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DEVELOPMENTAL FACTORS AND FIELD DEPENDENCE-INDEPENDENCE

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NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY
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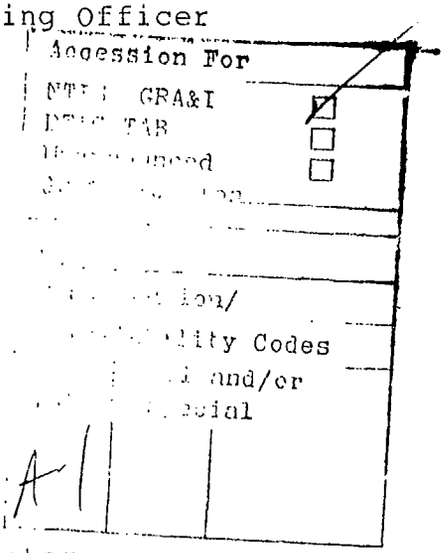

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SUMMARY PAGE

THE PROBLEM

The use of field dependence-field independence measures has been suggested both for the selection and classification of naval aviators. If measures of field dependence-field independence are predictive of pilot proficiency, the utility of the construct for selection and classification could be moderated by the influence of intraindividual changes in field dependence-field independence (FD-FI) over time. Prior to, or at least in conjunction with, assessments of the predictive validity of the construct in training and operational aviation environments, changes in the levels of field dependence-field independence that may be expected over the course of an aviator's career should be identified. To that end, this report reviews (1) particulars of the field dependence-field independence construct, (2) evidence for and against age-related changes in field dependence-field independence, (3) intraindividual lability in field dependence-field independence, and (4) various measurement, sampling, and experimental design concerns associated with investigations of the construct.

FINDINGS

Though great care may be taken to select subjects and statistically control known moderator variables in studies of FD-FI, it is often difficult, if not impossible, to impose appropriate selection and control procedures in an a priori fashion. This is especially the case when little information exists concerning the interaction of moderator variables and the developmental trend(s) of FD-FI. The simultaneous employment of cross-sectional and longitudinal sequences in data collection is best suited to the description of intraindividual changes in FD-FI with age.

RECOMMENDATIONS

In general, future investigations of FD-FI should employ at least two measures of the construct, preferably the portable rod-and-frame test (PRFT) and the embedded figures test. If the PRFT is suitable, care should be taken in controlling and reporting stimulus characteristics. Similarly, distributions of known moderator variables within the sample should be provided. Until such controls are introduced, questions regarding the orthogonality of FD-FI and developmental factors will remain unanswered.

Likewise, the utility of tests of FD-FI for aviator selection and classification also remains an open question. Not only must the predictive utility of FD-FI measures be assessed in both proximal and distal criterion environments, but also studies should be undertaken to assess intraindividual changes in FD-FI of aviators as they progress through the various criterion environments, from training to fleet aviation.

INTRODUCTION

The use of field dependence-independence measures has been suggested both for the selection (22) and the classification (4) of naval aviators. Long (22) argued, though, that the construct would have utility for naval aviation only to the extent that its assessment results in a measure that is constant over the life-span of the individual. According to Long the construct meets the constancy criterion and exhibits stability over: (a) long periods of time; (b) significant life events; and (c) strenuous attempts at experimental modification. Long's argument can be contested on two major points, however. First, assuming that field dependence-independence is related to pilot proficiency, it is sufficient that a functional relationship exists between field dependence-independence (FD-FI) and age for the construct to have predictive utility; the function may have either zero slope, as Long suggests, or some non-zero value. Second, the functional relationship between FD-FI and age remains unclear. Although some evidence supports the assertion that FD-FI remains stable over time, the literature on this issue is largely equivocal. After reviewing the particulars of the construct, this report focuses on investigations of age-related changes to determine if predictable changes in FD-FI occur over the life-span of individuals. If FD-FI is related to success in aviation training, as Long suggests, but more importantly to proficiency in more distal criterion environments, such as air combat maneuvering, the prediction of changes in FD-FI over the course of an aviation career becomes essential. Only then will it be possible to maximize the utility of tests of FD-FI as aviator selection and classification instruments.

