PERCEPTUAL STYLE, FIELD DEPENDENCE, AND ACCIDENT INVOLVEMENT

THESIS

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By

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It was hypothesized that field dependence and attention measures would differentiate accident-loaded and accident-free employees of a petroleum services company.

Analysis of variance revealed main effects and a three-way interaction for the Rod-and-Frame Test. Main effects occurred for the Attention-Diagnostic Method and Embedded-Figures Test. No differences occurred for the Closure Test. Regression analysis produced an R (76) = .41, $p < .01$, with the Attention-Diagnostic Method contributing more to prediction. Equality-symmetry violations occurred in the data.

Cautious interpretation was advised because of the assumption violations. The accident-loaded subjects produced consistently greater performance variances, which suggested general performance characteristics in several respects.

Future research should be longitudinal-predictive, oriented from Kerr's complementary safety theories.

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CHAPTER I

PERCEPTUAL STYLE, FIELD DEPENDENCE, AND ACCIDENT INVOLVEMENT

The study of accident causation and prevention has occupied the time and energy of several researchers for many years. Accidents and resulting personal injury have become increasingly costly, both in terms of human suffering and material and machine loss. Advancing technology, creating larger and more complicated equipment and more complex work and living situations, requires an intensification of efforts to understand and prevent vehicular and industrial accidents.

An attempt to cover adequately the entire field of accident research would require several years of work and several volumes of books. Thus the present paper necessarily limits itself to one small segment of accident research and thus to only a part of the variance involved in accidents. Although other aspects of accident etiology and prevention must be considered, due to the undeniable relatedness of all factors of accidents, the main concern of the present research is with certain perceptual characteristics that have been found to be related to accidents. The term <u>accident proneness</u> advisedly is avoided in the present argument. Strictly, it

is hypothesized that there are perceptual characteristics of individuals which intertwine with certain environmental characteristics to increase or decrease the probability of an accident. It is not the individual personality that produces the increased likelihood of an accident, as accident proneness suggests. Rather it is the combination of perceptual characteristics and environmental circumstances which raises or lowers the probability of an accident occurring in a given situation.

Primarily, the present research takes its orientation from the concept of field dependence. Briefly stated, field dependence postulates that differences in perceptual style among individuals determine to some degree the quality of individual responses to environmental circumstances. Specifically, individuals tending toward field dependence depend too much on environmental cues and hence tend to overreact to stimulus properties of the environment. On the other end of the continuum, field-independent individuals are able to distinguish correctly between relevant and irrelevant cues, and thus they are able to respond more adequately to stimulus properties affecting perceptual orientation. From their extensive work on this problem, Witkin, Dyk, Faterson, Goodenough, and Karp (1962) conclude:

> The person with a more field-independent way of perceiving tends to experience his surroundings analytically, with objects experienced as discrete

> from their backgrounds. The person with a more field-dependent way of perceiving tends to experience his surroundings in a relatively global fashion, passively conforming to the influence of the prevailing field or context (p. 35).

The general hypothesis of the present research is that the degree of an individual's field dependence/independence would affect that individual's ability to make judgments about and respond to environmental stimuli, and hence would have some relationship to the occurrence or nonoccurrence of accidents.

In a good review article of recent accident research, Signori and Bowman (1974) note that "driving behavior is essentially dependent on two kinds of factors: (a) those pertaining to the skill of the driver and (b) those imposed by the task or driving situation" (p. 1067). The concept of field dependence is clearly related to both factors, since it takes into account both the environmental stimulation and the individual's responses based on his perceptual processes. The initial impetus for this line of research surfaced in an article by Barrett and Thornton (1968). In a well-controlled experimental study, they found high significant correlations between measures of field dependence and simulated driving behavior. The Rod-and-Frame Test (RFT) and the Embedded-Figures Test (EFT) are both validated

measures of field dependence (Witkin et al., 1962). In the Barrett and Thornton study, the RFT series 3 correlated .61 with reaction time and -.55 with deceleration rate in a driver simulator. They also found that the EFT was highly related to the RFT. Barrett and Thornton (1968) concluded that Witkin's concept of perceptual style appears to be an important aspect of driving ability, and that "the present results support the hypothesis that field-independent individuals are more effective in responding to emergency situations" (p. 173). They also mention research by Spicer (cited in Barrett & Thornton, 1968) which found driving and traffic mishaps consistently related only to a visual perception measure.

This line of research was taken a step further by Harano (1970). Using the EFT, which measures the ability to identify figures in a complex geometric design, Harano found that there were significantly more field-dependent persons in an accident-loaded group than in an accident-free group. Harano (1970) concluded:

> Field dependence, as measured by the EFT, was significantly related to accident involvement. These results suggest that the ability to distinguish relevant from irrelevant cues is a factor in accident liability. The driver who is field-dependent may have a higher accident

> liability because he is easily influenced by irrelevant cues in the driving environment (p. 274).

Harano's study involved a matched-groups design with one group having a history of accident involvements and the control group having an accident-free history. Employing regression analysis, he found that only total EFT scores contributed significantly to the prediction of an accident history.

