A RESEARCH ON POSITIVE INTERESTS TOWARD THE SEA

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I. Introduction

Japan is surrounded by the sea. The Japanese people have been deeply concerned with the sea in their daily life ever since ancient times. A wide variety of seafoods has been supplied as keeping preferable protein, and for that reason the fishing industry has been prosperous for a long time. Japan has largely depended on foreign countries for importing raw materials and exporting finished products. Foreign trade has been one of the most important industries. The Japanese seacoasts are filled with long stretches of scenic beauty, called "hakusha seisho", which means white (golden) beach and evergreen pine trees, and in summer people enjoy swimming in the sea.

Recently, however, things have been changing gradually. Imports and exports by air are increasing; shipping is a declining industry nowadays. According to a previous social psychological survey (Kuroda, 1979), young men intending to engage in occupations concerning the sea are decreasing in both quality and quantity now. The sands have been turned into artificial lands by reclamation work; children who live near the sea are obliged to swim in a pool of their own school.

Foreign trade still remains one of the most important industries in Japan, and thus ships and seamen are indispensable for the prosperity of the nation. A triad of the sea, ships and seamen was chosen for the research described in this paper and investigated with relation to a hypothesis that the Japanese people still remain a maritime nation with an orientation toward the sea. People's affective feelings toward the sea, ships, and seafarers were temporarily defined as *the positive interests toward the sea and sea affairs* (abbreviated PITS hereafter) and a degree of inner images or deep feelings rather than the amount of knowledge concerning the sea affairs was tried to be measured operationally as a PITS score.

Although environmental assessment or preference of landscape has been dealt with in the field of environmental psychology (Russell & Ward 1982, and Stokols 1978), an aspect of affectionate feelings is centered on here in this paper. Bentler (1969) checked that semantic space obtained by SD (Semantic Differential) procedures and partial correlation methods is approximately bipolar. Meaning that people attribute to environment is divided into perceptual cognitive and affective connotative meanings. Bipolar dimensions of affective meanings such as pleasantness-unpleasantness, activationdeactivation, positive-negative social orientation, exciting-gloomy, and relaxing-distressing, etc. were proposed by correlational, regressional and factor analytical methods (Meddish 1972, Russell 1979, and Russell et al. 1977, 1980).

Before carrying out the surveys, the following purposes were set. The main one is to determine dimensions of the images that are necessary to describe the sea and sea affairs, and to measure their degrees as the PITS scores with relation to the geographical characteristics, especially as to the distance they live from the coast. It was intended to ascertain whether high scores of the images had been acquired by daily contacts with the sea or they came as a longing far away from the sea.

Six places were selected by drawing a line vertically through Hyogo Prefecture and the middle of the Kinki District (Table 2). They include two spots facing the sea at the opposite ends on the northern and the southern parts and four inland places far from the coasts, being located approximately the same distances from each other except the distance between Yoshino (B3) and Keihoku (B4). By selecting those six survey places, the geographical structure "seacoast-inland-seacoast" was obtained and consequently the following patterns of profiles could be hypothesized.

Pattern (i) —In areas close to the sea, people are familiar with the sea and ships, and receive a large amount of information concerning the sea affairs. Inhabitants of inland districts, however, have fewer opportunities for such contact, and this would exhibit less interest and affection. In this case, the image profile would be a U or cup-like curve.

Pattern (ii) —In contrast, young men raised in mountainous areas far from the sea often have longing for the sea and ships. It is said that people would have some desire for anything they cannot have. In this case, the profile would show an upside-down U or cap-like shape.

Pattern (iii) —A distinct type cannot be identified. The images of the inhabitants of the coastal areas and in inland regions show the same score level and the profile is marked as a horizontal line.

The profiles of the PITS scores were drawn and groups or clusters of respondents, coastal and inland, were investigated in order to ascertain the patterns.

The second and additional purpose is to investigate a gradient of the PITS scores among professional seamen, cadets of training ships, and students at maritime school. A hypothesis that seamen will show higher scores than other cadets and students going to sea will be tested.

II. Method

Subjects and Survey Procedures

Two kinds of surveys that have been conducted heretofore are shown in Table 1.

(1) The first was surveyed at various places (Table 2) of Hyogo Prefecture and the middle Kinki District. The subjects were both junior and senior high schools students and their parents. The surveys for students were administered in their classroom as a group, and those for parents were at home under the directions of their sons or daughters (high school students) who had already received instructions during group surveys at school. The total number of respondents was 3300 men and women. The seventh groups in the table are students of fishery high schools.

(2) The other was surveys for students and seamen. General and mercantile marine college's students in Kinki District were surveyed at their classroom and responded to the questionnaire sheets immediately after instructions. The surveys for cadets, senior students who were on board training ships of the Institute for Sea Training, Ministry of Transport, and seamen who were working on ocean lines, were administered on their ships while at sea under instructions of a teacher or chief officer of their ships.

The mercantile marine students, cadets and seamen were all male, and others both male and female, about half and half. The surveys were carried out from 1977 to 1983, and the return rate was almost 100% in all cases.

Table 1 Numbers of Respondents

Group	Number	District A		District B	
District A*	1258	A1. Tsuna	194	B1. Kushimoto	392
District B	2045	2. Himeji	188	2. Totsugawa	438
G: GS**	337	3. Ichinomiya	189	3. Yoshino	76
M: MMS	198	4. Oya	201	4. Keihoku	307
C: Cadets	467	5. Muraoka	186	5. Miyama	231
S: Seamen	438	6. Kasumi	192	6. Obama	434
		7. K. Fishery	108	7. O. Fishery	167
Total	4743		(1258)		(2045)

*A: Hyogo Prefecture, B: Middle Kinki District
**GS: General college students, MMS: Mercantile marine students

Table 2 Location of the Survey Places

District A: Hyogo Prefecture		latitude N, longitude E	District B: Middle Kinki		latitude N, longitude E
A1. TS	: Tsuna	34°26', 134°54'	B1. KU	: Kushimoto	33°28', 135°47'
2. HI	: Himeji	34°50', 134°41'	2. TO	: Totsugawa	33°59', 135°48'
3. IC	: Ichinomiya	35°06', 134°34'	3. YO	: Yoshino	34°17', 135°45'
4. OY	: Oya	35°20', 134°40'	4. KE	: Keihoku	35°09', 135°38'
5. MU	: Muraoka	35°28', 134°36'	5. MI	: Miyama	35°18', 135°33'
6. KA	: Kasumi	35°38', 134°38'	6. OB	: Obama	35°30', 135°44'

Questionnaire items

The surveys contained the following items:

(1) Face sheet of demographic items.

(2) Questions asking opinions about the sea affairs, attitudes toward seamen on ocean lines, and evaluations of the nation as a maritime country.

(3) Questions asking images about three concepts of *sea, ship and seaman.* Images were rated on a 7-point semantic differential format. Ten scales were arranged for *sea* and *ship* each, and twenty five for *seaman* as listed in Table 3, 4 and 5.

In this paper, it is mainly intended to report on the third item, namely the images of the sea, ships, and seamen.

Statistical methods

Although an image structure of the PITS (positive interests toward the sea) can be seen by plotting every mean on the bipolar adjective scales, it is usually recommended that factor analysis is a useful tool to discern clearly internal latent structures of complicated social phenomena (Cureton & D'Agostino 1983, Gorush 1974, Harris 1975, and Taylor 1977). First, correlations among scales were calculated and arranged into a correlation matrix, $\boldsymbol{R}$; second, PCA (Principal Component Analysis) was employed to find out some independent axes from it. As a stopping rule (Appendix 1), an empirical but effective and often used criterion, whether characteristic roots are larger than 1, was adopted here. An orthogonal procrustes rotation (Appendix 2) was applied to the loading matrix, where a target matrix was composed by an inspection of the varimax solution and the author's previous results (Kuroda and Yoshida, 1981 to 1984).

