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CRITICAL ANALYSIS OF A STUDY ON FIELD DEPENDENCE IN YOUNG CHILDREN[1]

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Summary.—Kojima's conclusion that our method of scoring performance in the rod-and-frame test did not produce satisfactory results in young children was invalid because our scoring method was used incorrectly, fallacious reasoning was used to reject our scoring method, subjects were classified wrongly, and the procedure used to test vertical perception in the children probably was unreliable.

We pointed out previously that behavior in the rod-and-frame test (RFT) can be analyzed in terms of four main parameters called constant deviation (μ), rod-starting-position effect (ρ), frame-tilt effect (ϕ), and response consistency (σ) (Nyborg, 1974). We described a method of scoring the RFT which enables each subject's performance to be expressed in terms of these four parameters (Nyborg, 1974, Nyborg & Isaksen, 1974). One feature of our scoring method is that it takes into account the side of physical vertical to which the subject adjusts the rod. Another feature is that the statistical significance of each subject's scores can be determined. Thus, our method divides rod-and-frame behavior into its components and provides a means for analyzing the performance of each subject individually.

Recently, Kojima (1978) claimed that our method of scoring the RFT failed to produce satisfactory results in a study on field-dependence in young children. We consider his claim to be unjustified for several reasons. First of all, Kojima did not use our scoring method correctly. Although he calculated mean signed rod-and-frame scores he did not discriminate between the frame-tilt effect (ϕ) and the rod-starting-position effect (ρ). He also misused the σ values, which according to our method are to test the significance of individual μ, ϕ and ρ values rather than for group mean descriptions.

Second, Kojima rejected our method of scoring the rod-and-frame task because the frame-tilt effect (ϕ) values did not correlate significantly with scores obtained by his subject in a new version of the Embedded Figures Test (EFT) in which new figures were drawn and color and shading omitted. In so doing, he committed a fallacy of factual verification known as circular reasoning (Ingle, 1972; Fischer, 1971) because whether the *new* embedded-figures scores actually measured field dependence was one of the "unknowns" in Kojima's study. His attempt to validate the new embedded-figures by ob-

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taining small but in most cases significant correlations between his embedded-figures and some WISC subscale scores appears unconvincing because these subscales also correlate with scores on the rod-and-frame which—as mentioned below—has been demonstrated to measure dimensions different from that measured by embedded-figures. Furthermore, correlations between scores obtained on the rod-and-frame and the embedded-figures often are nonsignificant (Fine & Danforth, 1975), so low correlation between ϕ scores and embedded-figures may be common. Finally, it has been demonstrated that performance on the rod-and-frame is better accounted for in terms of visual-vestibular (somesthetic) interaction than in terms of field dependence (Nyborg, 1977) and that the four parameters singled out by the new method develops differently over time.[2] Recently, Witkin and Goodenough (1977) also came to the conclusion that RFT and EFT measure different dimensions. Accordingly, neither traditional nor new embedded-figures scores can be used to prove that our decomposition of rod-and-frame scores is invalid as suggested by Kojima.

Third, the method used by Kojima to classify his subjects was unreliable. He classified them on face value based on what he considered to be their "pattern of responses" rather than by a statistical analysis of their individual scores. Kojima presented sufficient data for us to calculate the μ, ϕ, and ρ in five of his subjects. Unfortunately, the data did not allow our usual σ_1 score to be calculated. However, a less optimal measure for response consistency, σ_2, could be calculated according to the formula $\sigma_2 = |RR - RL - LR + LL|/4$. σ_2 is less optimal than σ_1 because the absence of raw data leads to loss of information. Furthermore, the number of *df* drops from four to one and numerical values have to be handled in order to obtain a positive measure of σ_2; for details see Nyborg and Isaksen (1974). Table 1 shows that only two of the five subjects (Nos. 1 and 3) were classified completely correctly by Kojima: Subject 1 heavily emphasized frame-tilt information; Subject 2 significantly emphasized frame-tilt information and was significantly influenced by the rod-starting-position; Subject 3 was not influenced by the frame tilt; Subject 4 significantly emphasized the frame tilt and had a significant constant deviation and rod-starting-position deviation; Subject 5 was affected significantly by the rod-starting-position. Kojima's classification did not differentiate between the effect of the frame tilt, the rod-starting-position, and the constant deviation of each subject. It is also to be noted that the significant negative ϕ score for Subject 2 indicates that this subject adjusted the rod consistently to the opposite side of the frame tilt. Likewise, the significant negative ρ score for Subject 5 denotes that this sub-