In another study directly relevant to driving behavior, Olson (1974) observed the behavior of field-dependent subjects and field-independent subjects under the conditions of a skidding task and a platoon car-following task. There were no significant differences under the skid condition, but, under the platoon car-following condition, the field-dependent subjects performed significantly poorer than the field-independent subjects. Olson concluded that the results suggested that field-dependent people were much too dependent upon information from the vehicle directly in front of them and thus were unable to perceive and use information from vehicles farther ahead of them. Olson suggested that this may have implications for congested traffic driving and the involvement of rear end collisions.

A study closely related to this research pursuit was conducted by Andersson, Nilsson, and Hendriksson (1970). The study offers encouraging evidence for the continuance

of this type research. Using another perceptual test instrument entitled the Spiral After-Effect (SAE), Andersson et al. found that they could significantly distinguish an accident-loaded group from an accident-free group of car drivers. Andersson et al. note that, "After-effect measurement implies that the subject has to differentiate between intraceptive and extraceptive factors of perception" (p. 410). This study also matched groups of individuals on background variables. Andersson et al. state:

> Compared with the control group, the accident-loaded group more often ($p < 0.0001$, at best) was found to be "hyposensitive to intraceptive perception". . . . This is an attribute indicative of individuals characterized by an extreme dependence on external factors (environment) and thus by weak inner control or delay of action (p. 409).

Hence the evidence, conclusions, and theoretical implications of the Andersson et al. study are highly similar to that postulated by field dependence theory, and supported by the previously cited studies concerned with driving behavior and accident involvement.

Studies peripheral to driving behavior and accident involvement, but which support the evidence of a relationship between perceptual characteristics and task performances, are worth mentioning. Ehri and Muzio (1974) found that field-independent subjects could correctly analyze the speed of

moving objects, whereas field-dependent subjects could not. Field-independent subjects have been found to perform significantly better than field-dependent subjects at identifying objects in aerial photographs (Thornton, Barrett, & Davis, 1968). Also, field-independent subjects have been found to respond significantly more quickly in detecting motion in depth (Ton, 1972), and field-independent subjects perform significantly better than field-dependent subjects on complex vigilance tasks (Moses, 1970).

The importance of moderating environmental variables upon the effects of field dependence/independence also has been borne out by research. An interesting finding, which has implications for accident prevention, was that under stress, performance on the RFT for field-dependent subjects appeared more extremely field dependent than in the absence of stress, and performance on the RFT for field-independent subjects appeared more extremely field independent under stress than in the absence of stress (Reinking, Goldstein, & Houston, 1974). In another well-controlled experimental study, in which subjects were classified as either field-dependent or field-independent by the EFT, Weiss (1972) observed the behavior of subjects under the conditions of instruction-induced high stress and low stress. Their performance under these conditions was assessed with an in-basket simulation test. Once again, under conditions of high stress, the degree and direction of field dependence

or independence became more pronounced, with field-dependent subjects performing poorer and field-independent subjects showing improvements in performance. Therefore, given a highly stressful situation, such as a complicated dangerous task or work environment, there may be more likelihood that a field-dependent individual will make judgment errors.

Thus the research evidence indicates that the degree of an individual's field dependence appears to affect his performance on tasks involving responses to visual stimuli, and measures of field dependence appear to be capable of distinguishing individuals in terms of their probability of accident involvement. The formal hypothesis of the present research is that field dependence, via measures of perceptual style, should be capable of distinguishing between groups of accident-free subjects and accident-loaded subjects in an industrial setting, where the work environment is highly complicated and the tasks often are dangerous and extremely demanding. Specifically, research was done with an oil field services company to determine if measures of perceptual style and attention processes could identify its employees with histories of accident involvement. The dependent variables in this research were performance scores on these measures of perceptual style.

CHAPTER II

Method

Subjects

The subjects were employees of a southwestern oil field services company, who were involved in the operations of driving of large trucks hauling heavy equipment and the skilled operation of this heavy equipment at oil well sites. There were 38 subjects each in two groups. The subjects in one group were chosen on the basis of their accident histories during the past three years. The criteria for selection was at least one heavy vehicle accident or at least two personal injuries. The subjects in the second group were selected from employees with records free from accidents and free from personal injuries for the same period. The subjects in the accident-loaded and accident-free groups were selected to be as comparable as possible in terms of tenure, age, and job classification. For the accident-loaded group, the mean age of the subjects was 28.00 years with a standard deviation of 4.43 years. For the accident-free group, the mean age of the subjects was 27.10 years with a standard deviation of 4.17 years. The mean tenure of the accident-loaded group was 22.90 months with a standard deviation of 14.41 months. The mean tenure of the accident-free group

was 21.58 months with a standard deviation of 13.10 months tenure.

