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RABBITS KEPT IN CAGES AND IN FLOOR PENS: REACTIONS IN THE OPEN FIELD-TEST.

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ABSTRACT

108 hybrid rabbits 75 days old were used in two experiments in order to assess their reactions in the open-field test. This test in fact can be used to assess emotionality and adaptation in a new environment. The animals were reared at different densities (700 sq cm/head and 580 sq cm/head) in the first experiment and with different housing systems (cages vs floor pens) in the second experiment. In each experiment the animals were tested twice at one week intervals. In the first test no differences were found between males and females. Some differences (e.g. alarm reaction and escape attempts) were found between the groups. Also in the second experiment there are not any differences between the two groups kept in cages. The rabbits always reared in floor pen differ from the animals always kept in cages especially for freezing time, and this behaviour can be considered as an indicator of adaptation. The rabbits showed a wide range of reactions from exploration to escape attempts and freezing. These reactions are grouped in orthogonal components such as orientation, attempts to escape and freezing which can be related to different kinds of emotionality. This trend is more evident in the second experiment in which the different housing system mainly seems to affect the behaviour strongly.

INTRODUCTION

The need to objectively quantify the adaptative capability of intensively farmed animals implies the utilization of behavioural tests, derived from basic ethological-psychological methodology. These tests are able to give some indications about the reactive-emotional state and about any possible stress of tested animals. One of these tests is the "open-field", already utilized in farm animals such as cattle (Dellmeier et al., 1990), poultry (Faure & Jones, 1981; Webster & Hurnik, 1990) and rabbits (Meijsser et al., 1989; Podberscek et al., 1991). It was originally used to study emotionality in laboratory rodents (Hall, 1934; Hall & Ballechey, 1932) and it measures the behaviour of the animal in a new space from where it cannot escape, depending on environmental variables such as moving from a known to an unknown environment, manipulation and transfer to the experimental structure and exposition to the test environment. The reactions of the animal depend both on its genetic characteristics and on previous experiences, either during the ontogenic development or during previous expositions to the same test. In fact habit and other learning mechanisms can modify the reactions of the same animal in subsequent experiments. Freezing, one of the possible recorded types of behaviour, can be

an indicator of high stress, related to the feeling of a danger, such as a predator, and therefore it is functional to the defence of the individual and, because of this, adaptative (Walsh & Cummins, 1976; Hofer, 1970; Kruijt, 1964; Faure et al., 1983). Aim of the research was to evaluate the reactions of rabbits reared in different housing systems and at different densities from the open-field test.

MATERIALS AND METHODS

Ist Experiment: 72 hybrid rabbits (36 males and 36 females) were used. The animals were 75 days old. All the rabbits were housed in battery cages at the following densities: -)groups 1 and 2 = three animals per cage (700 sq cm/head); -)groups 3 and 4 = four animals per cage (580 sq cm/head). The cages were placed in an air-conditioned barn (21°C, R.H. 70%), the light schedule was 16 h of light out of 24 h. All the rabbits were fed pelletized feed (18% crude protein) ad libitum, through a feed hopper, and fresh water was supplied through nippel troughs. The rabbits of two groups (group 2 and 4) had been housed on floor pens (850 sq cm/head) since weaning for thirty days. The first open-field test was performed 15 days after moving the floor pen rabbits to the cages. The test was repeated one week later; the open-field measured 140 x 140 cm and was surrounded by 80 cm high plywood walls; the floor was divided into 9 squares. The animals, individually marked, were placed in the center of the open-field and after 1 minute adaptation were observed by 2 researchers for 3 minutes. At each test the following types of behaviour were recorded: total squares entered (movement); freezing; escape attempts; alarm reactions. At the end of the test, the animals were weighed. The data were analyzed by multivariate analysis (PCA and KNN) (Forina et al.,1987) and univariate analysis (ANOVA) with test, group and sex as fixed factors and weight as co-variate.
IInd Experiment: this experiment was performed according to the same schedule of the previous experiment. The only differences were: three groups of twelwe rabbits each were tested: -)group 1: floor pen (8 females and 4 males);- group 2: 4 animals per cage (12 males); -)group 3: 4 animals per cage (12 females). All the rabbits were housed at the same density (sq cm 580/head). During the two open-field tests the following types of behaviour were recorded: total squares entered (movement), freezing, escape attempts, grooming, alarm reactions, investigation, standing still. The data were analyzed as in the previous experiment.
In both the experiments some kinds of behaviour (freezing, grooming, investigation and standing still) initially recorded in seconds were transformed in frequencies (1 freq.=10").