The FD-FI Construct

In 1978 at Clark University, Witkin (44) took the occasion of one of his last public addresses to recapitulate his nearly career-long investigation of the FD-FI construct. According to Witkin interest in cognitive styles, such as, leveling-sharpening, constricted-flexible control, reflection-impulsivity, and FD-FI, emerged from the "new look" perspective on psychology. FD-FI research was undertaken as a direct challenge to Ernst Mach's egocentric theory of space orientation, but since has been extended to investigations of interpersonal behavior, learning and memory, perceptual constancies, defense mechanisms, autonomic nervous system functioning, cultural differences, dreaming, schizophrenia, child-rearing, brain hemispheric laterality, alcoholism, and moral judgement.

Early studies of FD-FI revealed that individuals differed in the extent to which they employed either bodily sensations or properties of the visual field in the judgement of verticality. Originally, three experimental paradigms were employed to separate, or create disparities between, visual and bodily standards of verticality. In the first paradigm an erect subject, seated in a darkened room, adjusted a luminous rod which was contained within a luminous frame to vertical. In the second

paradigm, the subject, who was seated in a tilted room adjusted his/her body to vertical by instructing the experimenter to rotate the subject's chair. In each of these procedures, axes of the visual field were displaced while gravitational forces on the subject remained constant. In the third paradigm, constant changes in acceleration forces were generated while gravitational forces on the subject remained constant and the visual field remained aligned with the gravitational field. This was accomplished by seating the subject in a room that traveled about a circular tract at a fixed speed. Although subjects within any one of these three experimental situations were presented with the same visual field factors and the same kinesthetic and vestibular stimulation, Witkin observed that a given subject would characteristically employ either a visual or bodily standard of verticality across situations. Those who characteristically employed the visual standard were labeled field dependent; those who characteristically relied on bodily sensations were labeled field independent. Because field dependent individuals could adjust their bodies to gravitational vertical with their eyes closed, but not with their eyes open, Witkin asserted that field dependent behavior stemmed from suppression of bodily cues, rather than from sensory or neural deficits. This notion spurred the development of the theory of psychological differentiation.

A principal component of differentiation theory is the concept of self/non-self segregation. Self/non-self segregation is said to affect the development of internal frames of reference. Field independence, which reflects a high degree of differentiation, is a tendency to rely primarily on internal referents in a self-consistent way. Field dependence, which reflects a lack of differentiation, is a tendency to rely on external referents in a self-consistent way. These definitions make clear that the FD-FI dimension does not refer to classes of individuals, but rather to tendencies that vary in strength between individuals. Moreover, no value statements are implicit in these formations; the relationship between field characteristics and the characteristics of body stimulation determines the style that results in veridical perception in any given situation. For example, FD results in enhanced accuracy in rod adjustment, relative to FI, in the rotating room paradigm (44).

Differences in the behavior of FD and FI individuals are most apparent in ambiguous, or unstructured, situations. FI individuals tend to function autonomously within the social field; they tend to structure situations in terms of their internal referents. FD individuals, however, tend to rely on information from others to structure social situations. These differences are similarly manifested in cognitive task performance. While FD individuals tend to be influenced by salient characteristics of the stimulus array, FI individuals are adept at what Witkins refered to as "cognitive restructuring." Cognitive restructuring permits: (1 the organization of a field that lacks structure; (2 the reorganization of an existing

structure; (3 the breaking up of field organization to render figure and ground discrete. The embedded figures test (EFT) has served as the primary measure of these abilities in FD-FI research. Other measures of cognitive functioning that do not involve restructuring have little, if any, relation to FD-FI. It must be emphasized that these behavioral differences represent tendencies, not absolute differences between individuals. Moreover, these tendencies are not thought to be immutable over the life-span of the individual (44).

