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ABSTRACT

Procedures for analyzing common item effects or interscale structure were reviewed and a study using smallest space analysis of the California Psychological Inventory (CPI) reported. Solutions of three matrices--intercorrelation matrix of the original CPI scales, of reduced scales (with common items removed), and of the number of common items--were compared visually, and by interpoint distance correlations and configurational similarity analyses. Marked similarity among the original structure, the item-overlap-free structure, and the built-in structure was observed. It was concluded that common items magnify an intrinsic structure already existing among scales, and that the common-item problem is not a serious one in such personality assessment. (Author)

THE COMMON ITEM PROBLEM IN MEASUREMENT

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The early admonition by Guilford (1952) to avoid the factor analysis of test scales containing overlapping items has been little heeded by test researchers. This state of affairs may be due to the lack of information on the distortions or specific influences attributable to item overlap (Shure & Rogers, 1965), and thus such factor studies have continued apace. Significantly, few studies directly concerned with the effects on factor structure of item overlap have been reported (Rogers & Shure, 1965).

An extensive review of the literature indicates that two main methods have been employed in investigating the item overlap issue. The first method has been to obtain overlap-free intercorrelations and to compare them, or their factor structure, to original intercorrelations or their factor structure. The underlying assumption in this method is that similarity between the two factor structures indicates that item overlap is not significantly affecting scale structure. Four different techniques have been employed in obtaining the overlap-free intercorrelations:

1) removal of all overlapping items (Kessebaum et al., 1959);

2) partial removal of overlapping items (Rogers & Shure, 1965);

3) obtaining the square root of the differences between the squared common-elements correlations and the squared original correlations (Anderson et al., 1966); and

4) partialling the item-overlap effect by second-order partial correlations (Havlicek, 1965).

The studies employing the first three techniques indicated that item overlap had no significant effect on scale structure. The fourth study (Havlicek, 1965) indicated that item overlap affected the magnitude of the correlations, but unfortunately no information was available as to the effect on scale structure.

The second method has been to obtain the built-in intercorrelations based solely on the scale weights and to compare their factor structure to the factor structure of the original intercorrelations. The underlying assumption in this

method is that similarity between the two factor solutions indicates significant item overlap effects on scale structure. Two different techniques have been employed in obtaining the built in intercorrelation:

1) computing the common-elements correlations between the scales (Shure & Rogers, 1965; Silverstein & Fisher, 1968);

2) assigning random answers to the scale items and computing the intercorrelations from these scores (Wolf, 1971).

The three studies above which have employed this method have indicated that factor solutions based exclusively on item overlap are highly similar to solutions based on original intercorrelations, suggesting that item overlap is influencing scale structure.

Although factor analysis has been the most extensively employed technique in the analysis of structure among variables, there has recently developed an intense amount of theoretical and applied exploration into more parsimonious and nonmetric techniques for the identification of order relations in intercorrelation matrices (Guttman, 1966; Kruskal, 1964; Shepard, 1962). These methodologies are generally of a multidimensional scaling type that represent variables as points in Euclidean space with interpoint distances corresponding to the proximities of variables as provided by their intercorrelations. Thus, geometric representations of order relations are provided. A singular feature of these analyses is their parsimony where the number of dimensions is concerned. One of the better known of these techniques is that of smallest space analysis (SSA) (Guttman, 1966, 1968). Karni and Levin (1972) have recently extended the use of the SSA procedure to the study of personality scale structure, using intercorrelation matrices of CPI scales.

Because of the parsimony and the geometric representation properties of smallest space analyses, and related multidimensional scaling procedures, it may be anticipated that their use in the study of personality scale structure will increase. However, no consideration of item overlap effects on SSA solutions has yet been attempted, though on the basis of the factor analytic work reviewed above, it is clear that such research should be undertaken prior to any extended application of this tool. It is quite possible that item-overlap increases the magnitude of the correlations between scales due to the increase in the range of scores, or to the fact that the item has identical scores on both scales. In view of this, it might be argued that SSA is to be preferred to factor analysis in investigations of item-overlap effects, as SSA uses the order relations of intercorrelations and will be unaffected by increases in the magnitude of intercorrelations that have no effect on order, while the opposite is true of factor analysis.

The aim of the present study was to compare the original CPI scale structure obtained through SSA, with the built-in structure of the CPI on the one hand and with the item-overlap-free scale structure on the other hand.

Three techniques were employed to obtain the CPI item-overlap-free scale structure: (a) intercorrelation matrix based on reduced scales containing the non-overlapping items only; (b) intercorrelation matrix based on reduced scales containing non-overlapping items and overlapping items which were randomly distributed among their scales, so that any overlapping item appeared in one scale only; (c) intercorrelation matrix based on reduced scales containing non-overlapping items (as in (a) above) with correction for reduction in scale length.

Four matrices were employed for obtaining the CPI built-in structure: (a) common-elements intercorrelation matrix based solely on the number of overlapping items between the scales; (b) intercorrelation matrix based on correlations among CPI scales which had been constructed randomly from the CPI protocols of real subjects; (c) intercorrelation matrix based on correlations among CPI scales which had been constructed randomly from CPI protocols generated by computer (i.e., "stat rats"). Two such matrices were obtained, with each including 153 such "stat subjects".

The original CPI structure was obtained from an intercorrelation matrix of the CPI scales which appeared in the CPI manual (Gough, 1957). A similar solution was also obtained from an intercorrelation matrix of original scores based on 153 new subjects.

The similarity among the various solutions was assessed both visually and through numerical analysis.

In order to evaluate the similarity among the solutions at the visual level, Karni and Levin's (1972) interpretation of the CPI scale structure was adopted. Their interpretation fitted the SSA solution based on the original scores of the sample used in the present study. Such a result adds further support to the reliability of Karni and Levin's solution and indicates as well that the sample used in the present report is fairly representative, at least where scale structure is concerned.