When those factors (components) were able to be identified, they were named to show their contents plainly, and interpreted in factor space. After naming, factor scores were also calculated for each sample, and finally cluster analyses by centroid method were performed on the mean scores of the survey places.

The same weights computing for factor scores were applied to our second groups of seamen, cadets and students for the convenience of mutual comparisons. The data were also standardized with the same means and standard deviations. At every step when the data was taken, it was confirmed that the factor structures were almost the same, which denotes stability of our factors. In addition, profiles were also almost the same among the first (Hyogo and Kinki) and the second groups.

As cluster analysis, a centroid method with Euclidean distances was employed here after trying several methods. It led the most desirable results in obtaining our hypothetical clusters.

Finally, a method of canonical correlation was adopted for examining relations among the factors that were composed by combining with the three concepts (sea, ship and seaman) or concepts composed by combining with the factors (I, II, III and III′). Although every factor was extracted orthogonally within concepts, the factors when combined with other concepts, or concepts combined with the factors concerned, are not certain to remain independent. The maximum canonical correlation and the generalized coefficient of determination were calculated for this examination (Appendix 3).

The data were processed at the Computation Center of Osaka University. FORTRAN programs in Shiba (1979), Anderberg (1973) and BASIC programs in Tanaka et al. (1984) were used after being modified by the author.

III. Results and Discussion

Factor analysis

Factor loadings after orthogonal procrustes rotations are shown in Table 3, 4 and 5, where three effective factors can be seen about every concept of *sea*, *ship* and *seaman*. The total contributions of those three concepts were 59.6%, 60.7% and 44.2%, respectively.

In the previous studies (Kuroda & Yoshida 1981, 1983) two common factors of dynamism and affective evaluation, and a specific factor of mental closeness were observed by PCA and varimax rotation. However, by applying procrustes rotation on our data here, those three factors were obtained more clearly.

The first factor of *sea*, as is shown in Table 3, is a factor reflecting that we assume the sea to be great, powerful and grave, because sometimes it is rough and high. The high correlations were shown with such scales as '7. grave', '4. powerful', '8. great', '10. masculine', and '6. generous' in order of factor loading. This factor was

Table 3 Procrustes Factor Loadings (*sea*)

Scale	Target	I	II	III	Com.
1. intimate-distant	0 0 1	.215	-.225	**.899**	.905
2. delightful-frightening	0 1 1	-.259	**.619**	**.468**	.670
3. pleasant-unpleasant	0 1 1	.135	**.698**	.385	.654
4. powerful-weak	1 0 0	**.676**	.338	.084	.578
5. cheerful-melancholic	0 1 0	-.001	**.681**	.295	.551
6. generous-mean	0 1 0	**.529**	**.535**	-.071	.571
7. grave-frivolous	1 0 0	**.710**	-.006	-.030	.506
8. great-plain	1 0 0	**.664**	.389	-.097	.602
9. romantic-prosaic	0 1 0	.395	**.625**	.016	.547
10. masculine-feminine	1 0 0	**.598**	.078	.135	.382
Contributions		2.327	2.334	1.303	
Cont. ratio(%)		23.3	23.3	13.0	59.6

also named *dynamism*, and seemed to show a boisterous aspect of the sea. The second one, correlated with the scales of '3. pleasant', '5. cheerful', '9. romantic', '2. delightful', and '6. generous' was called the *affective evaluation* factor. People nourish good images of the sea as quiet and peaceful, and they have associations of dreaminess or romance when thinking of it. They have two opposite images concerning the sea in their minds (Hoshino & Hasegawa, 1986); somedays the sea is calm and quiet, while it becomes angry and dreadful on stormy or windy days. The third factor, having high correlations with the scales of '1. intimate', '2. delightful', and slightly little loading with '3. pleasant' was identified as the *mental closeness* factor. This seems to express a familiar or close sense with the sea in many people's minds independently of their frequency how many times they have actually had contacts with the sea.

As for *ship* (Table 4), nearly the same factors of *sea* were also obtained. The scales and structures were not the same, but the two configurations seemed to resemble each other. The first factor had high loadings with the scales of '8. masculine', '5. important', '2. dangerous', which showed a *dynamic* aspect of ships. The second factor, correlated with '6. attractve', '10. romantic', '7. pleasant', '4. delightful', '1. beautiful', and '9. interesting', was *affective evaluation* toward ships. Finally, the third factor was also called *mental closeness*, because it had high correlations with '3. familiar', '4. delightful', '2. safe', and '9. interesting'.

In the case of *seaman*, the first two factors were the same as the previous concepts. The third one, however, was correlated with the scales of '15. sober', '14. careful', '13. busy', '8. important', '1. difficult', '25. honest', '3. complicated', '18. respectful' etc., which showed that seamen were considered to be engaged in an important and highly skilled vocation. This factor was identified as the *evaluation of profession*

Table 4 Procrustes Factor Loadings (*ship*)

Scale	Target	I	II	III	Com.
1. beautiful-not beautiful	010	.349	**.506**	.289	.461
2. safe-dangerous	100	**-.432**	.361	**.541**	.609
3. familiar-unfamiliar	001	.320	-.305	**.858**	.931
4. delightful-frightening	011	-.148	**.579**	**.547**	.655
5. important-unimportant	100	**.488**	.310	.068	.339
6. attractive-boring	011	.128	**.764**	.260	.668
7. pleasant-unpleasant	010	.212	**.670**	.312	.632
8. masculine-feminine	100	**.742**	.171	.070	.585
9. interesting-uninteresting	001	.379	**.498**	**.420**	.567
10. romantic-prosaic	010	.301	**.719**	.129	.625
Contributions		1.517	2.777	1.777	
Cont. ratio(%)		15.2	27.8	17.8	60.7

factor (see Table 5). Sometimes officers or crews in ships operate modern machines and tools on navigation decks or in engine rooms. The fourth, fifth and sixth components were discarded as errors, though their characteristic roots were larger than one. They were difficult to identify and name.

Those factors were named uniformly after Osgood et al. (1957) as much as possible. Bentler (1969) checked that semantic space is approximately bipolar, and Russell & Mehrabian (1977) extracted bipolar dimensions such as pleasure-displeasure, arousal-nonarousal, and dominance-submissiveness, to be necessary and sufficient to describe a large variety of emotional states. While our results do not entirely coincide with those studies because of differences of the scales and the contents, the results seem quite similar. But they should be further checked by additional surveys in the future.