Measures

Although the RFT and EFT have been found to be significantly related (Barrett & Thornton, 1968), a factor-analytic study of the two measures produced results which suggest that they may be measuring different aspects of perceptual characteristics (Bergman & Engelbrekston, 1973). Thus it was decided to incorporate both measures in the research to assess field dependence within the groups. A modified version of the RFT and a short version of the EFT were used. Also, two experimental measures, which appeared to bear theoretical similarities to the RFT and the EFT, were incorporated to ascertain if multiple measurement would reveal any heretofore undisclosed relationships. A short version of a Gestalt completion test, entitled the Closure Test, described by C. M. Mooney (Note 1), was used. The Closure Test requires the subject to identify an object from an incomplete figure of the object. The other measure was the Attention Diagnostic Method (ADM), an instrument described by J. R. Block (Note 2). The ADM was designed to assess brief lapses of attention. Block (1975) states, "I am testing the hypothesis that such lapses leave a person vulnerable to accidents" (p. 1). Thus a total of four measures was used to assess perceptual characteristics of the subjects.

Procedure

The subjects were tested in various locations (company districts) in a four-state area: Texas, New Mexico, Louisiana, and Oklahoma. The subjects were tested individually in private district offices which were relatively free from noise and interruptions. The four tests were given in randomized orders to each subject within each group to counterbalance for order effects. The testing time averaged 30 minutes per subject for all four measures. Instructions for the four measures were relatively simple. The RFT requires the subject to align a moving black rod to the true vertical position and the true horizontal position against a luminous background within a framed viewing box. The viewing box is presented first in the true level position and then presented in a 28-degrees-tilted-right position. The subject is required to align the rod in the vertical and horizontal positions with the rod moving from first one direction and then from the other direction.

The EFT requires the subject to identify simple geometric figures from a series of increasingly complex forms in which the simple figures are embedded. The subject does this by tracing the outline of the simple figure with a pencil.

The Closure Test requires the subject to identify familiar objects from incomplete figures of the objects by verbalizing the object if he recognizes it.

The ADM requires the subject to locate and identify a series of numbers in numerical order from a board containing the numbers in random order. The numbers are in five different colors: red, yellow, green, blue, and white, against a matt black background. A further requirement of the ADM is that the subject correctly identify the color of the number, the subject being told beforehand the exact colors contained on the board.

Scoring

The RFT was scored by recording the degrees away from true vertical and true horizontal the subject aligned the black rod, as shown by an indicator on an angle protractor.

The EFT and The Closure Test were scored by recording the time to completion and number of errors for each figure.

The ADM was scored by recording the time and errors for each number and the total time to completion for all numbers.

CHAPTER III

Results

Analysis of variance was used on the data from the RFT, the EFT, and the ADM. The assumptions of symmetry and equality of the variance-covariance matrices were checked. The summary of a 2 x 2 x 2 analysis of variance for the RFT, with repeated measures on two factors (Rod Position and Box Position) for independent groups, is presented in Table 1.

Table 1

Summary of Analysis of Variance for

Rod-and-Frame Test

Source	Degrees of Freedom	Sum of Squares	Mean Square	*F* Ratio
Group	1	2.58	2.58	.51
Box Position	1	29.07	29.07	4.70*
Rod Position	1	9,822.32	9,822.32	187.65**
Group x Box Position	1	2.58	2.58	.42
Group x Rod Position	1	1,389.80	1,389.80	26.55**
Box Position x Rod Position	1	10,610.58	10,610.58	205.97**
Group x Box Position x Rod Position	1	1,389.80	1,389.80	26.98**

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

Significant main effects occurred for the Rod Position and the Box Position. Significant two-way interactions occurred for the Group by Rod Position and for the Box Position by Rod Position. However, a significant three-way interaction also was found (Group by Box Position by Rod Position). The means and standard deviations for the RFT are presented in Table 2.

Table 2

Means and Standard Deviations for

Rod-and-Frame Test

Group[a]		Condition[b]			
		LV	LH	TV	TH
A_1	M	.32	-.13	-15.34	16.39
	SD	1.16	.58	8.83	9.45
A_2	M	.32	-.13	-6.42	8.21
	SD	.74	1.12	5.23	5.67