The item-overlap-free solutions fitted the same interpretation almost completely. The only deviation occurred in the solutions based on reduced scores and reduced scores corrected for restricted range, where one scale appeared in a different region. Similarly, in the solutions based on the number of overlapping items, all solutions closely approximated the original solution with only two exceptions, these being obtained in one of the random solutions. One numerical analysis of the similarity among the various solutions was accomplished through Kendall rank correlations (Tau) among the derived distances between the scales based on the SSA solutions. These coefficients indicated that the item-overlap-free solutions were closer to the original solution than were the built-in solutions. The solution based on

partially reduced scales was the closest to the original (Tau = .73), followed by the solution based on reduced scales with correction for length (Tau = .53), the solution based on reduced scales without the correction (Tau = .53), the common elements solution (Tau = .46), the solution based on scales constructed randomly from protocols of real subjects (Tau = .30) and the two solutions based on scales constructed randomly from "stat subjects" (Tau = .23 and .20). The Kendall Coefficient of Concordance among all solutions was .520. All coefficients were significant at $p < .001$.

The configurational similarity (CS-I) analysis of Lingoes (1967) was also employed in comparing the various SSA solutions to the original solution. The results here were similar to those above.

Finally, the intercorrelation matrix based on the Kendall rank correlations among the interpoint distances was submitted to SSA. This solution indicated the existence of two dimensions among all the solutions. The first dimension represented the item-overlap effect, ordering the solutions as follows: reduced scales, partially reduced scales, original scales and random scales. The second dimension was interpreted as representing a response set effect, clustering separately all solutions based on real subjects on one side, and random solutions on the other side.

The high similarity between the item-overlap-free solutions and the original solution supports the claim that item-overlap has a negligible effect on CPI scale structure. On the other hand, the significant relationship between the built-in solutions and the original solution suggests that item-overlap <u>does affect</u> CPI scale structure. Such contradictory results are resistant to explication. One possible solution might lie in the notion that the number of overlapping items has a special meaning, that is, overlapping of items between scales does not just happen, but that there is a reason; if two scales have many items in common it is because the two scales are reflecting at least partially similar psychological characteristics, and the more items there are in common the greater the similarity in the characteristics. Thus the number of common items might be an indication of the relationship between scales.

On the basis of the above argument it might be concluded that overlapping items only magnify an intrinsic structure already existing among the scales. Such a conclusion, however, should be approached with caution. Overlapping items might indicate relationship among scales only in the culture in which the test was constructed. Thus, an item overlap effect might distort the scale structure when the scale is used in different cultures. In the western culture, for example, self-acceptance and dominance are characteristics that often go together, therefore it is not surprising that the Dominance scale and Self-acceptance scale in the CPI share six items in common. However, in some eastern cultures sense of self worth and self acceptance are independent of one's interest or ability to dominate others. Thus, when used in a culture that is different from the one in which the test was constructed, item overlap might impose erroneous relationships among the scales.

It should be pointed out that the present study was limited to the CPI--similar studies employing other tests and inventories, as well as measures in the cognitive domain, should be undertaken.

Keeping the foregoing limitations in mind, it might be tentatively concluded that item overlap and scale interdependency is not as serious a problem in personality test construction as some writers have suggested, and that its presence or absence may have no significant effect on test structure.

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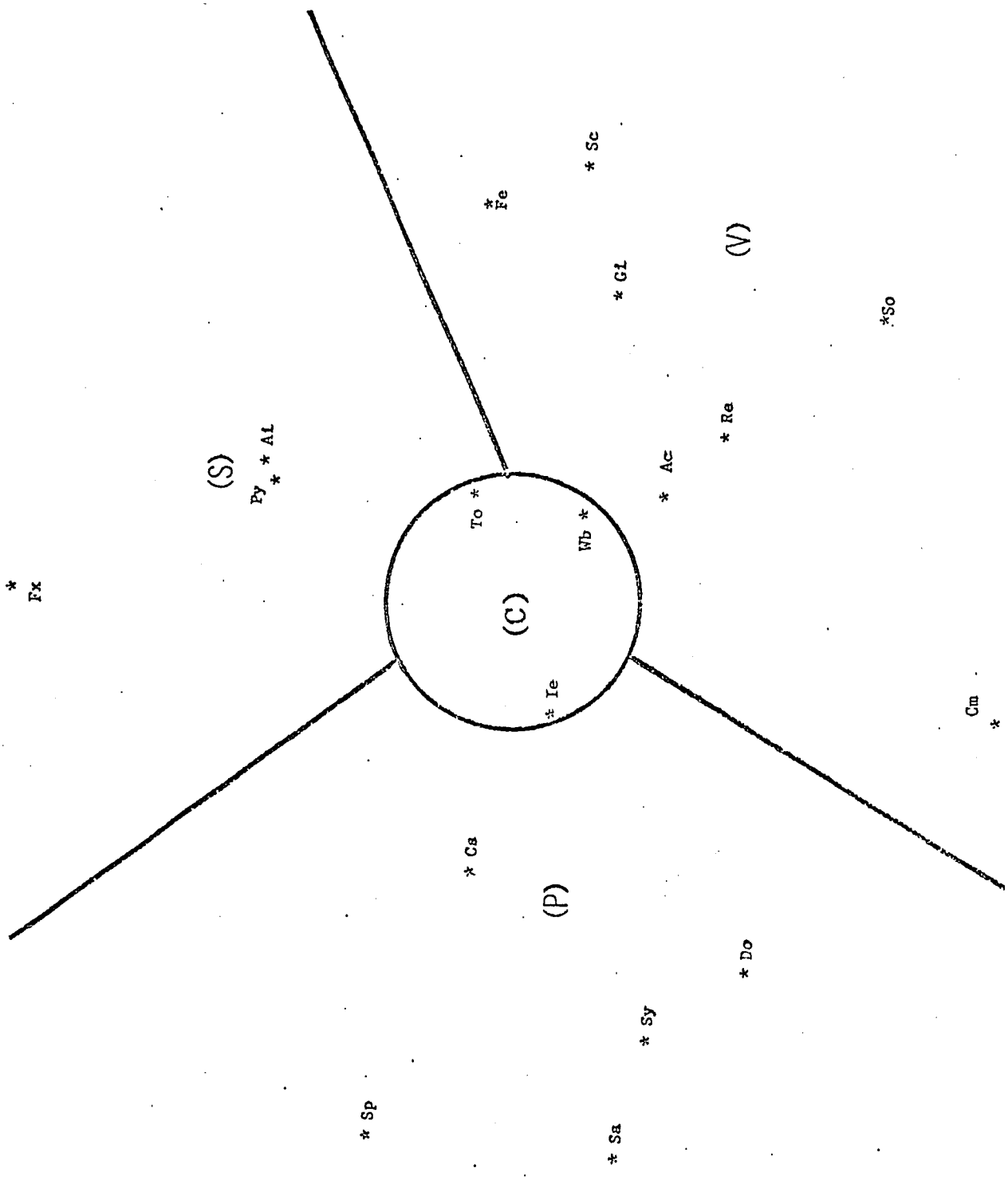