The means and standard deviations at survey places were listed in Table 6 and 7. To examine differences of the images having different geographical features, two

Table 5 Procrustes Factor Loadings (*seaman*)

Scale	Target	I	II	III′	Com.
1. difficult-easy	0 0 1	.094	-.067	**.491**	.254
2. sunny-gloomy	0 1 0	**.416**	**.486**	.040	.411
3. complicated-simple	0 0 1	.024	.186	**.472**	.258
4. glamorous-not glamorous	1 1 0	**.490**	**.478**	.166	.496
5. modern-old fashioned	0 1 0	.259	**.558**	.049	.381
6. showy-plain	0 0 1	-.240	-.082	.385	.213
7. high class-cheap looking	0 1 0	.195	**.577**	.239	.428
8. important-unimportant	0 0 1	.311	.158	**.519**	.391
9. joyful-painful	0 1 0	.155	**.629**	-.179	.452
10. powerful-weak	1 0 1	**.554**	-.118	.389	.472
11. prestigious-vulgar	0 1 0	-.120	**.660**	.253	.514
12. familiar-unfamiliar	0 1 1	.305	**.467**	.132	.329
13. busy-easy going	0 0 1	.058	.027	**.638**	.411
14. careful-careless	0 0 1	.237	.111	**.687**	.540
15. sober-trifling	0 0 1	.091	.259	**.697**	.561
16. romantic-prosaic	1 0 0	**.638**	**.424**	.131	.604
17. useful-useless	1 0 1	**.573**	.319	.342	.547
18. respectful-irreverent	0 0 1	.381	**.446**	**.417**	.518
19. safe-dangerous	0 0 1	**-.440**	.361	-.354	.449
20. daring-peaceful	1 0 0	**.664**	-.047	**.412**	.613
21. extraordinary-ordinary	1 0 0	**.410**	.079	.207	.217
22. masculine-feminine	1 0 1	**.672**	-.023	.370	.589
23. youthful-not youthful	1 0 0	**.650**	.302	.141	.534
24. independent-dependent	1 0 0	**.546**	.301	-.223	.438
25. honest-dishonest	0 1 0	.017	**.483**	**.434**	.422
Contributions		4.042	3.359	3.640	
Cont. ratio(%)		16.2	13.4	14.6	44.2

Table 6 Mean Factor Score (A. Hyogo)

Factor			1. TS	2. HI	3. IC	4. OY	5. MU	6. KA	7. KF
sea	I	Mean	.066	.074	.153	.039	.208	.225	.183
		SD	1.049	.892	.998	1.082	1.144	1.031	.988
	II	Mean	-.501	.009	.278	.069	-.144	-.473	-.271
		SD	1.055	.821	.963	.924	.965	.856	.896
	III	Mean	.377	.029	-.654	-.340	-.252	.618	.872
		SD	.958	.808	.925	.933	.906	.698	.693
ship	I	Mean	.036	-.249	.032	-.293	.046	.471	.690
		SD	1.006	.974	.916	.907	1.066	1.098	.977
	II	Mean	-.366	.095	.449	.220	.132	-.534	-.142
		SD	.828	.800	.917	.923	.962	.762	.899
	III	Mean	.479	.145	-.286	-.335	-.207	-.046	.710
		SD	.950	.954	1.004	.913	.975	.903	.818
seaman	I	Mean	.071	.082	.186	-.054	.109	-.076	.169
		SD	.928	.834	.864	.843	.895	.873	.874
	II	Mean	.239	.016	.194	-.202	-.053	-.516	-.093
		SD	1.111	.948	.857	1.128	1.001	.847	1.074
	III′	Mean	.180	.018	.113	-.033	.084	-.033	.124
		SD	.944	.971	.949	1.057	.951	1.051	1.058

Table 7 Mean Factor Score (B. Kinki)

Factor			1. KU	2. TO	3. YO	4. KE	5. MI	6. OB	7. OF
sea	I	Mean	.097	-.027	-.373	-.384	-.276	-.018	.154
		SD	1.016	1.020	.988	.978	.971	.957	.995
	II	Mean	-.308	.365	.367	.476	.062	-.008	-.283
		SD	1.051	1.022	.974	.903	.956	.900	.846
	III	Mean	.844	-.682	-.638	-.633	-.367	.369	.495
		SD	.705	.920	.744	.817	.889	.848	.867
ship	I	Mean	.158	-.030	-.283	-.351	-.212	-.004	.297
		SD	1.026	.929	.998	.881	.846	.907	.927
	II	Mean	-.298	.214	.171	.179	-.003	-.013	-.130
		SD	.925	.954	1.016	.897	.935	.828	.799
	III	Mean	.637	-.467	-.408	-.469	-.226	.159	.510
		SD	.938	.958	.839	.828	.949	.995	.997
seaman	I	Mean	.120	.010	-.218	-.093	-.128	-.087	.181
		SD	.837	.835	.849	.854	.936	.895	.797
	II	Mean	.087	.144	.207	-.112	-.036	-.109	.141
		SD	.974	.941	.921	1.011	1.023	1.040	.947
	III′	Mean	.102	130	.023	.023	-.260	-.174	.142
		SD	.978	1.003	1.023	.940	1.015	.929	.995

figures of Fig. 1 and Fig. 2 were made by connecting means of six places and fishery school's students. One-way layout analysis of variance showed that all profiles were highly significant at 0.1% level except two cases of the first factors of *sea* and the third factor of *seaman* of District A ($F=0.983$, 1.272, $df=(6, 1251)$, $p>0.05$).

Being normalized with a mean of 0 and a standard deviation of 1 in those figures, the scores show only relative evaluation; a plus or minus score does not always denote a positive or negative image. Factors I and III resulted in a cup-like curve in both *sea* and *ship*, and factor II a cap-like curve, though the first factors of *sea* (District A) resulted in a rather horizontal line.

Before the surveys, it was assumed that those people who live in mountainous areas would have rather positive images of the sea and ships. The results seemed to support this partly. Only the second factor, *affective evaluation*, was a cap-like curve of the pattern (ii). Recently in Japan, a network system of mass media, especially television, has made a remarkable and nation-wide spread, and consequently even inhabitants in mountain districts can easily watch scenes of the sea and ships on television in their living room. Those indirect and imaginary experiences seemed to make the people in these areas have a longing for the sea more than ever. Although popularization of car ownership, which has happened in the last twenty years in Japan, has enabled them to drive to the coasts easily in a day's trip, the geographical circumstances seem to have a stronger influence and there remains a differecne between those who live near the coast and those who do not.

The two factors *dynamism* and *mental closeness* showed cup-like curves of the pattern (i), though *sea* of the District A was a horizontal. People who live near the coasts and have daily contacts with the sea appear to have more dynamic images and intimate feelings toward the sea.

As for *seaman*, a consistent tendency was not observed. However, significant differences were revealed by comparing the southern coasts (A1, A2, B1) with the northern ones (A6, B6). The former three means were all positive, while the latter two were negative. Statistical tests between two grand means were highly significant ($z=3.87$, 6.38, 4.44, $p<0.001$).

Cluster Analysis

The places where the surveys were carrind out were classified by their factor scores. Centroid method with Euclidean distances for the distance between clusters (Everitt 1974, 1977) made two clusters of the coasts and the inland districts. The stopping rule on clustering was comparison of two variances, traces of the between ($\boldsymbol{B}$) and the within ($\boldsymbol{W}$) variance-covariance matrices. At the final step of all cases, the within variance became larger than the between variance, which denoted the cluster was so big as to include heterogeneous objects. Accordingly, the clusters at