RESULTS AND DISCUSSION

Ist Experiment: open-field behaviour does not differ between males and females ($P>0.05$); moreover, treatment (neither previous rearing for a period in floor pens, nor density in cages) does not significantly affect animals reactions (KNN: non error

rate=23.07%). A difference exists between the two tests (P=0.03) for groups 1 and 2 (3 animals/cage), whose escape attempts decrease in the second test. In these groups alarm too increases in the second test (P=0.03). Freezing remains constant, except in group 4, whose movement decreases too (fig. 1). PCA analysis shows the same five main components in both tests (fig.2): weight, freezing, movement, alarm and escape. Weight is not correlated to the behaviour and it does not significantly differ between the groups; freezing is opposed to the exploration-flight behaviour. Alarm and escape attempts are orthogonal, while movement is significantly correlated to both ones in both repetitions (P=0.016 and P=0.0001; P=0.027 and P=0.0002). These results could indicate, according to Meijsser et al. (1989), that "emotional and exploratory behaviour is facilitated in open-field test", and that "freezing is a kind of emotional behaviour different from active escape" (Archer, 1973; Archer & Birke, 1983). Whimbey & Denenberg (1967) believe that there is not a "continuum" between "emotional" reactivity and "exploration"; in the present experiment this could be confirmed by the opposition between "freezing" and the other types of behaviour. The positive correlation between movement and alarm and between movement and escape could show different levels of emotionality as different degrees of active reaction to the new environment. The few differences in the two tests could indicate that the animals do not modify their reactions after one week, and do not show learning by habit. Meijsser et al. (1989) have shown that open-field behaviour changes on 4 consecutive days; on the contrary, in this experiment, probably the longer interval between the two tests (7 days) seems to slightly affect the reactions.

IInd Experiment: also in this experiment the weight of the rabbits does not affect the behaviour, moreover it is not different in the three groups. Significant differences were found between the group reared on floor pen and the groups reared in cages, but not between these last two groups (fig.1,3; tab.1). Differences among the groups exist also in exploration (P=0.008), which is higher in the caged animals and in the Ist test. In particular, group 1 shows fewer movement and more freezing in the IInd test, together with less escape attempts (fig.4). This could indicate, according to Meijsser et al. (1989), that animals reared in floor pens, showing more freezing and less exploration, have a higher degree of adaptation to a new environment. This could mean that these animals show a more "natural" reaction in order to minimize detection in the face of possible predation (Gallup & Suarez, 1980). However, it is not possible, in this case, to link the "freeze" reaction to higher stress (Meijsser et al., 1989), due to the very low frequencies of defecation and urination recorded in this study. PCA analysis shows three main components: freezing, exploration-movement-escape and alarm-standing still-self-grooming behaviour. This could indicate that, in a new environment, the reactions shift from an orienting response to a more active attempt to avoid the stress situation; the other possible reaction is to adopt the "freezing" posture: this last choice is shown especially by the animals reared in floor pens; probably it is due to the experience that they have

had of a more natural environment and colony life, compared to the caged ones.

CONCLUSIONS

In both experiments there are not differences in the recorded behaviour between males and females. Few differences were found between the groups of the first experiment; the multivariate analysis shows that the behaviour is not interrelated except for the movement that is correlated both with escape attempts and alarm reactions. In the second experiment the rabbits always reared in floor pen differ from the animals always kept in cages especially for freezing time, and this behaviour can be considered as an indicator of adaptation. These reactions are grouped in orthogonal components such as orientation, attempts to escape and freezing which can be related to different kinds of emotionality. This trend is more evident in the second experiment in which the different housing system mainly seems to affect the behaviour strongly.