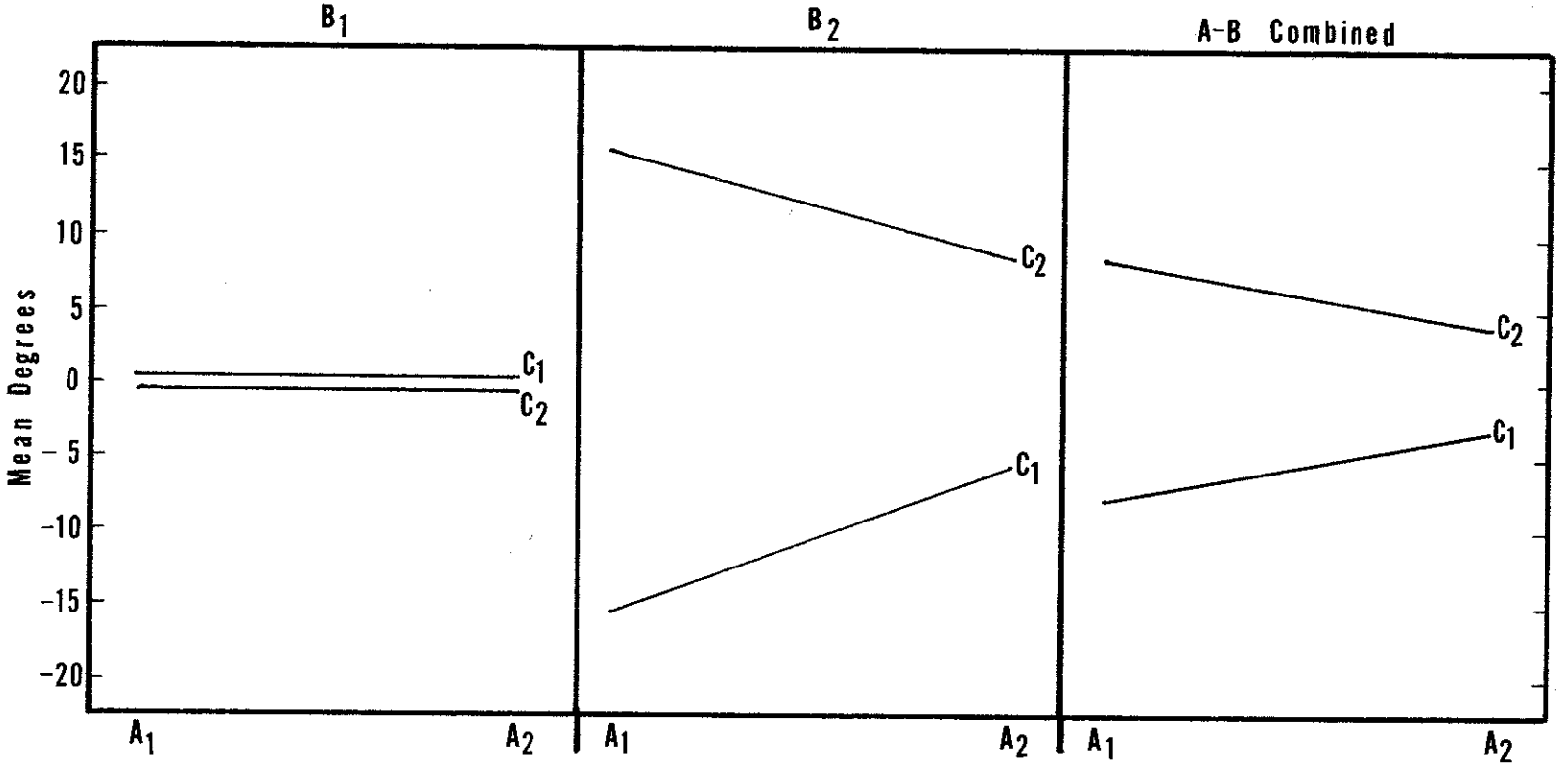
[a] A_1 = Accident-Loaded, A_2 = Accident-Free

[b] LV = Level Box, Vertical Rod
LH = Level Box, Horizontal Rod
TV = Tilted Box, Vertical Rod
TH = Tilted Box, Horizontal Rod

Figures 1 and 2 indicate the two-way interactions, and Figure 3 reveals the three way interaction.