According to Witkin, intraindividual, age-related changes in FD-FI stem from a process of attunement, i.e., the matching of cognitive style and the demands of life. Attunement is said to be a synergistic process: Initially, environmental demands determine the course of differentiation; later, individuals select, or are selected to, environments that are compatible with their degree of differentiation, and further attunement occurs. Therefore, this hypothesized function relating FD-FI to age may be described by a monotonic decrease in FD from childhood to adolescence, followed by a plateau, and then by a gradual return to FD. However, senescent levels of FD are not thought to approach that of childhood. Although many have inferred the above ontogenetic trend from developmental investigations of FD-FI, all such studies suffer to some degree from a variety of methodological shortcomings.

Evidence for Age-Related Changes in FD-FI

Age-related differences in FD-FI have been reported in a number of investigations. As will be shown, the conclusions drawn by the investigators generally support Witkin's notion of age-related changes in FD-FI, namely, that the function relating FD and age is U-shaped and inverted.

The most popular measure of FD-FI has been some form of the Embedded Figures Test (EFT). In cross-sectional studies, the EFT has revealed decreasing FD between the ages of 8 and 17 (47) and increasing FD between the ages of 17 and 80 (8) and 20 and 70 (19). Lee and Pollack (19) reported that the major increase in FD occurred between the ages of 40 and 50, and concluded that age, per se, rather than intelligence, was the determinant of that increase. With a group administered version of the EFT (GEFT), Panek, Barrett, Sterns, and Alexander (31) reported a linear increase of FD with age for cross-sectional comparisons of women aged 17 to 72 years.

A simplified version of the EFT, the Children's Embedded Figures Test (CEFT), has been employed in cross sectional investigations of FD among young children and the elderly. Decreasing FD has been documented (5) over the ages of 5 to 8 (7). At the other end of the age spectrum, increasing FD with age was noted for club-going, institutionalized, and infirmed elderly between the ages of 69 and 80 when an untimed version of the CEFT was employed (25, 26).

In the same study as previously described, Witkin, et al (47) found age-related changes in FD as measured by the rod-and-frame test (RFT) to be similar to those obtained with the EFT. Schwartz and Karp (36) reported a similar equivalence for their subjects. Likewise, Haywood, Teeple, Givins and Patterson (14) used the RFT and reported decreases in FD from about age 5 to 8, a finding similar to that obtained by Cecchini and Pizzamiglio (5) with the CEFT.

In 1968, Oltman (30) reported the development of a portable rod-and-frame test (PRFT) which since has replaced the RFT. Although measurement concerns surround the PRFT (these will be discussed later) the findings of several studies that have used the device parallel those that have employed traditional assessment techniques. Vaught, Pittman, and Roudin (41) reported decreasing FD between the ages of 4 and 9, while Gaines (11) found similar decreases between the ages of 5 and 15. Gaines additionally reported the provocative finding that although increased FD was noted for subjects over 30, a group of subjects whose mean age was 41.3 years exhibited significantly less FD than did high school students. In addition, Panek, Barrett, Sterns and Alexander (31) used the PRFT and reported increased FD between the ages of 17 and 72, a finding similar to that obtained with the same subjects and the GEFT.

Finally, only Schwartz and Kark (36) employed the body-adjustment test (BAT) in the assessment of age related changes in FD-FI. As before with the RFT and EFT, the investigators found that FD increased with age from 17 to 80 years.

It should be emphasized that all the results discussed thus far stem from cross-sectional investigations. It was the goal of these studies to infer intraindividual changes in FD from interindividual comparisons. Only Witkin et al (47) reported the results of longitudinal studies and there the authors concluded that the results were equivocal. In summary, then, although the previous investigations may be construed as support for Witkin's conception of changes in FD with age, the evidence is at best indirect and inferential; the pit-falls of both cross-sectional and longtidunal assessments of age-related changes in behavior are addressed along with other issues of concern in a later section.

Evidence Against Age-Related Changes in FD-FI

A relatively small number of studies seem to support the orthogonality of age and FD-FI. That the studies are fewer in number than those previously discussed should not be interpreted as support for some dependence of FD-FI on age: First, reports of negative findings are actively discouraged. Second, all the studies reviewed here suffer to some extent from methodological shortcomings. In any event, versions of both the embedded figures test and the portable rod-and-frame test have provided evidence against age-related changes in FD-FI.