[2]H. Nyborg, The rod-and-frame test in school children. I. Development of parameters of the task. (Unpublished paper submitted for publication, 1978)

TABLE 1

COMPARISON OF KOJIMA'S AND NYBORG'S CLASSIFICATION OF SUBJECTS ACCORDING TO PERFORMANCE ON ROD-AND-FRAME TASK

Subject No.	Kojima's observations under frame/rod-tilting conditions				Kojima's classification of subjects	Nyborg's score decomposition			
	R/R*	R/L	L/L	L/R		Constant deviation μ	Frame-tilt deviation ϕ	Rod-position deviation ρ	Response consistency σ
1.	32.5	29.6	−31.8	−24.1	Frame-side-dependent	1.55	*29.50*	2.65	1.20
2.	−10.1	−18.2	12.6	19.5	Frame-corner-dependent	.95	*−15.10*	*3.75*	.30
3.	1.8	− 7.4	− 1.8	2.8	Frame-independent	−1.15	− 1.65	3.45	1.15
4.	31.5	−19.3	−30.0	21.3	Inconsistent (within conditions)	*.88*	*5.23*	*25.53*	.13
5.	−12.4	17.5	14.0	−24.1	Inconsistent (between conditions)	−1.25	3.80	*−17.00*	2.05

*R/R signifies frame tilted to the Right/rod tilted initially to the Right; R/L signifies frame tilted to the Right/rod tilted initially to the Left.

Note.—Values in italics are statistically significant at $p < .05$. The statistical significance of the values was determined by the formula $[(\mu, \phi, \rho)/\sigma_2]2\sqrt{2}$ (Nyborg, 1974; Nyborg & Isaksen, 1974). The cut-off point for $p < .05$ in the t-distribution for the resultant was 12.7 (1 df).

ject adjusted the rod consistently to the opposite side of the rod-starting-position. Kojima decided to disregard the side to which his subjects adjusted the rod on the rod-and-frame so as to avoid negative scores. His decision was unfortunate, however, because it left an important question unanswered, namely, whether subjects who adjust the rod to the opposite side of the frame tilt are influenced by the frame in the same manner as subjects who adjust the rod to the same side as the frame tilts. If Kojima had determined whether the correlation between positive ϕ scores and embedded-figures scores differed significantly from the correlation between negative ϕ scores and embedded-figure values, i.e., if he had tested $r(\text{EFT}, \phi_{+}) = - r(\text{EFT}, \phi_{-})$ and further $r(\text{EFT}, |\phi|) = 0$, then he would have studied correctly whether there was a relationship between the subject's emphasis on frame-tilt information (ϕ) and the scores obtained in the new embedded-figures.

Fourth, it is an open question whether children in the age group studies by Kojima (4 yr., 11 mo. to 6 yr., 7 mo.) are suited for the rod-and-frame. Possibly the concept of uprightness is insufficiently developed in some or most children under 8-yr.-old for them to be tested reliably on the rod-and-frame. Kojima also noted that the portable task did not measure field dependence reliably in his subjects, so he devised another test procedure in which the child was told that he was helping an assistant adjust the inclined rod to the upright position. We consider this test procedure to be unsatisfactory because it permits the child's response to be influenced by both the experimenter and the assistant. Because of this, the reliability of Kojima's RFT procedure to test the vertical perception *of the child* is questionable.

In conclusion, the shortcomings and uncertainties in the study carried out by Kojima invalidate his statements about our scoring method.

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