FIGURE 1

THE EFFECT OF BOX POSITION ON PERFORMANCE ON THE RFT

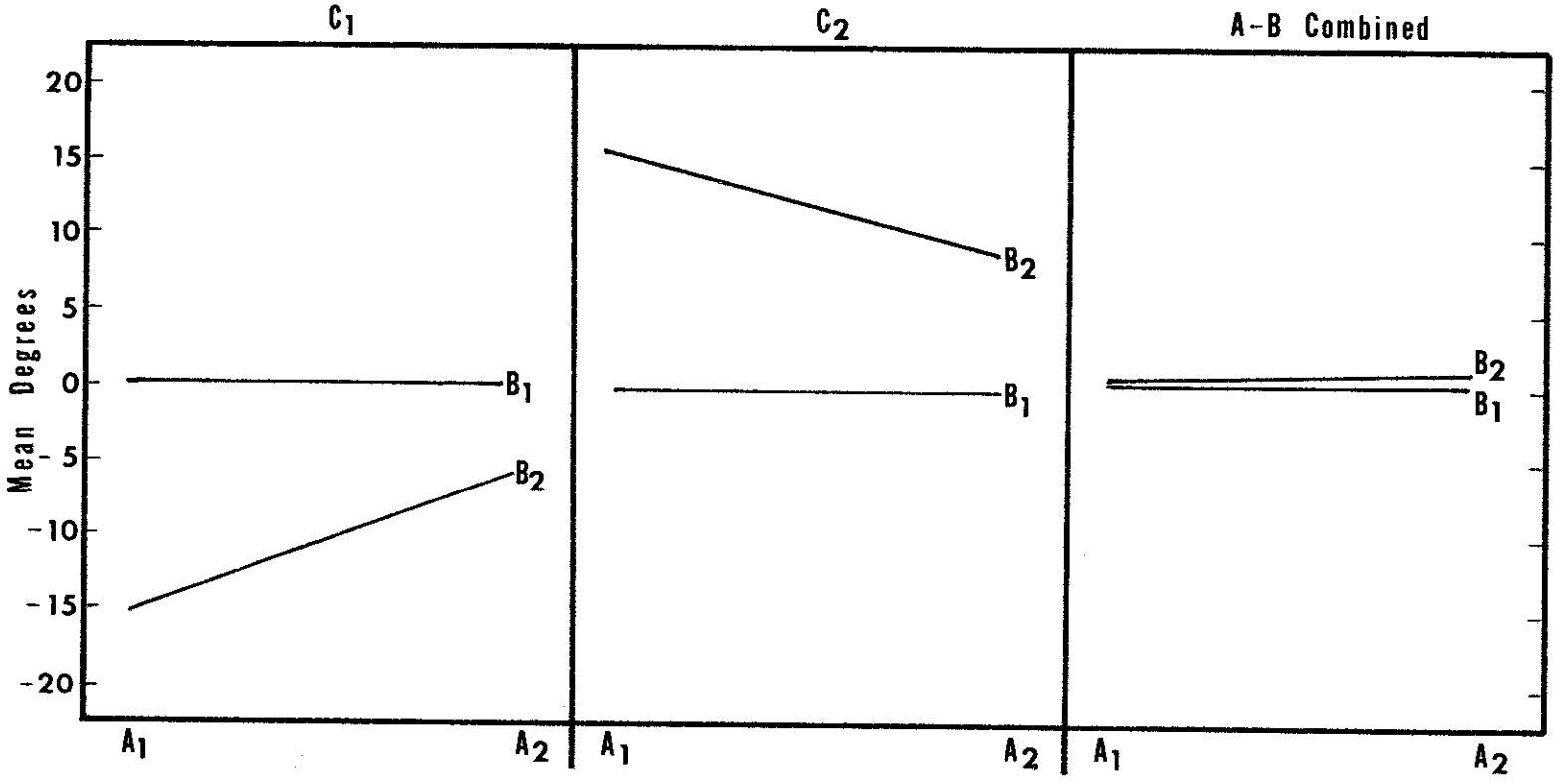


A_1 = Accident-Loaded. B_1 = Box, Level. C_1 = Rod, Vertical.

A_2 = Accident-Free. B_2 = Box, Tilted. C_2 = Rod, Horizontal.

