too low to allow for a meaningful analysis of the data. Following the above analyses, two approaches were used to assess the correspondence between half-field recognition and RT differences. An alpha level $p < .05$ (two-tailed test) was was adopted for all analyses.

RESULTS

False Alarm Data

In order to determine whether the recognition data had to be adjusted to reflect criterion differences in responding to stimuli in the left and right visual fields, false alarm rates for Landolt Cs and words were examined.[3] The group percentages of false alarms for LVF and RVF presentations were 3.1% and 3.2%, respectively, for the dextral group, and 3.8% and 3.1%, respectively, for the sinistral group. For each group of Os and for each O considered separately, acuity baseline comparisons (i.e., comparisons which were performed to control for differences in hemiretinal acuity) revealed that half-field differences in the verbal and acuity conditions were not significantly different for either left or right eye viewing (see Appendix C, Tables C_3 & C_4).[4] Accordingly, no adjustment for criterion differences was applied to the recognition data.

Recognition Data -- Group Findings

Graphic Represenation. Figures 2 and 3 present, for the dextral and sinistral groups, respectively, mean per cent correct recognition vs. exposure duration functions for the left eye (labelled OS on the top of the page) and right eye (labelled OD on the bottom of the page) viewing of Landolt Cs (left side of page) and words (right side of page).[5] The data for LVF and RVF presentations are represented by dashed and solid lines, respectively, and overall half-field differences are shown in parentheses in the lower right quadrant of each function.

Visual inspection of these figures reveals that, when differences in hemiretinal acuity are taken into account, both groups

Figure 2. Mean per cent correct recognition of Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for the dextral group. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function. Note -- A positive number indicates a favoring of the RVF.)

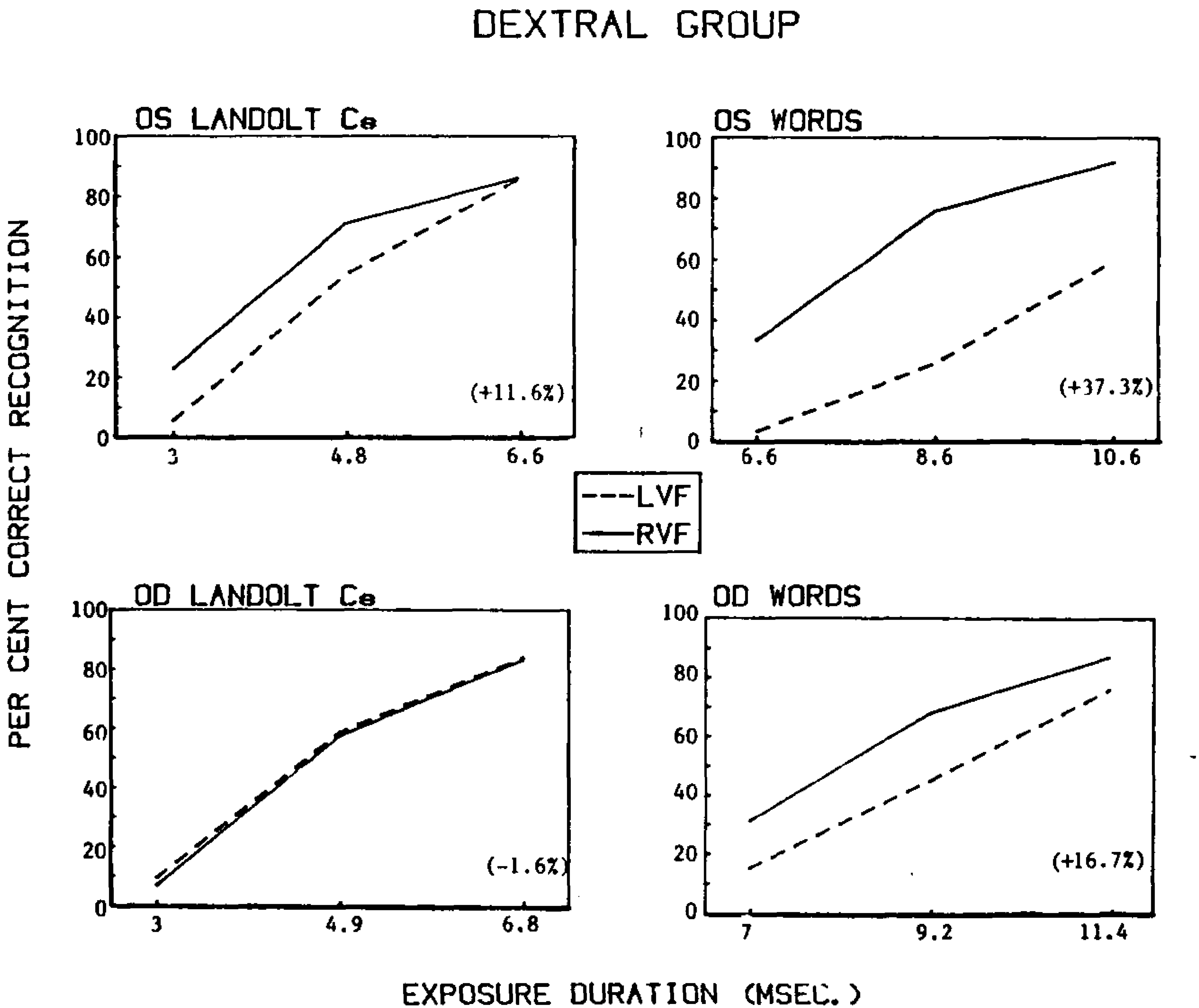
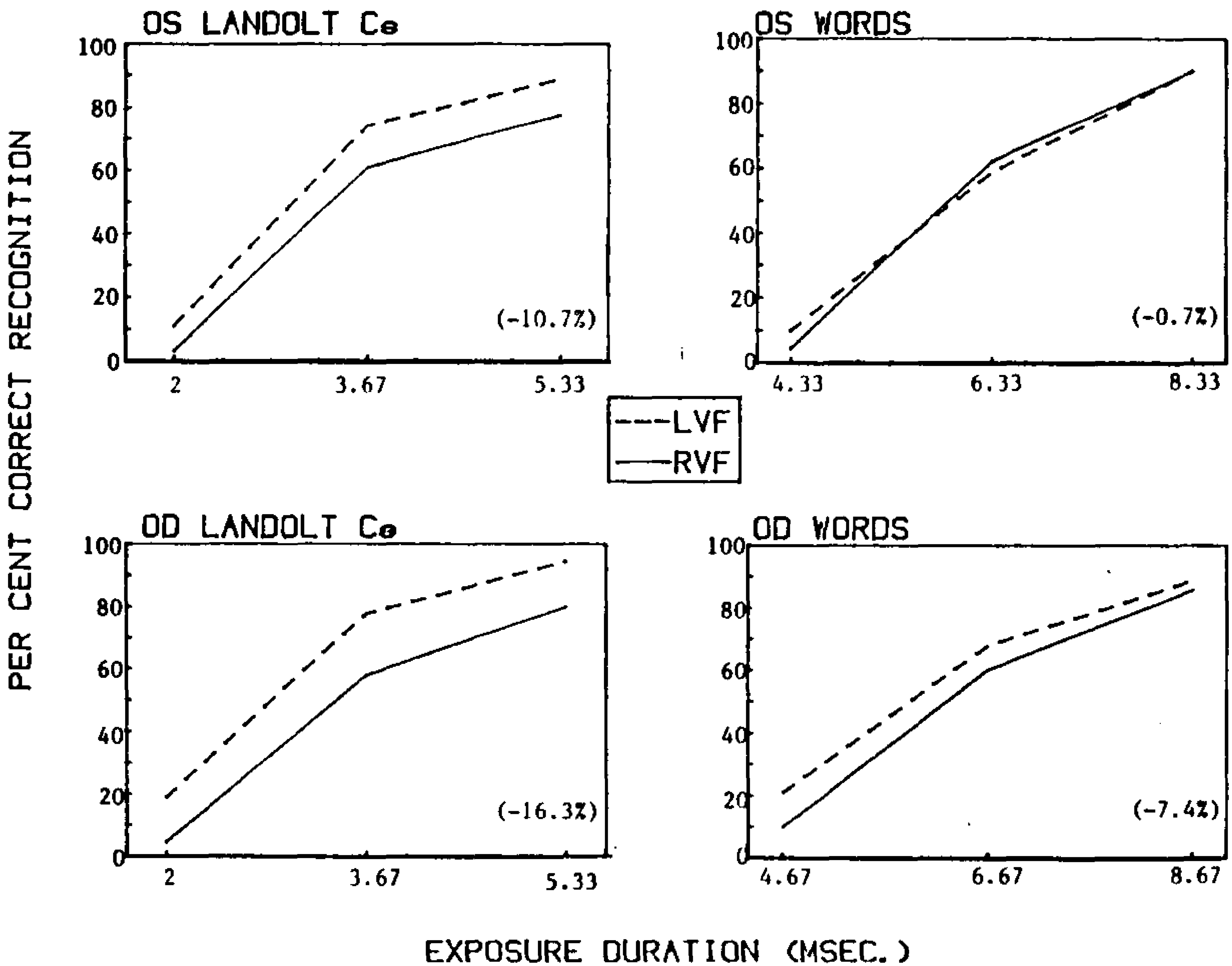

DEXTRAL GROUP
OS LANDOLT Cs
(+11.6%)
OS WORDS
(+37.3%)
OD LANDOLT Cs
(-1.6%)
OD WORDS
(+16.7%)
---LVF
—RVF
PER CENT CORRECT RECOGNITION
EXPOSURE DURATION (MSEC.)
0
20
40
60
80
100
3
4.8
6.6
6.6
8.6
10.6
3
4.9
6.8
7
9.2
11.4

Figure 3. Mean per cent correct recognition of Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for the sinistral group. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function. Note -- A positive number indicates a favoring of the RVF.)

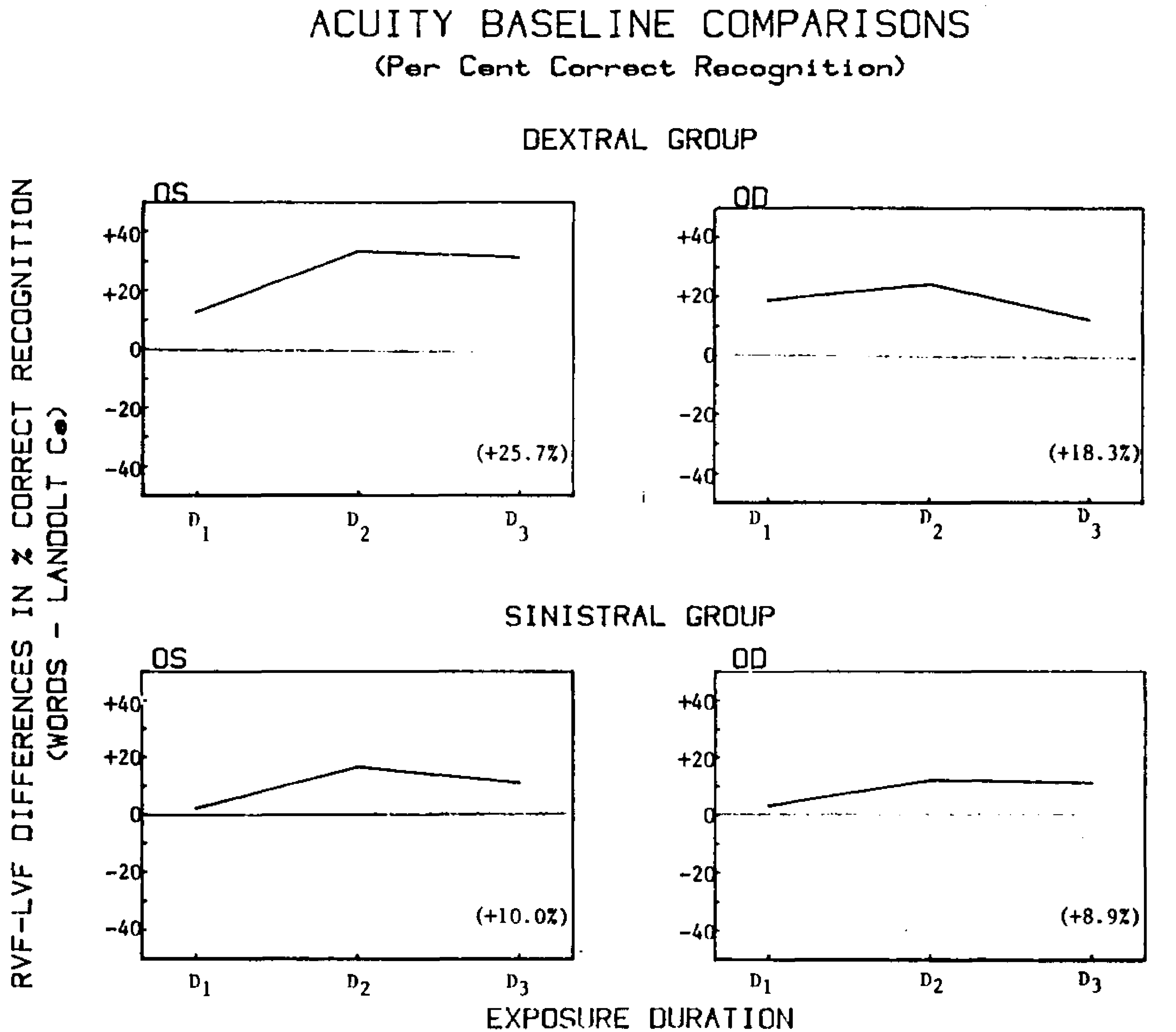
SINISTRAL GROUP



of Os showed a recognition differential favoring the RVF for both the left and right eye viewing of words. Figure 4 (which was derived by referring half-field differences in the verbal condition to their respective acuity baselines) shows, however, that the magnitude of this effect was substantially greater for the dextral group in both the left (25.7% vs. 10.0%) and right (18.3% vs. 8.9%) eye viewing conditions.

Acuity Baseline Comparisons. Acuity baseline comparisons evaluating the effects of Field (LVF vs. RVF), as well as Duration (D_1 vs. D_2 vs. D_3) and Hand (left hand responding vs. right hand responding), were accomplished by performing four 2 x 3 x 2 analyses of variance (one for each combination of group and eye). In each of these analyses, all three factors were repeated on Os, and the dependent variable was the difference in the proportion of correct responses in a given field for the viewing of the two types of stimuli.[6,7] The results of these analyses revealed that, when differences in hemiretinal acuity were taken into account, the dextral group showed a significant RVF superiority for the recognition of words in both the left and right eye viewing conditions, while the sinistral group showed no significant half-field differences in either viewing condition. With the exception of the significant Field effects mentioned above and a significiant main effect, Duration, that occurred for the dextral group for the right eye recognition of words, all other findings were insignificant (see the summary tables of these analyses of variance in Appendix C, Tables C_5-C_8).[8,9]

Figure 4. Half-field (RVF-LVF) recognition differences for the viewing of words minus half-field recognition differences for the viewing of Landolt Cs as a function of exposure duration. Dextral group on the top; sinistral group on the bottom. (Mean differerces analyzed across all data points are shown in parentheses in the lower right quadrant of each function. Note -- A positive number indicates a favoring of the RVF.)


ACUITY BASELINE COMPARISONS
(Per Cent Correct Recognition)
DEXTRAL GROUP
SINISTRAL GROUP
OS
OD
+40
+20
0
-20
-40
(+25.7%)
(+18.3%)
(+10.0%)
(+8.9%)
D_1
D_2
D_3
RVF-LVF DIFFERENCES IN % CORRECT RECOGNITION
(WORDS - LANDOLT Cs)
EXPOSURE DURATION

Threshold Comparisons. In order to further evaluate half-field recognition differences, LVF and RVF threshold (50% correct recognition) exposure durations were computed for each *O* in each of the four test sessions.[10] Then, as in the previous per cent correct recognition analysis, the data for the two groups of *O*s were analyzed separately to determine whether significant half-field differences occurred in the verbal condition when the data were adjusted to take into account differences in hemiretinal acuity. As can be seen in Table 1, threshold exposure duration for the dextral group was significantly shorter in the RVF for both the left and right eye viewing of words. In comparison, the sinistral group showed no significant half-field differences in threshold exposure duration for the viewing of words in either viewing condition.

Recognition Data -- Individual Findings

Graphic Representation. In the manner described previously, Figures B_1 - B_5 (see Appendix B) present, for the five dextral *O*s, per cent correct recognition in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration for each combination of observer-eye and stimulus material. Figures B_6 - B_8 (see Appendix B) present, in the same fashion, the functions for the three sinistral *O*s. A summary of the data shown in these figures is presented in Table 2 in the main body of the text.

Inspection of Table 2 shows that, when differences in hemiretinal acuity are taken into account (see columns labelled $D_W - D_L$), all dextral *O*s showed a recognition differential favoring the RVF for both the left and right eye viewing of words. The magnitude

TABLE 1

Group Data: Same eye comparisons of half-field (RVF-LVF) differences (D) in threshold exposure duration (in msec.) for the viewing of words (W) and Landolt Cs (L).

	OS							OD							
	WORDS			LANDOLT Cs				WORDS			LANDOLT Cs				
<u>O</u>	RVF	LVF	D_W	RVF	LVF	D_L	$D_W - D_L$	RVF	LVF	D_W	RVF	LVF	D_L	$D_W - D_L$
							DEXTRAL GROUP								
CD	6.9	9.0	-2.1	4.6	6.2	-1.6	-0.5	7.3	8.4	-1.1	5.5	6.4	-0.9	-0.2
HC	8.7	14.4	-5.7	5.3	6.1	-0.8	-4.9	8.9	9.4	-0.5	5.6	5.1	0.5	-1.0
WG	5.9	9.2	-3.3	3.2	3.6	-0.4	-2.9	5.7	8.7	-3.0	3.7	4.0	-0.3	-2.7
TY	8.0	11.5	-3.5	2.8	4.4	-1.6	-1.9	14.4	13.9	0.5	5.5	4.0	1.5	-1.0
BK	5.9	6.7	-0.8	4.6	4.3	0.3	-1.1	4.8	7.1	-2.3	4.5	4.6	-0.1	-2.2
$\bar{X}$	7.1	10.2	-3.1	4.1	4.9	-0.8	-2.3	8.2	9.5	-1.3	5.0	4.8	0.2	-1.4
t_4							-2.92*							-3.14*
							SINISTRAL GROUP								
TS	5.9	5.7	0.2	3.7	3.2	0.5	-0.3	5.3	5.9	-0.6	3.2	3.4	-0.2	-0.4
HM	6.0	5.8	0.2	3.4	3.4	0.0	0.2	6.1	5.5	0.6	3.2	3.3	-0.1	0.7
RC	6.7	7.1	-0.4	4.3	3.4	0.9	-1.3	8.3	6.8	1.5	6.5	1.4	5.1	-3.6
$\bar{X}$	6.2	6.2	0.0	3.8	3.3	0.5	-0.5	6.6	6.1	0.5	4.3	2.7	1.6	-1.1
t_2							-1.06							-0.85

*$p < .05$

TABLE 2

Individual Data: Half-field (RVF-LVF) differences (D) in per cent correct recognition for the left (OS) and right (OD) eye viewing of words (W) and Landolt Cs (L).

	OS							OD						
	WORDS			LANDOLT Cs				WORDS			LANDOLT Cs			
O	RVF	LVF	D_W	RVF	LVF	D_L	$D_W - D_L$	RVF	LVF	D_W	RVF	LVF	D_L	$D_W - D_L$
DEXTRAL Os														
CD	70.0	31.1	38.9	65.6	46.7	18.9	20.0	61.1	42.2	18.9	60.0	43.3	16.7	2.2
HC	74.4	17.8	56.7	61.1	48.9	12.2	44.4	51.1	44.4	6.7	38.9	48.9	-10.0	16.7
WG	73.3	32.2	41.1	58.9	47.8	11.1	30.0	74.4	41.1	33.3	55.6	50.0	5.6	27.8
TY	64.4	28.9	35.6	65.6	43.3	22.2	13.3	45.6	51.1	-5.6	41.1	64.4	-23.3	17.8
BK	53.3	38.9	14.4	47.8	54.4	-6.7	21.1	78.9	48.9	30.0	50.0	46.7	3.3	26.7
SINISTRAL Os														
TS	51.1	55.6	-4.4	45.6	57.8	-12.2	7.8	62.2	52.2	10.0	60.0	54.4	5.6	4.4
HM	48.9	54.4	-5.5	52.2	54.4	-2.2	-3.3	48.9	60.0	-11.1	58.9	54.4	4.4	-15.6
RC	56.7	48.9	7.8	44.4	62.2	-17.8	25.6	44.4	65.6	-21.1	23.3	82.2	-58.9	37.9

of this effect ranged from 13.3% to 44.4% in the left eye viewing condition ($\bar{X}$=25.8%), and from 2.2% to 27.8% in the right eye viewing condition ($\bar{X}$=18.2%). With respect to the sinistral group, two of the three Os (TS and RC) also showed a recognition differential favoring the RVF for both the left and right eye viewing of words. Only for O:RC, however, was the magnitude of this effect comparable to that displayed by the average dextral O.

Acuity Baseline Comparisons. In order to evaluate the statistical signficance of the recognition differentials of each of the eight Os, a series of z tests were performed.[11] As can be seen in Table 3, three dextral Os (HC, WG, and BK) and one sinistral O (RC) showed a significant RVF superiority in the left eye viewing condition, and two dextral Os (WG and BK) and one sinistral O (RC) showed a significant RVF superiority in the right eye viewing condition. None of the other half-field differences were significant.

Before considering the RT data, a comment should be made about the stringency of the test used in the preceding acuity baseline comparisons. As was the case when group data were examined, half-field differences for the viewing of Landolt Cs were not treated as population parameters (i.e., as measures without any variability associated with them), but as sample statistics.[12] Since, however, the findings for words and Landolt Cs were not correlated for individual Os, half-field differences for the two types of stimuli had to differ on the average by more than 20.7% to be significant.[13]

RT Data -- Group Findings

Graphic Representation. Figures 5 and 6 present, for the

TABLE 3

Individual Data: Same eye comparisons of half-field (RVF-LVF) differences (D) in per cent correct recognition for the viewing of words (W) and Landolt Cs (L).