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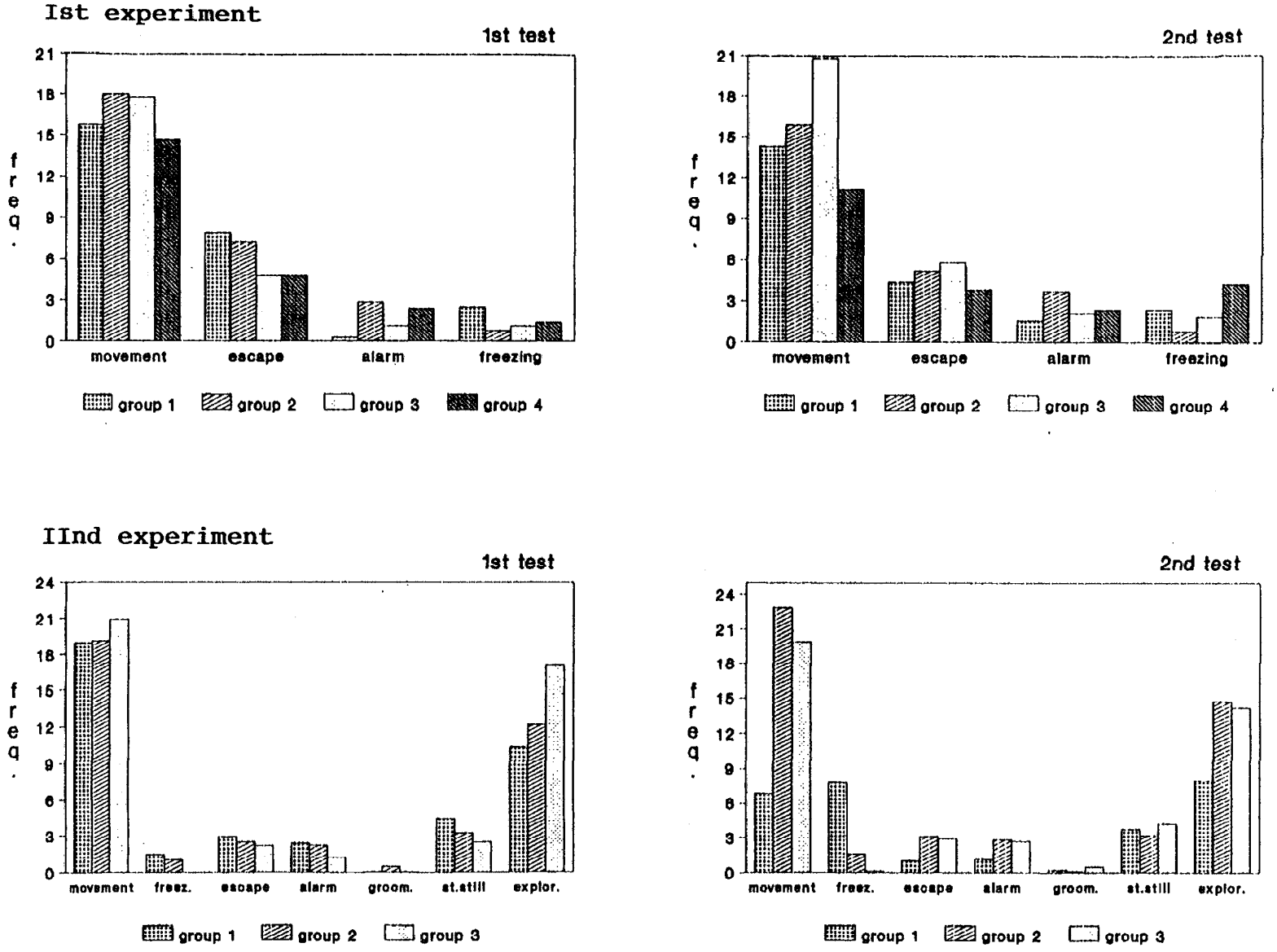
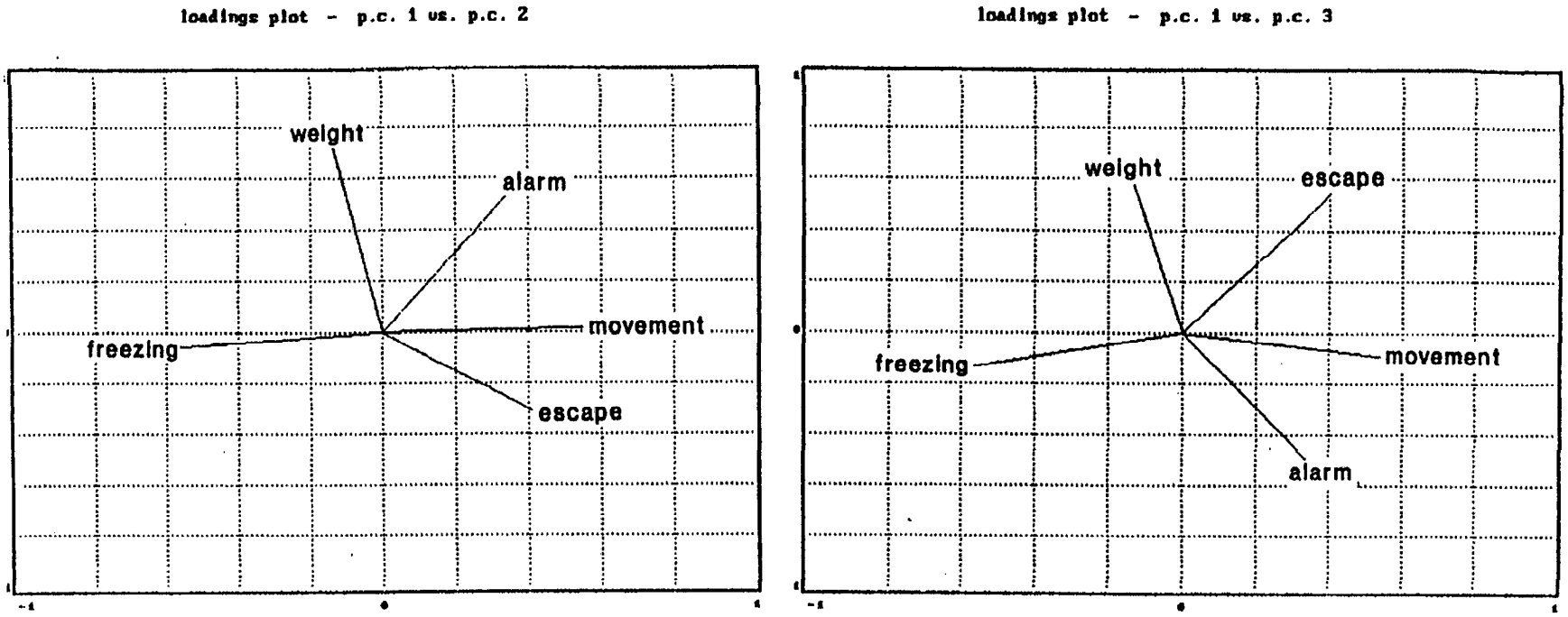