Eisner and Williams (9) reported no reversal in FD for subjects between the ages of 18 and 22 as had been predicted by Witkin et al (47). Although Arbuthonot (1) questioned the validity of the hidden-pattern and hidden-figures test employed by Eisner and Williams, Morell (28) similarly reported no significant age effects on the performance of 11, 14, and 18 year olds on the embedded figures test. Rehermann and Brun (33) found no significant age differences in FD for psychiatric patients ranging in age from 25 to 69 years. Cionini, Smith, Magaro and Velocogna (6) reported significant but low correlations (r = .25) between FD and age for subjects ranging in age from the early 20s to the late 50s.

Most recently, Braune and Wickens (4) reported no significant differences in the accuracy of subjects ranging in age from about 20 to 60 years on a computer-based version of a hidden figures test. Response latencies were found to vary with age rather than any specific decrement in FI. Similar age-related response speed decrements were noted for a variety of cognitive and psychomotor tasks performed by the same subjects.

Morell (28) also assessed FD via the PRFT and found, as with the EFT, no significant age-related differences. Gruenfeld and Mac Eachron (13) reported only nonsignificant partial correlations between age and PRFT performance for subjects 20 to 60 years of age. Whether subjects were categorized by menapausal status, hormonal level maintenance, or age, no categorization revealed significant group differences in FD for women ranging in age from 40 to 60 (20). Finally, Jacobson, Van Dyke, Sternbach and Brethaver (17) reported only a low correlation between age and PRFT adjustment error for hospitalized alcoholics.

Lability of FD-FI

While the utility of the FD-FI construct is not necessarily limited by its lability, a number of studies provide evidence which runs counter to the conclusion of Long (22) that FD-FI is a relatively enduring trait. Witkin (44) maintained that the course of FD-FI over age is determined by a process of attunement. Though not explicit on this point, Witkin apparently believed that this process occurred within the limits imposed by dedifferentiation, a regression toward a childlike cognitive style with increasing age. However, even if this trend is real, modification of PRFT performance with training is possible (10, 24, 27, 37, 43). Mobility, the capacity of some individuals to shift from a field dependent to a field independent style to accommodate task demands, is subject to training (44). Little information exists concerning the transfer of this training to other perceptual, cognitive, and personality indices of FD-FI. Nonetheless, these findings suggest that developmental trends in FD-FI may be highly individualized on the one hand, or specific to particular occupations or life-styles, on the other, if attunement does have a role in FD-FI lability.

METHODOLOGICAL ISSUES

An unambiguous determination of the orthogonality (or lack of it) of FD-FI and aging from the above data is not possible. First, because no one study has explored age-related changes over the entire human life-span, it becomes necessary to piece together the findings of several studies to approximate a life-span trend. Unfortunately, the confounding of various theoretical, procedural, and sampling errors within studies render discrepancies between studies uninterpretable. Second, all developmentally oriented studies of FD-FI have confounded age and time of testing effects, or age and cohort effects (35); only simple longitudinal and simple cross-sectional investigations have been attempted to date (45). These issues will now be addressed.

Measurement Concerns

Several authors have questioned the validity of employing any single measure in the assessment of FD-FI. Witkin (44) argued that performance on both the EFT and RFT involves the disembedding of figure from ground and, therefore, that the tests may be viewed as equivalent. Nonetheless, Arbuthnot (1) reported that performance on the two tasks is only moderately correlated ($r = .54$) in most studies. Moreover, Bergman and Englebrekston (3) and Lee and Pollack (20) have suggested that different processes underlie performance on the two tasks. Of equal or greater importance is the issue raised by Arbuthnot (1) and Wachtel (42) who maintain that because trans-situational behavior is implicit in the construct, no one measure provides a sufficient operationalization of FD-FI. Because a majority of FD-FI studies, particularly those concerned with development, have employed only one measure of the construct (42) it is unclear whether these developmental studies have assessed changes in FD-FI or merely changes in task performance.

