Higher-order factors in the differential emotions scale (DES-III)

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Abstract

The 30-item version of Izard's Differential Emotions Scale (DES-III) was submitted to an iterative principal factoring plus oblique (direct Oblimin) rotation to simple structure, on a sample of 204 University of Delaware undergraduates. The intercorrelation matrix for the eight primary emotional-state factors derived, was subsequently subjected to a higher-order factoring. Four second-order factors accounted readily for the variance measured in the DES-III scales and this suggests that the multivariate mood-state instrument might be more profitably scored for secondary factors, in certain instances. This conclusion in no way detracts from the importance of the DES-III primaries, but adds to the usefulness of the instrument in applied studies.
Introduction

An important question is the nature of relationships among emotional states (Schwartz and Weinberger, 1980; Sirota and Schwartz, 1982). One measure used to quantify such relationships is the Differential Emotions Scale DES-III (Izard, Dougherty, Bloxom and Kotsch, 1974). As a multivariate mood-state scale, it was designed to tap the subjective-experience components of 10 fundamental emotions (Interest, Joy, Surprise, Sadness, Anger, Disgust, Contempt, Fear, Shame/Shyness and Guilt) purported to be discernible universally in the facial expression (cf. Izard, 1977, 1978, 1979a,b, 1980, 1982; Izard and Buechler, 1979, 1980; Schwartz, Ahern and Brown, 1979a; Schwartz, Weinberger and Singer, 1979b; Schwartz, Fair, Salt, Mandel and Klerman, 1976; Schwartz, Brown and Ahern, 1980). The reliability and validity of the DES-III has been examined in several studies (e.g. Blumberg and Izard, 1984, 1985; Izard, Oyster, Lelwica and Blumberg, 1985; Kotsch, Gerbing and Schwartz, 1982). Boyle (1984) conducted a repeated-measures multiple discriminant function analysis on the 30 DES-III items across five different treatment conditions [on advice from Nunnally (1981)] which suggested that most of the items exhibited high discriminant validity. Test-retest evidence of reliability (Izard et al., 1974) was encouraging although not as high as desirable. However, some of the internal-consistency estimates reported by Boyle (1984) in the mid- to high-0.8 range suggested that there was significant item redundancy in the DES-III subscales (cf. Kline, 1979, p. 3; Cattell, 1982; Lachar and Wirt, 1981; Allen and Potkay, 1983). This issue has been discussed more fully in Boyle (1983a, pp. 389-390, 1985c, pp. 48-49). With only three items per subscale, the subscale reliabilities are necessarily reduced in accord with the Spearman-Brown formulation (cf. Boyle, 1975).
Notwithstanding these limitations, factor analyses of the DES-III item intercorrelations have supported the construct validity of at least eight of the fundamental emotions postulated by Izard (e.g. Emde, 1980; Fuenzalida, Emde, Pannabecker and Stenberg, 1981; Boyle, 1984) thereby essentially supporting the primary factor structure of the instrument (cf. Mosher and White, 1981) sufficient to justify higher-order analyses. Furthermore, the DES-III is unique in conceptualization as it assumes characteristic patterns of fundamental emotions for various mood states [such as Curiosity, Anxiety or Depression—see Boyle (1979, 1983a)]. As Blumberg and Izard (1985) stated, differential emotions theory, "recognizes a reciprocal causal relationship between emotions and cognition but emphasizes the motivational functions of emotions and hence their status as independent variables.... A pattern of emotions is defined as an interactive set of emotions, in which one of them, the key emotion, is experienced more intensely and more frequently than the others. The emotions in the pattern are causally linked; that is, the activation of one of them, particularly the key emotion, increases the likelihood that the others in the set will be activated. As Izard et al. (1985) pointed out, the strong current of belief in cognitive theories in recent years has resulted in comparative neglect of emotional factors in human development. The work of Schwartz and his colleagues (e.g. Schwartz and Weinberger, 1980) has also supported Izard's contention that mood states such as Depression are associated with complex patterns of fundamental emotions.

In line with neuropsychological evidence on brain functioning (Powell, 1979). Izard's research with the DES-III has demonstrated the importance of affective-cognitive structures. In applied studies, however, measurement on all 10 subscales (12 subscales in a more recent 49-item version - DES-IV) might be
unnecessary and perhaps even cumbersome. Under certain circumstances (see Boyle, 1985c), it might be preferable to obtain measurement on a smaller set of higher-order factors which nevertheless, account for most of the variance in the primary factors. Barrett (1983) and Rawlings (1984) have pointed out that, "the most fruitful approach will result from relating broad clusters of higher-order personality measures to profiles of cognitive, psychophysiological, behavioural and environmental (stimulus) measures" (Barratt, 1983, p. 390). The present paper reports some data on the higher-order factor structure of the DES-III, in accord with the rationale of Barratt (1983), Kline (1979, 1980, 1982), Eysenck (1984) and Rawlings (1984).