Fig.1 - Average values of behaviour in the groups



Principal Component Analysis (PCA)

variables used: weight movement escape alarm freezing

			loadings - > original variables <				
	var.%	cum.%	weight	movem.	escape	alarm	freez.
p.c.1	43.62	43.62	-0.139	0.571	0.425	0.356	-0.589
p.c.2	20.47	64.09	0.765	0.019	-0.319	0.556	-0.057
p.c.3	18.70	82.80	0.611	-0.093	0.573	-0.521	-0.136
p.c.4	10.48	93.28	-0.117	-0.551	0.581	0.537	0.238
p.c.5	6.72	100.00	0.095	0.601	0.227	0.056	0.758

Fig.2 - Loadings plot and PCA results for the Ist experiment

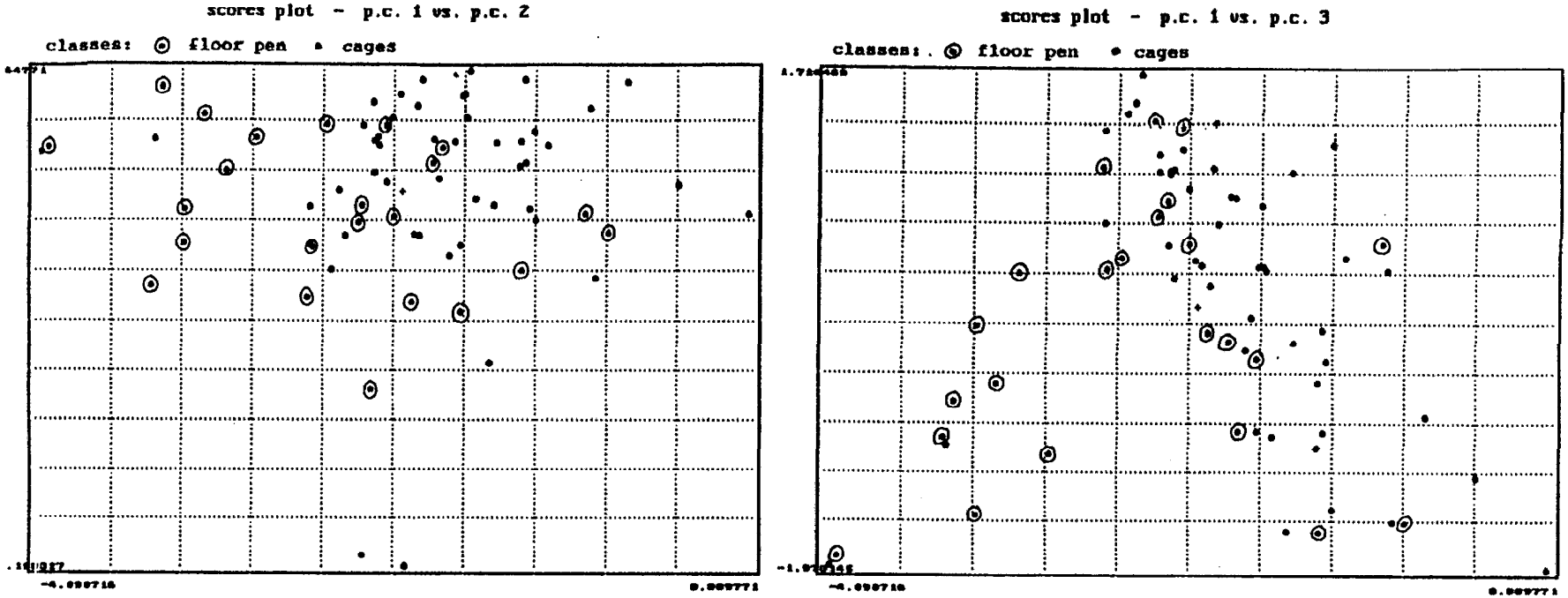


Fig.3 - Scores plot for the IInd experiment

K-Nearest Neighbour method (KNN)