The related issue of establishing a criterion to distinguish between field independent and field dependent individuals has posed other problems. Inasmuch as FD-FI has been defined as a global perceptual, cognitive, and personality construct, individual differences in task performance, per se, are not of particular interest. Rather, of greater concern is the determination of performance differences that permit prediction of behavior across situations. As an offshoot of other investigations, Immergluck (15), Pressey (32) and Vaught (39) became engaged in attempts to establish a criterion to divide populations into field dependent and field independent sub-groups. Immergluck proposed that a mean absolute deviation of adjustment of 10° on the RFT be adopted as such a criterion. Both Pressey and Vaught reported that between six to 10 percent of their large samples would be considered field dependent under this criterion. However, this criterion resulted in the identification of nearly three times as many field dependent individuals in a psychiatric population (29). The investigators offered a number of plausible intrepretations of this finding.

However, none included the observation that the latter study employed a subject-apparatus distance of six feet, while the former studies employed twelve foot separations. While seemingly trivial, this observation points out a set of difficulties that plague cross-study comparisons in the FD-FI literature.

Several investigators have reported that RFT performance is significantly affected by stimulus characteristics that go largely unreported in the literature. In a signal detection study of RFT performance, Gross, Schuck, and Dannemiller (12) reported significant main and interaction effects of exposure duration and luminance. Lester (21) reported significant effects of head movements, control readings, and instructions. Head movements, ambient room illumination, and rod-adjustment rate were reported to significantly affect PRFT performance (23). None of the developmental studies cited here provide information on all of these parameters; a few provide minimal information (20,41).

The effects of uncontrolled procedural and environmental variables have been exacerbated by the replacement of the RFT apparatus originally employed by Witkin, Goodenough and Karp (47) by the PRFT. The data reported by Witkin et al and Schwartz and Karp (36) gave rise to the generally accepted notions of developmental changes in FD-FI. Both studies employed a large luminous rod-and-frame which a dark-adapted subject viewed in a darkened room. In 1968, Oltman (30) devised and tested the portable rod-and-frame device that facilitated the testing of young children and the elderly by obviating the need to transport subjects or obtain light-tight rooms. Oltman tested a large number of male and female college students on both the standard and portable devices and found that performance on the two tasks was highly and positively correlated ($r = .89$, across sex). It is possible to use Oltman's reported correlations, performance means, and standard deviations in a regression equation to convert PRFT scores to equivalent RFT scores. This procedure enables the comparison of recent studies with the classic studies of Witkin and his associates. However, these comparisons raise more questions that they answer.

For example, mean absolute deviation scores of elderly subjects on the RFT, as reported by Schwartz and Karp (36), are considerably higher than those for same age subjects tested on the PRFT by Lee and Pollack (20). Applying the regression equation to Lee and Pollack's data reduces the discrepancy, but large differences remain. Conversely, scores reported by Witkin et al (47) are considerably lower than the transformed scores of Vaught, Pittman, and Roudin (41). In addition, Jacobson, Van Dyke, Sternbach and Brethaver (17) reported untransformed scores which were higher than those obtained by same age subjects on the RFT (transforming the scores would only increase the disparity). Four alternative, but not mutually exclusive, interpretations of these findings are evident. The discrepancies may stem from: (1 cohort effects; (2 sampling effects; (3 procedural differences, such as, differences in instructions or rod-adjustment rate; or

(4 the inability of the regression equation to properly calibrate the PRFT for young and elderly subjects such that the PRFT assesses FD-FI in a non-linear fashion across age.

In addition, doubt has been cast upon the equivalence of the RFT and PRFT by Vaught (40) and Irving and Henderson (16). Vaught reported that the performance of college students on the two tasks was not significantly correlated (r = .46). Irving and Henderson reported correlations ranging from .44 for one group to /.83 for another demographically distinct group. The high correlations obtained once light leaks in the PRFT apparatus were eliminated. In any event, further calibration studies of the PRFT are warranted, particularly with young and elderly subjects.

The importance of calibration is this: Until the PRFT is definitively calibrated for the populations in question, it is unjustifiable to maintain that the PRFT assesses FD-FI. Because the two tasks appear so similar, this assertion may be extreme; however, had Oltman's original correlations been lower, perhaps more attention would have been paid to differences between the tasks.