**Method**

**Subjects**

The mean age of the 204 University of Delaware students was 20.46 years (SD = 2.78 yrs). Virtually all students (about 90%) were females, ranging in age from 18 to 45 years. As participation in the study was voluntary, most students seemed to take the study quite seriously and followed instructions without hesitation. The sample was from a predominantly middle-class socio-economic background. Almost all students were American born and were fluent in both written and oral English. Testing occurred in normal class periods, whereby the students were familiar with the testing situation and this may have facilitated their co-operation.

**Design and procedure**
On the compelling evidence of Schwartz and Weinberger (1980), as well as Sirota and Schwartz (1982) suggesting the validity of laboratory induction of mood states via imaginal techniques, Ss were asked to respond to the DES-III items after imagining that they felt 'depressed'. Use of this particular treatment was employed in part to test Izard's claim (1972) that mood states involve patterns of underlying fundamental emotions. On the evidence of Price, Cattell and Patrick (1981) it was expected that depressed mood would display a complex pattern of DES-III subscale elevations and depressions. Use of the imaginal depressive treatment also allowed some appraisal of the suitability of the DES-III as a measure of depression. Izard (1972) had provided some evidence that hospitalized depressed patients responded to DES-III items like normal Ss asked to imagine depressed mood. Instruments used in the present study comprised a certificate of informed consent, the DES-III and a computer score sheet all stapled together for ease of administration.

**Factor analytic methodology**

An iterative principal factoring of the DES-III item intercorrelations (the 30 x 30 inter-correlation matrix was the starting point for the factor analysis) was performed in accord with criteria recommended by Cattell (1973, pp. 282-287. 1978, 1979, p. 351, 1984, pp. 149-156). Kline (1979, pp. 38-41. 1980, pp. 323-324, 1982), Gorsuch (1983), Cureton and D'Agostino (1983) and Carroll (1984). These criteria have been discussed critically by Boyle (1985d). Convergence of communality estimates at the third decimal place required 18 iterations. Boyle (1983c) demonstrated that increasing the number of iterations of the unrotated factor matrix beyond convergence at the third decimal place has a trivial effect
only in increasing the ± 0.10 hyperplane count and on the resultant approximation of the factor pattern solution to maximum simple structure.

The Scree test (Barrett and Kline, 1982; Hakstian, Rogers. and Cattell, 1982; Gorsuch. 1983) indicated eight first-order factors, rather than the 10 designated by Izard and his colleagues as having a measurement basis in the DES-III. Extraction and rotation of the eight factors to oblique simple structure using the SPSS direct Oblimin method (Nie, Hadlai Hull, Jenkins, Steinbrenner and Bent, 1975), resulted in a total solution ± 0.10 hyperplane count of 60.42% and provided clear support for the DES-III subscales of Contempt, Surprise, Fear and Disgust (Boyle, 1984), as well as tentative evidence for the remaining subscales. The intercorrelations of the eight primary factors were then submitted to a second-order iterative principal factoring using the same methodology as for the first-order analysis. Orthogonal rotation was not employed given its limitations (e.g. Loo, 1979) and it is now generally recognized that it is only a special instance of the more appropriate oblique rotation strategy (cf. Cattell, 1978, pp. 136-137).

According to Cattell, "even if hyperplanes happen to be orthogonal, an oblique program will stop appropriately at the orthogonal special position. On the other hand, if they are oblique, and if the orthogonal program is used, the orthogonal program will have a 'neurosis', oscillating between the incompatible satisfaction of one hyperplane and another actually oblique to it ...."

**Results and Discussion**

The second-order oblique factor pattern solution is presented in Table 1. As is evident, the first three secondaries were defined by combinations of the eight primary factors extracted, whereas the fourth secondary suggested a general
depression factor with an emphasis on Guilt. Factor I accounted for 48.2% of the variance, whereas Factor IV explained only 7.6% of the variance. While the fourth factor was therefore a small one, its emergence in the final rotated solution nevertheless suggests that the DES-III is a useful measure of depressed mood (cf. Boyle, 1985c, d). As Table 1 indicates, Factor I was bipolar, contrasting Fear with Shame/Shyness, Disgust and Guilt. The factor loadings were 0.57 on Fear, and 0.53 and 0.43, respectively, on Shame/Shyness and Disgust. Factor II also was bipolar, contrasting Surprise (loading 0.90) with Joy and Interest (which loaded -0.48). The third secondary loaded 0.65 on Contempt and 0.62 on Anger.