	CS				OD			
O	D_W	D_L	$D_W - D_L$	Z	D_W	D_L	$D_W - D_L$	Z
DEXTRAL Os								
CD	38.9%	18.9%	20.0%	1.90	18.9%	16.7%	2.2%	0.21
HC	56.7	12.2	44.4	4.22***	6.7	-10.0	16.7	1.59
WG	41.1	11.1	30.0	2.85**	33.3	5.6	27.8	2.65**
TY	35.6	22.2	13.3	1.26	-5.6	-23.3	17.8	-1.69
BK	14.4	-6.7	21.1	2.00*	30.0	3.3	26.7	2.55*
SINISTRAL Os								
TS	-4.4	-12.2	7.8	0.74	10.0	5.6	4.4	0.43
HM	-5.5	-2.2	-3.3	-0.32	-11.1	4.4	-15.6	-1.48
RC	7.8	-17.8	25.6	2.43*	-21.1	-58.9	37.8	3.59***

*p<.05
**p<.01
***p<.001

Figure 5. Mean RT (in msec.) to Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for the dextral group. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function. Note -- In contrast to the recognition data, a negative sign indicates a favoring of the RVF.)

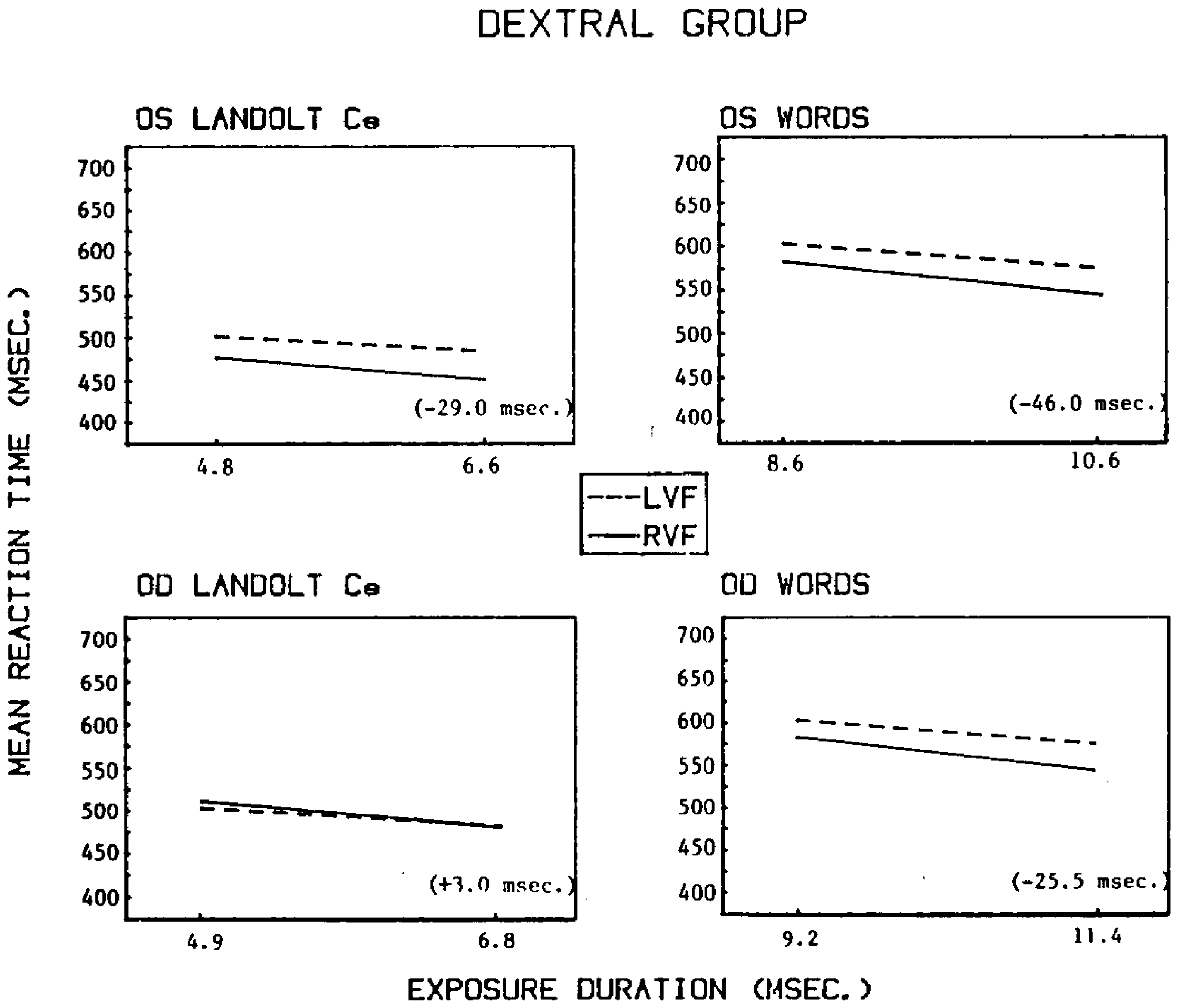
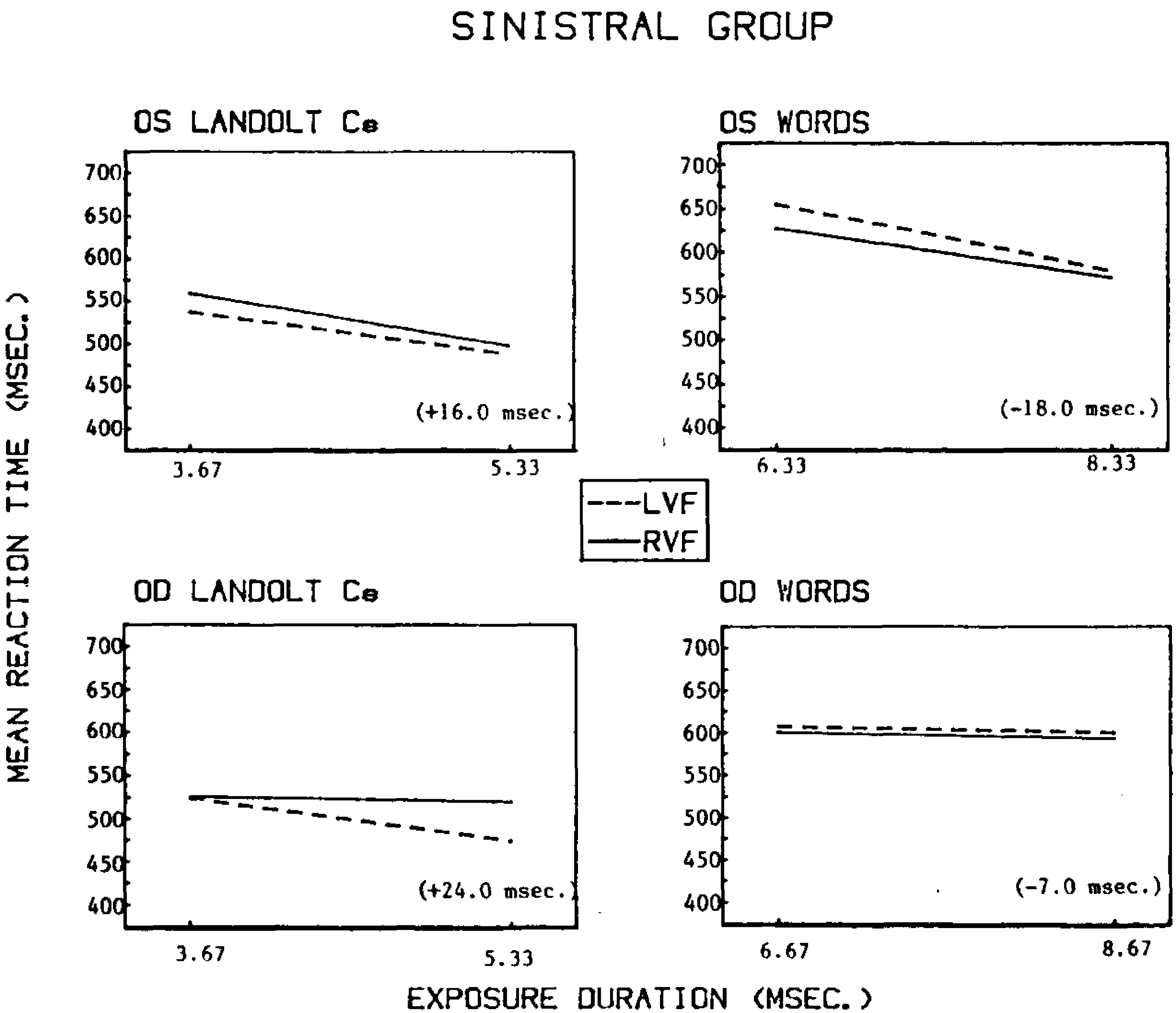

DEXTRAL GROUP
OS LANDOLT Cs
OS WORDS
OD LANDOLT Cs
OD WORDS
700
650
600
550
500
450
400
4.8
6.6
8.6
10.6
4.9
6.8
9.2
11.4
(-29.0 msec.)
(-46.0 msec.)
(+3.0 msec.)
(-25.5 msec.)
LVF
RVF
MEAN REACTION TIME (MSEC.)
EXPOSURE DURATION (MSEC.)

Figure 6. Mean RT (in msec.) to Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for the sinistral group. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function. Note -- In contrast to the recognition data, a negative sign indicates a favoring of the RVF.)


SINISTRAL GROUP
OS LANDOLT Cs
OS WORDS
OD LANDOLT Cs
OD WORDS
MEAN REACTION TIME (MSEC.)
EXPOSURE DURATION (MSEC.)
700
650
600
550
500
450
400
3.67
5.33
6.33
8.33
6.67
8.67
(+16.0 msec.)
(-18.0 msec.)
(+24.0 msec.)
(-7.0 msec.)
LVF
RVF

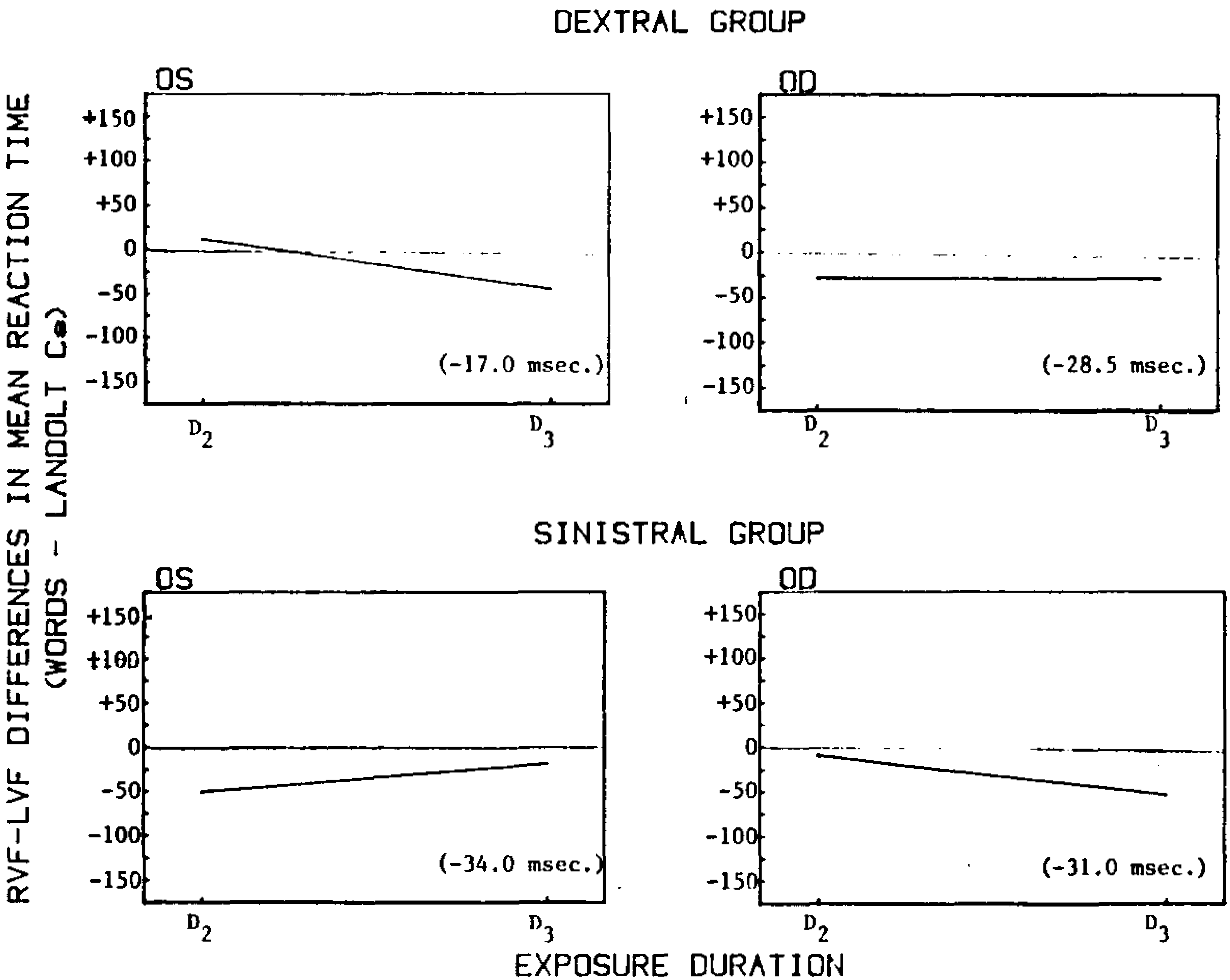
dextral and sinistral groups, respectively, mean RTs at the intermediate and longest exposure durations for the left and right eye viewing of Landolt Cs and words.[14,15] The data for LVF and RVF presentations are represented by dashed and solid lines, respectively, and overall half-field differences are shown in parentheses in the lower right quadrant of each function. Figure 7 shows, for both groups of Os, the functions which were derived by referring half-field differences for the viewing of words to their respective acuity baselines.

Visual inspection of these figures reveals that when the data in the verbal condition are adjusted to take into account differences in hemiretinal acuity, both groups of Os showed a favoring of the RVF in both viewing conditions. However, unlike the recognition data, the magnitude of this effect was greater for the sinistral group than the dextral group for both left (-34.0 msec. and -17.0 msec., respectively) and right (-31.0 msec. and -28.5 msec., respectively) eye viewing. As will be shown later, the results displayed by the sinistral group were due largely to a single O (RC).

Acuity Baseline Comparisons. In order to analyze the group RT data, an approach similar to the one used in analyzing the group recognition data was employed. Separate 2 x 2 x 2 analyses of variance, with repeated measures on each factor, were performed for each combination of group and eye. The factors tested were Field (LVF vs. RVF), Duration (D_2 vs. D_3), and Hand (left hand responding vs. right hand responding), and the dependent variable was the mean RT difference per field for the viewing of both stimulus types. The results revealed that, when differences in

Figure 7. Half-field (RVF-LVF) differences in RT (in msec.) for the viewing of words minus half-field differences in RT for the viewing of Landolt Cs as a function of exposure duration. Dextral group on the top; sinistral group on the bottom. (Mean differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function. Note -- In contrast to the recognition data, a negative sign indicates a favoring of the RVF.)

ACUITY BASELINE COMPARISONS
(Mean Reaction Time)



hemiretinal acuity were taken into account, the dextral group showed a significant RVF superiority for the right eye viewing of words. With the exception of this finding and a significant Field x Duration interaction that occurred for the dextral group in the left eye viewing condition, all other findings were not significant. (see the summary tables of these analyses of variance in Appendix C, Tables C_{13} - C_{16}).[16]

RT Data -- Individual Findings

Graphic Representation. Figures B_9 - B_{13} (see Appendix B) present, for the five dextral Os, mean RTs to left (dashed line) and right (solid line) visual field presentations as a function of exposure duration for each combination of observer-eye and stimulus material. Figures B_{14} - B_{16} (see Appendix B) present, in the same fashion, the functions for the three sinistral Os. A summary of these data is presented in Table 4 in the main body of the text.[17]

Inspection of Table 4 shows that, when differences in hemiretinal acuity are taken into account (see columns labelled D_W - D_L), dextral Os generally responded faster to words presented in the RVF. This was true of four of the five dextral Os (CD, HC, WG and TY) in the left eye viewing condition, and for all five dextral Os in the right eye viewing condition. As was true for the recognition data, the half-field differences displayed by sinistral Os:TS and RC were directionally similar to those found for dextral Os, while those displayed by sinistral O:HM were not.

Acuity Baseline Comparisons. In order to evaluate the statistical significance of the individual RT data over the intermediate and longest exposure durations, a procedure outline by

TABLE 4

Individual Data: Half-field (RVF-LVF) differences (D) in mean RT (in msec.) for the left and right eye viewing of words (W) and Landolt Cs (L).

	OS							OD						
	WORDS			LANDOLT Cs				WORDS			LANDOLT Cs			
O	RVF	LVF	D_W	RVF	LVF	D_L	$D_W - D_L$	RVF	LVF	D_W	RVF	LVF	D_L	$D_W - D_L$
							DEXTRAL *O*s							
CD	542	597	-55	489	543	-54	-01	536	596	-60	536	559	-22	-38
HC	600	710	-110	460	486	-26	-84	642	617	25	469	434	35	-10
WG	496	525	-29	427	431	-04	-25	433	495	-62	436	466	-30	-32
TY	575	658	-83	430	474	-44	-39	531	520	11	514	470	44	-33
BK	626	627	-01	512	531	-19	18	677	720	-43	522	536	-14	-29
							SINISTRAL *O*s							
TS	616	624	-08	511	495	16	-24	615	654	-39	483	493	-10	-29
HM	602	562	40	500	493	07	33	578	532	46	501	482	19	27
RC	582	667	-85	575	550	25	-110	598	627	-29	586	524	62	-91

Winer (1962) was followed. This procedure consisted of performing two independent t-tests: one to compare half-field differences at the intermediate exposure duration, the other to compare half-field differences at the longest exposure duration. A z score was then derived by summing the resultant t-values and dividing by the square root of the number of values summed (in all but one case, two).[18] As can be seen in Table 5, significant results were found for only two _O_s. Dextral _O_:HC showed a significant RVF superiority in the left eye viewing condition and, as was the case for the recognition data, sinistral _O_:RC showed a significant RVF superiority in both viewing conditions.

Correspondence Between Half-Field Differences in Recognition and RT

Two approaches were used to assess the correspondence between recognition and RT measures of half-field differences. In the first, statistical tests were performed to determine the significance of half-field recognition and RT differences for each group and _O_ in each of the four test sessions (2 viewing conditions x 2 types of stimulus material).[19] In order to make meaningful comparisons between the two measures, however, both the recognition and RT data were evaluated over the intermediate and longest exposure durations. After the above tests were performed, the half-field recognition and RT differences that occurred in each session were compared on a group and individual basis with respect to their statistical significance (i.e., LVF significant, RVF significant, or statistically nonsignificant) and the directionality (i.e., favoring the LVF or favoring the RVF) of the two sets of findings. The results of this analysis revealed that for group data (see Table 6), half-field recognition and RT differences

TABLE 5

Individual Data: Same eye comparisons of half-field (RVF-LVF) differences (D) in mean RT (in msec.) to the presentation of words (W) and Landolt Cs (L).

		OS					OD				
O	DURATION	D_W	D_L	$D_W - D_L$	t	z	D_W	D_L	$D_W - D_L$	t	z
					DEXTRAL Os						
CD	2	-39	-58	19	0.53		-32	-30	-02	-0.04	
	3	-71	-51	-20	-0.68	-0.11	-88	-14	-74	-2.69**	-1.93
HC	2	---	-11	---	----		30	29	01	0.02	
	3	-138	-40	-99	-2.43*	-2.43*	18	41	-22	-0.65	-0.45
WG	2	-15	10	-24	-0.48		-64	-15	-49	-1.35	
	3	-43	-17	-26	-0.76	-0.88	-61	-44	-17	-0.74	-1.48
TY	2	-65	-63	-02	-0.04		19	56	-37	-0.74	
	3	-101	-24	-78	-1.88	-1.36	02	31	-29	-0.65	-1.01
BK	2	31	-03	34	0.96		-56	-06	-50	-1.35	
	3	-35	-34	-01	-0.02	0.59	-33	-22	-10	-0.36	-1.21
					SINISTRAL Os						
TS	2	01	34	-34	-0.77		-39	-19	-20	-0.55	
	3	-15	-02	-13	-0.41	-0.93	-38	-01	-37	-1.20	-1.24
HM	2	43	01	42	0.92		84	22	63	1.40	
	3	38	11	27	1.49	1.70	09	17	-08	-0.26	0.81
RC	2	-125	29	-154	-2.30*		-56	01	-68	-1.06	
	3	-45	21	-66	-1.79	-3.03**	09	123	-114	-2.36*	-2.42*

*$p < .05$
**$p < .01$

TABLE 6

Group Data: The statistical significance of half-field (RVF-LVF) recognition (REC.) and RT differences (evaluated over the intermediate and longest exposure durations) in each of the four test sessions.

	OS				OD			
	WORDS		LANDOLT Cs		WORDS		LANDOLT Cs	
GROUP	REC.	RT	REC.	RT	REC.	RT	REC.	RT
DEXTRAL	RVF*	RVF*	RVF	RVF*	RVF	RVF	LVF	LVF
SINISTRAL	RVF	RVF	LVF	LVF	LVF	RVF	LVF	LVF

*p<.05

were in agreement in 7 out of 8 cases with respect to their statistical significance ($p<.05$) and the favored visual half-field ($p<.05$). As can be seen in Table 7, significant correspondences were also found when the individual data were examined. Individual half-field recognition and RT differences were in agreement in 20 out of 32 cases in terms of their statistical signficance ($p<.05$), and in 27 out of 32 cases in terms of the favored visual half-field ($p<.05$).

The second approach used to assess the correspondence between recognition and RT measures consisted of computing four Pearson product-moment correlation coefficients. Each coefficient was computed by correlating individual half-field recognition and RT differences (both of which were evaluated over the intermediate and longest exposure durations) that occurred in a given test session. As can be seen in Table 8, the recognition and RT differences correlated significantly for three of the four test sessions. The average amount of variance accounted for (i.e., r^2) in the four test sessions was 58%, ranging from 36% for the right eye viewing of words to 76% for the right eye viewing of Landolt Cs.

TABLE 7

Individual Data: The statistical significance of half-field (RVF-LVF) recognition (REC.) and RT differences (evaluated over the intermediate and longest exposure durations) in each of the four test sessions.

	OS				OD			
	---WORDS--		LANDOLT Cs		---WORDS--		LANDOLT Cs	
O	REC.	RT	REC.	RT	REC.	RT	REC.	RT
				DEXTRAL Os				
CD	RVF*	RVF*	RVF	RVF*	RVF	RVF*	RVF*	RVF
HC	RVF*	RVF*	RVF	RVF	RVF	LVF	LVF	LVF*
WG	RVF*	RVF	RVF	RVF	RVF*	RVF*	RVF	RVF*
TY	RVF*	RVF*	RVF*	RVF*	LVF	LVF	LVF*	LVF
BK	RVF*	RVF	LVF	RVF	RVF*	RVF*	RVF	RVF
				SINISTRAL Os				
TS	LVF	RVF	LVF	LVF	RVF	RVF	RVF	RVF
HM	LVF	LVF*	LVF	LVF	LVF	LVF	RVF	LVF
RC	RVF	RVF*	LVF*	LVF	LVF*	RVF	LVF*	LVF*

$*p < .05$

TABLE 8

Correlations (r) between half-field (RVF-LVF) differences in recognition and RT (evaluated over the intermediate and longest exposre durations) in each of the four test sessions.