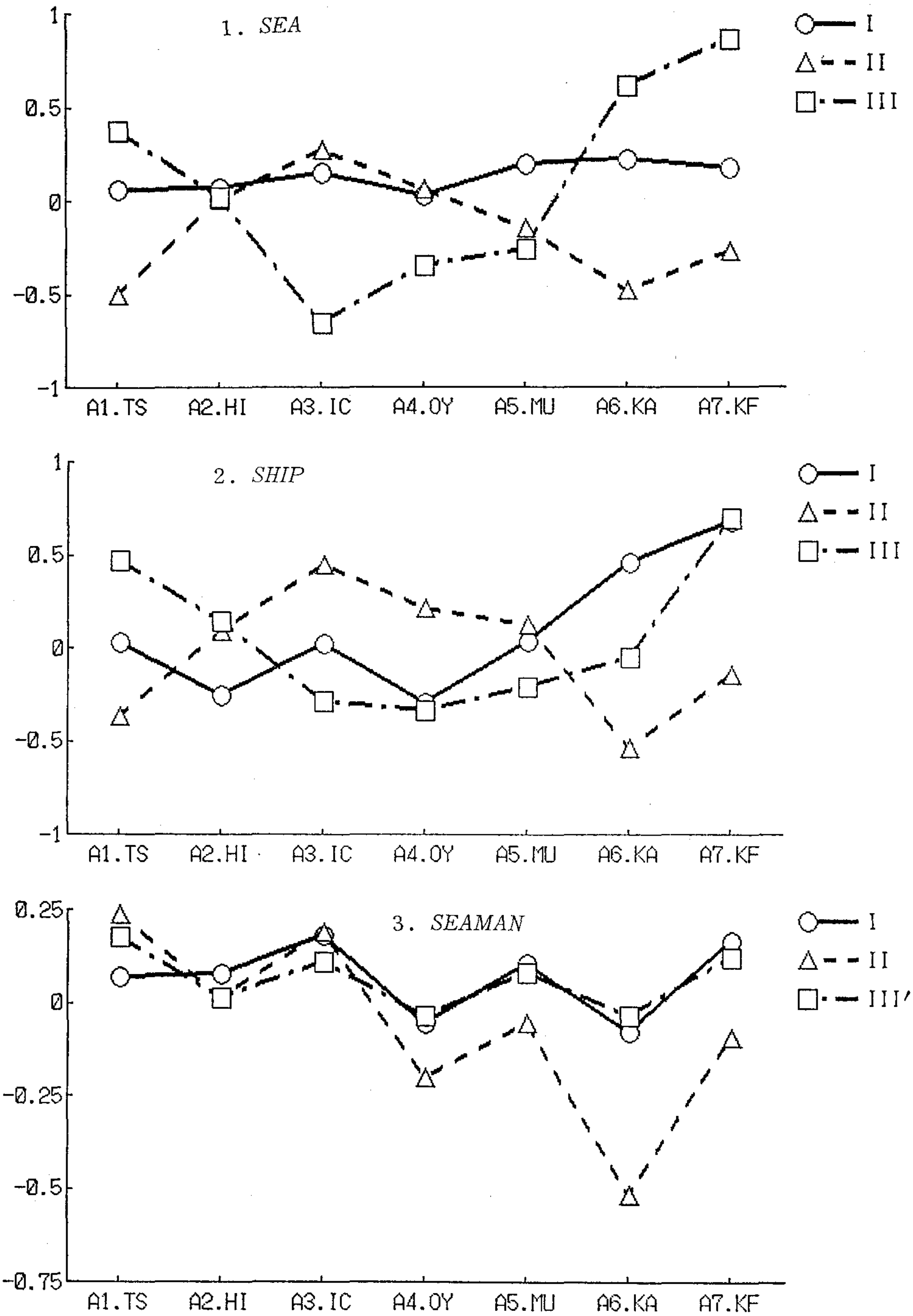

Fig. 1 Mean factor scores of District A (Hyogo). Factor I, dynamism; II, affective evaluation;' III, mental closeness for *sea* and *ship*, and III′ professional evaluation for *seaman*.

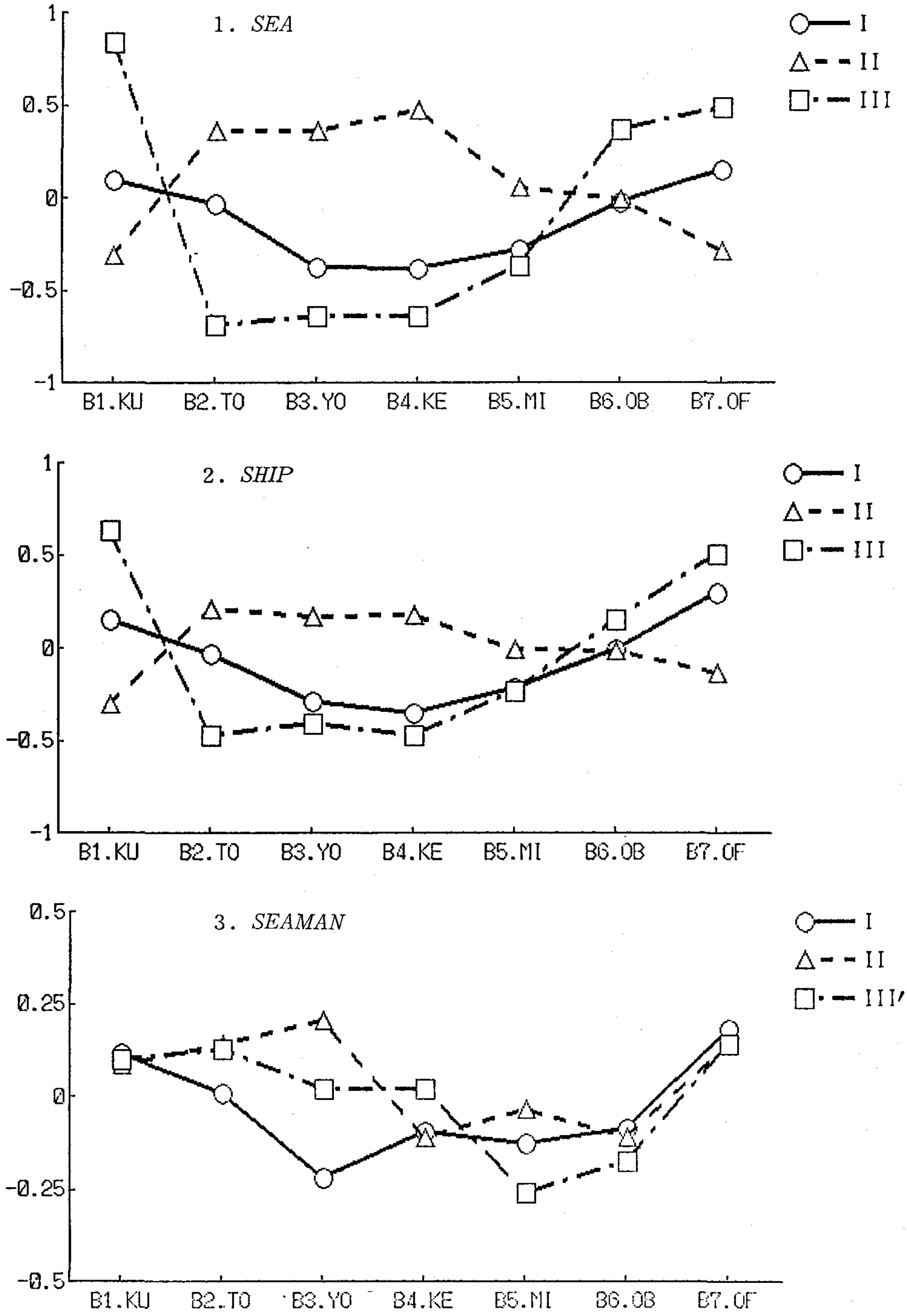

Fig. 2 Mean factor scores of District B (Kinki). Factor I, dynamism; II, affective evaluation; III, mental closeness for *sea* and *ship*, and III′ professional evaluation for *seaman*.

the previous stage seemed to be appropriate. Covariances were almost negligible here, because factor scores were calculated as mutually independent among factors.