FIGURE 2

THE EFFECT OF ROD POSITION ON PERFORMANCE ON THE RFT

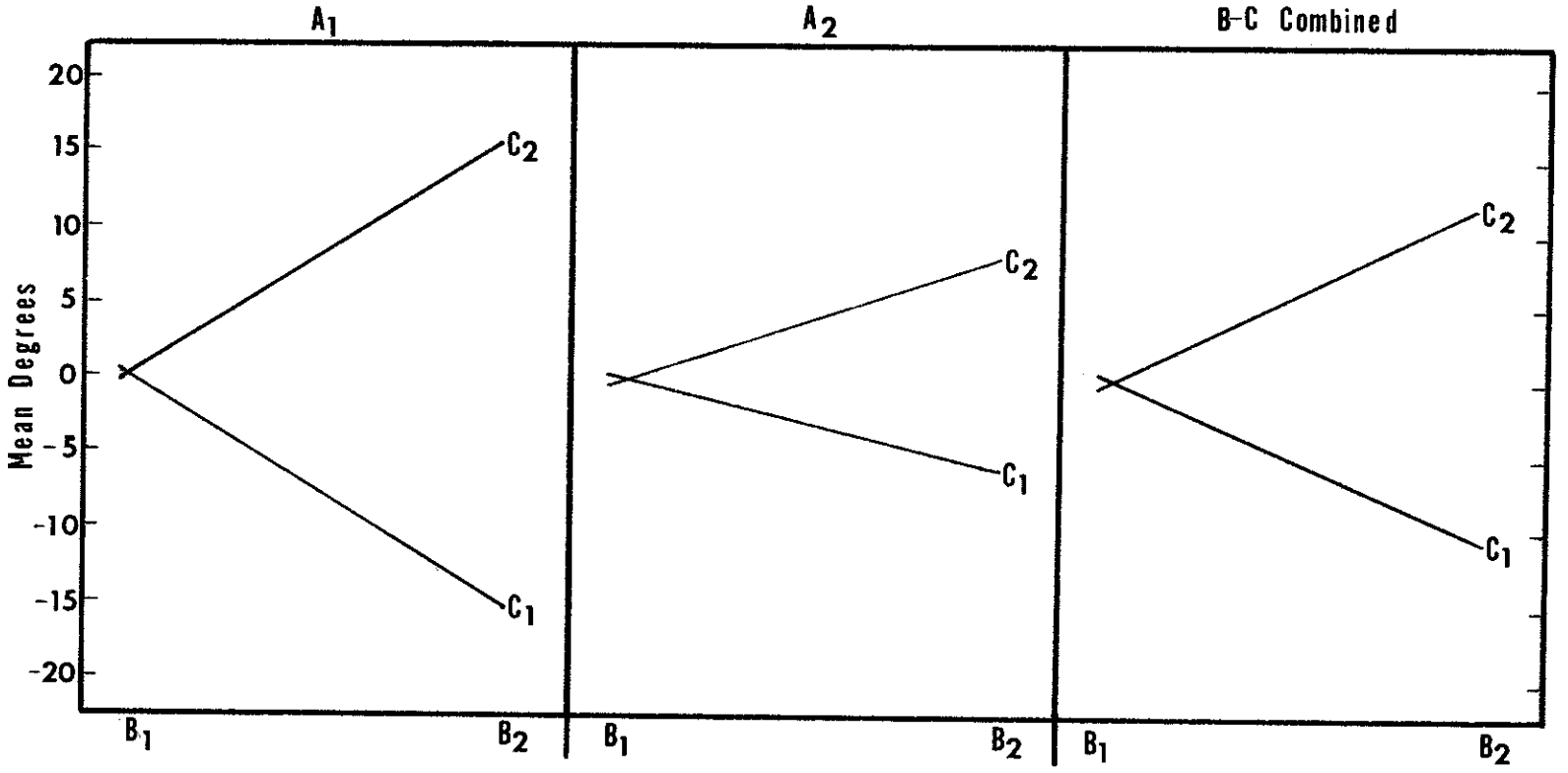


A_1 = Accident-Loaded. B_1 = Box, Level. C_1 = Rod, Vertical.

A_2 = Accident-Free. B_2 = Box, Tilted. C_2 = Rod, Horizontal.

FIGURE 3

THE EFFECT OF GROUP MEMBERSHIP ON PERFORMANCE ON THE RFT



A_1 = Accident-Loaded. B_1 = Box, Level. C_1 = Rod, Vertical.

A_2 = Accident-Free. B_2 = Box, Tilted. C_2 = Rod, Horizontal.

The summary of a 2 x 2 analysis of variance for the EFT is presented in Table 3.

Table 3

Summary of Analysis of Variance for the Embedded-Figures Test

Source	Degrees of Freedom	Sum of Squares	Mean Square	*F* Ratio
Group	1	6,461.06	6,461.06	1.73
Difficulty of Figures	1	1,146,142.11	1,146,142.11	307.15*
Group x Difficulty of Figures	1	6,025.32	6,025.32	1.61

*$p < .001$.

As previous research (Harano, 1970) has shown that only total EFT scores and not individual figures data contribute to discriminative and predictive effectiveness, the data from the EFT were combined into simple figures and complex figures for the analysis of variance. The means and standard deviations for the Embedded-Figures Test are presented in Table 4. A significant main effect occurred for the difficulty of figures; no significant interaction occurred. As can be seen from Table 4, both the accident-loaded group and the accident-free group consistently had more difficulty with the complex figures than the simple figures.

Table 4

Means and Standard Deviations for

Embedded-Figures Test

Group		Figure Difficulty	
		Simple	Complex
Accident-Loaded	M	23.55	209.82
	SD	10.84	91.51
Accident-Free	M	23.11	184.18
	SD	11.20	79.43

The summary of a 5 x 2 analysis of variance for the ADM is presented in Table 5.

Table 5

Summary of Analysis of Variance for

Attention Diagnostic Method

Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Group	1	8077.64	8077.64	18.52*
Colors	4	8667.80	2166.95	4.97*
Group x Colors	4	522.36	130.59	.30

*$p < .001$.

From his research with the ADM, Block (1975) recommends that most fruitful results are obtained by examining the data from the five colors and the errors that are made. Thus the data were combined into total-time scores for the five color categories for the analysis of variance. The means and standard deviations for the ADM are presented in Table 6.

Table 6

Means and Standard Deviations for

Attention Diagnostic Method

Group[a]		Color				
		Green	Blue	White	Yellow	Red
A_1	M	66.66	70.58	81.42	80.79	72.61
	SD	21.43	22.92	25.92	30.51	20.29
A_2	M	60.42	61.13	69.34	69.34	65.71
	SD	16.99	16.26	14.48	16.32	18.40

[a] A_1 = Accident-Loaded, A_2 = Accident Free.

There was not a significant interaction for the ADM.

The summary of the analysis of equality and symmetry of the variance-covariance matrices for the RFT, EFT, and ADM is presented in Table 7.

Table 7

Summary of Equality-Symmetry Analysis

of the Covariance Matrices

Measure	Equality		Symmetry		Matrix Determinants	
	Degrees of Freedom	Chi Square	Degrees of Freedom	Chi Square	Accident Loaded	Accident Free
	3	12.03*	1	.43	1916.53	419.74
RFT	3	3.31	1	121.74**	34.16	14.76
	10	38.68**	8	430.50**	762.24	183.34
EFT	3	.97	1	225.41**	643.31[a]	561.06[a]
ADM	15	34.72*	13	19.57	22.42[b]	1.22[b]

*$p < .01$.