Fig, 1. The SSA of the original CPI scales from the CPI manual.

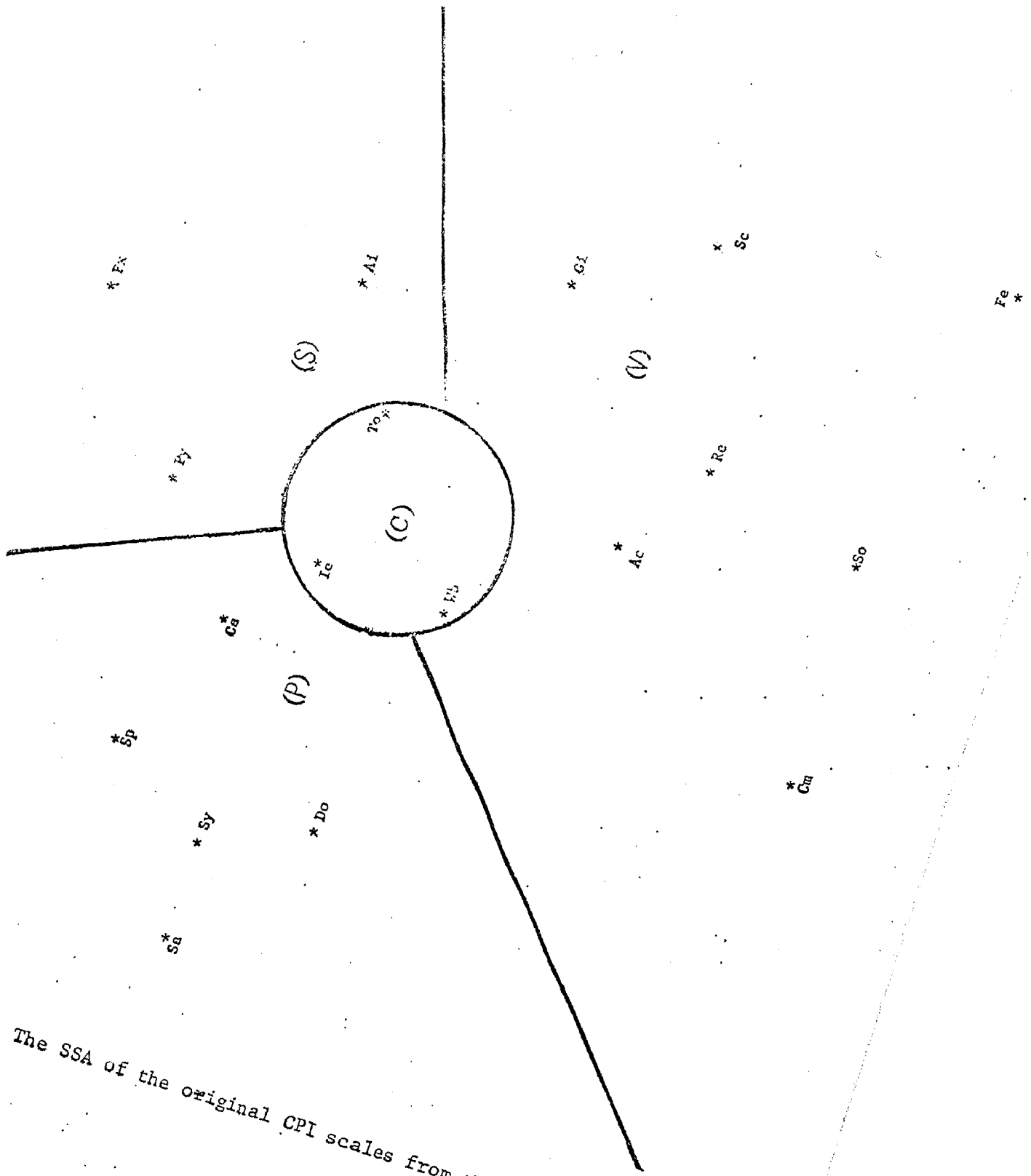

Fig. 2. The SSA of the original CPI scales from the present study.