We obtained almost the same two clusters of seaside and inland areas at the final step of *sea* and *ship*. They are shown in dendrograms of Fig. 3, and also signified as follows after Hartigan (1975).

((A1, A6), A7), (((A4, A5), A2), A3) *sea*
((A1, A6), A7), (((A3, A5), A4), A2) *ship*
((B6, B7), B1), (((B3, B4), B2), B5) *sea*
((B1, B7), B6), (((B3, B4), B2), B5) *ship*

The southern and the northern parts of the two districts were clearly clustered concerning the images of *seaman*.

((A1, A3), A2), (((A5, A7), A4), A6)
((B1, B2), B3), ((B5, B6), B4), (B7)

While there was no significant differences among the four inland places in Fig. 1 and Fig. 2, a comparison of the two coasts revealed that people who live near the southern coast showed higher scores than those who lived near the northern coast. The Inland Sea of Seto, where Himeji (A2) and Tsuna (A1) are located, is one of the main straits with the Hanshin (meaning Osaka and Kobe) Industrial District. Large ocean vessels enter and leave the ports daily. In addition, Kushimoto (B1) is one of the main mother ports for deep-sea fishing and many fishing boats leave for the Southern Pacific Ocean, the Indian Ocean or the coast of Africa. In those districts, the people seem to have positive images toward ships and seamen. On the contrary, the fishing industry located on the Japan Sea is small scale, and people there may usually associate small fishing boats with the word '*ship*', which often reminds them of a fear of wreckage.

Canonical correlation

Factor analysis was employed to the data in order to see some typical features of the PITS, especially with respect to its geographical characteristics. However, a question arises as to how the concepts of *sea*, *ship* and *seaman* are correlated with each other, that is, what is a relation among the factors, I, II, and III. Although those factors were extracted theoretically as mutually independent, they might not be independent when combined with the three concepts. Another multivariate method, canonical correlations (Harris 1975, and Srivastava & Carter 1983), was adopted to examine this point. Results are shown in Table 8.

At first, Peason's simple correlation coefficients were calculated among nine items. Each of the concepts has three factors and canonical correlations were computed through them. The square root of a generalized coefficient of determination (Yanai & Takane 1985), containing full information of all canonical correlations, was used

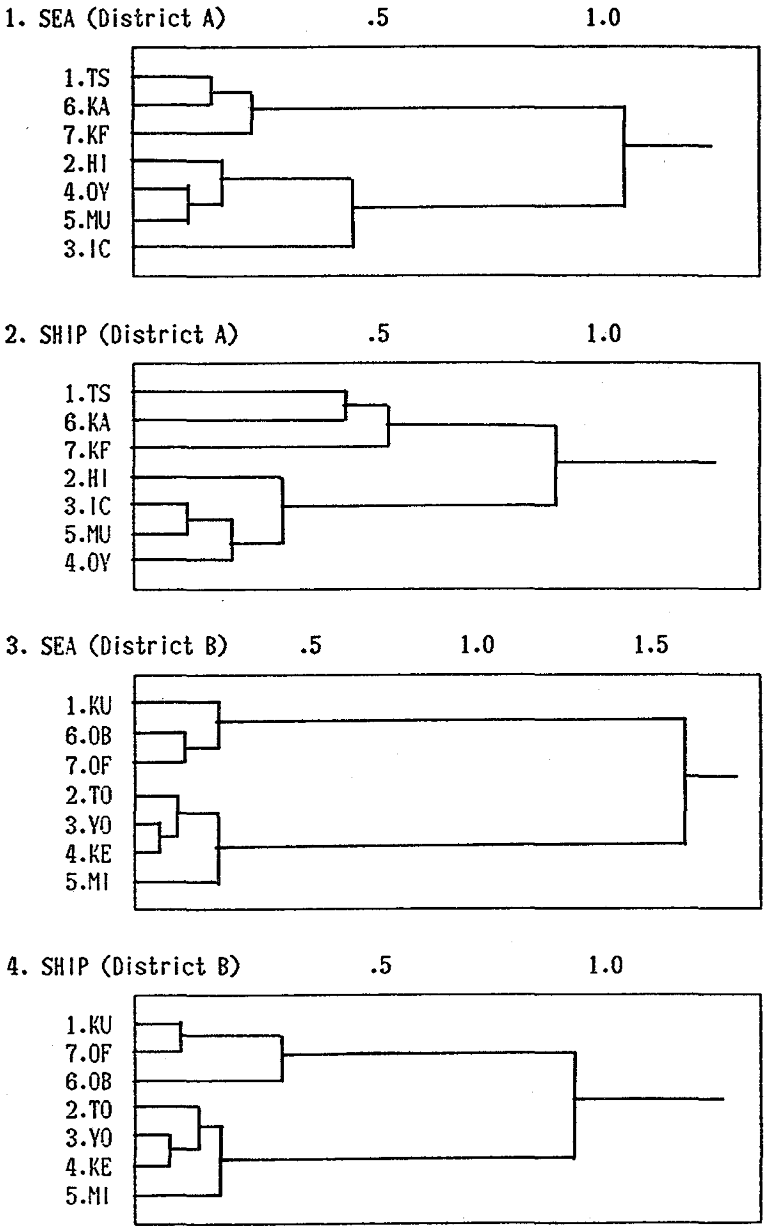

Fig. 3 Dendrograms produced by applying centroid method to survey spots of District A and B.

Table 8 Canonical Correlation and Coefficient of Determination

	Concepts		*sea-ship*		*sea-seaman*		*ship-seaman*
A. Hyogo	r_{c1}		.6046		.5253		.6142
	D		.5107		.3203		.4185
B. Kinki	r_{c1}		.6328		.5801		.6471
	D		.5167		.3529		.4101
	Factors	I-II	I-III	I-III′	II-III	II-III′	III-III′
District A	r_{c1}	.3651	.3281	.3881	.3798	.2206	.0184
	D	.2395	.2323	.3880	.3122	.2206	.0184
District B	r_{c1}	.4309	.1675	.4449	.2900	.3332	.0637
	D	.2711	.1580	.4449	.2175	.3332	.0637

r_{c1} : the largest canonical correlation. D : square root of generalized coefficient of determination. I : *dynamism*, II : *affective evaluation* for *sea*, *ship* and *seaman*, III : *mental closeness* for *sea* and *ship*, III′ : *professional evaluation* for *seaman*.

here to find a degree of dependence. Table 8 shows coefficients among three concepts (upper half of the table) and among three factors after replacing concepts for factors (lower half). The three concepts of *sea*, *ship*, and *seaman* have rather high correlations. The Bartlett test of no correlation (Morrison 1976, Appendix 4) showed that χ^2-values are 204.27 and 111.17, and those were highly significant. Thus we conjecture that images of the sea affairs are correlated with each other.

The three factors are less correlated, but χ^2-values of Districts A and B were 57.94 and 13.72 respectively, which showed significant correlations; both dynamic and affective images of the sea affairs are close in our minds.

Tests by Fisher' inverse hyperbolic tangent transformation (Morrison 1976) indicated that there were no significant differences between respondents of the two districts.

Mercantile marine students

Our data had three groups of maritime occupations; seamen, prospective seamen (cadets in training ships) and college students of mercantile marine. The differences of the PITS score are plotted in Fig. 4, where four diagrams show the dispersion of the groups in a two-dimensional space. An axis of g_1, being obtained after rotating by some degrees, denotes a better estimate of the images. The ranking is students, cadets and seamen. While students (KUMM) show positive scores, seamen are plotted in the negative area.