Results of the first-order factoring of the DES-III item intercorrelations were reported fully in Boyle (1984), where interpretations for each of the eight derived oblique factors were provided. The descriptive labels allocated each of the eight primary factors are included above in Table 1. As pointed out in Boyle (1984), neither seven-factor nor nine-factor solutions were as appropriate as the eight-factor solution retained (the first exhibited a ± 0.10 hyperplane count of only 57.62%, while the second gave a count of 60.41% which was clearly no better than that for the eight-factor solution of 60.42% ). Correlations of these primary factors were mostly moderate (in the 0.4--0.5 range) suggesting the appropriateness of conducting the present higher-order factor analysis. In the present analysis, both three- and five-factor second-order solutions were rejected. The three-factor solution gave an unacceptably low hyperplane count (below 40%), while the fifth factor in the five-factor solution accounted for an unacceptably low percentage of the variance involved (below 4%). Using the criteria for simple structure advocated by Cattell (e.g. 1973, pp.
Factor loadings are rounded to two decimal places. Criteria pertaining to significance of factor loadings, validity of factors with only a single but high loading, as in Factor IV, and the relevance of hyperplane counts are discussed in Gorsuch (1983) as a function of small factor matrices (cf. Boyle, 1985d). Loadings < 0.40 or thereabouts are considered conceptually non-significant (cf. Cattell, 1978, pp. 479-485; Gorsuch, pp. 208-210). Accordingly, only factor loadings > 0.40 are underlined.

Orthogonal rotation was not employed for the reasons stated above.

Comparison of the present higher-order DES factors with higher-order factors derived from the Eight State Questionnaire (8SQ; Curran and Cattell, 1976) yields some interesting parallels (cf. Boyle, 1985d). The first factor in Table I above seems similar to the first higher-order 8SQ factor which was interpreted as
neuroticism (after Eysenck, 1984). The second factor also seems similar to the second higher-order 8SQ factor which was labelled Extraversion. The third factor above clearly represents Anger and Contempt and has no parallel in the 8SQ higher-order solution. The fourth factor is clearly pertaining to depressed mood and might possibly be regarded as related to the Fatigue/ Arousal dimension expressed in the third higher-order 8SQ factor in Boyle's (1985d) study. This comparison of higher-order emotional state factors across separate instruments and samples suggests that the DES-III and the 8SQ both provide evidence in support of Eysenck's basic Neuroticism and Extraversion factors, while the 8SQ also indexes a CNS arousal dimension (cf. Meites, Lovallo and Pishkin, 1980), whereas the DES-III additionally measures both Anger/Contempt and Depression dimensions. On this evidence, these two latter dimensions are complex secondary emotions comprised of more fundamental primary emotional states (cf. Schwartz and Weinberger, 1980).

In particular, the emergence of the depressive-mood factor (Factor IV) at the second-order level suggests that depressed mood involves a pattern of fundamental emotions in accord with Izard's claims (e.g. Izard et al., 1985). This finding is consistent with previous work on the factor structure of depressed mood. Thus Cattell (1979, pp. 76-79), as well as Price, Cattell and Patrick (1981) have listed up to seven primary depression factors, along with three secondary ones, the first of which was a general depressive-mood factor. Schwartz and Weinberger (1980) similarly reported that depression is a complex emotion involving fundamental emotions such as sadness, anger, fear and anxiety.

In conclusion, the present findings suggest the possibility of measuring second-order DES-III factors in applied studies with the instrument. While
measurement even of first-order factors has often been controversial in the past, there is now some consensus as to appropriate factor analytic methodology (e.g. Cattell, 1978; Carroll, 1984; Kline, 1979; Gorsuch, 1983). On the issue of oblique vs orthogonal rotation, even Guilford (1981) who built his structural model of the intellect on orthogonality, has been re-analysing his data using oblique rotational strategies. As for other procedures such as second-order component analysis, it is true that this method would produce dimensions which are linear combinations of the primary factors. However, component analysis, while mathematically elegant, has no necessary psychological meaning (Boyle, 1983c, 1985d; Cattell, 1978; Gorsuch 1983). Given that the factor analytic methodology employed in the present study was appropriate, then scoring for second-order DES-III factors would seem justified, thereby adding to the flexibility and usefulness of the instrument.

Nevertheless, replication with different samples is required before any definitive conclusions can be reached regarding the second-order structure of the DES-III. For example, would the present findings hold for samples of males, or for patients in a clinic? Would the correlations between primaries remain constant over different samples? Certainly, comparison of the DES-III second-order factors in the present study with 8SQ second-orders suggested the validity of the present findings, as two factors seemed to match directly across instruments, samples and studies. There was also some evidence of discrete measurement variance in the two mood-state instruments at the second-order factor level. Although the present findings are clearly prefatory, it is hoped that they will provide the springboard for further studies in this important area.
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References