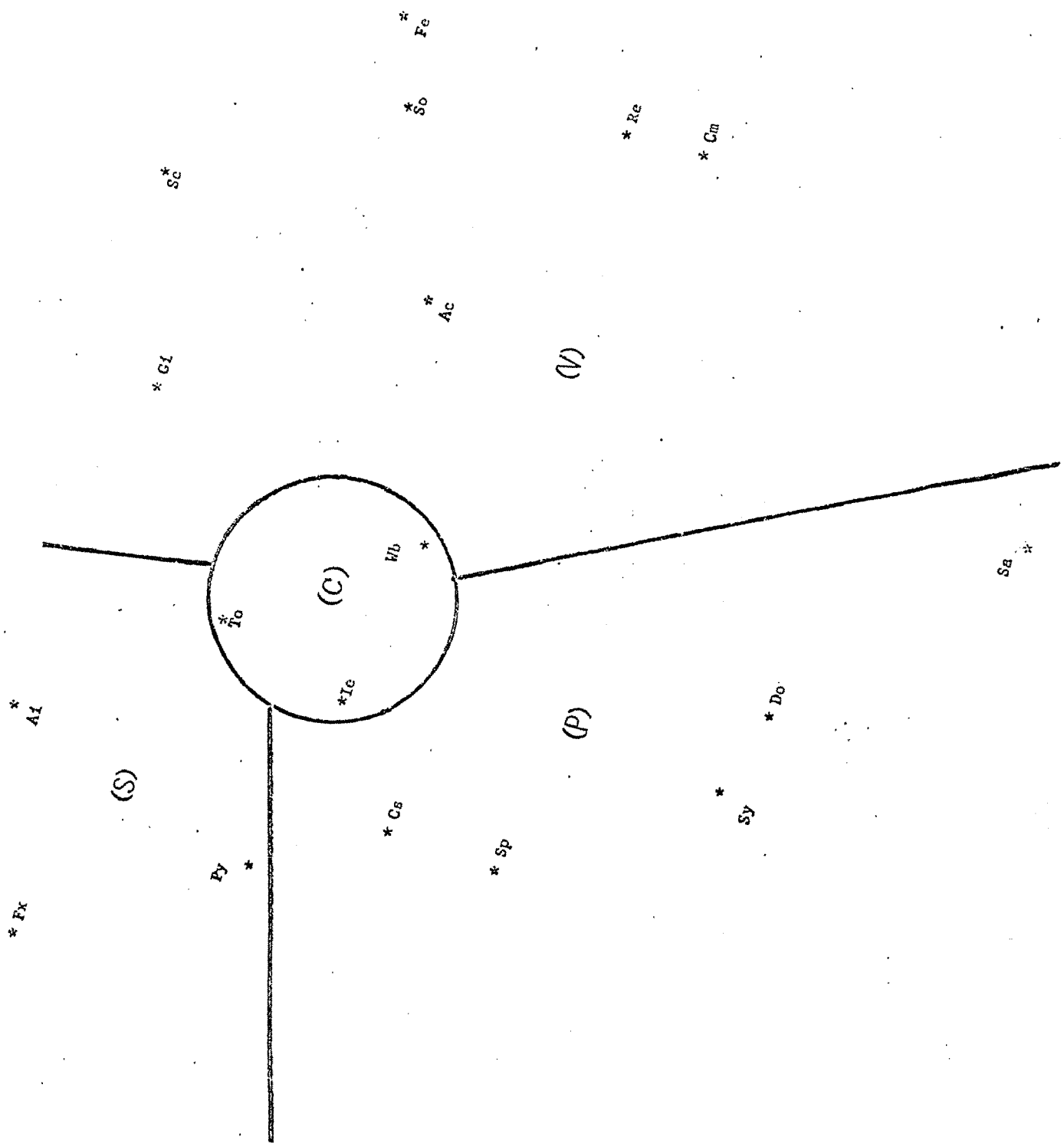

Fig. 3. The SSA of the partially reduced scales.

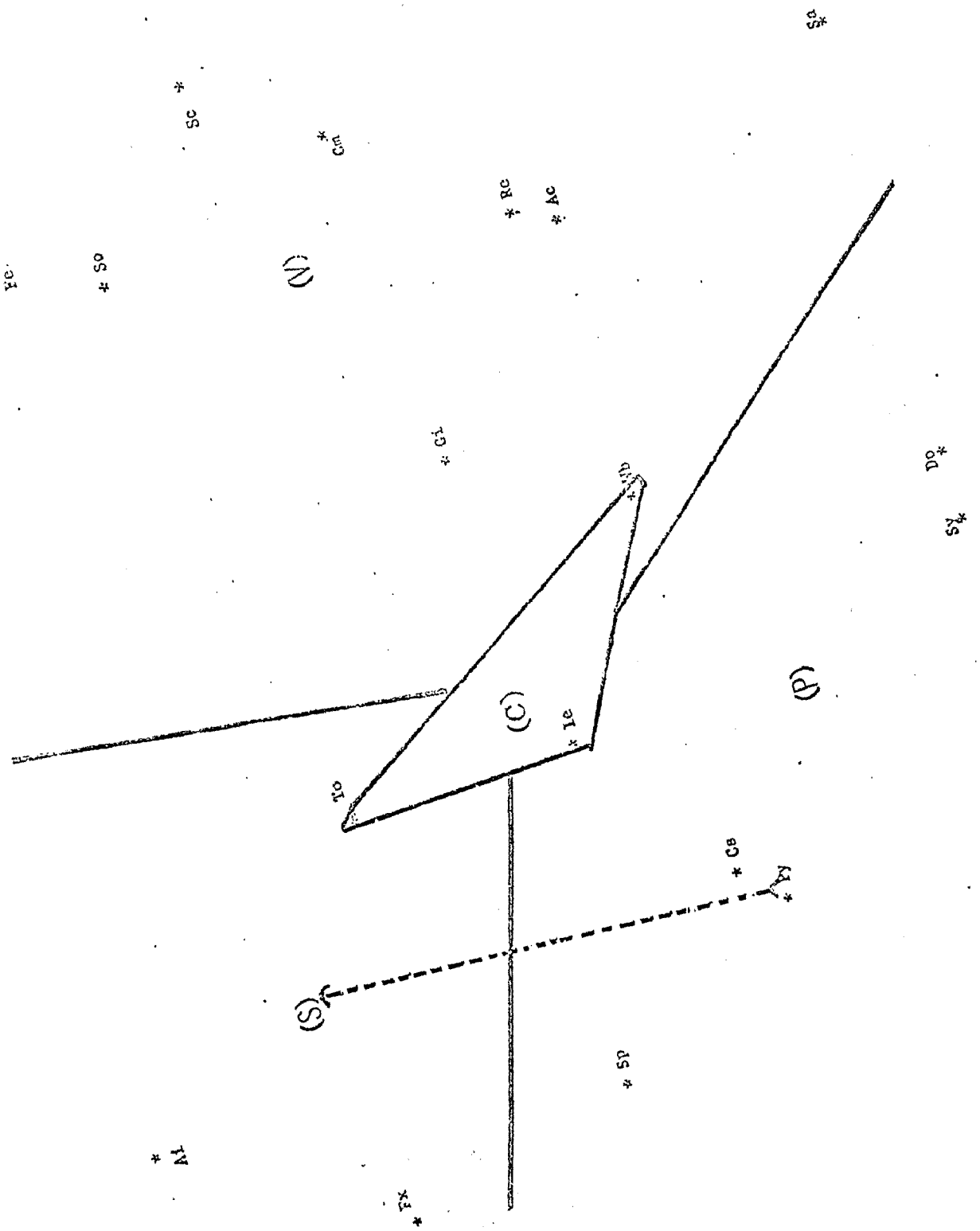

Fig. 4. The SSA of the reduced scales.