The images became negative by degree of concern with sea affairs as is shown in *mental closeness* factor. Hard work on stormy days seems to make them feel troublesome. People have come to have negative images due to the fact that the shipping industry is declining and finding a job in any shipping company is difficult.

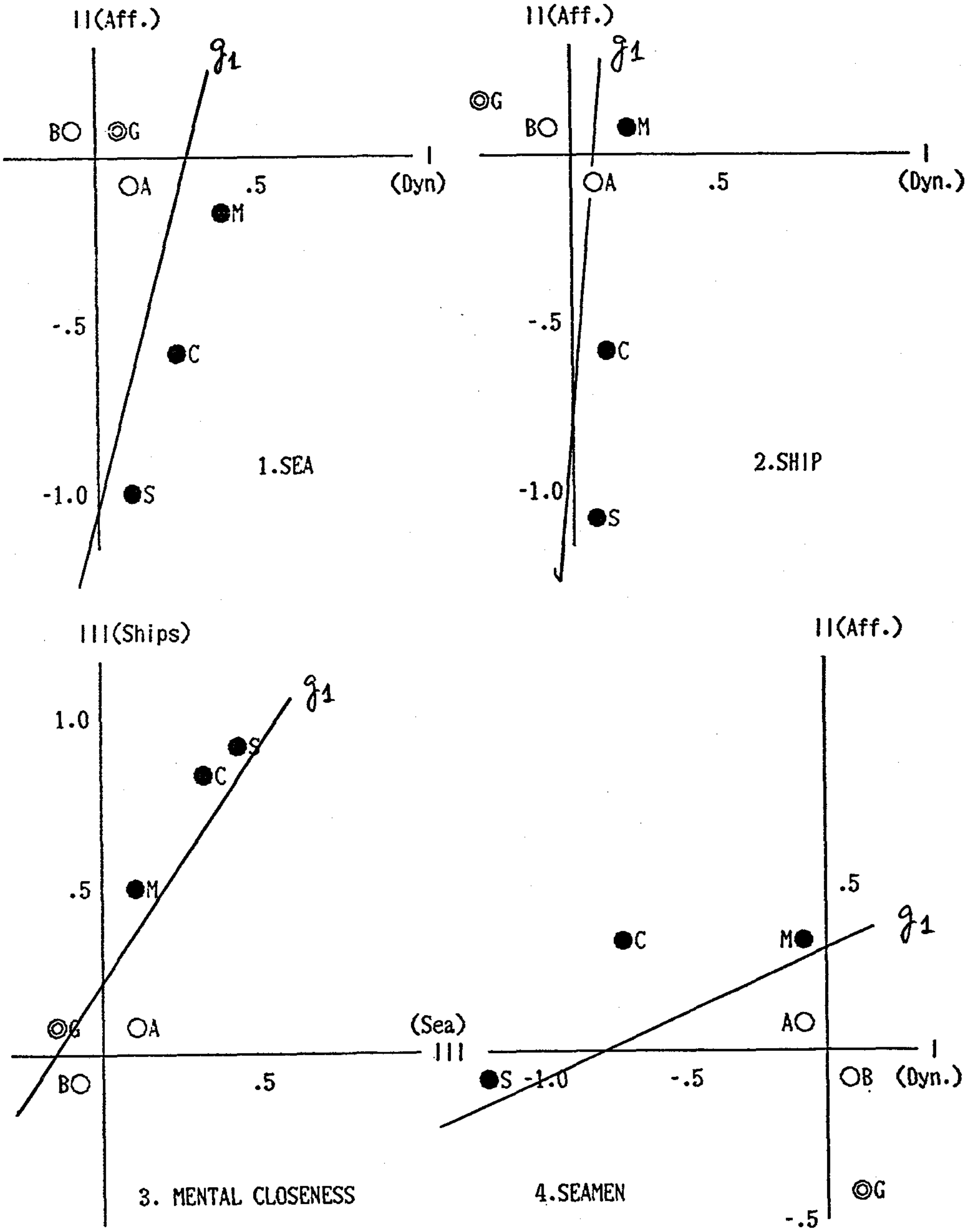

Fig. 4 Scatter diagrams of mean factor score. A, B : District A and B, G : general college students, M : mercantile marine students, C : cadets of training ships, and S : seamen. Dyn.: dynamism factor, Aff.: affective evaluation factor.

KUMM students are classified into two major fields; navigation and engine. Cadets and seamen are also working in ships as navigators or engineers. Generally throughout our data, people of the navigation division seemed to have better images than those of engine of the same group in every sea affair. Navigators still remain appropriately called "men at sea".

The results of this research were obtained through only SD method, a kind of social surveys. Since an image is a very ambiguous concept and depends on methodology, further verification should be obtained through case studies, interviews and other kinds of social surveys before a general conclusion can be reached.

IV. Summary

The positive interests toward the sea and sea affairs (PITS) were defined as people's affective feelings toward the sea, ships and seafarers, and measured by a method of social surveys.

To clarify their geographical characteristics, the SD method measuring images of those three concepts was conducted at different cities and villages on nearly the same longitude and different distances from the seacoasts both in Hyogo Prefecture and the middle of Kinki District.

Respondents were 3300 men and women of junior and senior high school students and their parents, who were instructed and filled out the sheets in their classrooms or homes.

Three factors of *dynamism*, *affective evaluation* and *mental closeness* for the images of *sea* and *ship* were extracted by PCA and orthogonal procrustes rotations. As for *seamen,* the third factor was replaced by *professional evaluation* of seafarers.

The six survey places, selected in a form of 'seacoast-inlands-seacoast', showed three types of factor score profiles as a cup-like curve, a cap-like curve, or a horizontal line.

They were also classified into two clusters reflecting geographical characteristics by cluster analysis of centroid method with Euclidean distances. One is two clusters including seaside and mountain districts for the images of *sea* and *ship* and the other is clusters of the southern and the northern districts for the image of *seaman.*

Canonical correlations revealed that those concepts and factors were correlated with each other, when combined by the factors or by the concepts.

On applying the same weights to other groups, namely the author's previous survey groups of seamen on ocean lines, cadets on board training ships, and students (freshmen) of mercantile marine and general colleges, the factor scores were computed and examined among them. Respondents amounted to more than 1400 men.

In factor score space, two colleges' students showed the highest score, and seamen at work on ocean line did the lowest of the groups. Cadets and seamen seemed to develop negative attitudes toward their vocation as they continue in their careers.

An image is a very ambiguous concept and depends on methodology. The above-mentioned results were obtained and summarized by a SD method. Further approaches such as case studies, interviews and other kinds of social surveys, will be necessary to close the gap in figures and to draw a more general conclusion.

Appendix; Statistical Comments

(1) *Principal components and rules for excluding*

Principal components are obtained by linear combinations of the original data (variables). To use them as 'parsimonious summarization', components whose variances are smaller should be excluded. The most objective method for this purpose is a statistical test.

The Bartlett's (1951) LRT (Likelihood Ratio Test) is suitable for this aim to test the hypothesis that the $(p-m)$ smallest characteristic roots of $\boldsymbol{R}$ are equal, namely

$$H_0 : \lambda_{m+1} = \cdots\cdots = \lambda_p$$

where the roots are ordered from largest to smallest

$$\lambda_1 \geq \lambda_2 \geq \cdots\cdots \geq \lambda_m \geq \cdots\cdots \geq \lambda_p$$

and here $m<p-1$. The test statistic is given by

$$\chi^2 = (n-1)(p-m)\log(a_0/g_0),$$

which under H_0 has an asymptotic chi-squared distribution with degrees of freedom $df=(p-m+2)(p-m-1)/2$, where a_0 and g_0 are the arithmetic and geometric means of the $(p-m)$ smallest characteristic roots of $\boldsymbol{R}$.