TEST SESSION	r	t	df	r^2
OS WORDS	-.72	2.55*	6	.52
OS LANDOLT Cs	-.82	3.50*	6	.67
OD WORDS	-.60	1.84	6	.36
OD LANDOLT Cs	-.87	4.35**	6	.76

*p<.05
**p<.01

DISCUSSION

In the present study an attempt was made to determine whether hemispheric specialization (as inferred by handedness) plays a role in determining half-field differences in the perception of unilaterally presented alphabetical material. Towards that end, various methodological controls were employed to eliminate, minimize or take into account, directional (left to right) reading habits, differential ocular and hemiretinal acuity, and the biases that may result from using a verbal response indicator and failing to equate for luminance in the two visual half-fields. Specifically, directional reading habits were minimized by exposing three letter words in a vertical direction. Differential ocular and hemiretinal acuity were taken into account by using a monocular viewing paradigm and comparing, for a given eye, half-field differences for unilaterally presented words and Landolt Cs (a traditional measure of acuity). The biases that may result from: (1) using a verbal response indicator and (2) failing to equate for luminance in the two visual half-fields were eliminated by employing a nonverbal response indicator (which provided information concerning the accuracy and latency of the response) and equating for luminance in the left and right visual fields to within one per cent.

As discussed below, the findings of the present study are of significance not only with respect to the role hemispheric specialization plays in determining half-field differences in the perception of alphabetical material, but also with respect to: (1) the degree of correspondence between recognition and reaction time measures for evaluating half-field differences, and (2) a re-evaluation of previous half-field studies that have used a monocular viewing paradigm.

Half-Field Differences in Recognition. The present findings support Kimura's (1966, 1973) claim that hemispheric specialization is an important determinant of half-field differences in the recognition of alphabetical material. Probably the strongest supportive evidence for Kimura's claim comes from an analysis of the half-field recognition and threshold differences that were found for dextral Os. Specifically, when the data for the viewing of words were adjusted to take into account differences in ocular and hemiretinal acuity, the dextral group showed a significant RVF superiority for recognition and threshold in both the left and right eye viewing conditions. Moreover, when the individual data in the two viewing conditions were analyzed in the manner described above, all five dextral Os displayed half-differences in recognition and threshold that were directionally similar to those that were found for the group as a whole. It should be pointed out, however, that in the case of threshold, a test of significance could not be applied to the data and, in the case of recognition, individual half-field differences failed to reach significance 50% of the time. The failure to find significance in many cases, however, may have been due to the stringency of the statistical test that was employed. As mentioned previously, group and individual half-field differences for the viewing of Landolt Cs were not treated as population parameters, but as sample statistics. Since half-field differences for the viewing of words and Landolt Cs were not correlated for the individual data, the average critical difference needed to reach significance was greater than 20.7%. Evidence indicating that the stringency of the test was responsible for the failure to find significant results in a greater percentage of the cases comes from an analysis in which half-field differences for the viewing of Landolt Cs were treated as parameters. When this was done, a significant RVF superiority was found in 80% of the cases for dextral Os.

Additional evidence to support Kimura's claim comes from an analysis of the half-field differences that were found for sinistral Os. Previous studies that have evaluated the effect of handedness on half-field differences for alphabetical material have generally found that subjects for whom the right is the preferred hand show greater recognition differentials favoring the the RVF than do subjects for whom the left hand is preferred (Bryden, 1964, 1965; Levy & Reid, 1976; Orbach, 1967). One interpretation of this relationship is that handedness and hemispheric specialization are interdependent. Evidence supporting this interpretation comes from clinical studies which have shown that left hemispheric specialization for language is more likely to occur in the right handed population and that a bilateral capacity for language is more likely to occur in the left handed population (Goodglass & Quadfasel, 1954; Milner, Branch, & Rasmussen, 1964; Warrington & Pratt, 1973). Though based on a limited sample, the findings of the present study support the notion that left hemispheric specialization for language is less pronounced and/or less likely to occur in the left handed population. As a group, sinistral Os showed a small and nonsignificant favoring of the RVF for recognition and threshold in both left and right eye viewing conditions. Moreover, an analysis of the individual data revealed that only one of the three sinistral Os (RC) displayed RVF recognition and threshold superiorities that were comparable to those displayed by the average dextral O.

Half-Field Differences in Reaction Time. The reaction time findings of the present study, like the collective findings of previous RT studies (e.g., Klatzky & Atkinson, 1970; Rizzolatti *et al.*, 1971, Umilta *et al.*, 1972), are inconclusive with respect Kimura's hemispheric specialization hypothesis. For example, examination of group half-field differences revealed that, when the data were adjusted to take into account differences in ocular and hemiretinal acuity, both groups of Os showed a favoring of the RVF. Unlike the recognition data, however, the magnitude of this effect was somewhat greater for the sinistral group in both viewing conditions. It should be pointed out, however, that because of the limited sample size and greater variability, the results failed to reach significance for the sinistral group for either left or right eye viewing. In comparison, the dextral group showed a significant RVF superiority in the right eye viewing condition.

The inconclusiveness of the reaction time data was also seen when the individual data were examined. For example, all dextral Os, excepting BK, responded to words faster when they were presented in the RVF for both left and right eye viewing. This, however, was also true for two of the three sinistral Os (TS and RC). Moreover, significant findings were found for only two Os. One dextral O (HC) showed a significant RVF superiority in the left eye viewing condition and, as was the case for recognition data, sinistral O:RC showed a significant RVF superiority in both viewing conditions.

Although the present RT findings may be interpreted to suggest that the two cerebral hemispheres do not differ in their ability to process alphabetical material, this suggestion seems unlikely in the light of the half-field recognition and threshold differences that were found in the present study. There are several factors that may, in part, account for the inconclusiveness of the reaction time data. The first is the instructions which were given to Os prior to each test session. Specifically, Os were told that accuracy of responding was more important than speed of responding. Furthermore, when Os committed a false alarm during a test sesion, they were further cautioned to respond only when they were certain that a positive stimulus had been presented. In all likelihood, these instructions increased reaction time variability (since speed of responding was of secondary importance) and, thus, decreased the chances of finding significant half-field differences. A second factor that may have been responsible for the inconclusiveness of the present findings was the limited number of RT trials in each test session. As mentioned previously, mean RTs were based only on responses to postive stimuli presented at the intermediate and longest exposure durations. Mean RTs to stimuli presented at the shortest exposure duration were not analyzed because of the low response rate. Since per cent corect recognition at the longest two exposure durations averaged only 71.9%, half-field RT differences were based on approximately 172 trials per O, as compared to 360 trials per O for half-field differences in recognition.

Before discussing the tests which were used to evaluate the correspondence between half-field recognition and reaction time measures, a comment should be made about the manner in which Landolt Cs were used in the present study. Although Landolt Cs may not have been the most appropriate stimuli for providing an acuity baseline, the following two points should be considered. Firstly, numerous studies have used Landolt Cs to evaluate differences in ocular and hemiretinal acuity (e.g., Lythgoe, 1932; Markowitz &

Weitzman, 1969; Shlaer, 1937). Secondly, and more importantly, the purpose of the present study was not to evaluate half-field differences in acuity, *per se*, but rather to determine whether half-field differences vary as a function of stimulus material. The importance of this second point is suggested by studies which indicate that visual half-field differences may be related to: (1) peripheral factors (Gardner & Bramski, 1976; Davidoff, 1977; Hayashi & Bryden, 1967; Kershner & Gwan-Rong Jeng, 1972); (2) the report instructions given the subjects (Dick & Mewhort, 1967); (3) individual differences in the mode in which letters are processed (Cohen, 1972); (4) the method of stimulus presentation (Heron, 1957); and (5) the optical characteristics of the viewing apparatus (White, 1972). Thus, the importance of functional hemispheric asymmetries in determining half-field differences can only be inferred when it is demonstrated that these differences vary as a function of stimulus material using the same viewing apparatus, methodology and, preferably, the same subjects.

Correspondence Between Recognition and Reaction Time Measures. A review of the half-field literature suggests that recognition and manual reaction time measures do not always yield similar results. For example, when single Latin letters were unilaterally presented to dextral *O*s, Bryden (1964, 1965, 1966a) and Bryden and Rainey (1963) found a significant RVF superiority for recognition, whereas Klatzky (1970) and Klatzky and Atkinson (1971) found a significant LVF superiority for manual reaction time. Moreover, in many of the studies in which significant half-field RT differences were found for unilaterally presented alphabetical material, half-field recognition differences failed to reach significance (e.g., Isseroff, Carmon, & Nachshon 1973; Klatzky, 1970; Rizzolatti *et al.*, 1971).

Although some of the earlier evidence suggests that recognition and manual reaction time measures may not be related, the present findings indicate that there is a correspondence between these two measures. For example, when half-field recogntion and reaction time differences that were found in each test session were compared on a group and individual basis with respect to: (1) their statistical significance (i.e., LVF significant, RVF significant, or statistically nonsignificant) and (2) the directionality (i.e., favoring of the LVF or favoring of the RVF) of the two sets of findings, the results were significant in all cases for both the group and individual data. Moreover, in all but one test session the correlation between half-field recognition and reaction time differences was significant, with the average amount of variance accounted for in the four test sessions being 58%.

One possible explanation that may account for the correspondence between recognition and reaction time measures in the present study, and the failure to find such a correspondence in most previous manual reaction time experiments (e.g., Isseroff, *et al.*, 1974; Rizzolatti *et al.*, 1971), is the difference in the stimulus energy levels used in the former and latter cases. Specifically, in the present study, stimuli were presented at threshold level. In most previous manual reaction time experiments, on the other hand, stimuli were presented well above threshold with consequent detection rates of 90% - 100% in both the left and right visual fields. Thus, the failure to find significant half-field recognition differences in studies reporting significant half-field reaction time differences may have been due to a ceiling effect (as evidenced by the high detection rates in both visual half-fields), rather than to a lack of correspondence between the two measures.

<u>Previous Monocular Half-Field Studies</u>. Most past studies that have investigated half-field recognition differences for unilaterally presented alphabetical material have typically relied upon binocular viewing (e.g., Bryden, 1964, 1965, 1973; Forgays, 1953; Heron, 1957; Mishkin & Forgays, 1952; Orbach, 1952, 1967). In the few monocular viewing studies, the results have been contradictory. For example, Overton and Wiener (1966) found that dextral <u>O</u>s recognized words better in the RVF only when they used their left eye. Markowitz and Weitzman (1969), McKeever and Huling (1970), Neil <u>et al</u>. (1971), Shai, Goodglass and Barton (1972), and Nelson (1976) have reported a similar finding for the monocular recognition of unilaterally presented letters, nonsense syllables, and words. In comparison, like the present study, Goodglass and Barton (1963) and Barton <u>et al</u>. (1965) found that dextral <u>O</u>s recognized words better in the RVF regardless of the viewing eye.

Thus, the preponderance of past evidence is in opposition to the present findings. There are, however, at least two reasons that may account for this apparent discrepancy. The first is that in only one previous monocular study was an attempt made to control for differences in ocular and hemiretinal acuity (Markowitz & Weitzman, 1969). In that study, the authors found that the visual acuity of either eye, as measured by the Landolt C, was greater for the LVF of the right eye and the RVF of the left eye. Thus, the differential half-field findings that have been reported for the two eyes may be due, in part, to the influence of peripheral factors.

A second reason is that in almost all past monocular studies the authors did not report whether head or eye centering was employed. That is to say, no mention was made in these studies as to whether the center of the subject's head or of the viewing eye was at 90 degrees to the midpoint of the fixation and stimulus channels. As mentioned previously (see Footnote 2 & Appendix A), preliminary research revealed that, regardless of the viewing eye, head centering resulted in an inequality of the physical size of the left and right visual fields and, as a consequence, produced half-field differences which were not the same as those found in the eye centered and border equated conditions. Specifically, in the head centered condition, relative to the other two viewing conditions, stimuli presented in the LVF of the right eye or the RVF of the left eye appeared farther from the blackened border and were better recognized than stimuli presented in the opposite half-fields. Thus, the typical finding of a RVF superiority for only left eye viewing may be due, in part, to the type of viewing that was employed in past studies.

The findings of the present study and past experiments indicate that in order to assess the importance of functional hemispheric asymmetries as a determinant of half-field differences, controls must be employed to eliminate other influences. Specifically, controls must be employed to rule out the influence of: (1) directional reading habits, (2) the optical characteristics of the viewing apparatus (e.g., lack of homogeneity of luminance in the two visual half-fields), (3) differential ocular and hemiretinal acuity, (4) the bias that may result from using a verbal response indicator, and (5) in the case of monocular viewing, the border contrast effect that results from not having the subjects's eye at 90 degrees to the midpoint of the fixation and stimulus channels.

FOOTNOTES

[1] Prior to conducting the present study, photometric readings revealed that the luminance levels of the two visual half-fields were not comparable in Channel 1 (the channel that was used to deliver the stimulus material). Specifically, the luminance of the RVF was approximately 16% greater than that of the LVF. A discussion of this problem with Mr. Feldstein (a technical representative of Scientific Prototype) revealed that, for most planar tachistoscopes, the luminance of the RVF is considerably (approximately 15%-20%) greater than that of the LVF in Channel 1, while the reverse is true for Channel 2 (the other stimulus channel in which the stimuli are rotated 180 degrees).

[2] Preliminary investigation revealed that, for both left and right eye viewing, the centering of the head in the chin rest (and not the eye) resulted in an inequality of the physical size of the two visual half-fields. Specifically, stimuli presented in the RVF of the left eye or the LVF of the right eye appeared farther from the blackened border than stimuli presented in the opposite half-fields. The effects of each type of viewing on recognition are presented in Appendix A.

[3] As mentioned previously, RTs in excess of 1,000 msec. to negative stimuli were not counted as false alarms, but as correct rejections. In the present study, they occurred on only 16 (<.28%) out of a possible total of 5,760 trials (8 <u>O</u>s x 4 test sessions x 180 negative stimuli per session).

[4] The individual data were evaluated using the following formula (Hovland, Lumsdaine, & Sheffield, 1949):

$$z = \frac{(P_4 - P_3) - (P_2 - P_1)}{\sqrt{\frac{p(1-p)}{n} + \frac{p(1-p)}{n} + \frac{p(1-p)}{n} + \frac{p(1-p)}{n}}}$$

where: P_4 = the false alarm rate for words presented in the RVF

P_3 = the flase alarm rate for words presented in the LVF

P_2 = the false alarm rate for Landclt Cs presented in the RVF

P_1 = the false alarm rate for Landolt Cs presented in the LVF

n = the number (90) of negative stimuli presented in each visual half-field in a given test session

$p = (P_1 + P_2 + P_3 + P_4)/4$

[5] As mentioned previously, RTs in excess of 1,000 msec. to positive stimuli were not counted as correct identifications, but as misses. In the present study, they occurred on only 14 (<.25%) out of a possible total of 5,760 trials (8 Os x 4 test sessions x 180 positive stimuli per session).

[6] The following example illustrates how the dependent variable was derived in the above analyses. When stimuli were presented at the intermediate exposure duration in the RVF and the right hand was used in responding, dextral O:CD recognized 14 out of 15 words (93.3%), and 11 out of 15 Landolt Cs (73.3%). Therefore, the difference in the proportion of correct responses was 20.0% (93.3% - 73.3%).

[7] In the above analyses, an arc sin transformation (2 x arc sin proportion of correct responses) was performed to normalize the data and reduce the covariance between the mean and standard deviation (Kirk, 1968).

[8] These analyses were also run without an arc sin transformation. In all cases, the statistical significance of the findings remained unchanged (see Appendix C, Tables C_9 - C_{12}).

[9] A Duncan's Multiple Range Test was used to investigate the significant main effect, Duration, that occurred for the dextral group in the right eye viewing condition (Bruning & Kintz, 1977). The results of this test showed that, at the the shortest exposure duration, per cent correct recognition was significantly greater than at each of the other two exposure durations. This finding indicates that words, as compared to Landolt Cs, were better recognized by the dextral group at the shortest exposure duration in the right eye viewing condition.

[10] Based on the phi gamma hypothesis, a linear least squares solution was used to calculate threshold exposure duration.

[11] The individual data were evaluated using the following formula (Hovland, Lumsdaine, & Sheffield, 1949):

$$z = \frac{(P_4 - P_3) - (P_2 - P_1)}{\sqrt{\frac{p(1 - p)}{n} + \frac{p(1 - p)}{n} + \frac{p(1 - p)}{n} + \frac{p(1 - p)}{n}}}$$

where: P_4 = per cent correct recognition of words presented in the RVF

P_3 = per cent correct recognition of words presented in the LVF

P_2 = per cent correct recognition of Landolt Cs presented in the RVF

P_1 = per cent correct recognition of Landolt Cs presented in the LVF

n = the number (90) of positive stimuli presented in each visual half-field in a given test session

$p = (P_1 + P_2 + P_3 + P_4)/4$

[12] As can be seen in Footnote 11, half-field recognition differences for the viewing of Landolt Cs were treated as estimates of hemiretinal differences in acuity. Accordingly, there were four sources of variance that were taken into account when acuity baseline comparisons were performed.

[13] If the data for the viewing of Landolt Cs were treated as population parameters, a significant RVF superiority would have obtained for four dextral Os (CD, HC, WG, and BK) and one sinistral O (RC) in the left eye viewing condition, and for four dextral Os (HC, WG, TY, and BK) and one sinistral O (RC) in the right eye viewing condition.

[14] As mentioned previously, half-field differences in RT at the shortest exposure duration were not analyzed because the response rate at this duration was too low to allow for a meaningful analysis of the data.

[15] Logarithmic transformations were not applied to the RT data because reaction times were generally faster to Landolt Cs than to words. Thus, equivalent half-field RT differences for the two types of stimulus material would not be equivalent if the data were transformed using logarithms. It should be pointed out, however, that, for both the group and individual data, the statistical significance of the RT findings remained unchanged when logarithmic transforms were used.

[16] To identify which of the Fields (LVF vs. RVF) was responsible for the significant Field x Duration interaction that occurred for the dextral group in the left eye viewing condition, simple main effects were calculated (Bruning & Kintz, 1977). The results of this test showed that, relative to the results that occurred at the intermediate exposure duration, words were responded to faster at the longest exposure duration when they were presented in the RVF.

[17] Each mean in Table 4 was derived by taking an unweighted average of the mean RTs that obtained at the intermediate and longest exposure durations.

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This procedure was employed because, in most cases, recognition increased and RT decreased with increasing exposure duration. Thus, if the mean RT for a given field was based on the combined data at the intermediate and longest exposure durations, two problems would have resulted. Firstly, the variance associated with the mean would have been greatly increased. Secondly, and more importantly, the mean for the field with lower recognition would have been underestimated. To illustrate this second point, consider the data for sinistral *O*:RC for the right eye viewing of Landolt Cs. For LVF presentations, the mean RTs at the intermediate and longest exposure durations were based on 29 and 30 trials, respectively. For RVF presentations, on the other hand, mean RTs at the intermediate and longest exposure durations were based on 8 and 13 trials, respectively. Thus, if the data at the two exposure durations were combined before computing the mean, there would have been a disproportionate weighting of the data at the longest duration for the field with lower recognition.

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The statistical tests which were used to evaluate the group and individual data, as well as the results of these tests, appear in Appendix C (see Tables C_{17} - C_{34}).

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APPENDIX A

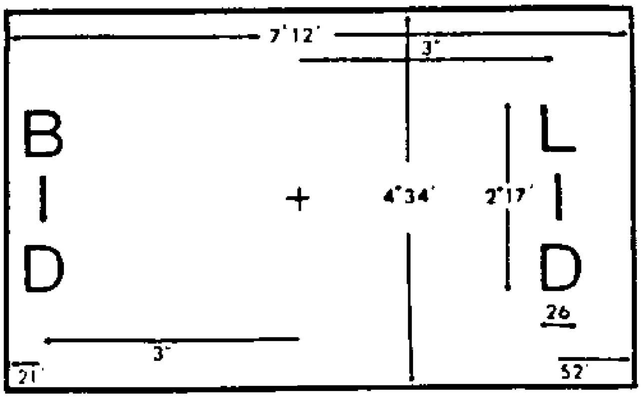
(THE EFFECTS OF HEAD AND EYE CENTERING ON RECOGNITION)

As mentioned previously (see Footnote 2), preliminary research revealed that, regardless of the viewing eye, head centering resulted in an inequality of the physical size of the two visual half-fields, while eye centering did not. Specifically, in the head centered condition, stimuli presented in the LVF of the right eye or the RVF of the left eye appeared farther from the blackened border of the stimulus channel. In the eye centered condition, on the other hand, stimuli appeared equally distant from the blackened border regardless of the viewing eye or field of presentation.

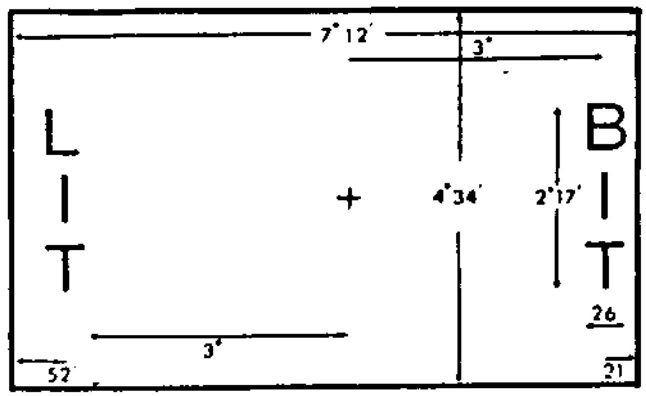
In order to determine whether the above viewing conditions have an effect on half-field recognition differences, and whether this ef-effect is due to border contrast, a control experiment was conducted prior to the present study. In this experiment, two Os (dextral O:CD and sinistral O:TS) were tested monocularly under the following viewing conditions: (1) eye centering, (2) head centering, and (3) head centering with the border in the smaller appearing field moved in so that the left and right visual fields appeared comparable in size (see Figure A_1). In each of these conditions, the vertically-mounted words used in the verbal condition of the present study were presented unilaterally at a single exposure duration which was selected at the beginning of each test session to generate a per cent correct recognition rate of approximately 50%. In total, 180 stimuli (90 per field) were presented randomly to either the left or right of fixation and the O's task was to identify verbally the stimuli and field of presentation. As can be seen in Figure A_2, half-field differences varied as a function of viewing condition. Specifically, in the head centered condition, relative to the eye centered and border equated conditions, stimuli presented in either the LVF of the right eye or the RVF of the left eye were better recognized than stimuli presented in the opposite half-fields.