variables used : movement freezing escape alarm grooming standing exploration

k value = 3
Euclidean distance

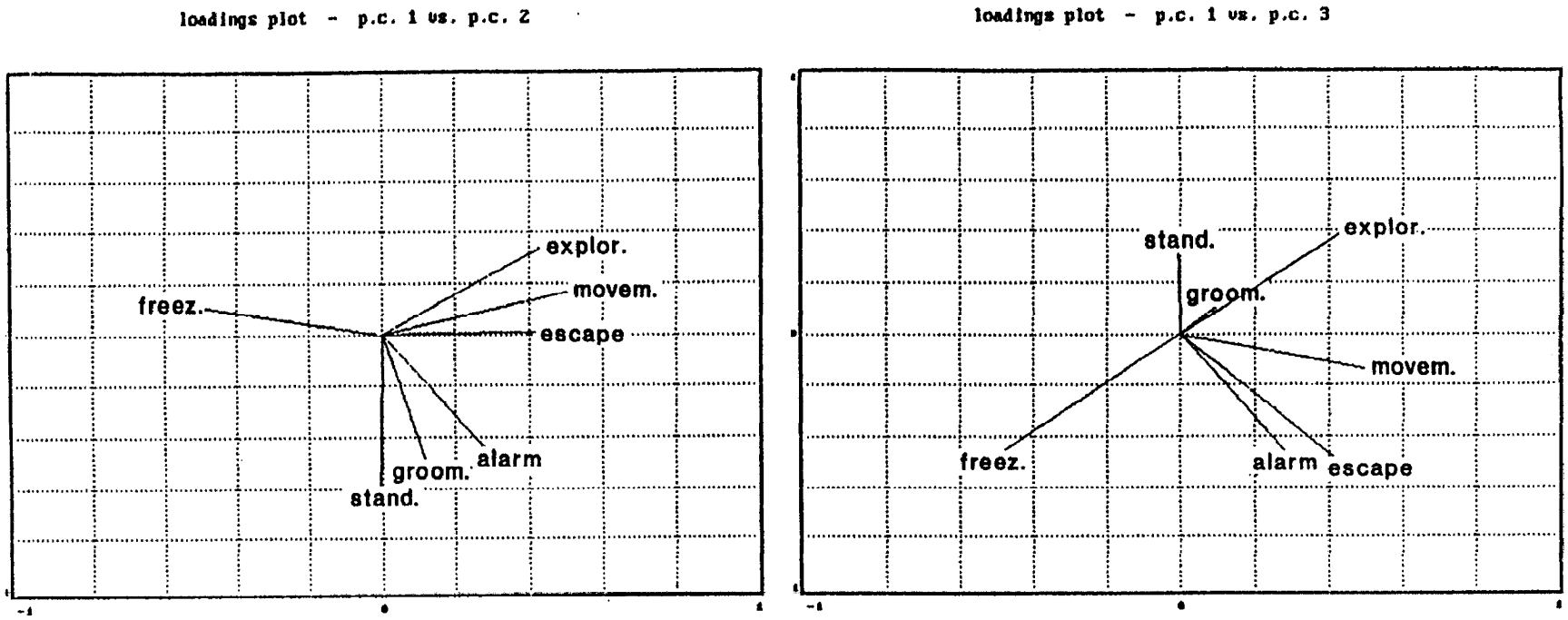
training set

total n.e.r (%)	=	75.00
miscl. risk (%)	=	31.25
n.e.r. for floor pen	=	50.00
n.e.r. for cages	=	87.50

confusion matrix

ID	true class	n.obj.	> assigned classes <	
1	floor pen	24	50.0 (12)	50.0 (12)
2	cages	48	12.5 (6)	87.5 (42)

Tab.1 - Classification analysis results (KNN)



Principal Component Analysis (PCA)

variables used : movement freezing escape alarm grooming standing exploration

			loadings - > original variables <						
	var.%	cum.%	movem.	freez.	escape	alarm	groom.	stand.	explor.
p.c.1	35.94	35.94	0.521	-0.498	0.430	0.290	0.125	-0.004	0.443
p.c.2	22.98	58.92	0.172	0.111	0.012	-0.457	-0.511	-0.606	0.349
p.c.3	14.74	73.66	-0.143	-0.470	-0.499	-0.471	0.137	0.332	0.397
p.c.4	12.15	85.81	-0.101	-0.195	0.340	-0.101	-0.719	0.533	-0.158
p.c.5	6.56	92.37	0.284	0.180	0.438	-0.679	0.392	0.176	-0.222
p.c.6	5.05	97.42	0.750	-0.005	-0.505	0.033	-0.180	0.118	-0.367
p.c.7	2.58	100.00	-0.158	-0.669	0.055	-0.114	0.043	-0.440	-0.562

Fig.4 - Loadings plot and PCA results for the IInd experiment