Finally, Morell (28) has contrasted the conventional absolute deviation scoring method of the RFT (and PRFT) with a procedure that takes into account the direction of the deviations. The latter method assumes that rod deviations opposite in direction to the tilt of the frame are not field-induced errors and, therefore, are errors stemming from an inability to accurately perceive the vertical under any circumstances. This method is conceptually more reasonable than the traditional approach and suggests that findings of sex and age differences in RFT performance may be spurious and attributable to scoring procedures.

In summary several problems in FD-FI measurement have been noted. It is not clear what any one measure of FD-FI actually measures (1); indeed, Wachtel (42) has argued that the construct and its measures are often confused. Moreover, inconsistancies in stimulus characteristics and inaccurate or inapplicable instrument calibration, along with inappropriate scoring procedures, render cross-study comparisons of dubious value and an estimation of life-span trends in FD-FI impossible.

Sampling Concerns

Witkin, Cox and Friedman (45) have identified several FD-FI modifier variables including age, intelligence, masculinity/feminity, pathology, sex, and socioeconomic status. Another variable, which for the present can only be referred to in a general way as "activity level," has been reported to be positively correlated with FI (38). Occupational activity also appears to be related to FD-FI (11, 18, 34).

The distribution of known and other unknown moderator variables within and across groups probably influences the findings of any one study and therefore limits the generalizability of those findings. Unfortunately, none of the developmental studies of FD-FI report the distributions of all the identified moderator variables; many report only sex and age distributions (14, 14); a few report the distributions of several variables (e.g., 5, 13, 19, 20). Occasionally, age-related differences in these variables are noted and no statistical or methodological corrections are attempted (11). Again, unknown sampling differences render cross-study comparisons hazardous.

Design Concerns

Over and above sampling concerns, Schaie's (35) criticisms of simple cross-sectional and longitudinal designs suggest that there is no unambiguous evidence for or against the orthogonality of aging and FD-FI. Schaie's criticisms are premised on the reasonable assumption that behavior is a joint function of age, cohort membership, and time of measurement. Age differences in performance reported in longitudinal studies are confounded by time of measurement effects and may be confounded by instrumentation and repeated measurement effects. On the other hand, age differences in performance reported in cross-sectional studies are confounded by cohort effects. Different cohorts may exhibit different developmental trends of FD-FI and, therefore, it is unreasonable to assume that performance differences between cohorts measured at the same time exhibit the expected performance of the younger cohorts at a future time. Under the best of circumstances (i.e., when no cohort effects are present) the cross-sectional design only yields an approximation of intraindividual change when growth is linear and additive (2).

Though Schaie has recommended several sequential-developmental designs that avoid the confounds attributable to cohort membership and time of measurement effects (design selection depends upon the precise developmental question to be addressed), they have yet to be employed in this research area. Some authors, however, have at least acknowledged the possible influence of cohort effects in cross-sectional FD-FI research. Gruenfeld and Mac Eachron (13) and Cionini et al (6) partialled out various socioeconomic factors and found that the correlation between age and FD was primarily due to the relationship between educational level and cohort. However, the latter authors reported that for men, FD-FI was found to be related solely to age. Lee and Pollack (20) sought to minimize cohort effects by selection procedures and by statistically controlling visual acuity, personality factors, and intelligence. The authors reported that partialling out intelligence did not significantly reduce the obtained correlation between FD-FI and age. If it is assumed that educational level and intelligence measurement scores are positively related, the findings of Gruenfeld and Mac Eachron and Cionini et al are clearly discrepant with those of Lee and Pollack, at least for women.