Figure A_1. Diagram of how the verbal stimuli appeared relative to fixation and the blackened borders for left (OS) and right (OD) eye viewing in the head centered, eye centered, and border equated conditions. Retinal eccentricity and dimenions of field and stimulus material are indicated in degrees of visual angle subtended. (Notes -- (a) In each of these conditions a single stimulus was delivered to either the left or right of fixation per exposure. (b) The perceived distances of the stimuli from the blackened borders were empirically determined.)

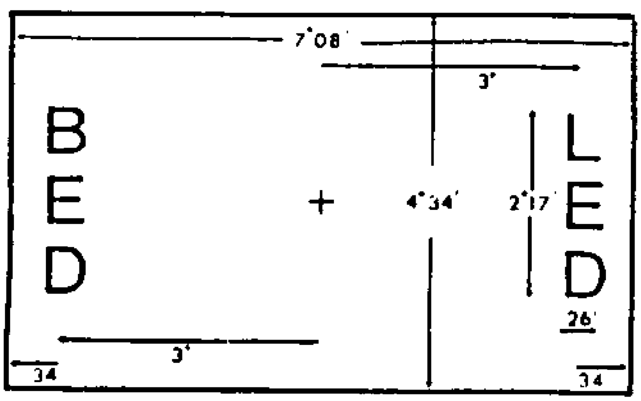
HEAD CENTERED OS



HEAD CENTERED OD



EYE CENTERED OS + OD



BORDER EQUATED OS + OD

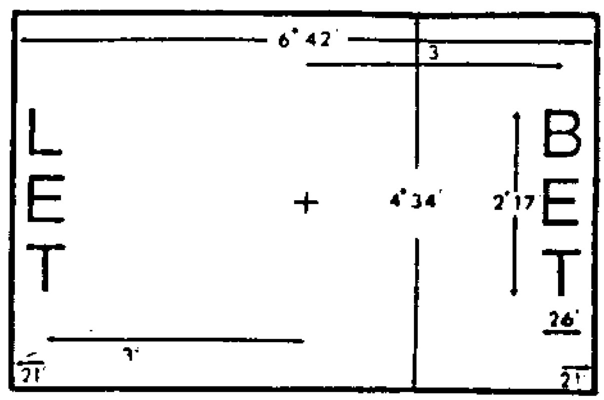
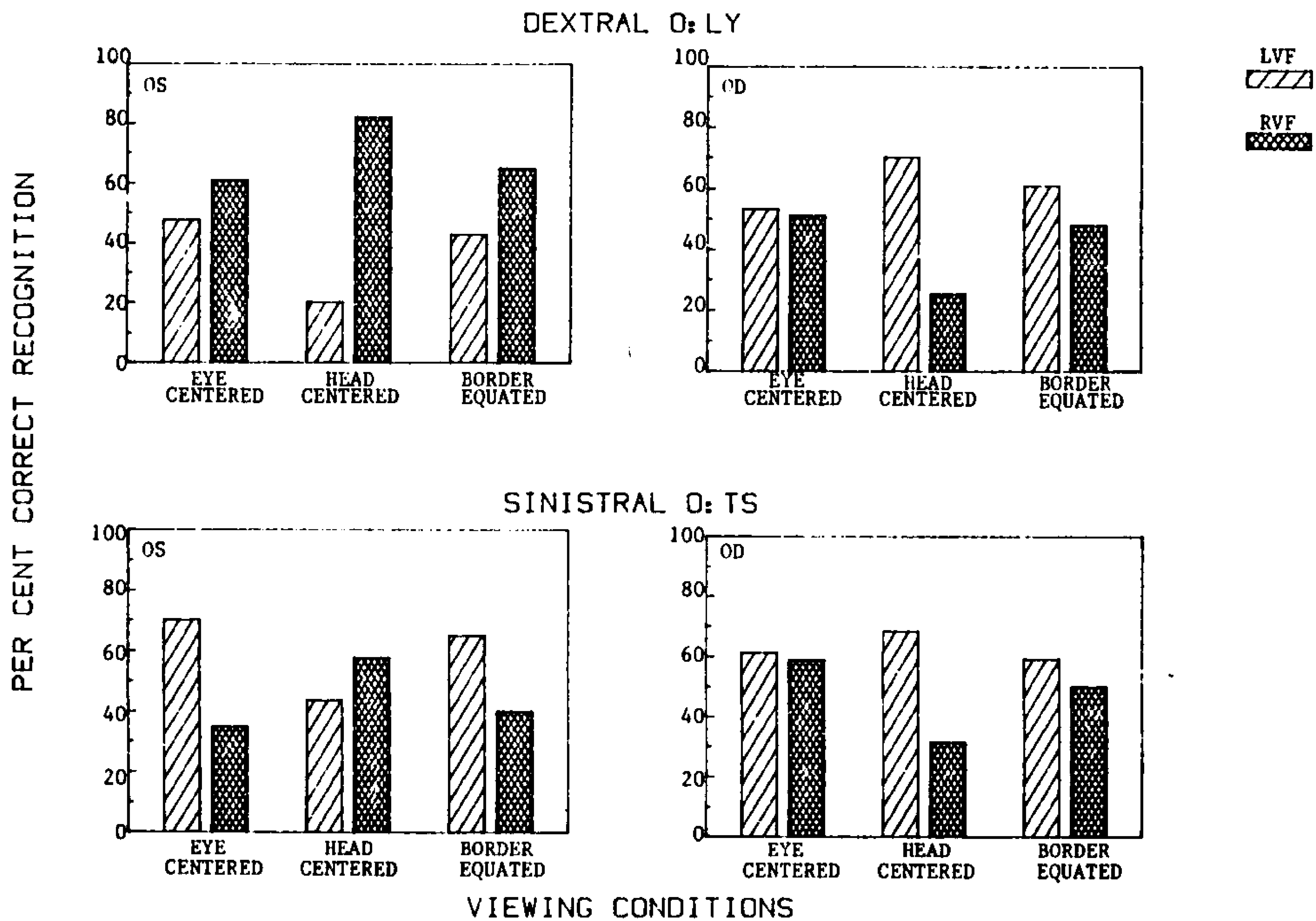


Figure A_2. Mean per cent correct recognition of words in the left (striped bar) and right (cross hatched bar) visual half-fields as a function of viewing condition for dextral O:LY (top of page) and sinistral O:TS (bottom of page).

THE EFFECTS OF HEAD AND EYE CENTERING ON THE MONOCULAR RECOGNITION OF VERTICALLY-MOUNTED WORDS



APPENDIX B

(SUPPORTING FIGURES)

Figure B_1. Mean per cent correct recognition of Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for dextral O:CD. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

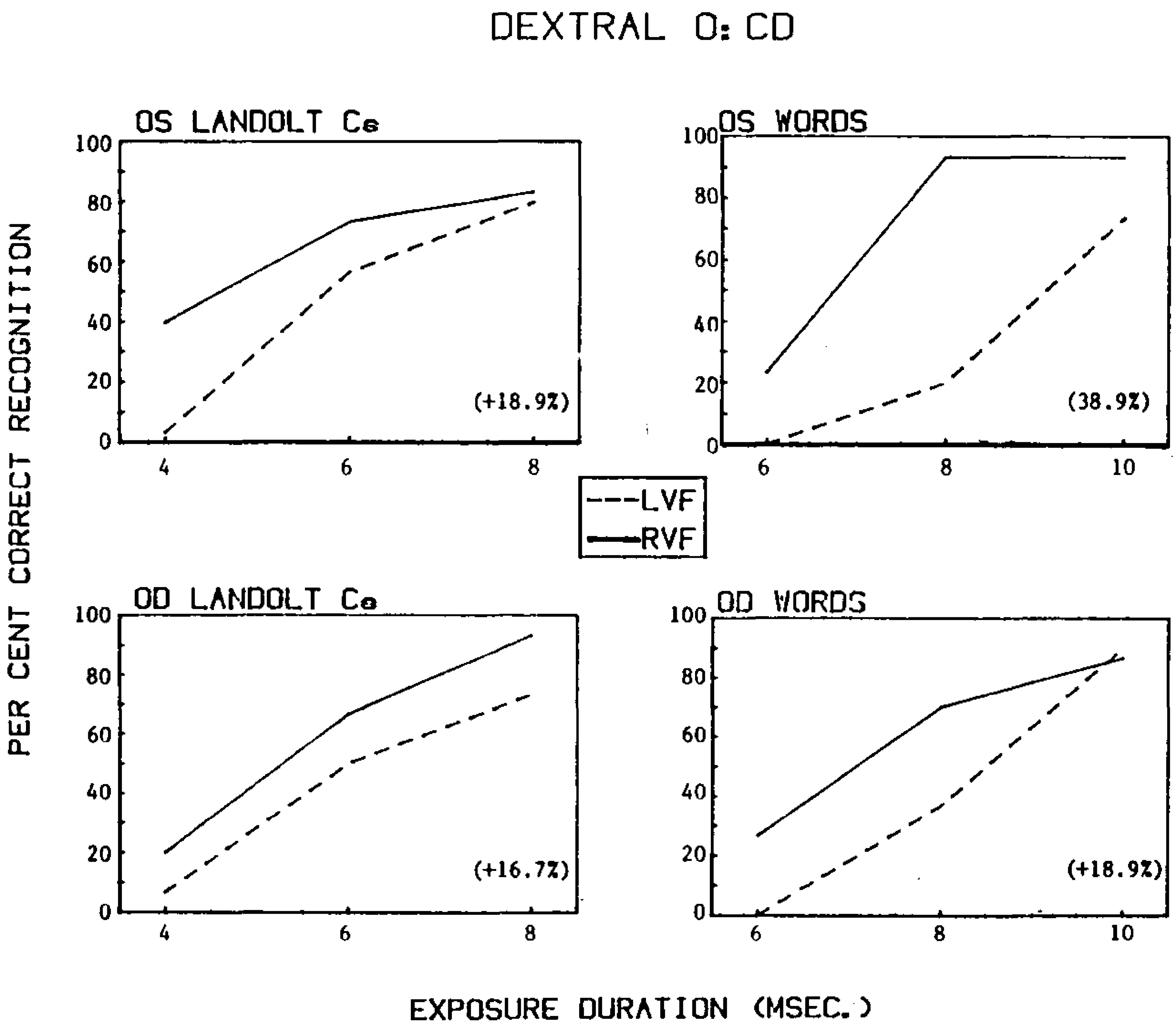

DEXTRAL O: CD
OS LANDOLT Cs
(+18.9%)
OS WORDS
(38.9%)
OD LANDOLT Cs
(+16.7%)
OD WORDS
(+18.9%)
LVF
RVF
PER CENT CORRECT RECOGNITION
EXPOSURE DURATION (MSEC.)

Figure B_2. Mean per cent correct recognition of Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for dextral O:HC. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

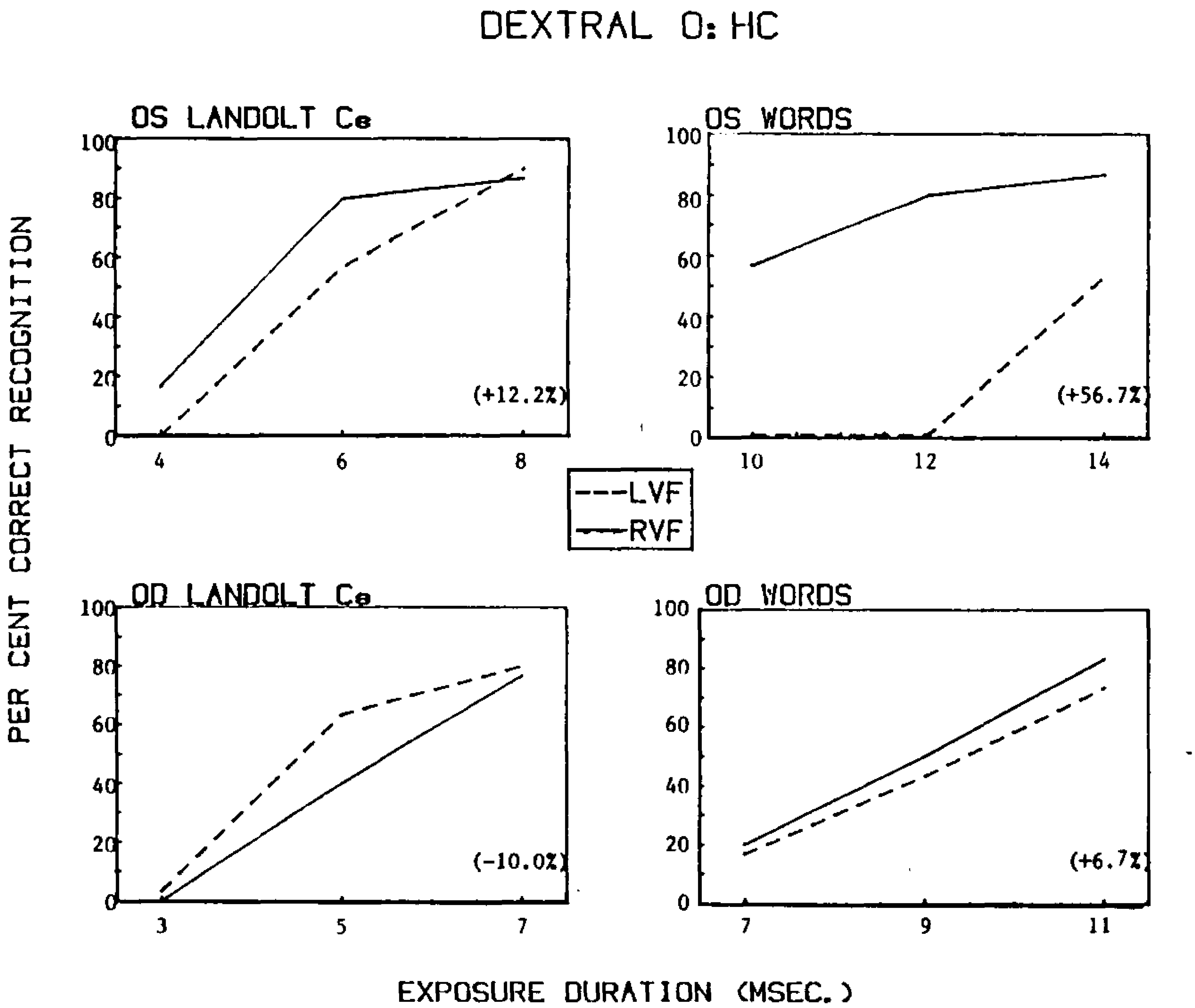
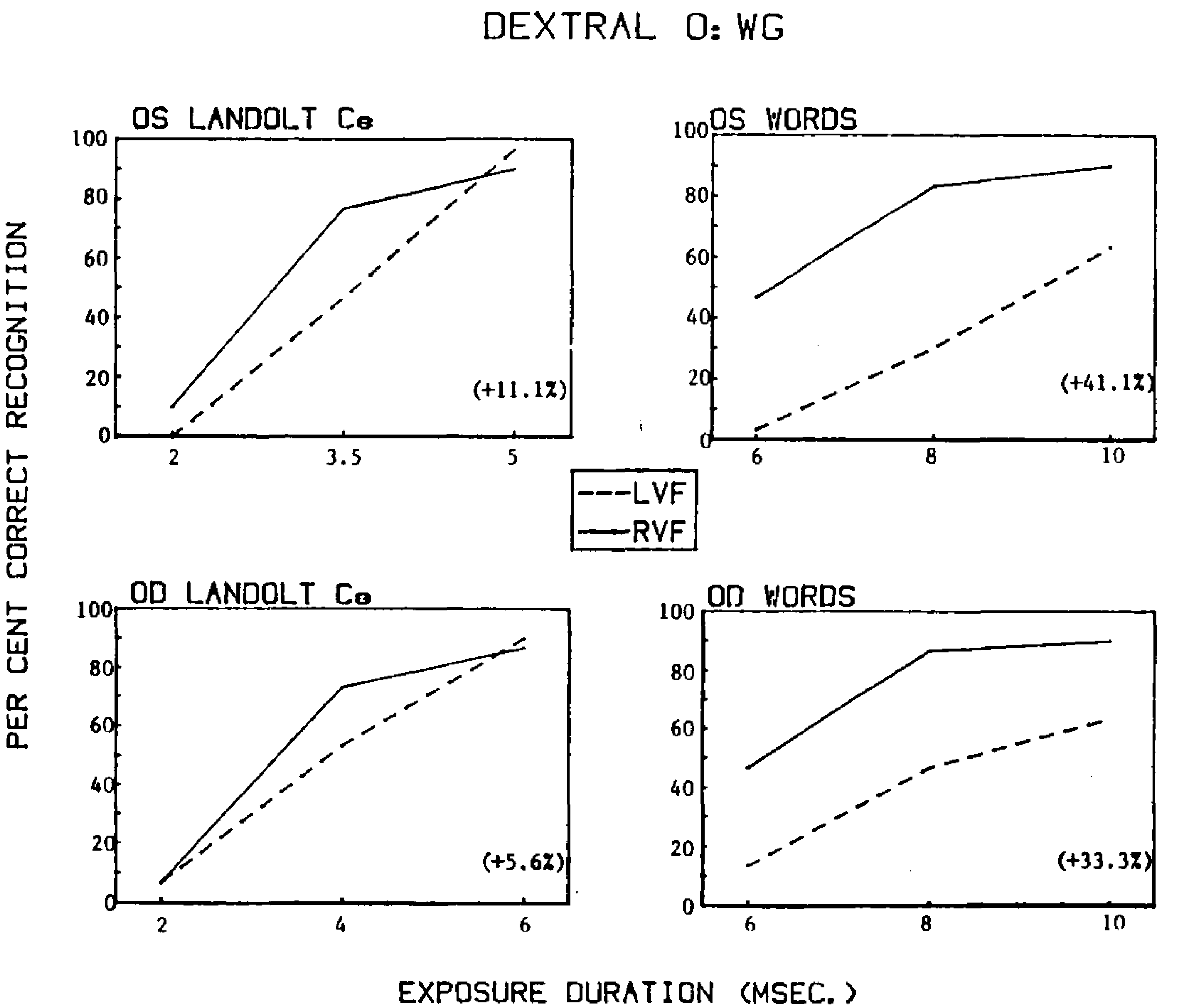

DEXTRAL O: HC
OS LANDOLT Cs
OS WORDS
OD LANDOLT Cs
OD WORDS
PER CENT CORRECT RECOGNITION
EXPOSURE DURATION (MSEC.)
---LVF
——RVF
(+12.2%)
(+56.7%)
(-10.0%)
(+6.7%)
0
20
40
60
80
100
4
6
8
10
12
14
3
5
7
7
9
11

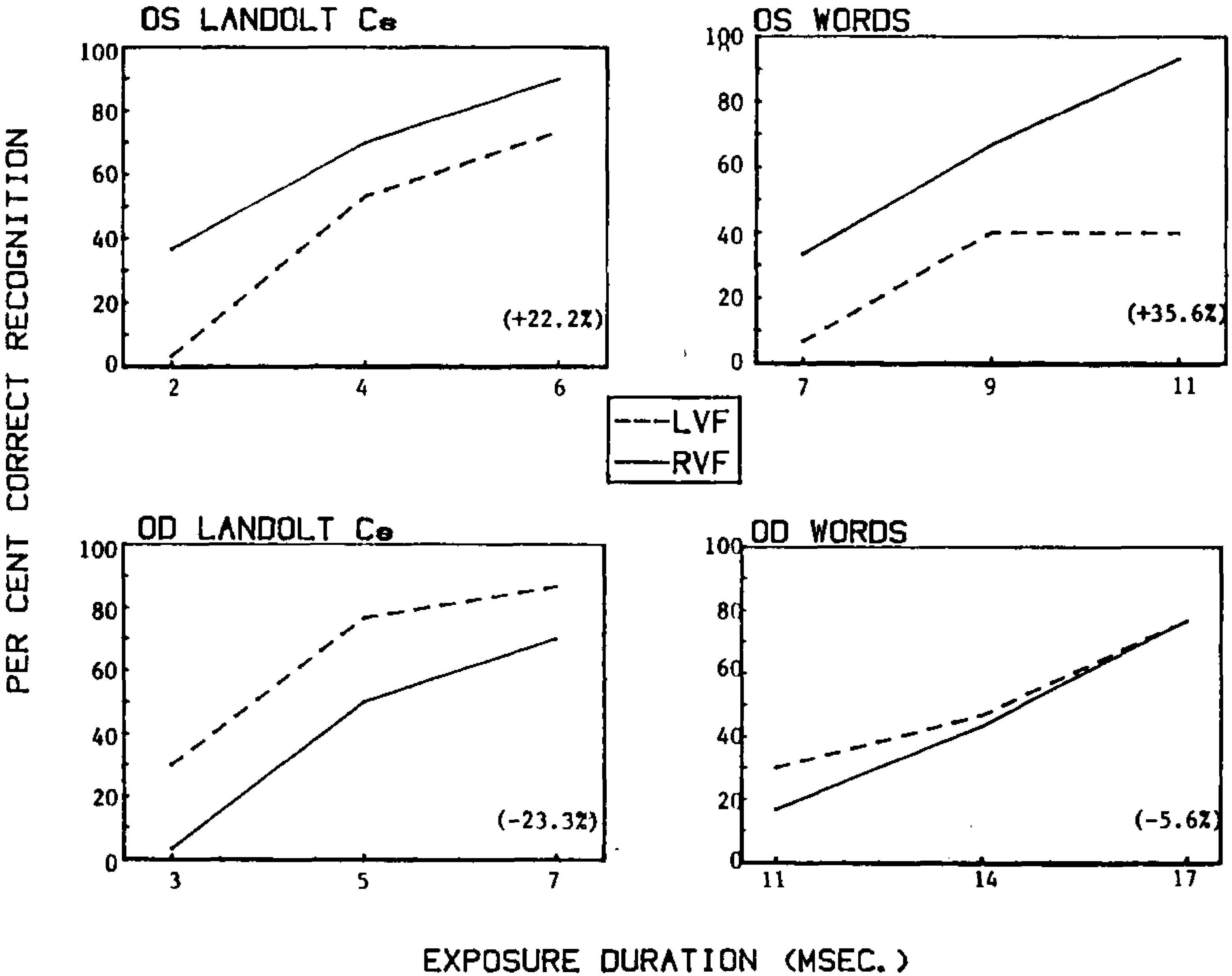
Figure B$_3$. Mean per cent correct recognition of Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for dextral O:WG. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)



DEXTRAL O: WG
OS LANDOLT Cs
OS WORDS
OD LANDOLT Cs
OD WORDS
(+11.1%)
(+41.1%)
(+5.6%)
(+33.3%)
LVF
RVF
PER CENT CORRECT RECOGNITION
EXPOSURE DURATION (MSEC.)