The results applied to our data are Table 9. Partly because of the large sample number, $n=3301$, almost all results are highly significant; accordingly this test was not applicable in our cases.

Mardia, Kent & Bibby (1979) introduced "rule of thumb" for excluding principal components: (a) a scree graph, which indicates where large characteristic roots cease and small ones begin, (b) including just enough componenents to explain, for example, 90% of the total variation, and (c) Kaiser's criterion excluding those principal components whose characteristic roots are less than the average.

Although empirical, the third rule, a component which have a characteristic root over 1, was employed in this research.

(2) *Procrustes rotation*

Cureton & D'Agostino (1983) explained the origin of the name (p. 246); According to Greek legend Procrustes lived on the Corinthian isthmus, between Megara and

Table 9 Results of Bartlett Test of Characteristic Roots

	sea			ship			seaman			
m	c. root	χ^2	*df*	c. root	χ^2	*df*	*m*	c. root	χ^2	*df*
1	3.386	2190.24	44	3.862	3177.55	44	1	6.906	21944.40	299
2	1.572	859.60	35	1.195	2237.47	35	2	2.338	18898.66	275
3	1.007	416.36	27	1.012	1105.77	27	3	1.671	17203.18	252
4	.811	189.76	20	.818	688.07	20	4	1.287	16245.07	230
5	.650	121.79	14	.685	443.78	14	5	1.200	15346.49	209
6	.594	82.46	9	.636	209.18	9	6	1.009	14775.52	189
7	.568	44.31	5	.611	116.63	5			.	
8	.526	16.47	2	.444	67.66	2			.	
9	.477			.383					.	
10	.410			.344			21	.461	11747.59	9
							22	.444	11358.38	5
							23	.388	10762.45	2
							24	.358		
							25	.002		

Corinth, near the main road from Athens to Sparta. He inveigled unwary (and unguarded) passer-by spending the night with him in his wonderful guests bed which fit exactly every traveler, whether tall or short. This exact fit, however, was attained by fitting the traveler to the bed. If he was too tall, Procrustes chopped off his feet. If he was to short, he was stretched on a rack until he was the same length as the bed. The term 'Procrustes transformation or rotation' appears to be due to Mosier (1939), Hurley and Cattel (1962).

If $\boldsymbol{A}$ is the original factor loadings matrix, and $\boldsymbol{H}$ is the hypothetical (target or criterion) matrix, which is not itself a rotation of $\boldsymbol{A}$, the rotated matrix, $\boldsymbol{B}$, is obtained by premultiplying a transformation matrix, $\boldsymbol{T}$ as $\boldsymbol{B}=\boldsymbol{AT}$. To obtain a least-square solution, the following Q

$$\begin{aligned} Q &= \mathrm{tr}(\boldsymbol{B}-\boldsymbol{H})'(\boldsymbol{B}-\boldsymbol{H}) \\ &= \mathrm{tr}(\boldsymbol{AT}-\boldsymbol{H})'(\boldsymbol{AT}-\boldsymbol{H}) \\ &= \mathrm{tr}(\boldsymbol{T}'\boldsymbol{A}'\boldsymbol{AT}-2\boldsymbol{T}'\boldsymbol{A}'\boldsymbol{H}+\boldsymbol{H}'\boldsymbol{H}) \end{aligned}$$

is minimized. However, the second term

$$Q_2=\mathrm{tr}(\boldsymbol{T}'\boldsymbol{A}'\boldsymbol{H})$$

leads the same result, so an easier form in differentiating with respect to $\boldsymbol{T}$,

$$Q_2=\mathrm{tr}(\boldsymbol{T}'\boldsymbol{A}'\boldsymbol{H})-\mathrm{tr}(\boldsymbol{M}(\boldsymbol{T}'\boldsymbol{T}-\boldsymbol{I}))=\max$$

is used in stead of that Q, where $\boldsymbol{M}$ is Lagrangian multiplier.

The final solution is

$$\begin{aligned} \boldsymbol{T} &= \boldsymbol{A}'\boldsymbol{H}\boldsymbol{L}^{-1} \\ &= \boldsymbol{A}'\boldsymbol{H}(\boldsymbol{H}'\boldsymbol{A}\boldsymbol{A}'\boldsymbol{H})^{-1/2} \end{aligned}$$

$$=\boldsymbol{A'HPD^{-1/2}P'},$$

where $\boldsymbol{L}=\boldsymbol{M}'+\boldsymbol{M}$, and $\boldsymbol{D}$ is a diagonal matrix of characteristic roots and $\boldsymbol{P}$ is characteristic vectors of a $(\boldsymbol{H'AA'H})$. $\boldsymbol{T}$ is an orthogonal transformation matrix, because

$$\boldsymbol{T'T}=\boldsymbol{PD^{-1/2}P'H'AA'HPD^{-1/2}P'}$$
$$=\boldsymbol{PD^{-1/2}P'(PDP')P'D^{-1/2}P'}=\boldsymbol{I}.$$

(3) *Canonical correlations*

Suppose two kinds of variables, p variables of $\boldsymbol{X}=(X_1, X_2, \cdots, X_p)'$ and q variables of $\boldsymbol{Y}=(Y_1, Y_2, \cdots, Y_q)'$, are combined with linear combinations,

$$u=a_0+a_1X_1+a_2X_2+\cdots\cdots+a_pX_p=\boldsymbol{a'X}$$
$$v=b_0+b_1Y_1+b_2Y_2+\cdots\cdots+b_qY_q=\boldsymbol{b'Y}$$

respectively. The weights, $\boldsymbol{a}$ and $\boldsymbol{b}$, are determined so that a correlation between the two compound variables, u and v, may become maximum, namely $r^2(u, v)=\max$. A correlation matrix of the pooled $(p+q)$ variables, $\boldsymbol{R}$, is partitioned as

$$\boldsymbol{R}=\begin{bmatrix}\boldsymbol{R}_{11} & \boldsymbol{R}_{12}\\ \boldsymbol{R}_{21} & \boldsymbol{R}_{22}\end{bmatrix}.$$

Since the correlation coefficient is

$$r(u, v)=\frac{\boldsymbol{a'R_{12}b}}{\sqrt{\boldsymbol{a'R_{11}ab'R_{22}b}}},$$

the maximum value of $r^2(u, v)$ is determined by maximizing the following Q under the constrains of

$$\boldsymbol{a'R_{11}a}=1 \qquad \boldsymbol{b'R_{22}b}=1.$$

That is, r^2 is at the maximum when the derivatives of

$$Q(a, b)=(\boldsymbol{a'R_{12}b})^2-\lambda(\boldsymbol{a'R_{11}a}-1)-\mu(\boldsymbol{b'R_{22}b}-1)$$

with respect to the elements of $\boldsymbol{a}$ and $\boldsymbol{b}$ are equal to zero, where λ and μ are Lagrangian multipliers.