Resolution of the discrepancies outlined above is encumbered for a number of reasons. First, each study employed a different FD-FI assessment device. Gruenfeld and Mac Eachron employed the PRFT and failed to report many of the relevant stimulus characteristics previously discussed. In addition, the appropriateness of using the PRFT with children and the elderly is questionable. Cionini et al employed a hidden-figures test which Arbuthnot criticized with regard to the validity in FD-FI assessment. Lee and Pollack used the EFT on which performance is only moderately correlated with performance on the PRFT. Second, each study used only one assessment technique; the covariance of at least two measures is a more suitable index of FD-FI, which is a trans-situational construct. Third, Gruenfeld and Mac Eachron and Cionini et al failed to report the distribution of IQ scores, or other intelligence measurements, within their samples. Although Lee and Pollack's subjects were roughly equivalent in verbal intelligence, they may have differed markedly in a perceptual organization factor which is measured by three subtests of the WAIS and which has been identified by Witkin, Dyk, Faterson, Goodenough, and Karp (47) as the source of the high positive correlations generally obtained between IQ and FI.

CONCLUSIONS AND RECOMMENDATIONS

The above considerations emphasize several important points. Though great lengths may be taken to select subjects and statistically control known moderator variables, it is difficult, if not impossible, to impose appropriate selection and control procedures in an a priori fashion, especially when little information exists concerning the interaction of moderator variables and the developmental trend(s) of FD-FI. Rather, the simultaneous employment of cross-sectional and longitudinal sequences in data collection is best suited to the description of intraindividual changes (2) in FD-FI with age. Moreover, the investigation should employ at least two measures of FD-FI, preferably the PRFT and the EFT (1). However, if the PRFT is to be used with children or the elderly, calibration studies would have to be undertaken first. If the PRFT is suitable, care should be taken in controlling and reporting stimulus characteristics. Similarly, distributions of known moderator variables within the sample should be provided. Until such an investigation is completed, questions regarding the orthogonality of the FD-FI and aging dimensions will remain unanswered.

Likewise, the utility of tests of FD-FI for aviator selection and classification also remains an open question. The goal of naval aviation selection tests, in general, must be twofold; (1 to identify those candidates with the lowest probability of completing training; and (2 to identify candidates with the highest probability of becoming proficient fleet aviators. That is, the tests must be predictive of both near- and long-term success in naval aviation. Thus, not only must the predictive utility of FD-FI measures be assessed in both proximal

and distal criterion environments, but also studies should be undertaken to assess intraindividual changes in FD-FI of aviators as they progress through the various criterion environments, from training to fleet aviation.

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The use of field dependence-field independence measures has been suggested both for the selection and classification of naval aviators. If measures of field dependence-field independence are predictive of pilot proficiency, the utility of the construct for

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selection and classification could be moderated by the influence of intraindividual changes in field dependence-field independence (FD-FI) over time. Prior to, or at least in conjunction with, assessments of the predictive validity of the construct in training and operational aviation environments, changes in the levels of field dependence-field independence that may be expected over the course of an aviator's career should be identified. To that end, this report reviews (1) particulars of the field dependence-field independence construct, (2) evidence for and against age-related changes in field dependence-field independence, (3) intraindividual lability in field dependence-field independence, and (4) various measurement, sampling, and experimental design concerns associated with investigations of the construct.

Though great care may be taken to select subjects and statistically control known moderator variables in studies of FD-FI, it is often difficult, if not impossible, to impose appropriate selection and control procedures in an a priori fashion. This is especially the case when little information exists concerning the interaction of moderator variables and the developmental trend(s) of FD-FI. The simultaneous employment of cross-sectional and longitudinal sequences in data collection is best suited to the description of intraindividual changes in FD-FI with age.

In general, future investigations of FD-FI should employ at least two measures of the construct, preferably the portable rod-and-frame test (PRFT) and the embedded figures test. If the PRFT is suitable, care should be taken in controlling and reporting stimulus characteristics. Similarly, distributions of known moderator variables within the sample should be provided. Until such controls are introduced, questions regarding the orthogonality of FD-FI and developmental factors will remain unanswered.

Likewise, the utility of tests of FD-FI for aviator selection and classification also remains an open question. Not only must the predictive utility of FD-FI measures be assessed in both proximal and distal criterion environments, but also studies should be undertaken to assess intraindividual changes in FD-FI of aviators as they progress through the various criterion environments, from training to fleet aviation.