Figure B_4. Mean per cent correct recognition of Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for dextral Q:TY. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

DEXTRAL O: TY



OS LANDOLT Cs
(+22.2%)
OS WORDS
(+35.6%)
OD LANDOLT Cs
(-23.3%)
OD WORDS
(-5.6%)
---LVF
—RVF
PER CENT CORRECT RECOGNITION
EXPOSURE DURATION (MSEC.)

Figure B_5. Mean per cent correct recognition of Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for dextral _O_:BK. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

DEXTRAL O: BK

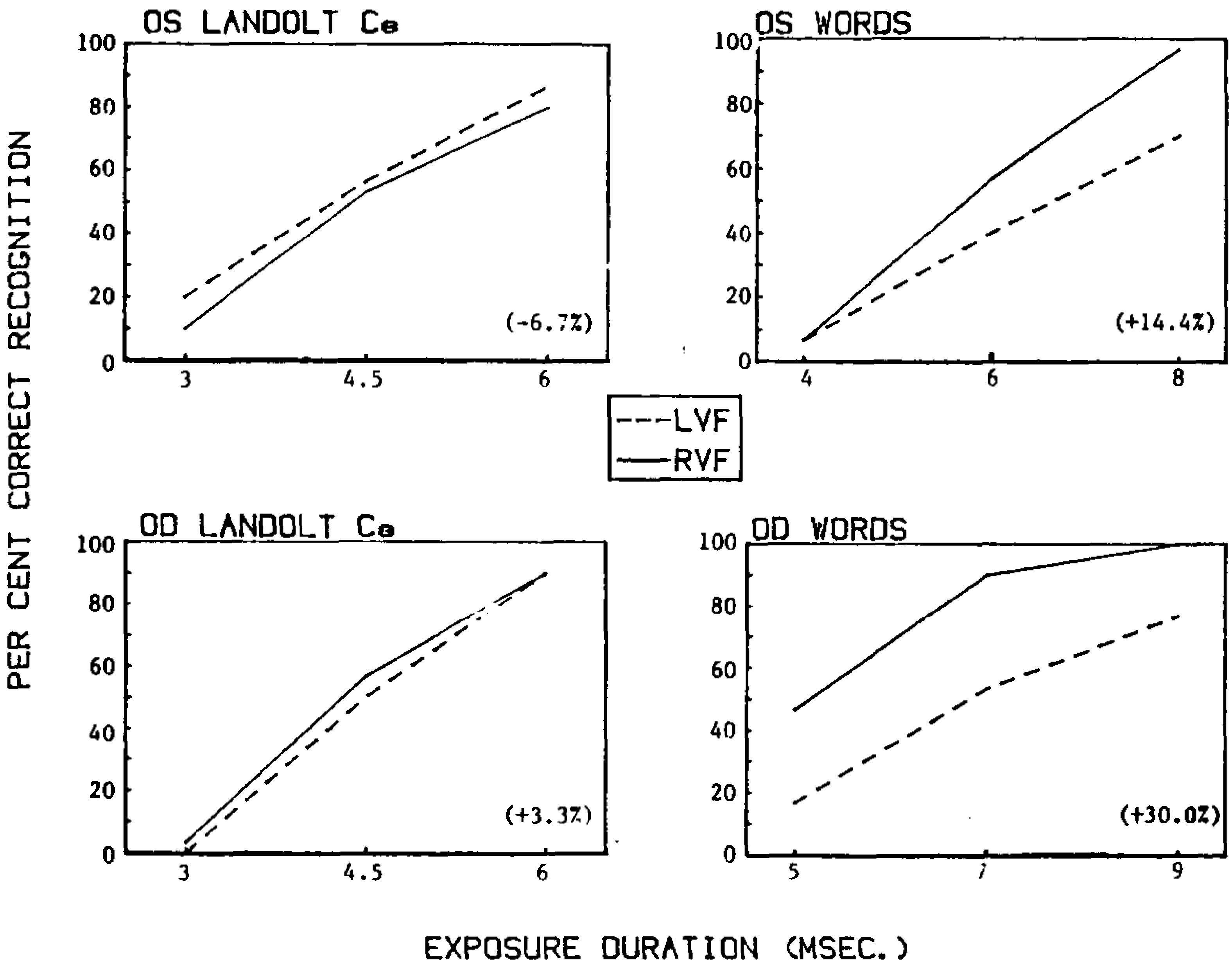

OS LANDOLT Cs
OS WORDS
OD LANDOLT Cs
OD WORDS
(-6.7%)
(+14.4%)
(+3.3%)
(+30.0%)
LVF
RVF
PER CENT CORRECT RECOGNITION
EXPOSURE DURATION (MSEC.)
0
20
40
60
80
100
3
4.5
6
4
8
5
7
9

Figure B_6. Mean per cent correct recognition of Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for sinistral O:TS. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

SINISTRAL O: TS

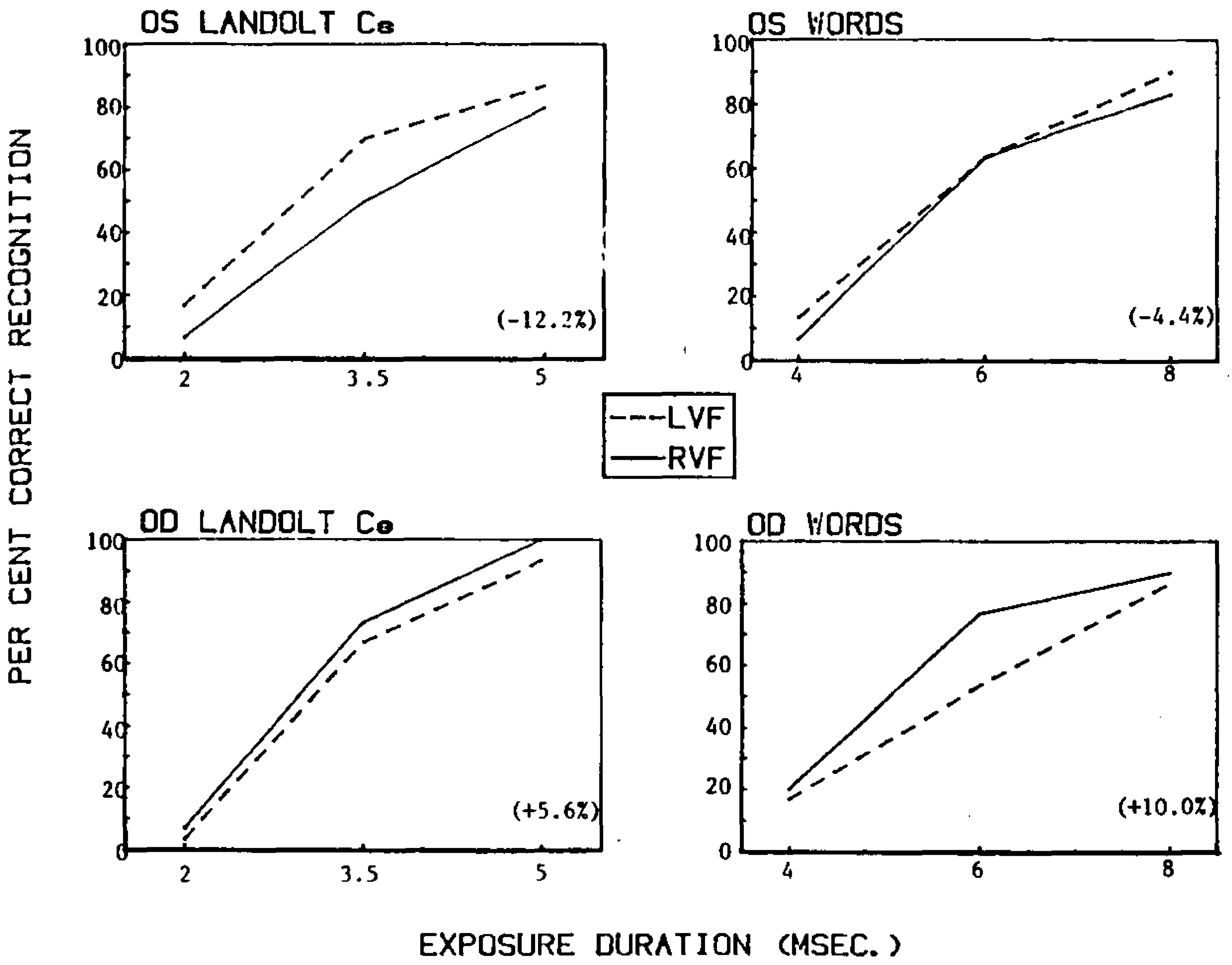


Figure B_7. Mean per cent correct recognition of Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for sinistral O:HM. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

SINISTRAL O: HM

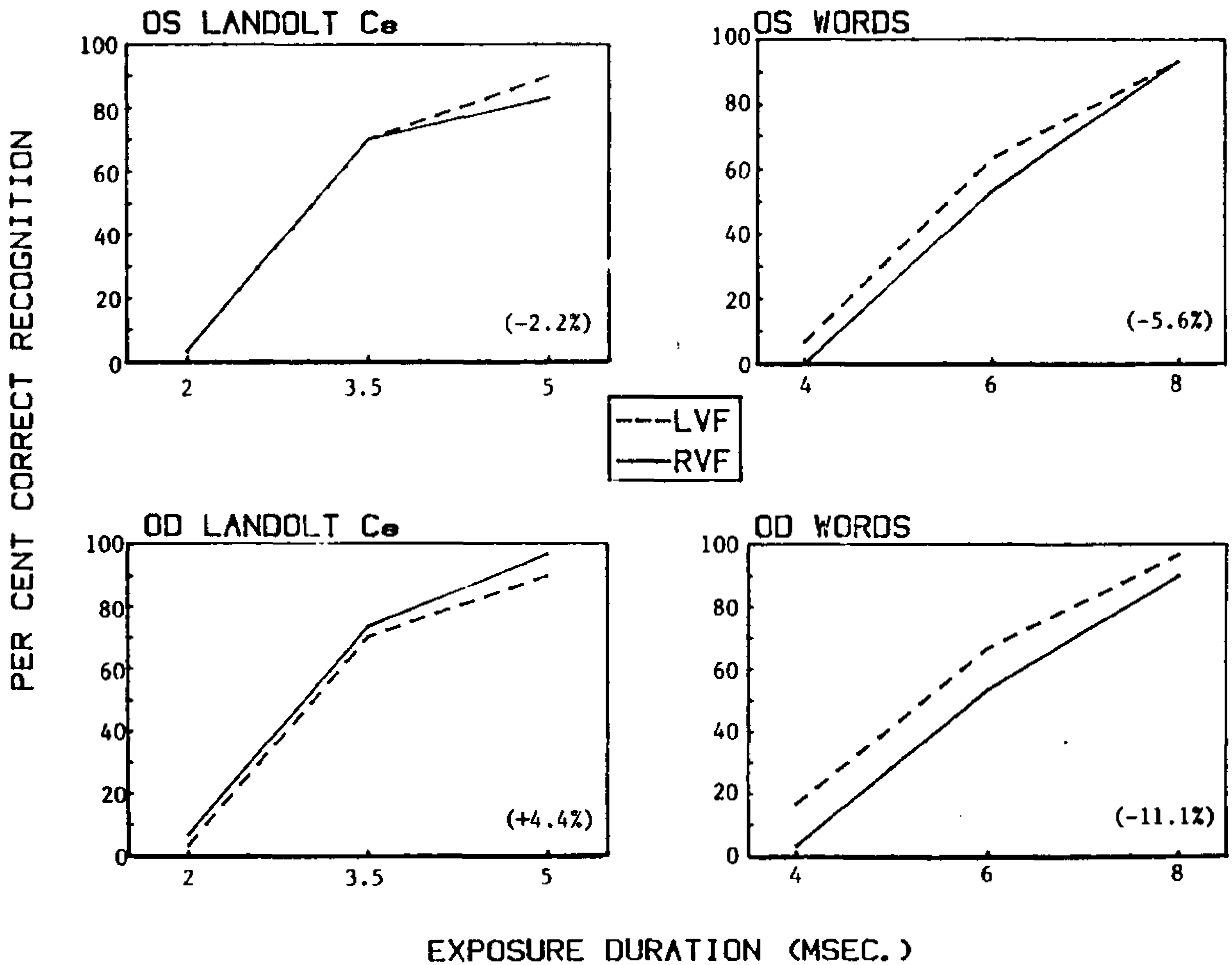


Figure B_8. Mean per cent correct recognition of Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for sinistral O:RC. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differences analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

SINISTRAL O: RC

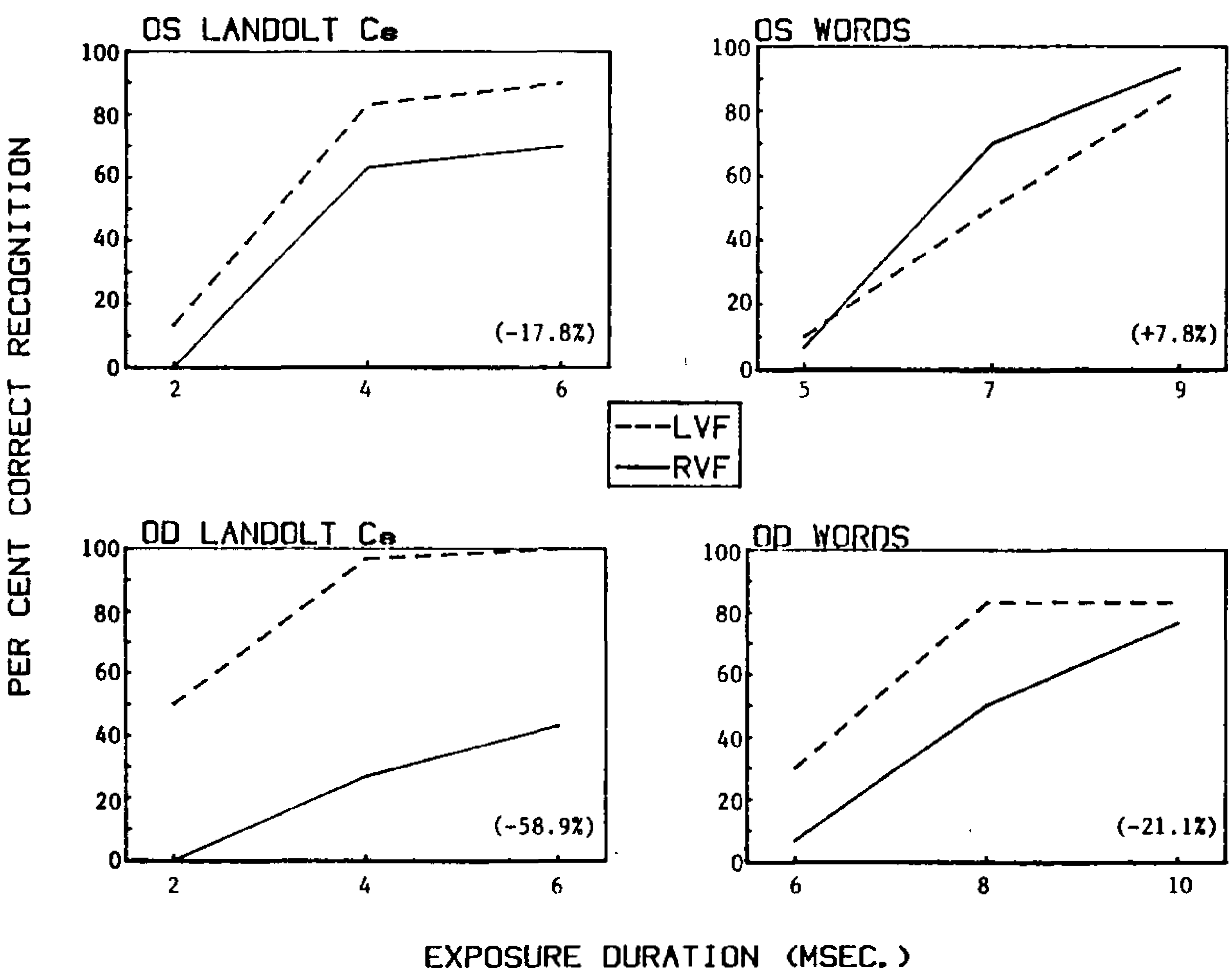


Figure B_9. Mean RT (in msec.) to Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for dextral O:CD. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differemces analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

DEXTRAL O: CD

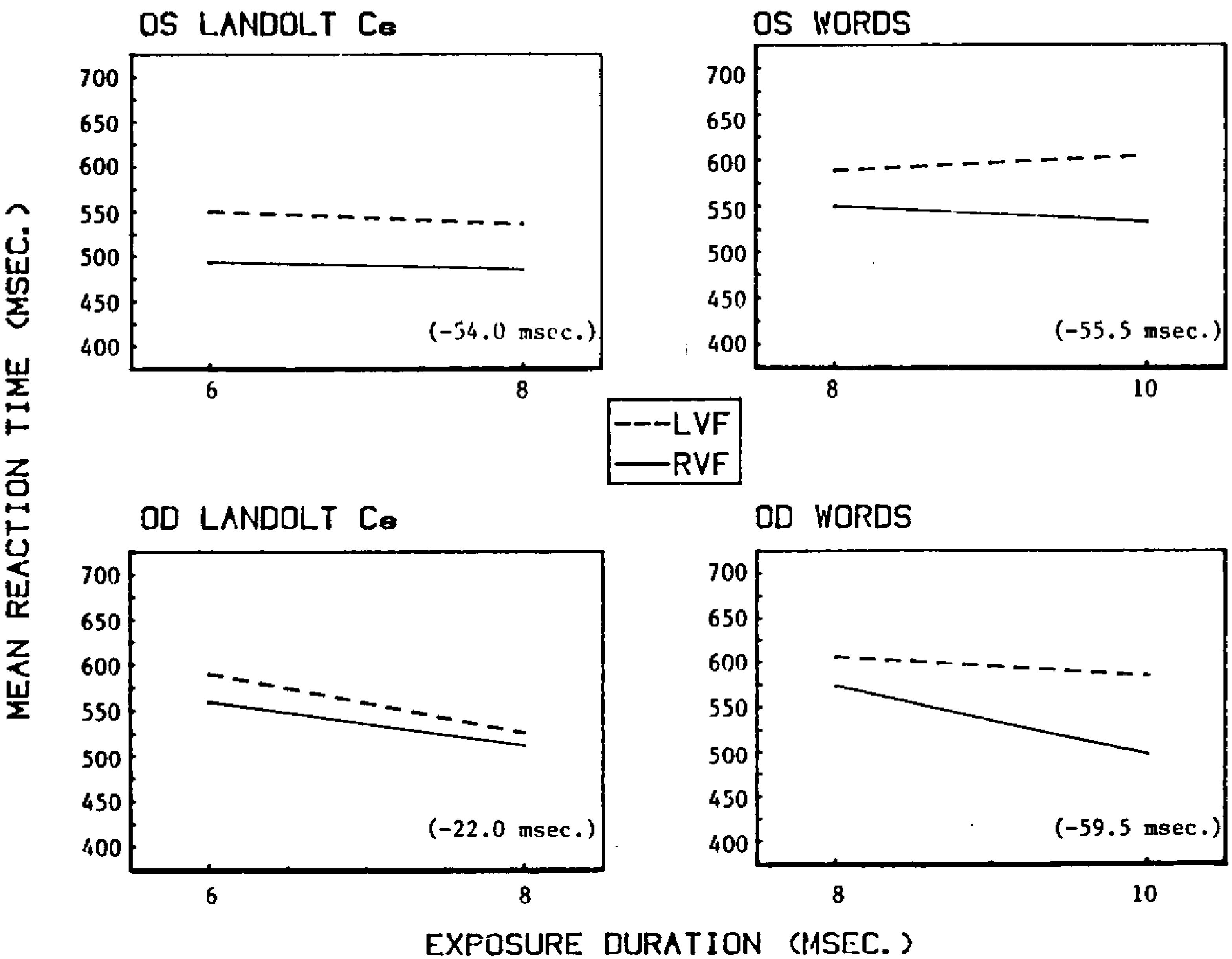

OS LANDOLT Cs
OS WORDS
OD LANDOLT Cs
OD WORDS
MEAN REACTION TIME (MSEC.)
EXPOSURE DURATION (MSEC.)
700
650
600
550
500
450
400
6
8
10
(-54.0 msec.)
(-55.5 msec.)
(-22.0 msec.)
(-59.5 msec.)
LVF
RVF

Figure B_{10}. Mean RT (in msec.) to Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for dextral O:HC. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differemces analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