**$p < .001$.

[a]in thousands.

[b]in billions.

It appears that both assumptions were violated in the RFT data; the assumption of symmetry was violated in the EFT data; and the assumption of equality was violated in the ADM data, as indicated by the significant chi square values in Table 7. The accident-loaded group produced consistently greater performance variances on the RFT, EFT, and ADM than the accident-free group, as shown by the matrix determinants for the two groups in Table 7.

The data from the individual figures of the Closure Test were combined to obtain total time scores and total error scores. There were no significant differences between the groups for either of these scores, t (1) = 1.33, $p > .05$ for total time, and t (1) = 1.84, $p > .05$ for total errors. Also, errors were recorded for the ADM, and again there was not a significant difference between the groups on this aspect, t (1) = .21, $p > .10$.

Since it was decided to include multiple measurement in the study, regression analysis was employed to assess what combination of the measures would best contribute to differentiation between the two groups. Total-time scores from the four measures were used in the regression analysis. A moderately high significant multiple correlation was obtained, R (76) = .41, $p < .01$, corrected for shrinkage, with the ADM contributing most significantly to the differentiation of the two groups. The point-biserial correlations of each of the measures with the criterion of group

membership were as follows: ADM, r_{pb} (76) = .44, $p < .01$; Closure Test, r_{pb} (76) = -.15, $p > .10$; EFT, r_{pb} (76) = -.14, $p > .10$; and the RFT, r_{pb} (76) = .08, $p > .10$.

As an adjunct to the research and consistent with the theory of field dependence, the non-work-related driving records of the subjects for the past 3 years were examined. There was not a significant difference between the two groups for the number of non-accident-related traffic violations for the 3-year period, t (76) = 1.35, $p > .10$. However, there was a significant difference between the two groups for the number of traffic accidents for the 3-year period, t (76) = 2.02, $p < .05$. The accident-loaded group had more non-work-related accidents than the accident-free group. Of the subjects in each group, 17 of the accident-loaded group were involved in the non-work-related type of accidents, as opposed to 9 of the accident-free group being involved in the non-work-related accidents.

CHAPTER IV

Discussion

Considered strictly, the analyses of variance for the RFT and the ADM were uninterpretable due to the violation of the assumption of equality of the covariance matrices. Also, the analysis of variance for the EFT would have to be qualified because of the violation of the assumption of symmetry of the covariance matrices for this measure. For these reasons, the data from this research should be interpreted with caution. The violation of the assumption of equality indicated that the two groups differed significantly in terms of their variability of performance on the measures. As noted in the results, the accident-loaded group performed with consistently greater variance than the accident-free group on the RFT, the EFT, and the ADM, and with significantly greater variance on the RFT and the ADM. For these reasons, an attempt at interpretation from the analysis of variance would be questionable. However, this consistently greater variability of performance for the accident-loaded group suggested another hypothesis which requires further specific research, and which will be discussed below.

The results from the EFT were obviously inconsistent with the previous research with this measure (Barrett & Thornton, 1968; Bergman, 1973; Harano, 1970). The main effect of Difficulty of Figures was expected and not surprising; the complex figures of the EFT were designed to be more difficult than the simple figures. However, the lack of a main effect by Group or an interaction of Figures by group is not consistent with the previously cited research with the EFT. The previous research has found definite and consistent differences between groups of accident-loaded and accident-free subjects with respect to EFT performance. An obvious difference between the present study and previous studies, with respect to the EFT, is that the present research employed a short form of the EFT, whereas the previous research used the complete version of the EFT. This fact alone could account for the inconsistency between the present results and the results of the previous research with the EFT. Inconsistent results are often a problem with modified psychological measures. Further research could confirm this suspicion.

A second possible explanation of the failure of the EFT to distinguish between the two groups appeared in a previous study. Williams (1972) administered Witkin's two dimensional version of the EFT and a three-dimensional version of the EFT to accident-loaded and accident-free drivers of the New Jersey Bell Telephone Company. It was

discovered that the three-dimensional version significantly distinguished between the two groups, but the two-dimensional version did not. It is interesting to note, that if the assumptions had not been violated in the present data, there would have been further evidence that a three-dimensional measure, the RFT, produced results indicating differences between the groups (the significant interaction of the Group condition with the Box Position and Rod Position), whereas the two-dimensional measure, the EFT, did not. Again further research is needed to clarify this issue.

For similar reasons, caution is advised in interpreting the results of the Closure Test. There was not a significant difference between the groups' performances on this measure, but here again a short form was employed, and this may account for the lack of significant results. Although research with the Closure Test is still in the experimental stage, the measure may yet prove useful in this research pursuit. The conceptual similarities between the Closure Test and measures of field dependence are difficult to ignore; future research needs to consider this.