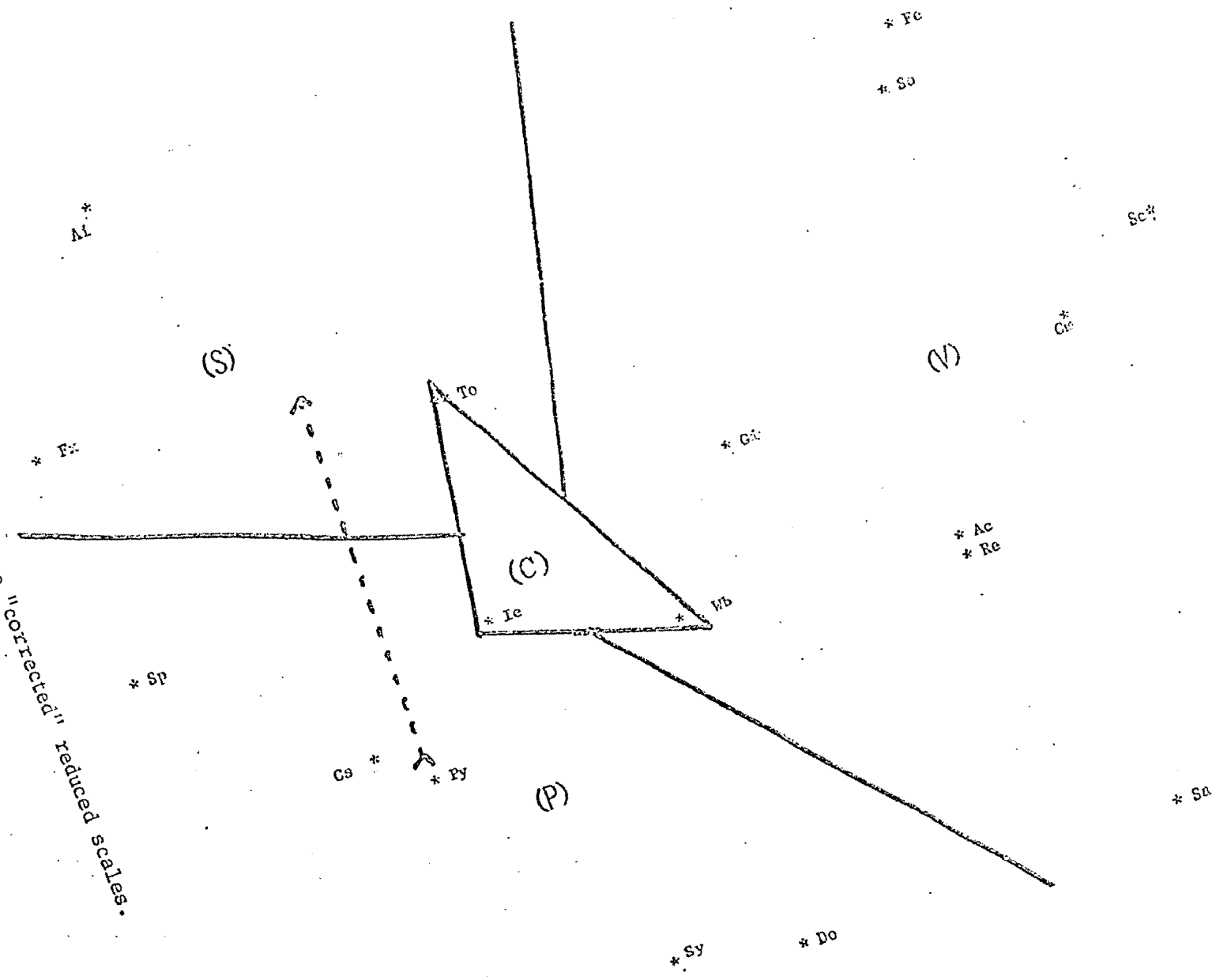

Fig. 5. The SSA of the "corrected" reduced scales.