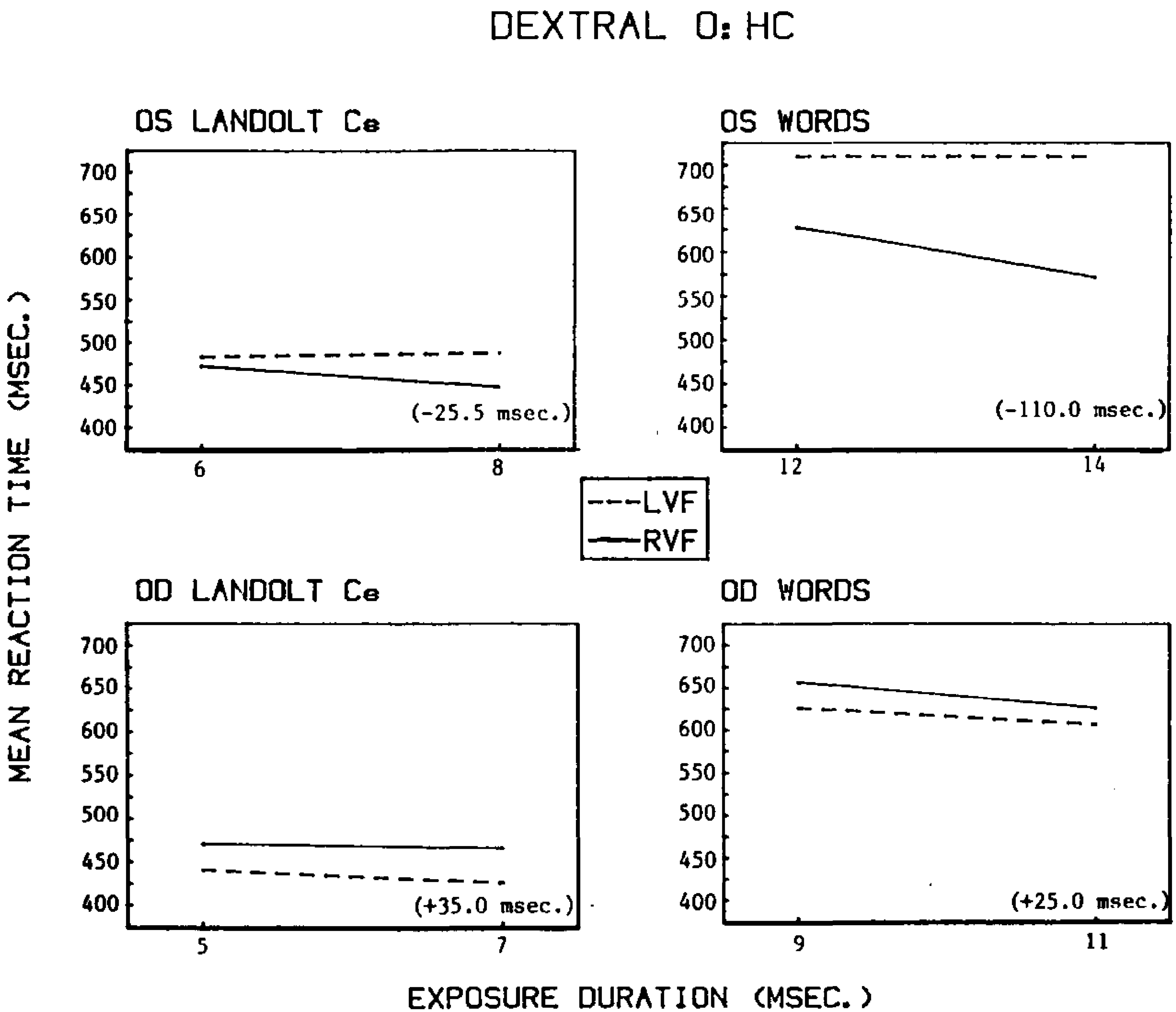
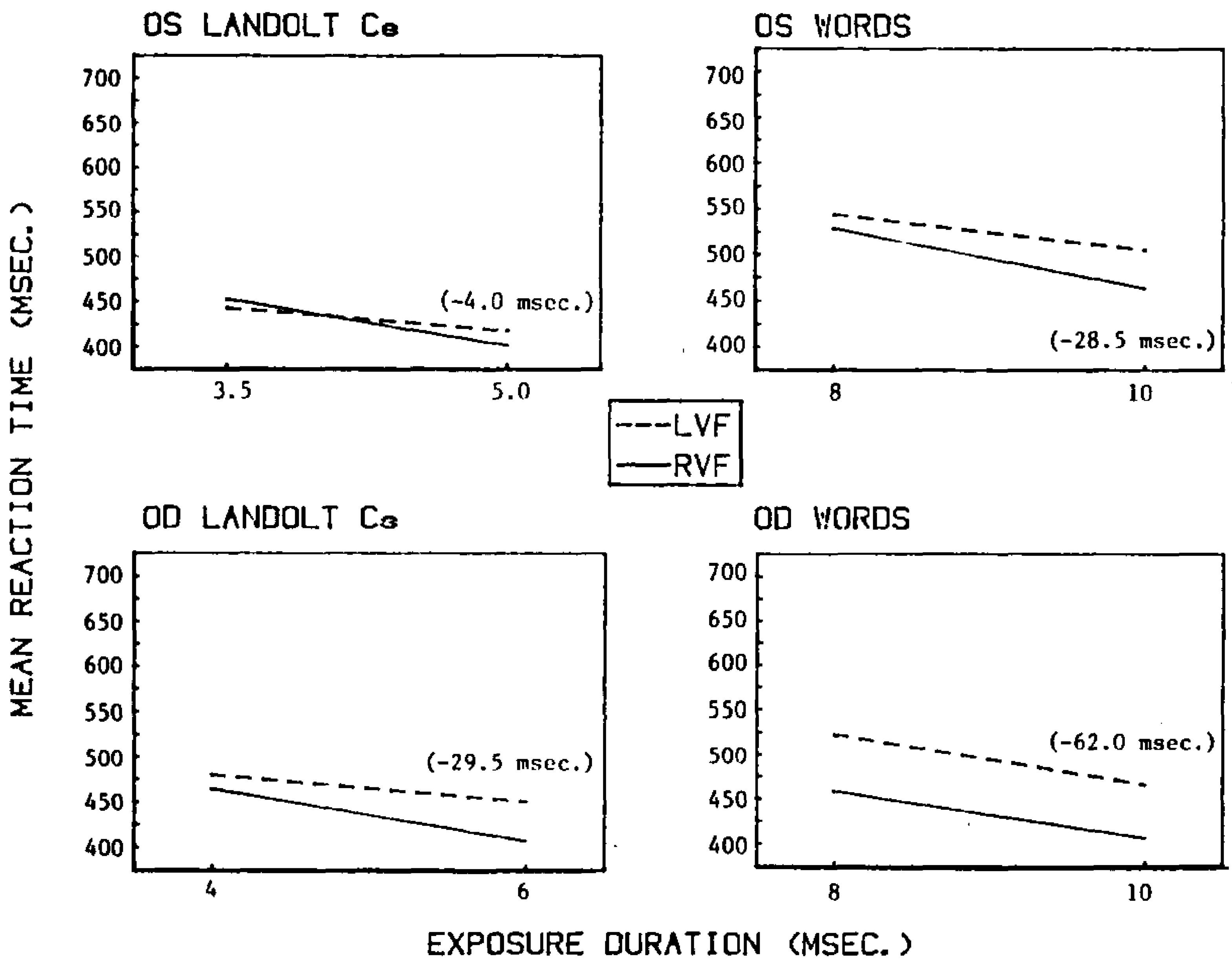

DEXTRAL O: HC
OS LANDOLT Cs
(-25.5 msec.)
OS WORDS
(-110.0 msec.)
OD LANDOLT Cs
(+35.0 msec.)
OD WORDS
(+25.0 msec.)
---LVF
——RVF
700
650
600
550
500
450
400
6
8
12
14
5
7
9
11
MEAN REACTION TIME (MSEC.)
EXPOSURE DURATION (MSEC.)

Figure B_{11}. Mean RT (in msec.) to Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for dextral O:WG. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differemces analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

DEXTRAL O: WG



OS LANDOLT Cs
OS WORDS
OD LANDOLT Cs
OD WORDS
700
650
600
550
500
450
400
3.5
5.0
8
10
4
6
(-4.0 msec.)
(-28.5 msec.)
(-29.5 msec.)
(-62.0 msec.)
---LVF
—RVF
MEAN REACTION TIME (MSEC.)
EXPOSURE DURATION (MSEC.)

Figure B_{12}. Mean RT (in msec.) to Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for dextral O:TY. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differemces analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

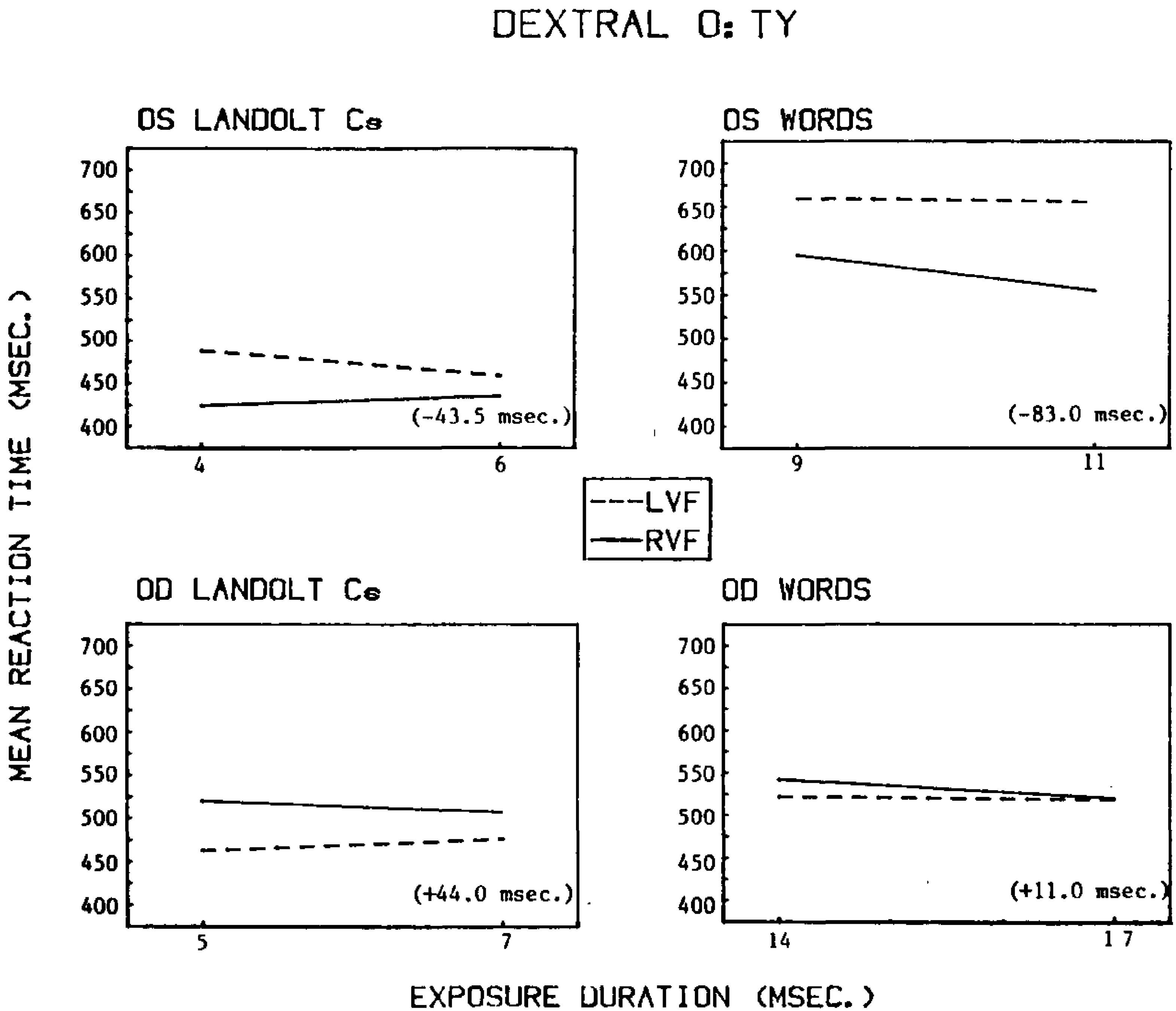

DEXTRAL O: TY
OS LANDOLT Cs
OS WORDS
OD LANDOLT Cs
OD WORDS
700
650
600
550
500
450
400
(-43.5 msec.)
(-83.0 msec.)
(+44.0 msec.)
(+11.0 msec.)
4
6
9
11
5
7
14
17
LVF
RVF
MEAN REACTION TIME (MSEC.)
EXPOSURE DURATION (MSEC.)

Figure B_{13}. Mean RT (in msec.) to Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for dextral O:BK. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differemces analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

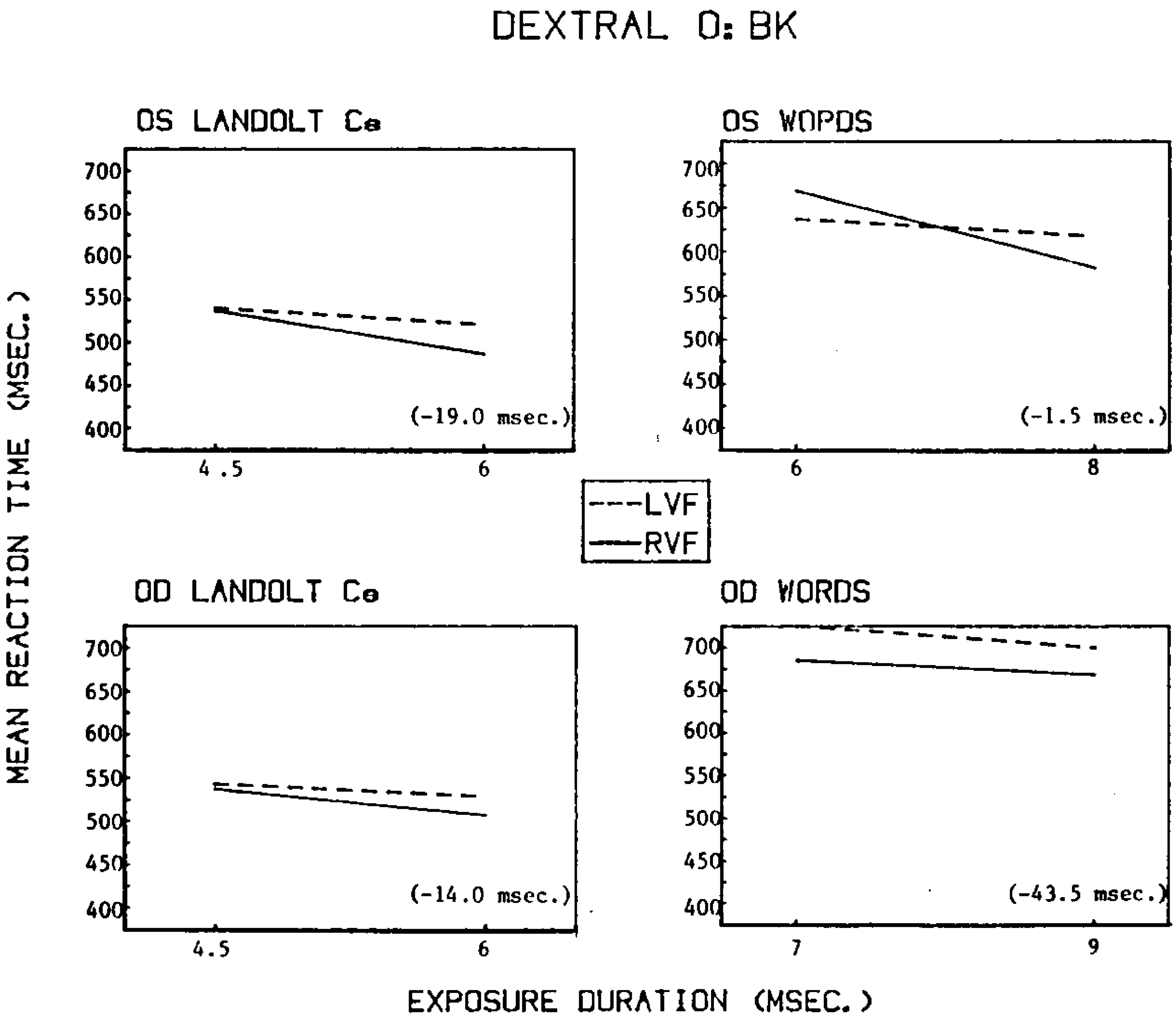

DEXTRAL O: BK
OS LANDOLT Cs
(-19.0 msec.)
OS WORDS
(-1.5 msec.)
OD LANDOLT Cs
(-14.0 msec.)
OD WORDS
(-43.5 msec.)
LVF
RVF
MEAN REACTION TIME (MSEC.)
EXPOSURE DURATION (MSEC.)
700
650
600
550
500
450
400
4.5
6
8
7
9

Figure B_{14}. Mean RT (in msec.) to Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for sinistral O:TS. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differemces analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)

SINISTRAL O: TS

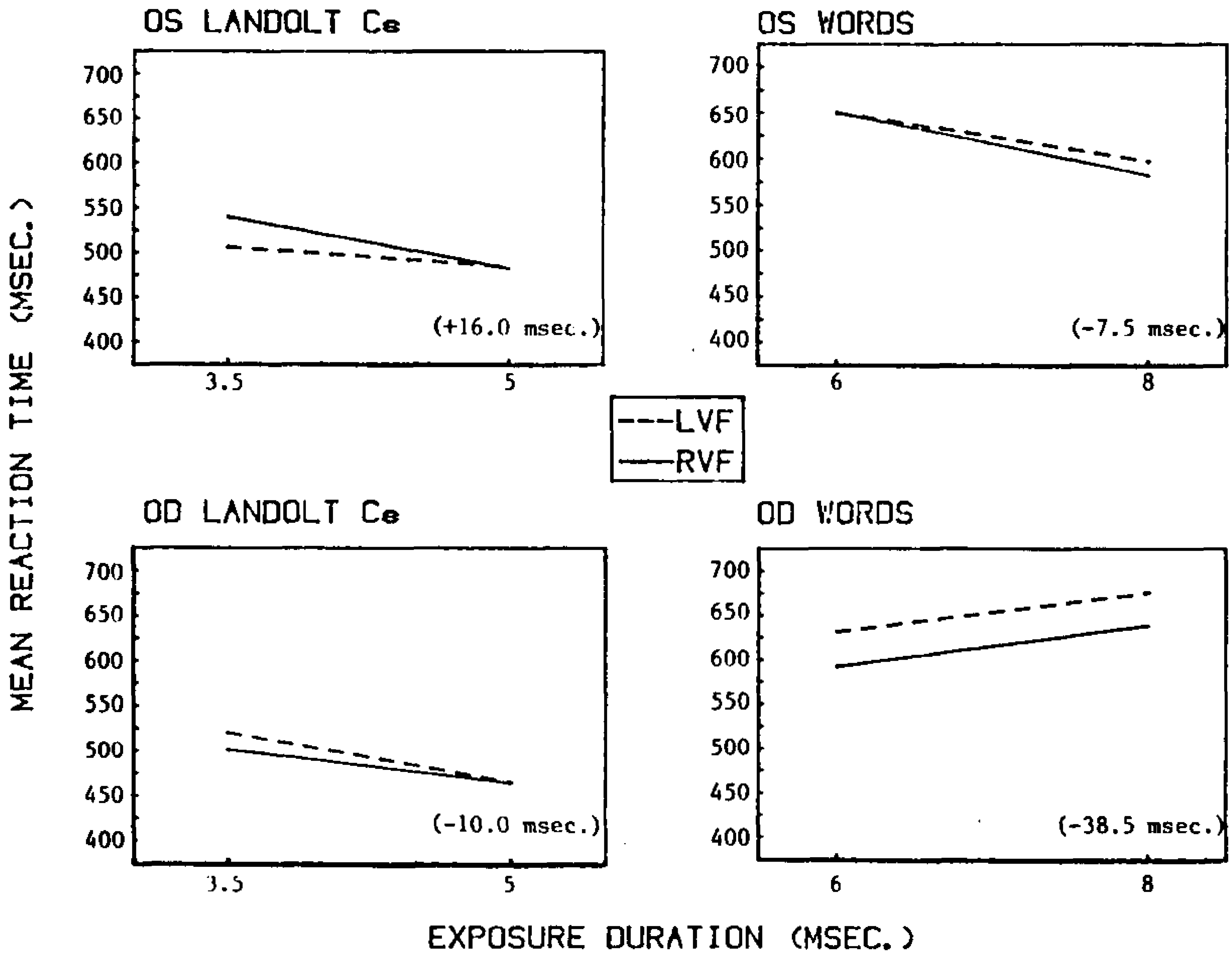


Figure B_{15}. Mean RT (in msec.) to Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for sinistral O:HM. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differemces analyzed across al' data points are shown in parentheses in the lower right quadrant of each function.)