The regression analysis produced some encouraging results for the other experimental measure, the ADM. The results from the regression analysis also would be expected given the results of the analysis of variance, since the ADM was the only measure in that analysis that produced a significant main effect for the Group condition. Therefore, it follows

that the ADM would contribute significantly more to group differentiation. As Block (1975) has cautioned that the ADM is still an experimental test, the next step in research for this measure should be with well-designed validation studies.

As was stated previously, the consistency with which the accident-loaded group performed with more variability than the accident-free group on these measures suggested another hypothesis: that this difference in performance variance may be a real characteristic of individuals who differ in their probability of accident involvement. In other words, individuals who can be differentiated along these dimensions may in fact be two different groups of people, in the respect that one group has a general tendency toward more heterogeneous performance and the other group has a general tendency toward more homogeneous performance, for several aspects of their behavior. There may be general performance characteristics of these individuals, which would account for the present results. This possibility requires further research aimed specifically at this hypothesis.

Another possible explanation for the present results is that some contaminating factor existed in the conduct of the research and collection of the data. Again, however, this possibility requires further research for clarification.

The analysis of the non-work-related driving records of the subjects is encouraging and consistent with the theory of field dependence. The theory would predict that individuals who tend to be involved in accidents in one aspect of their behavior would also tend to be involved in accidents in other aspects of their behavior. Although the results of this analysis are only suggestive, they are consistent with previous research and theoretical postulates.

The present research suffers from the usual drawbacks of accident research. One of the major problems with this line of study is the lack of clear guidelines along which to classify accidents and injuries. What is being treated as essentially the occurrence of homogeneous phenomena may in fact involve rather heterogeneous incidents. That is, an accident or injury in one situation may be extensively different from the same accident or injury in a different situation. Even similar accidents occuring under the same circumstances may be quite different functionally. Arbous and Kerrich (1974) point out:

> The unreliability of the criterion may in some measure be due to the fact that accident data are not uniform, and that by merely including for study all accidents (from existing records), irrespective of causes or the manner in which they occurred, one is in effect collecting a hotchpotch of events which are by no means

homogeneous or representative of the phenomenon (p. 487).

Thorough work remains to be done on the definition of what constitutes an accident. This definition should be expanded to include the considerations of what the total statistical population of events constitutes, how the sample is selected, and to what extent the sample is considered to be representative of the whole (Arbous & Kerrich, 1974).

A continuing problem with this approach to accident research also must be considered. Persons included in an accident-loaded sample may be at least two types of accident victims. One type causes the accident and the other type is caught in an accident through minimal fault of his own. The particular measures included in most accident research could identify correctly only one type from mixed samples. This is at least one aspect of the unreliability of measures that continues to surface in accident research results.

Another major drawback of this and previous research is that it is predicated on hindsight. Most accident studies to date involve retrospective research employing the after-the-fact criterion of accident occurrence in the past. This approach has produced needed insights into the problem, but it also has produced conflicting evidence about the accident phenomenon, and ultimately it appears to be an inadequate means to assess the total variance of accident occurrence. The next step must be in the direction of well-designed

longitudinal predictive studies to clear up the incongruous evidence about variables involved in accident occurrence. It is suggested that two years be employed as a minimum time period for such research, as different short time periods (six months or less) have been shown to produce unstable results (Arbous & Kerrich, 1974). Also, it is suggested that multiple measurement again be employed, since single psychological measures tend to produce restricted perspectives of multidimensional phenomena.

Finally, it is proposed that the inclusive concepts of Willard Kerr be adopted in future accident research. Kerr (1974) proposed that accident research be directed from the orientations of three complementary theories of safety psychology. The three theories are the Accident-Proneness theory, the Goals-Freedom-Alertness theory, and the Adjustment-Stress theory. These three theories essentially reduce to the three important variables which Kerr contends account for most of the variance in accident involvement. The three variables are constitutional characteristics of individuals (proneness, 1 to 15 percent of the variance), the interaction between the work environment and the individual's behavior (goals-freedom-alertness, 30 to 40 percent of the variance), and the cognitive processes of the individual in response to environmental stress (adjustment-stress, 45 to 60 percent of the variance). In Kerr's conception, there is a marked shift in emphasis from personal characteristics to environmental

characteristics. Kerr does not deny the importance of personal characteristics in the accident phenomenon, but he does reduce the role of personal characteristics from a major to a minor source of the problem. Kerr (1974) contends:

> In the adjustment-stress theory it must be admitted that individual differences do exist in ability to withstand what ordinarily would be stress-inducing situations. Yet, such individual differences account for less than one fifth of the variance in individual accident rates; therefore, the limitations on the accident-proneness theory appear to be much more severe than those on the adjustment-stress theory (p. 499).

Thus Kerr suggests that a modification in perspective from individual characteristics in isolation, to the study of the moderating effects of environmental variables upon individual behavior, will produce more fruitful research. Within this conception is not only the characteristics of the work environment and their behavioral consequences, but also the effects of the social milieu under which the individual must function. It is proposed that the adoption of such a framework as Kerr conceives, included with the previous suggestions of multiple measurement in long range predictive studies, will result in the clarification of existing ambiguities and conflicting evidence in the field of accident research.

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