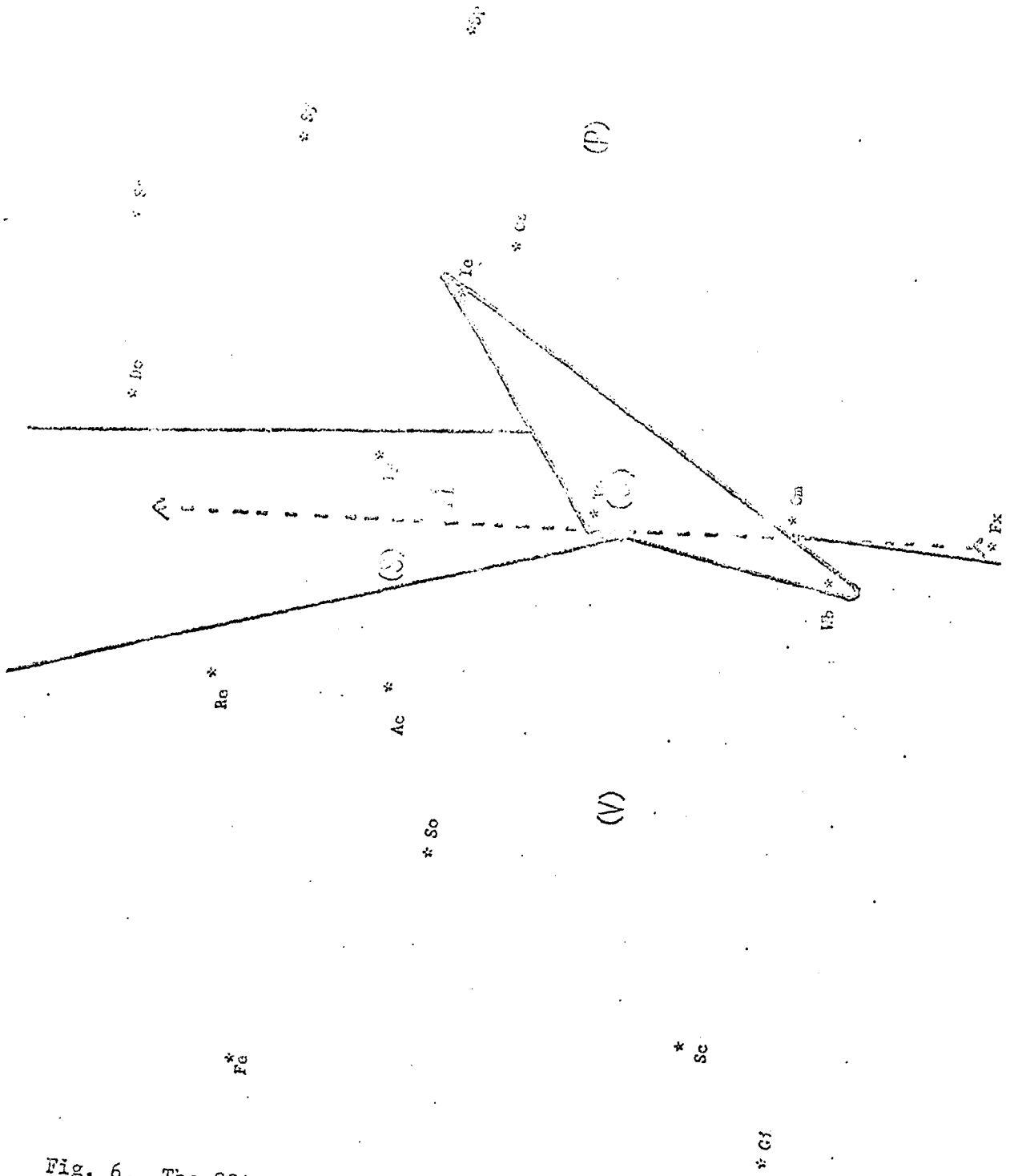

Fig. 6. The SSA of the common-elements correlations.

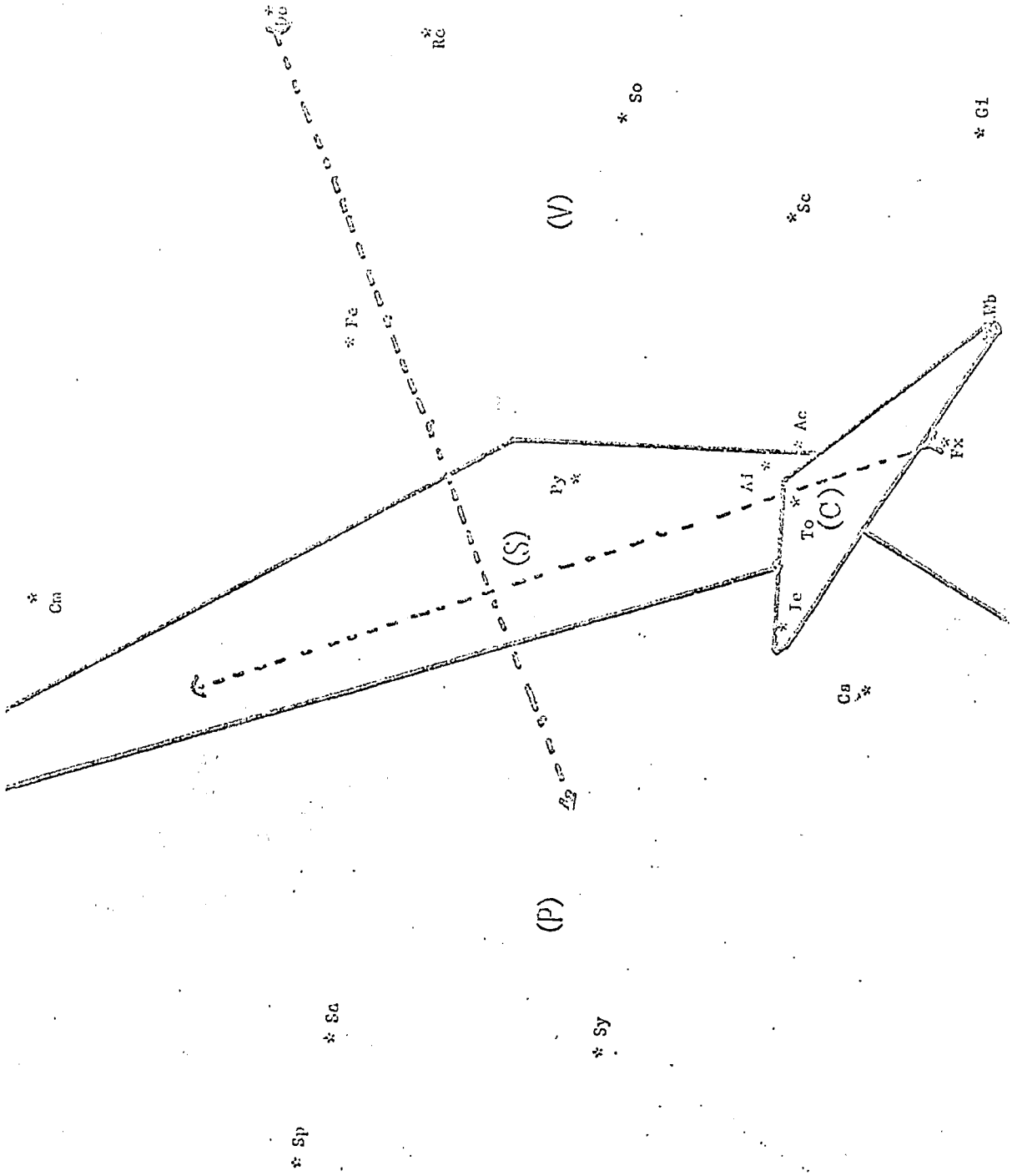

Fig. 7. The SSA of randomly constructed scales from real subjects.