SINISTRAL O: HM

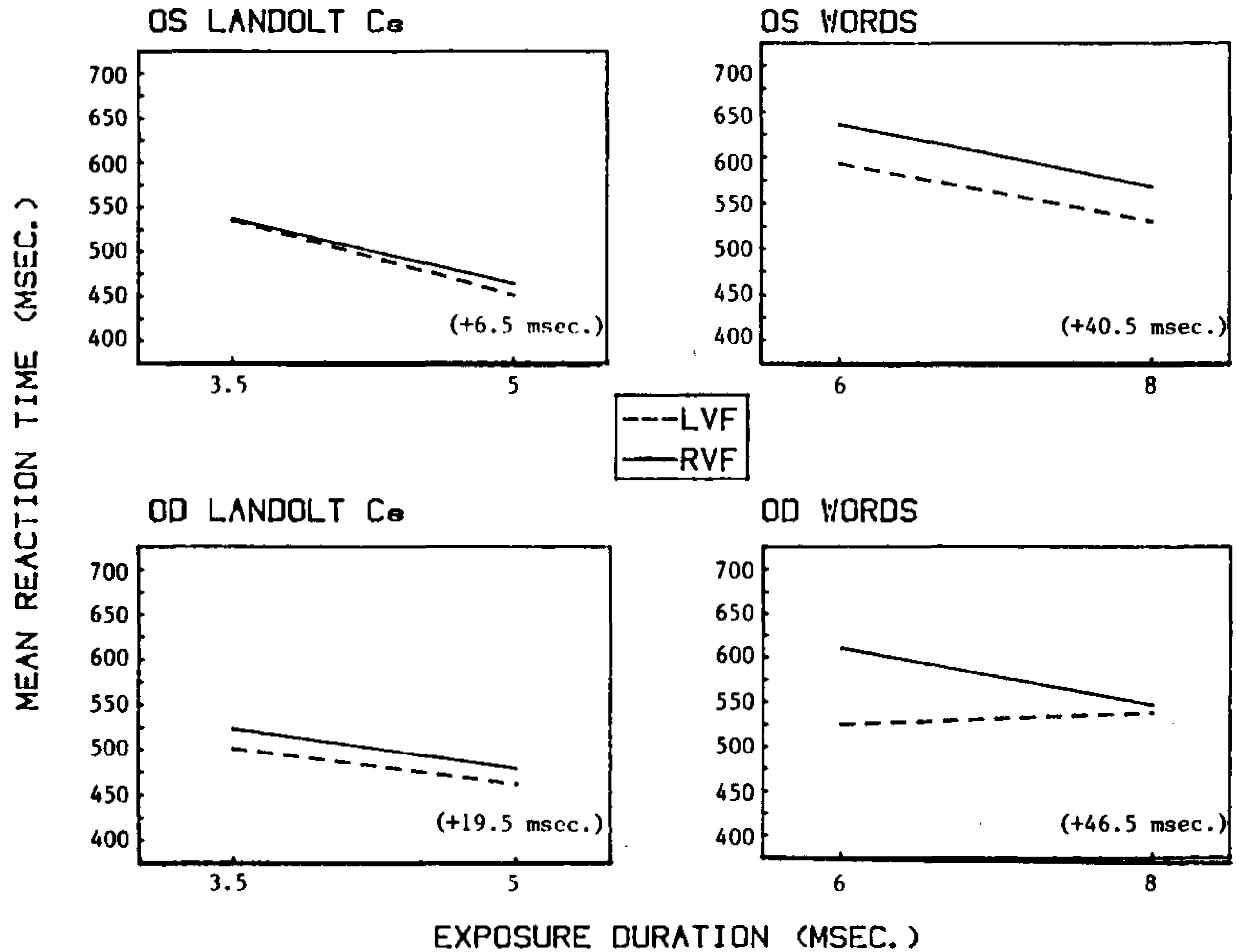
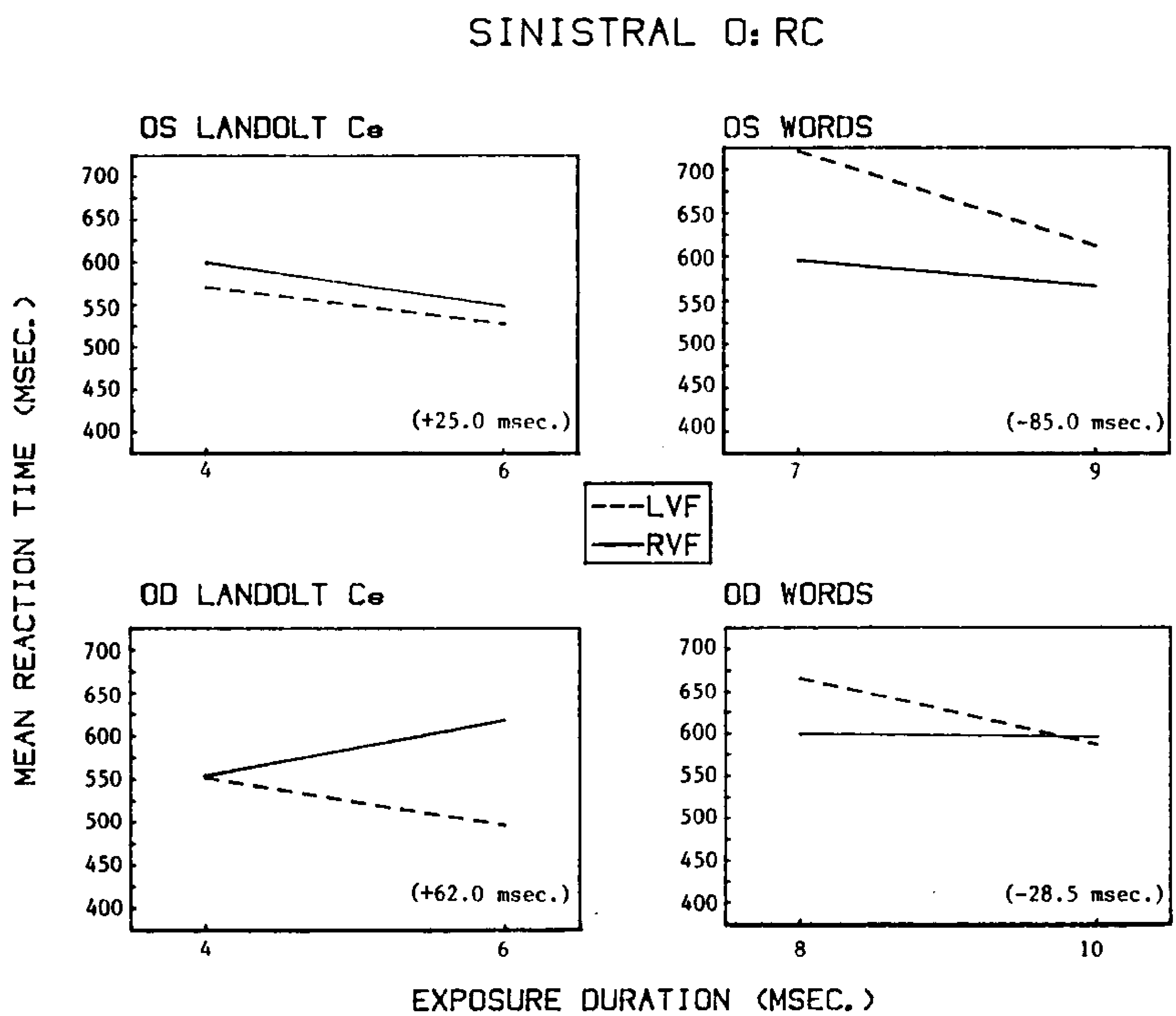


Figure B_{16}. Mean RT (in msec.) to Landolt Cs and words in the left (dashed line) and right (solid line) visual half-fields as a function of exposure duration (in msec.) for sinistral O:RC. Left eye (OS) on the top; right eye (OD) on the bottom. (Mean RVF-LVF differemces analyzed across all data points are shown in parentheses in the lower right quadrant of each function.)



SINISTRAL O: RC
OS LANDOLT Cs
OS WORDS
OD LANDOLT Cs
OD WORDS
700
650
600
550
500
450
400
(+25.0 msec.)
(-85.0 msec.)
(+62.0 msec.)
(-28.5 msec.)
4
6
7
9
8
10
---LVF
—RVF
MEAN REACTION TIME (MSEC.)
EXPOSURE DURATION (MSEC.)

APPENDIX C

(SUPPORTING TABLES)

TABLE C[1]

The Crovitz and Zener test for handedness and the scores of each of the eight Os on this test.

Answer the following questions carefully. Imagine yourself performing the activity described before answering the question. Answer by drawing a circle around the appropriate set of letters appearing to the left of each question whose meaning is:

Ra = right hand always
Rm = right hand most of the time
E = both hands equally
Lm = left hand most of the time
La = left hand always
X = do not know which hand

(1) Ra Rm E Lm La X: is used to write with.
(2) Ra Rm E Lm La X: to hold nail when hammering.
(3) Ra Rm E Lm La X: to throw a ball.
(4) Ra Rm E Lm La X: to hold bottle when removing top.
(5) Ra Rm E Lm La X: is used to draw with.
(6) Ra Rm E Lm La X: to hold potato when peeling.
(7) Ra Rm E Lm La X: to hold pitcher when pouring out of it.
(8) Ra Rm E Lm La X: to hold scissors when cutting.
(9) Ra Rm E Lm La X: to hold knife when cutting food.
(10) Ra Rm E Lm La X: to hold needle when threading.
(11) Ra Rm E Lm La X: to hold drinking glass when drinking.
(12) Ra Rm E Lm La X: to hold tooth brush when brushing teeth.
(13) Ra Rm E Lm La X: to hold dish when wiping.
(14) Ra Rm E Lm La X: holds tennis racket when playing.

Every item is scored on a 5-point scale. On Items 1, 3, 5, 7, 9, 11, 12, and 14, Ra is scored "1"; Rm, "2"; E, "3"; Lm, "4"; and La, "5". All other items (2, 4, 6, 10, 13) are scored in the reverse fashion. Items marked X are prorated. The highest possible right-handed score is 14, and the highest left-handed score is 70.

Scores for Dextral Os

O	Score
CD	16
HC	16
WG	16
TY	20
BK	14

Scores for Sinistral Os

O	Score
TS	57
HM	68
RC	44

TABLE C_2

The Crovitz and Zener test for sighting dominance and the scores of the eight Os on this test.

The subject was instructed to sit erect and fixate a point placed upon the blackboard before him. While fixating this point, he was instructed to bring a pencil, which until then had been held vertically with his right (left) hand at his nose into line with the fixation-point. He was then told to close his right (left) eye and to note whether the pencil was still in line with the fixation point or had shifted to the right or left of it. Eight trials were given every _O_; two each with a specified eye covered and with a pencil in a specified hand. When the right eye was closed, a report of the pencil remaining in line was classified as a "left-eyeoness report", while a report of the pencil jumping to the right was classified as a "right-eyedness report". The reverse scoring procedure was used when the left eye was closed.

Scores for Dextral Os

_O_	Dominant Eye	Score
CD	Right	8/8
HC	Right	8/8
WG	Left	8/8
TY	Right	8/8
BK	Left	8/8

Scores for Sinistral Os

_O_	Dominant Eye	Score
TS	Right	8/8
HM	Right	8/8
RC	Left	8/6

TABLE C_3

Group Data: Same eye comparisons of half-field (RVF-LVF) differences (D) in false alarm rates for the viewing of words (W) and Landolt Cs (L).

	OS							OD						
	WORDS			LANDOLT Cs				WORDS			LANDOLT Cs			
S	RVF	LVF	D_W	RVF	LVF	D_L	$D_W - D_L$	RVF	LVF	D_W	RVF	LVF	D_L	$D_W - D_L$
DEXTRAL GROUP														
CD	2.2	0.0	2.2	1.1	2.2	-1.1	3.3	0.0	2.2	-2.2	2.2	1.1	1.1	-3.3
HC	7.8	4.4	3.3	3.3	3.3	0.0	3.3	3.3	5.6	-2.2	5.6	7.8	-2.2	0.0
WG	4.4	5.6	-1.1	4.4	4.4	0.0	-1.1	7.8	3.3	4.4	3.3	4.4	-1.1	5.5
TY	4.4	1.1	3.3	2.2	5.6	-3.3	6.7	1.1	4.4	-3.3	1.1	1.1	0.0	-3.3
BK	4.4	2.2	2.2	2.2	2.2	0.0	2.2	2.2	1.1	1.1	1.1	0.0	1.1	0.0
$\bar{X}$	4.7	2.7	2.0	2.7	3.6	-0.9	2.9	2.9	3.3	-0.4	2.7	2.9	-0.2	-0.2
t_4							2.32							-0.14
SINISTRAL GROUP														
TS	3.3	2.2	1.1	6.7	4.4	2.2	-1.1	6.7	2.2	4.4	7.8	3.3	4.4	0.0
HM	2.2	2.2	0.0	0.0	4.4	-4.4	4.4	1.1	5.6	-4.4	1.1	3.3	-2.2	-2.2
RC	1.1	3.3	-2.2	2.2	5.6	-3.3	1.1	3.3	2.2	1.1	2.2	6.7	-4.4	5.5
$\bar{X}$	2.2	2.6	-0.4	3.0	4.8	-1.9	1.5	3.7	3.3	0.4	3.7	4.4	-0.7	1.1
t_2							0.52							0.48

TABLE C

Individual Data: Same eye comparisons of half-field (RVF-LVF) diferences (D) in false alarm rates for the viewing of words (W) and Landolt Cs (L).

	OS				OD			
S	D_W	D_L	$D_W - D_L$	z	D_W	D_L	$D_W - D_L$	z
				DEXTRAL Ss				
CD	2.2%	-1.1%	3.3%	1.35	-2.2%	1.1%	-3.3%	-1.35
HC	3.3	0.0	3.3	0.75	-2.2	-2.2	0.0	0.00
WG	-1.1	0.0	-1.1	-0.51	4.4	-1.1	5.5	1.24
TY	3.3	-3.3	6.7	1.76	-3.3	0.0	-3.3	-1.15
BK	2.2	0.0	2.2	0.64	1.1	1.1	0.0	0.00
				SINISTRAL Ss				
TS	1.1	2.2	-1.1	-0.26	4.4	4.4	0.0	0.00
HM	0.0	-4.4	4.4	1.43	-4.4	-2.2	-2.2	-0.64
RC	-2.2	-3.3	1.1	0.31	1.1	-4.4	5.5	1.41

TABLE C_5

Dextral Group: Analysis of variance comparing the recognition data for the left eye viewing of words and Landolt Cs.*

Source	SS	df	ms	F	p
Field (F)	14.039	1	14.039	37.97	p<.01
Error (F)	1.479	4	.370		
Duration (D)	2.487	2	1.243	1.04	n.s.
Error (D)	9.528	8	1.191		
Hand (H)	.189	1	.189	4.16	n.s.
Error (H)	.182	4	.045		
F x D	2.764	2	1.382	2.97	n.s.
Error (FD)	3.728	8	.465		
F x H	.063	1	.063	.17	n.s.
Error (FH)	1.453	4	.363		
D x H	.954	2	.477	1.55	n.s.
Error (DH)	2.468	8	.308		
F x D x H	.140	2	.070	.21	n.s.
Error (FDH)	2.670	8	.334		

*An arc sin transformation (2 x arc sin $\sqrt{\text{\% correct responses}}$) was applied to the data.

TABLE C_6

Dextral Group: Analysis of variance comparing the recognition data for the right eye viewing of words and Landolt Cs.*

Source	SS	df	ms	F	p
Field (F)	9.254	1	9.254	19.79	p<.025
Error (F)	1.870	4	.468		
Duration (D)	6.977	2	3.489	6.44	p<.025
Error (D)	4.332	8	.541		
Hand (H)	.784	1	.784	.89	n.s.
Error (H)	3.540	4	.884		
F x D	.361	2	.181	.42	n.s.
Error (FD)	3.463	8	.433		
F x H	.094	1	.094	.57	n.s.
Error (FH)	.654	4	.163		
D x H	.259	2	.130	1.10	n.s.
Error (DH)	.950	8	.118		
F x D x H	.908	2	.454	2.08	n.s.
Error (FDH)	1.739	8	.217		

*An arc sin transformation (2 x arc sin $\sqrt{\text{\% correct responses}}$) was applied to the data.

TABLE C_7

Sinistral Group: Analysis of variance comparing the recognition data for the left eye viewing of words and Landolt Cs.*

Source	SS	df	ms	F	p
Field (F)	.025	1	.015	.30	n.s.
Error (F)	2.411	2	1.206		
Duration (D)	3.008	2	1.504	4.12	n.s.
Error (D)	1.460	4	.365		
Hand (H)	.030	1	.030	.08	n.s.
Error (H)	.775	2	.388		
F x D	.395	2	.197	1.75	n.s.
Error (FD)	.451	4	.113		
F x H	.004	1	.004	.01	n.s.
Error (FH)	.851	2	.425		
D x H	.604	2	.302	1.62	n.s.
Error (DH)	.743	4	.186		
F x D x H	1.116	2	.558	.77	n.s.
Error (FDH)	2.909	4	.727		

*An arc sin transformation (2 x arc sin $\sqrt{\%\ \text{correct responses}}$) was applied to the data.

TABLE C_8

Sinistral Group: Analysis of variance comparing the recognition data for the right eye viewing of words and Landolt Cs.*

Source	SS	df	ms	F	p
Field (F)	.992	1	.992	.19	n.s.
Error (F)	10.183	2	5.092		
Duration (D)	1.397	2	.699	.74	n.s.
Error (D)	3.798	4	.949		
Hand (H)	.123	1	.123	.63	n.s.
Error (H)	.386	2	.193		
F x D	.354	2	.177	1.15	n.s.
Error (FD)	.614	4	.154		
F x H	.000	1	.000	.00	n.s.
Error (FH)	.307	2	.153		
D x H	.562	2	.281	1.47	n.s.
Error (DH)	.762	4	.190		
F x D x H	.145	2	.073	.21	n.s.
Error (FDH)	1.380	4	.345		

*An arc sin transformation (2 x arc sin $\sqrt{\%\ \text{correct responses}}$) was applied to the data.

TABLE C_9

Dextral Group: Analysis of variance comparing the recognition data for the left eye viewing of words and Landolt Cs.*

Source	SS	df	ms	F	p
Field (F)	224.267	1	224.267	23.06	p<.01
Error (F)	38.899	4	9.725		
Duration (D)	66.633	2	33.317	1.98	n.s.
Error (D)	134.533	8	16.817		
Hand (H)	.067	1	.067	.13	n.s.
Error (H)	2.100	4	.525		
F x D	29.233	2	14.617	1.93	n.s.
Error (FD)	60.600	8	7.575		
F x H	2.400	1	2.400	.41	n.s.
Error (FH)	23.433	4	5.858		
D x H	7.433	2	3.717	.63	n.s.
Error (DH)	47.399	8	5.925		
F x D x H	1.900	2	.950	.20	n.s.
Error (FDH)	38.264	8	4.783		

*An arc sin transformation was not applied to the data.

TABLE C_{10}

Dextral Group: Analysis of variance comparing the recognition data for the right eye viewing of words and Landolt Cs.*

Source	SS	df	ms	F	p
Field (F)	114.817	1	114.817	15.43	p<.025
Error (F)	29.766	4	7.442		
Duration (D)	85.033	2	42.517	4.97	p<.05
Error (D)	68.467	8	8.558		
Hand (H)	10.417	1	10.417	.92	n.s.
Error (H)	45.500	4	11.375		
F x D	7.233	2	3.617	1.16	n.s.
Error (FD)	24.933	8	3.117		
F x H	.817	1	.817	.44	n.s.
Error (FH)	7.433	4	1.858		
D x H	1.633	2	.817	.50	n.s.
Error (DH)	13.199	8	1.650		
F x D x H	4.233	2	2.117	.67	n.s.
Error (FDH)	25.265	8	3.158		

*An arc sin transformation was not applied to the data.

TABLE C_{11}

Sinistral Group: Analysis of variance comparing the recognition data for the left eye viewing of words and Landolt Cs.*

Source	SS	df	ms	F	p
Field (F)	20.250	1	20.250	1.41	n.s.
Error (F)	28.667	2	14.333		
Duration (D)	26.056	2	13.028	3.23	n.s.
Error (D)	16.111	4	4.028		
Hand (H)	.694	1	.694	.20	n.s.
Error (H)	6.889	2	3.444		
F x D	7.167	2	3.583	1.23	n.s.
Error (FD)	11.667	4	2.917		
F x H	.250	1	.250	.06	n.s.
Error (FH)	8.667	2	4.333		
D x H	5.056	2	2.528	1.11	n.s.
Error (DH)	9.111	4	2.278		
F x D x H	9.500	2	4.750	.70	n.s.
Error (FDH)	27.333	4	6.833		

*An arc sin transformation was not applied to the data.

TABLE C_{12}

Sinistral Group: Analysis of variance comparing the recognition data for the right eye viewing of words and Landolt Cs.*

Source	SS	df	ms	F	p
Field (F)	16.000	1	16.000	.33	n.s.
Error (F)	98.000	2	49.000		
Duration (D)	8.167	2	4.083	.40	n.s.
Error (D)	40.667	4	10.167		
Hand (H)	1.778	1	1.778	1.23	n.s.
Error (H)	2.889	2	1.444		
F x D	3.167	2	1.583	.76	n.s.
Error (FD)	8.333	4	2.083		
F x H	.444	1	.444	.31	n.s.
Error (FH)	2.889	2	1.444		
D x H	2.722	2	1.361	.45	n.s.
Error (DH)	12.111	4	3.028		
F x D x H	1.722	2	.861	.28	n.s.
Error (FDH)	12.444	4	3.111		

*An arc sin transformation was not applied to the data.

TABLE C13

Dextral Group: Analysis of variance comparing the RT data for the left eye viewing of words and Landolt Cs.

Source	SS	df	ms	F	p
Field (F)	4494.398	1	4494.398	3.09	n.s.
Error (F)	5820.289	4	1455.072		
Duration (D)	384.400	1	384.400	.82	n.s.
Error (D)	1877.288	4	469.322		
Hand (H)	608.400	1	608.400	.50	n.s.
Error (H)	4830.285	4	1207.571		
F x D	6200.098	1	6200.098	8.13	p<.05
Error (FD)	3049.961	4	762.490		
F x H	84.100	1	84.100	.03	n.s.
Error (FH)	10583.020	4	2645.756		
D x H	16.900	1	16.900	.02	n.s.
Error (DH)	4049.158	4	1012.290		
F x D x H	115.597	1	115.597	.10	n.s.
Error (FDH)	4781.090	4	1195.272		

TABLE C_{14}

Dextral Group: Analysis of variance comparing the RT data for the right eye viewing of words and Landolt Cs.

Source	SS	df	ms	F	p
Field (F)	8410.500	1	8410.000	27.96	p<.01
Error (F)	1203.188	4	300.797		
Duration (D)	240.100	1	240.100	1.30	n.s.
Error (D)	736.525	4	184.131		
Hand (H)	828.100	1	828.100	.37	n.s.
Error (H)	9062.523	4	2265.631		
F x D	57.599	1	57.599	.04	n.s.
Error (FD)	5601.020	4	1400.255		
F x H	1040.400	1	1040.400	.45	n.s.
Error (FH)	9192.223	4	2298.056		
D x H	1322.500	1	1322.500	.59	n.s.
Error (DH)	8973.684	4	2243.421		
F x D x H	102.398	1	102.398	.35	n.s.
Error (FDH)	1156.418	4	289.105		

TABLE C
15

Sinistral Group: Analysis of variance comparing the FT data for the left eye viewing of words and Landolt Cs.

Source	SS	df	ms	F	p
Field (F)	7957.039	1	7957.039	.73	n.s.
Error (F)	21806.070	2	10903.040		
Duration (D)	630.375	1	630.375	.85	n.s.
Error (D)	1490.250	2	745.125		
Hand (H)	210.042	1	210.042	.78	n.s.
Error (H)	540.587	2	270.294		
F × D	2185.043	1	2185.043	1.40	n.s.
Error (FD)	3128.082	2	1564.041		
F × H	5612.043	1	5612.043	4.37	n.s.
Error (FH)	2570.074	2	1285.037		
D × H	210.042	1	210.042	.16	n.s.
Error (DH)	2282.570	2	1141.285		
F × D × H	2882.040	1	2882.040	.67	n.s.
Error (FDH)	8564.969	2	4282.464		

TABLE C_{16}

Sinistral Group: Analysis of variance comparing the RT data for the right eye viewing of words and Landolt Cs.

Source	SS	df	ms	F	p
Field (F)	6370.039	1	6370.039	.98	n.s.
Error (F)	13020.060	2	6510.031		
Duration (D)	2420.042	1	2420.042	.25	n.s.
Error (D)	19309.040	2	9654.520		
Hand (H)	1080.042	1	1080.042	.30	n.s.
Error (H)	7221.074	2	3610.537		
F x D	2380.044	1	2380.044	8.75	n.s.
Error (FD)	544.010	2	272.005		
F x H	92.044	1	92.044	.05	n.s.
Error (FH)	3580.979	2	1790.490		
D x H	1717.042	1	1717.042	.32	n.s.
Error (DH)	10818.000	2	5408.996		
F x D x H	287.033	1	287.033	.28	n.s.
Error (FDH)	2077.100	2	1038.550		

TABLE C
17

Dextral Group: Analysis of variance evaluating the recognition data over the intermediate and longest exposure durations for the left eye viewing of Landolt Cs.

Source	SS	df	ms	F	p
Field (F)	.310	1	.310	4.28	n.s.
Error (F)	.290	4	.073		
Duration (D)	3.190	1	3.190	59.54	$p < .01$
Error (D)	.214	4	.054		
Hand (H)	.090	1	.090	1.45	n.s.
Error (H)	.248	4	.062		
F x D	.338	1	.336	4.16	n.s.
Error (FD)	.325	4	.087		
F x H	.055	1	.055	.79	n.s.
Error (FH)	.279	4	.070		
D x H	.016	1	.016	.32	n.s.
Error (DH)	.205	4	.051		
F x D x H	.000	1	.000	.02	n.s.
Error (FDH)	.104	4	.026		

Notes

1. The recognition data were evaluated using a 2 x 2 x 2 analysis of variance, with all three factors repeated on <u>O</u>s.
2. The dependent variable was per cent correct recognition.
3. An arc sin transformation ($2 \times \text{arc sin} \sqrt{\%\ \text{correct responses}}$) was applied to the data.