Those equations are

$$-\lambda\boldsymbol{R}_{11}\boldsymbol{a}+(\boldsymbol{a'R_{12}b})\boldsymbol{R}_{12}\boldsymbol{b}=0$$
$$(\boldsymbol{a'R_{12}b})\boldsymbol{R}_{21}\boldsymbol{a}-\mu\boldsymbol{R}_{22}\boldsymbol{b}=0,$$

and these are written as determinantial equations

$$|-\lambda\boldsymbol{R}_{11}+\boldsymbol{R}_{12}\boldsymbol{R}_{22}^{-1}\boldsymbol{R}_{21}|=0$$
$$|-\mu\boldsymbol{R}_{22}+\boldsymbol{R}_{21}\boldsymbol{R}_{11}^{-1}\boldsymbol{R}_{12}|=0.$$

It is easily seen that those roots are characteristic roots of the matrices $(\boldsymbol{R}_{11}^{-1}\boldsymbol{R}_{12}\boldsymbol{R}_{22}^{-1}\boldsymbol{R}_{21})$ and $(\boldsymbol{R}_{22}^{-1}\boldsymbol{R}_{21}\boldsymbol{R}_{11}^{-1}\boldsymbol{R}_{12})$, which have the same s roots, where $s=\min(p, q)$.

The canonical correlations are obtaind as the square root of the characteristic roots.

In most cases, only the largest correlation is adopted, but the generalized coefficient of determination, D, which is defined as

$$D=(r_{c1}^2+r_{c2}^2+\cdots\cdots+r_{cs}^2)/s$$

is useful, because it has full information of the data.

(4) *Bartlett test of correlation*

The hypothesis that all the variables are uncorrelated with one another, $H_0 : \boldsymbol{P}=\boldsymbol{I}$, is tested as a LRT. The statistic is given in terms of the sample correlation matrix, $\boldsymbol{R}$,

$$-2\log\lambda=-n\log|\boldsymbol{R}|,$$

and it has an asymptotic χ^2-distribution with degrees of freedom $df=p(p-1)/2$. Bartlett (1954) has improved the approximation of the limiting distribution by adopting the statistic

$$\chi^2=-(n-1-(2p+5)/6)\log|\boldsymbol{R}|.$$

The degrees of freedom remain unchanged. Lawley (1940) showed through a multiple Maclaurin expansion that the term $\log|\boldsymbol{R}|$ was replaced by $-\sum\sum_{i<j} r_{ij}^2$. This approximation is rather better for small correlations. The original Bartlett test was applied in this paper.

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References

Anderberg, M. R. 1973 *Cluster analysis for application*. New York: Academic Press.

Bartlett, M. S. 1951 The effect of standardization on a χ^2 approximation in factor analysis. *Biometrika*, **38**, 337-344.

Bartlett, M. S. 1954 A note on multiplying factors for various chi-squared approximation. *Journal of the Royal Statical Society*, **B**, **16**, 296-298.

Bentler, P. M. 1969 Semantic space is (approximately) bipolar. *The Journal of Psychology*, **71**, 33-40.

Cureton, E. E. & D'Agostino, R. B. 1983 *Factor analysis: An applied approach*. New Jersey: Lawrence Erlbaum Associates.

Everitt, B. S. 1974 *Cluster Analysis*. London: Heineman.

Everitt, B. S. 1977 Cluster analysis. In C. A. O'Muircheartaigh & C. Payne (ed), *Exploring data structures*. London: John Wiley.

Gorush, R. L. 1974 *Factor analysis*. Philadelphia: W. B. Saunders.

Harris, R. J. 1975 *A primer of multivariate statistics.* New York: Academic Press.

Hartigan, J. A. 1975 *Clustering algorithms.* New York: John Wiley. Translated into Japanese by H. Nishida et al. 1983 Tokyo: Micro Software.

Hoshino, A. & Hasegawa, K. 1986 High school students' image of sea, boat and dangerous accidents measured by means of the Semantic Differential and other Questionnaire method —A psychological study of residents in the coast of Japan—. *Antholopological Science (Jinrui Kagaku)*, **38**, 51–70. (In Japanese with English summary)

Hurley, J. R. & Cattel, R. B. 1962 The procrustes program: Producing direct rotation to test a hypothesized factor structure. *Behavioral Science*, **7**, 258–262.

Kuroda, T. 1979 Positive interests toward the sea of KUMM students. *Review of KUMM (Kobe University of Mercantile Marine)*, **28**, 111–140. (In Japanese)

Kuroda, T. & Yorhida, M. 1981 Positive interests toward the sea of the inhabitants of Hyogo Prefecture. *Review of KUMM*, **30**, 57–104. (In Japanese)

Kuroda, T. & Yoshida, M. 1982 Research by factor analysis on the positive interests toward the sea. *Proceeding of Japan Institute of Navigation*, **66**, 39–46. (in Japanese with English summary)

Kuroda, T. & Yoshida, M. 1983 The self image of seamen (approach by factor analysis). *Proceeding of Japan Institute of Navigation*, **68**, 87–94. (In Japanese with English summary)

Kuroda, T. & Yoshida, M. 1984 The self image of training ship cadets. *Proceeding of Japan Institute of Navigation*, **70**, 159–166. (in Japanese with English summary)

Kuroda, T. & Yoshida, M. 1984 The positive interests towards the sea of the inhabitants of mountain districts. *Review of KUMM*, **33**, 1–26. (In Japanese)

Lawley, D. N. 1940 The estimation of factor loadings by the method of maximum likelihood. *Proceedings of the Royal Society of Edinburgh*, **60**, 64–82.

Mardia, K. V., Kent, J. T. & Bibby, J. M. 1979 *Multivariate analysis* London: Academic Press.

Meddish, R. 1972 Bipolar factors in mood adjective check lists. *British Journal of Social and Clinical Psychology*, **11**, 178–184.

Morrison, D. F. 1976 *Multivariate statistical methods*, 2nd ed. New York: McGraw-Hill.

Mosier, C. I. 1939 Determining a simple structure when loadings for certain tests are unknown. *Psychometrika*, **4**, 149–162.

Osgood, C. E., Suci, G. J. & Tannebaum, P. H. 1957 *Measurement of meaning.* Urbana: University of Illinois Press.

Russell, J. A. & Mehrabian, A. 1977 Evidence for a three-factor theory of emotions. *Journal of Research in Personality*, **11**, 273–294.

Russell, J. A. 1979 Affective space is bipolar. *Journal of Personality and Social Psychology*, **37**, 345–356.

Russell, J. A. & Pratt, G. 1980 A descripition of the affective quality attributed to environments. *Journal of Personality and Social Psychology*, **38**, 311–322.

Russell, J. A. & Ward, L. M. 1982 Environmental psychology. *Annual Review of Psychology*, **33**, 651–688.

Shiba, S. 1979 *Methods of factor analysis (Inshi bunseki hou)*, 2nd ed. Tokyo: University of Tokyo Press. (In Japanese)

Shrivastava, M. S. & Carter, E. M. 1983 *An introduction to applied multivariate statistics.* New York: North-Holland.

Stokols, D. 1978 Environmental psychology. *Annual Review of Psychology*, **29**, 253–295.

Tanaka, Y. et al. 1984 *Handbook of statistical analysis by personal computer II (Pasokon tokei kaiseki handobukku)*. Tokyo: Kyoritsu. (In Japanese)

Taylor, C. C. 1977 Principal component and factor analysis. In C. A. O'Muircheartaigh & C. Payne (ed), *Exploring data structure.* London: John-Wiley.

Yanai, H. & Takane, Y. 1985 *Multivariate analysis (Tahenryou kaiseki) 2nd ed.* Tokyo: Asakura Shoten. (In Japanese)