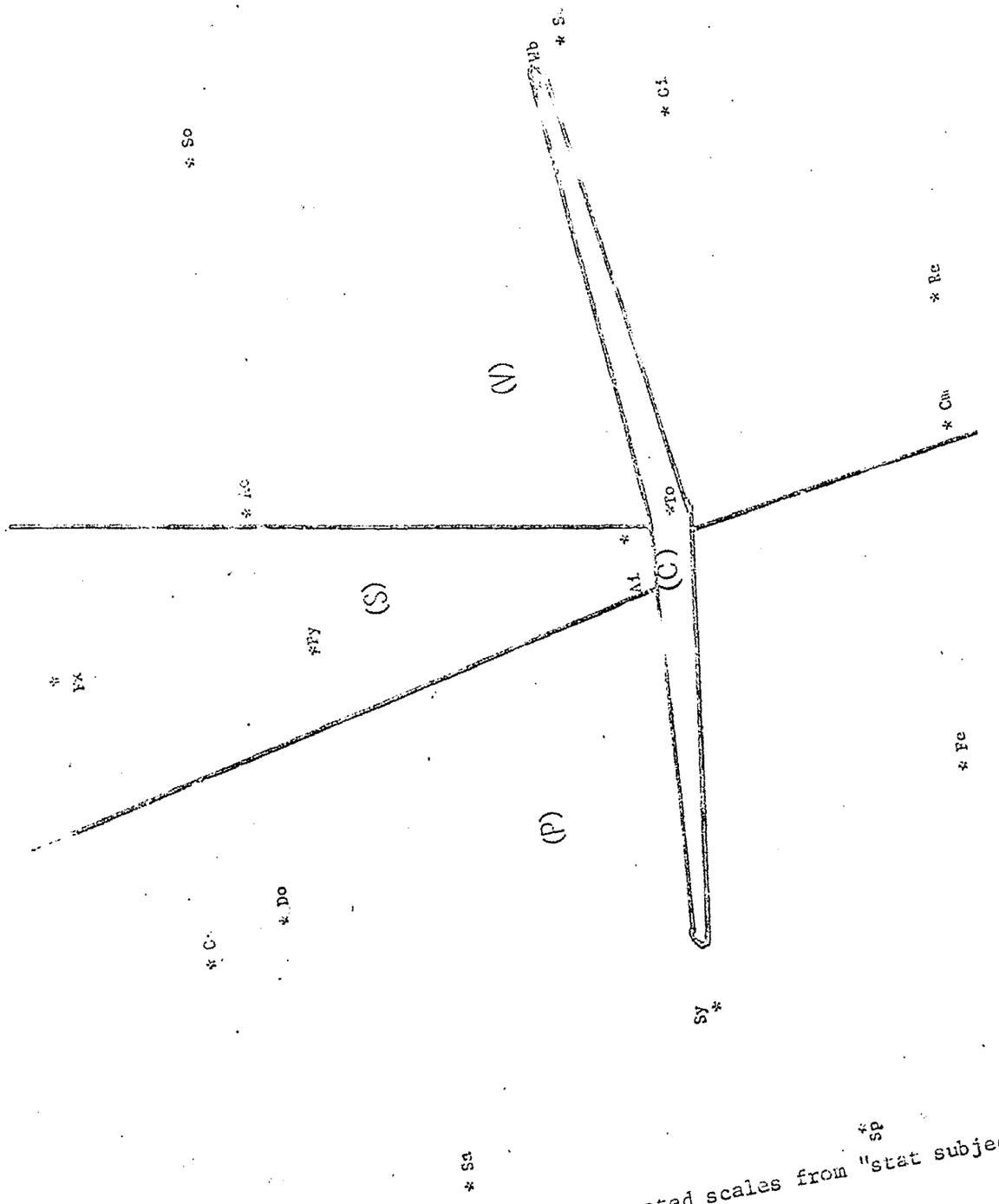

Fig. 8. The SSA of randomly constructed scales from "stat subjects" sample one.