TABLE C_{18}

Dextral Group: Analysis of variance evaluating the recognition data over the intermediate and longest exposure durations for the left eye viewing of words.

Source	SS	df	ms	F	p
Field (F)	9.349	1	9.349	47.95	p<.01
Error (F)	.780	4	.195		
Duration (D)	3.592	1	3.592	44.19	p<.01
Error (D)	.325	4	.081		
Hand (H)	.000	1	.000	.01	n.s.
Error (H)	.154	4	.038		
F x D	.315	1	.315	.80	n.s.
Error (FD)	1.584	4	.396		
F x H	.008	1	.008	.12	n.s.
Error (FH)	.277	4	.069		
D x H	.132	1	.132	1.43	n.s.
Error (DH)	.369	4	.092		
F x D x H	.000	1	.000	.00	n.s.
Error (FDH)	.525	4	.131		

Notes

1. The recognition data were evaluated using a 2 x 2 x 2 analysis of variance, with all three factors repeated on Os.
2. The dependent variable was per cent correct recognition.
3. An arc sin transformation (2 x arc sin $\sqrt{\%\text{ correct responses}}$) was applied to the data.

TABLE C19

Dextral Group: Analysis of variance evaluating the recognition data over the intermediate and longest exposure durations for the right eye viewing of Landolt Cs.

Source	SS	df	ms	F	p
Field (F)	.004	1	9.004	.01	n.s.
Error (F)	1.064	4	.266		
Duration (D)	3.610	1	3.610	51.61	p<.01
Error (D)	.280	4	.070		
Hand (H)	.015	1	.015	.23	n.s.
Error (H)	.261	4	.065		
F x D	.000	1	.000	.00	n.s.
Error (FD)	.305	4	.076		
F x H	.009	1	.009	.46	n.s.
Error (FH)	.080	4	.020		
D x H	.001	1	.001	.01	n.s.
Error (DH)	.259	4	.065		
F x D x H	.200	1	.200	2.08	n.s.
Error (FDH)	.385	4	.096		

Notes

1. The recognition data were evaluated using a 2 x 2 x 2 analysis of variance, with all three factors repeated on Ss.
2. The dependent variable was per cent correct recognition.
3. An arc sin transformation (2 x arc sin $\sqrt{\%\ \text{correct responses}}$) was applied to the data.

TABLE C_{20}

Dextral Group: Analysis of variance evaluating the recognition data over the intermediate and longest exposure durations for the right eye viewing of words.

Source	SS	df	ms	F	p
Field (F)	1.726	1	1.726	6.13	n.s.
Error (F)	1.126	4	.282		
Duration (D)	3.188	1	3.188	27.71	p<.01
Error (D)	.460	4	.115		
Hand (H)	.085	1	.085	1.34	n.s.
Error (H)	.253	4	.063		
F x D	.092	1	.092	1.36	n.s.
Error (FD)	.270	4	.067		
F x H	.009	1	.009	.09	n.s.
Error (FH)	.401	4	.100		
D x H	.246	1	.246	13.14	p<.05
Error (DH)	.075	4	.019		
F x D x H	.128	1	.128	15.92	p<.05
Error (FDH)	.032	4	.008		

Notes

1. The recognition data were evaluated using a 2 x 2 x 2 analysis of variance, with all three factors repeated on Ss.
2. The dependent variable was per cent correct recognition.
3. An arc sin transformation ($2 \times \arcsin\sqrt{\%\ \text{correct responses}}$) was applied to the data.

TABLE C_{21}

Sinistral Group: Analysis of variance evaluating the recognition data over the intermediate and longest exposure durations for the left eye viewing of Landolt Cs.

Source	SS	df	ms	F	p
Field (F)	.552	1	.552	6.91	n.s.
Error (F)	.160	2	.080		
Duration (D)	.817	1	.817	10.08	n.s.
Error (D)	.162	2	.081		
Hand (H)	.017	1	.017	.22	n.s.
Error (H)	.160	2	.080		
F x D	.000	1	.000	.01	n.s.
Error (FD)	.043	2	.022		
F x H	.003	1	.003	.26	n.s.
Error (FH)	.021	2	.010		
D x H	.080	1	.080	.57	n.s.
Error (DH)	.281	2	.140		
F x D x H	.053	1	.053	1.56	n.s.
Error (FDH)	.068	2	.034		

Notes

1. The recognition data were evaluated using a 2 x 2 x 2 analysis of variance, with all three factors repeated on Ss.
2. The dependent variable was per cent correct recognition.
3. An arc sin transformation ($2 \times \arcsin \sqrt{\%\ \text{correct responses}}$) was applied to the data.

TABLE C_{22}

Sinistral Group: Analysis of variance evaluating the recognition data over the intermediate and longest exposure durations for the left eye viewing of words.

Source	SS	df	ms	F	p
Field (F)	.007	1	.007	.05	n.s.
Error (F)	.245	2	.122		
Duration (D)	3.142	1	3.142	55.29	p<.025
Error (D)	.113	2	.057		
Hand (H)	.006	1	.006	.22	n.s.
Error (H)	.051	2	.026		
F x D	.006	1	.006	.27	n.s.
Error (FD)	.047	2	.023		
F x H	.001	1	.001	.02	n.s.
Error (FH)	.123	2	.062		
D x H	.020	1	.020	4.45	n.s.
Error (DH)	.009	2	.005		
F x D x H	.107	1	.107	1.01	n.s.
Error (FDH)	.212	2	.106		

Notes

1. The recognition data were evaluated using a 2 x 2 x 2 analysis of variance, with all three factors repeated on <u>O</u>s.
2. The dependent variable was per cent correct recognition.
3. An arc sin transformation (2 x arc sin $\sqrt{\text{\% correct responses}}$) was applied to the data.

TABLE C_{23}

Sinistral Group: Analysis of variance evaluating the recognition data over the intermediate and longest exposure durations for the right eye viewing of Landolt Cs.

Source	SS	df	ms	F	p
Field (F)	.996	1	.996	.50	n.s.
Error (F)	3.961	2	1.981		
Duration (D)	1.788	1	1.788	11.89	n.s.
Error (D)	.301	2	.150		
Hand (H)	.002	1	.002	.04	n.s.
Error (H)	.101	2	.050		
F x D	.033	1	.033	15.67	n.s.
Error (FD)	.004	2	.002		
F x H	.002	1	.002	.28	n.s.
Error (FH)	.013	2	.007		
D x H	.077	1	.077	.55	n.s.
Error (DH)	.281	2	.140		
F x D x H	.017	1	.017	.30	n.s.
Error (FDH)	.118	2	.059		

Notes

1. The recognition data were evaluated using a 2 x 2 x 2 analysis of variance, with all three factors repeated on Os.

2. The dependent variable was per cent correct recognition.

3. An arc sin transformation ($2 \times \arcsin\sqrt{\%\ \text{correct responses}}$) was applied to the data.

TABLE C_{24}

Sinistral Group: Analysis of variance evaluating the recognition data over the intermediate and longest exposure durations for the right eye viewing of words.

Source	SS	df	ms	F	p
Field (F)	.980	1	.980	.76	n.s.
Error (F)	2.562	2	1.281		
Duration (D)	2.519	1	2.519	39.12	p<.025
Error (D)	.129	2	.064		
Hand (H)	.001	1	.001	.02	n.s.
Error (H)	.086	2	.043		
F x D	.080	1	.080	.28	n.s.
Error (FD)	.571	2	.285		
F x H	.007	1	.007	.27	n.s.
Error (FH)	.050	2	.025		
D x H	.010	1	.010	.14	n.s.
Error (DH)	.146	2	.073		
F x D x H	.023	1	.023	1.19	n.s.
Error (FDH)	.039	2	.020		

Notes

1. The recognition data were evaluated using a 2 x 2 x 2 analysis of variance, with all three factors repeated on Ds.
2. The dependent variable was per cent correct recognition.
3. An arc sin transformation ($2 \times \text{arc sin} \sqrt{\% \text{ correct responses}}$) was applied to the data.

TABLE C_{25}

Dextral Group: Analysis of variance evaluating the RT data over the intermediate and longest exposure durations for the left eye viewing of Landolt Cs.

Source	SS	df	ms	F	p
Field (F)	8037.223	1	8037.223	9.40	p<.05
Error (F)	3421.090	4	855.273		
Duration (D)	3629.025	1	3629.025	10.18	p<.05
Error (D)	1426.319	4	356.580		
Hand (H)	207.025	1	207.025	.19	n.s.
Error (H)	4311.801	4	1077.950		
F x D	198.026	1	196.026	.37	n.s.
Error (FD)	2147.300	4	536.825		
F x H	70.225	1	70.225	.08	n.s.
Error (FH)	3554.619	4	888.655		
D x H	105.625	1	105.625	.22	n.s.
Error (DH)	1942.215	4	485.554		
F x D x H	366.023	1	366.023	.69	n.s.
Error (FDH)	2121.832	4	530.458		

Notes

1. The RT data was evaluated using 2 x 2 x 2 analysis of variance, with all three factors repeated on Ds.

2. The dependent variable was mean RT.

TABLE C_{26}

Dextral Group: Analysis of variance evaluating the RT data over the intermediate and longest exposure durations for the left eye viewing of words.

Source	SS	df	ms	F	p
Field (F)	23571.020	1	23571.020	11.91	p<.05
Error (F)	7918.039	4	1979.510		
Duration (D)	5978.023	1	5978.023	3.88	p<.05
Error (D)	6155.539	4	1538.885		
Hand (H)	1836.025	1	1836.025	4.07	n.s.
Error (H)	1806.534	4	451.634		
F x D	9211.227	1	9211.227	8.67	p<.05
Error (FD)	4250.336	4	1062.584		
F x H	1155.624	1	1155.624	6.17	n.s.
Error (FH)	748.937	4	187.234		
D x H	1550.026	1	1550.026	1.81	n.s.
Error (DH)	3418.095	4	854.524		
F x D x H	616.198	1	616.198	1.85	n.s.
Error (FDH)	1331.550	4	332.888		

Notes

1. The RT data was evaluated using 2 x 2 x 2 analysis of variance, with all three factors repeated on Os.

2. The dependent variable was mean RT.

TABLE C_{27}

Dextral Group: Analysis of variance evaluating the RT data over the intermediate and longest exposure durations for the right eye viewing of Landolt Cs.

Source	SS	df	ms	F	p
Field (F)	96.100	1	96.100	.04	n.s.
Error (F)	10499.836	4	2624.957		
Duration (D)	8643.598	1	8643.598	7.54	n.s.
Error (D)	4586.832	4	1146.708		
Hand (H)	14.400	1	14.400	.01	n.s.
Error (H)	5005.465	4	1251.366		
F x D	184.698	1	184.698	.42	n.s.
Error (FD)	1779.984	4	444.996		
F x H	940.900	1	940.900	.88	n.s.
Error (FH)	4271.543	4	1067.886		
D x H	32.401	1	32.401	.03	n.s.
Error (DH)	4531.543	4	1132.886		
F x D x H	108.901	1	108.901	.27	n.s.
Error (FDH)	1599.466	4	399.867		

Notes

1. The RT data was evaluated using 2 x 2 x 2 analysis of variance, with all three factors repeated on Os.

2. The dependent variable was mean RT.

TABLE C_{28}

Dextral Group: Analysis of variance evaluating the RT data over the intermediate and longest exposure durations for the right eye viewing of words.

Source	SS	df	ms	F	p
Field (F)	6708.098	1	6708.098	1.90	n.s.
Error (F)	14136.150	4	3534.038		
Duration (D)	11764.900	1	11764.900	16.09	p<.025
Error (D)	2524.352	4	731.088		
Hand (H)	577.600	1	577.600	.21	n.s.
Error (H)	10953.650	4	2738.412		
F x D	490.004	1	490.004	1.25	n.s.
Error (FD)	1564.121	4	391.030		
F x H	2.508	1	2.508	.01	n.s.
Error (FH)	1342.623	4	335.658		
D x H	1716.099	1	1716.099	1.52	n.s.
Error (DH)	4528.898	4	1132.225		
F x D x H	409.596	1	409.596	.67	n.s.
Error (FDH)	2451.463	4	612.867		

Notes

1. The RT data was evaluated using 2 x 2 x 2 analysis of variance, with all three factors repeated on Qs.

2. The dependent variable was mean RT.

TABLE C_{29}

Sinistral Group: Analysis of variance evaluating the RT data over the intermediate and longest exposure durations for the left eye viewing of Landolt Cs.

Source	SS	df	ms	F	p
Field (F)	1633.500	1	1633.500	7.070	n.s.
Error (F)	462.250	2	231.125		
Duration (D)	19380.160	1	19380.160	25.54	p<.05
Error (D)	1517.570	2	758.785		
Hand (H)	308.167	1	308.167	.84	n.s.
Error (H)	536.068	2	268.034		
F x D	266.668	1	266.668	.01	n.s.
Error (FD)	638.551	2	319.275		
F x H	16.667	1	16.667	.01	n.s.
Error (FH)	2393.095	2	1196.547		
D x H	54.001	1	54.001	.34	n.s.
Error (DH)	316.702	2	158.351		
F x D x H	60.165	1	60.165	.21	n.s.
Error (FDH)	583.138	2	291.569		

Notes

1. The RT data was evaluated using 2 x 2 x 2 analysis of variance, with all three factors repeated on Os.

2. The dependent variable was mean RT.

TABLE C_{30}

Sinistral Group: Analysis of variance evaluating the RT data over the intermediate and longest exposure durations for the left eye viewing of words.

Source	SS	df	ms	F	p
Field (F)	2320.667	1	2320.667	.29	n.s.
Error (F)	16062.570	2	8031.281		
Duration (D)	27202.660	1	27202.660	898.22	p<.01
Error (D)	60.570	2	30.285		
Hand (H)	.167	1	.167	.00	n.s.
Error (H)	503.079	2	251.540		
F x D	962.668	1	962.668	.80	n.s.
Error (FD)	2410.551	2	1205.275		
F x H	1380.167	1	1380.167	1.64	n.s.
Error (FH)	1680.094	2	840.047		
D x H	433.501	1	433.501	.23	n.s.
Error (DH)	3844.733	2	1922.366		
F x D x H	3601.496	1	3601.496	1.55	n.s.
Error (FDH)	4635.566	2	2317.783		

Notes

1. The RT data was evaluated using 2 x 2 x 2 analysis of variance, with all three factors repeated on Os.
2. The dependent variable was mean RT.

TABLE C
31

Sinistral Group: Analysis of variance evaluating the RT data over the intermediate and longest exposure durations for the right eye viewing of Landolt Cs.

Source	SS	df	ms	F	p
Field (F)	3952.667	1	3952.667	1.44	n.s.
Error (F)	5490.074	2	2745.037		
Duration (D)	4160.664	1	4160.664	2.70	n.s.
Error (D)	3078.063	2	1539.031		
Hand (H)	1380.167	1	1380.167	.81	n.s.
Error (H)	3389.076	2	1694.538		
F x D	2860.168	1	2860.168	1.11	n.s.
Error (FD)	5164.590	2	2582.295		
F x H	1535.999	1	1535.999	5.54	n.s.
Error (FH)	554.210	2	277.105		
D x H	1410.669	1	1410.669	3.11	n.s.
Error (DH)	906.587	2	454.294		
F x D x H	181.496	1	181.496	.09	n.s.
Error (FDH)	3952.774	2	1976.387		

Notes

1. The RT data was evaluated using 2 x 2 x 2 analysis of variance, with all three factors repeated on Os.

2. The dependent variable was mean RT.

TABLE C_{32}

Sinistral Group: Analysis of variance evaluating the RT data over the intermediate and longest exposure durations for the right eye viewing of words.

Source	SS	df	ms	F	p
Field (F)	273.375	1	273.375	.06	n.s.
Error (F)	8669.234	2	4334.617		
Duration (D)	234.375	1	234.375	.05	n.s.
Error (D)	8464.719	2	4232.359		
Hand (H)	1.042	1	1.042	.01	n.s.
Error (H)	173.052	2	86.526		
F x D	18.375	1	18.375	.01	n.s.
Error (FD)	6320.188	2	3160.094		
F x H	3577.042	1	3577.042	1.49	n.s.
Error (FH)	4791.516	2	2395.758		
D x H	1335.042	1	1335.042	.49	n.s.
Error (DH)	5494.094	2	2747.047		
F x D x H	26.038	1	26.038	.02	n.s.
Error (FDH)	2423.638	2	1211.819		

Notes

1. The RT data was evaluated using 2 x 2 x 2 analysis of variance, with all three factors repeated on Ss.

2. The dependent variable was mean RT.

TABLE C[33]

Individual Data: Half-field (RVF - LVF) per cent correct recognition differences (D) and their significance evaluated over the the intermediate and longest exposure durations for the left (OS) and right (OD) eye viewing of words (W) and Landolt Cs (L).

	OS								OD							
	WORDS				LANDOLT Cs				WORDS				LANDOLT Cs			
O	RVF	LVF	D_W	z	RVF	LVF	D_L	z	RVF	LVF	D_W	z	RVF	LVF	D_L	z
DEXTRAL Os																
CD	93.3	46.7	46.7	5.57***	78.3	68.3	10.0	1.23	78.3	63.3	15.0	1.81	80.0	61.7	18.3	2.21*
HC	83.3	26.7	56.7	6.24***	83.3	73.3	10.0	1.32	66.7	58.3	8.3	.56	58.3	71.7	-13.3	-1.53
WG	86.7	46.7	40.0	4.66***	83.3	71.7	11.7	1.54	88.3	55.0	33.3	4.07***	80.0	71.1	8.3	1.07
TY	80.0	40.0	40.0	4.47***	80.0	63.3	16.7	2.03*	60.0	61.7	-1.7	-.19	60.0	81.7	-21.7	-2.62**
BK	76.7	55.0	21.7	2.51*	66.7	71.7	-5.0	-.59	95.0	65.0	30.0	4.11***	73.3	70.0	3.3	.41
SINISTRAL Os																
TS	73.3	76.7	-3.3	-.42	65.0	78.3	-13.3	-1.62	83.3	70.0	13.3	1.74	86.7	80.0	6.7	.97
HM	73.3	78.3	-5.0	-.64	76.7	80.0	-3.3	-.44	71.7	81.7	-10.0	-1.30	85.0	80.0	5.0	.71
RC	81.7	68.3	13.3	1.69	66.7	86.7	-20.0	-2.60**	63.3	83.3	-20.0	-2.47*	35.0	98.3	-63.3	-7.38***

*$p < .05$
**$p < .01$
***$p < .001$

Notes

1. The following formula was used to evaluate the statistical significance of half-field differences in per cent correct recognition (Bruning & Kintz, 1977):

$$z = \frac{P_2 - P_1}{\sqrt{\frac{p(1-p)}{n} + \frac{p(1-p)}{n}}}$$

where: P_2 = per cent correct recognition of stimuli (words or Landolt Cs) presented in the RVF
P_1 = per cent correct recognition of stimuli (words or Landolt Cs) presented in the LVF
n = the number (60) of positive stimuli presented at the intermediate and longest exposure durations in each test session
$p = (P_1 + P_2)/2$

TABLE C

Individual Data: Half-field (RVF - LVF) differences (D) in mean RT (in msec.) and their significance evaluated over the intermediate and longest exposure durations for the left (OS) and right (OD) eye viewing of words (W) and Landolt Cs (L).

		OS										OD									
	DURA-	WORDS					LANDOLT Cs					WORDS					LANDOLT Cs				
O	TION	RVF	LVF	D_W	t	z	RVF	LVF	D_L	t	z	RVF	LVF	D_W	t	z	RVF	LVF	D_L	t	z
DEXTRAL Os																					
CD	2	550	589	-39	-1.37	-3.27**	493	550	-57	-2.67**	-3.71***	574	606	-32	-.86	-3.33***	560	590	-30	-.77	-1.14
	3	533	605	-72	-3.25**		485	536	-51	-2.51*		498	585	-87	-3.85***		512	526	-14	-.84	
HC	2	628	---	---	----	-3.86***	472	483	-11	-.47	-1.60	657	626	31	.65	.91	471	441	30	1.04	2.30*
	3	572	710	-138	-3.86***		448	488	-40	-1.79		626	607	19	.63		466	426	40	2.21*	
WG	2	529	544	-15	-.35	-1.41	452	443	09	.31	-.41	459	523	-64	-2.32*	-4.12***	465	480	-15	-.61	-2.46*
	3	463	505	-42	-1.64		401	418	-17	-.89		406	466	-60	-3.50***		407	451	-44	-2.87**	
TY	2	595	660	-65	-1.41	-2.88**	424	488	-64	-2.97**	-2.88**	542	522	20	.52	.42	520	463	57	1.59	1.83
	3	555	656	-101	-2.67*		436	459	-23	-1.10		520	518	02	.07		507	476	31	1.00	
BK	2	669	637	32	.86	-.35	537	540	-03	-.15	-1.48	685	740	-55	-2.09*	-2.46*	537	543	-06	-.25	-1.12
	3	582	617	-35	-1.36		486	521	-35	-1.94		668	700	-32	-1.39		507	529	-22	-1.33	
SINISTRAL Os																					
TS	2	650	650	00	.00	-.40	540	506	34	1.16	.74	592	631	-39	-1.40	-1.92	501	520	-19	-.81	-.63
	3	582	597	-15	-.58		482	484	-02	-.12		638	676	-38	-1.32		464	465	-01	-.08	
HM	2	636	593	43	1.13	1.99*	536	535	01	.03	.52	610	525	85	2.38*	1.92	523	501	22	.77	1.26
	3	568	530	38	1.69		463	451	12	.71		546	538	08	.34		479	462	17	1.01	
RC	2	596	721	-125	-2.29*	-2.70**	600	571	29	.87	1.33	600	666	-66	-1.58	-.94	554	552	02	.03	2.61**
	3	567	612	-45	-1.53		549	528	21	1.01		596	587	09	.25		618	496	122	3.66	

$^{*}p < .05$
$^{**}p < .01$
$^{***}p < .001$

Notes

1. The following formula was used to evaluate the statistical significance of half-field differences in mean RT (Winer, 1962):

$$z = \frac{\sum t_j}{\sqrt{k}}$$

where: t_j = the sum of the t-values that obtained at the intermediate and longest exposure durations
k = the number of t-values summed