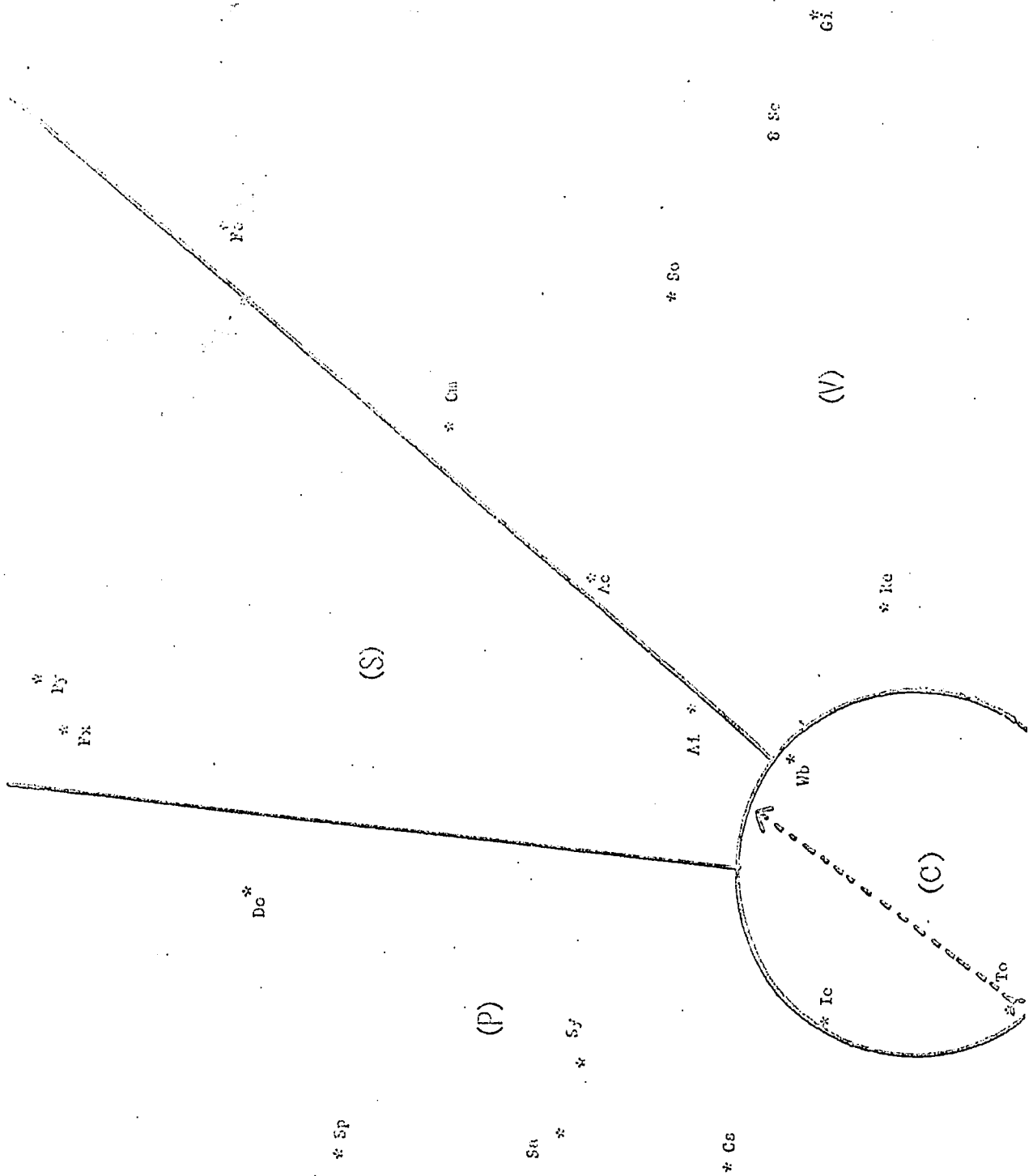

Fig. 9. The SSA of the randomly constructed scales from "stat subjects" sample two.

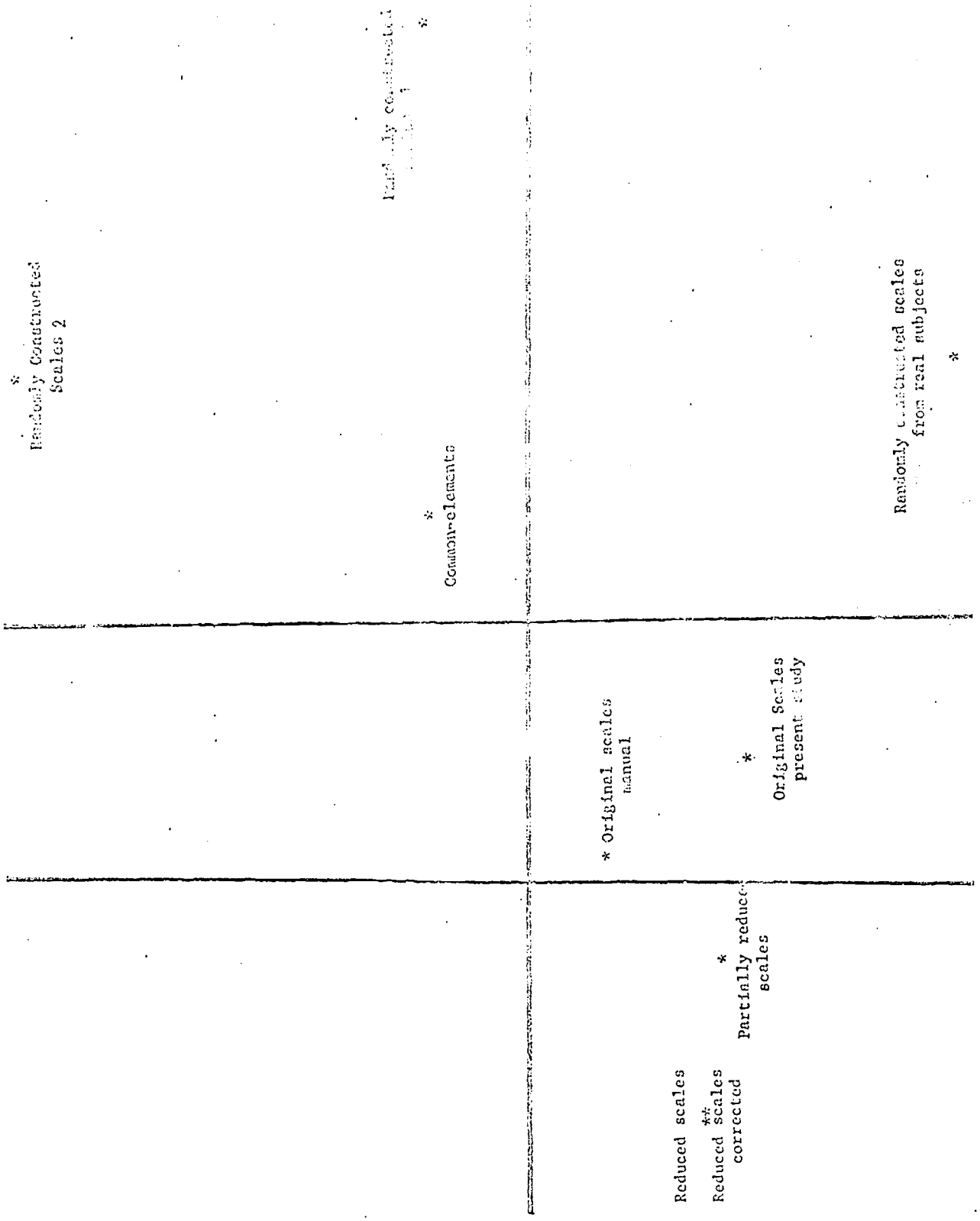

Fig. 10. The SSA of the various CPI intercorrelation matrices.