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# Anticipatory behaviour and stereotypical behaviour in farmed mink (*Mustela vison*) in the presence, absence and after the removal of swimming water

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## Abstract

Captive animals are often provided with cage enrichments in order to improve their welfare. Swimming water is an often-discussed requirement for farmed mink. The present study aimed to give insight into the value of swimming water for farmed mink by measuring anticipatory and stereotypical behaviour in subjects raised and housed in the presence and absence of swimming water and in subjects that were deprived of swimming water.

The major findings of the present experiments are that: (1) there was no significant difference in anticipatory behaviour between subjects reared and housed in the presence or absence of swimming water; nor was there a significant difference in anticipatory behaviour after removing the water for 2.5 weeks, (2) there was no significant difference in stereotypical behaviour in winter in the presence, absence and after 2.5 months deprivation of swimming water, and finally, (3) there was no significant correlation between anticipatory activity and stereotypical behaviour.

The results suggest that mink might not experience consequences, in the sense of increased reward-sensitivity or stereotypy levels, due to the absence of swimming water if they never experienced this incentive before, and that swimming water and an empty bath, such as used in this experiment, might be equally valued incentives for mink.

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## 1. Introduction

One of the key questions in animal husbandry is to what extent the species-specific behavioural repertoire is relevant for animal welfare. The deprivation of behavioural (ethological) needs is generally considered to be stressful for animals and is often forwarded as a potential cause for the development of abnormal behaviours (e.g. Dawkins, 1983, 1988, 1990; Hughes and Duncan, 1988; Poole, 1992; Lindberg and Nicol, 1997). In order to improve their welfare, captive animals are often provided with cage enrichments as substitute requirements, to let them (at least partly) fulfil the behavioural patterns they are strongly motivated for.

The effects of enrichments can be assessed by measuring changes in stress-related behavioural and physiological parameters (e.g. stereotypical behaviour, stress hormones: see Broom and Johnson, 1993; Mason et al., 2001; Pedersen and Jeppesen, 2001; Nicol et al., 2001; Vinke et al., 2002; Larsson et al., 2002; Korhonen et al., 2003). Such stress-related indicators are sometimes characterized as “negative indicators of welfare” as they can only be measured at the moment when the stress syndrome is developed full-blown, and thus clearly manifest. It should be noted that the absence of these stress-related parameters is not a synonym for good welfare. For welfare assessment, therefore, preferably potentially stressful conditions of animals should be detected at an earlier stage. In this respect, Spruijt et al. (2001) forwarded anticipatory behaviour as a potential tool to assess early stages of poor welfare, whereby the level of anticipatory behaviour is hypothesized to present the status of the underlying reward-related neuro-circuitry (see for more details Van der Harst, 2003): the outcome of the balance between rewarding and stress-inducing stimuli in the animals’ environment.

Anticipatory behaviour has been shown to be sensitive to differences in housing and rearing conditions: increased levels of anticipatory behaviour on social contact and an increased tendency on sucrose were shown in isolated rats (van den Berg et al., 1999). Subsequently, Van der Harst et al., (2003) found increased levels of anticipatory behaviour on sucrose in not enriched stimulus-poor housing systems. Interestingly, decreased levels of anticipatory behaviour were found in individuals that were exposed to social defeat and solitary housing (“depressive state”: von Frijtag et al., 2000, 2002). In the study of Van der Harst et al. (2003), where enriched housed rats showed less anticipatory behaviour to sucrose-rewards than standard housed rats, the presence of enrichments in a stimulus-poor cage environment may have compensated for the absence of other behavioural needs.

Based on this latter study, anticipatory behaviour was also used to assess the effects of cage enrichments in farmed mink. In this study, Vinke et al. (2004) found no significant difference in the level of anticipatory behaviour between the three housing systems in the experiment, which was explained by the poor differentiating properties of the experimental systems as compared to the control system. In other words, the provision of a more contrast full, highly valued requirement might have given a better discriminatory design to show differences in anticipatory behaviour in mink.

For farmed mink, swimming water is one of the most discussed requirements whereby several methods have been used to give insight into the importance of this requirement for mink (Skovgaard et al., 1997; Hansen and Jeppesen, 2001; Mason et al., 2001; Korhonen et al., 2003; Mohaibes et al., 2001, 2003). Although no differences were found in the levels

of stereotypical behaviour between mink that were housed in the presence or absence of swimming water (Skovgaard et al., 1997; Hansen and Jepessen, 2001), mink highly valued the water bath (“pay high costs for access to the water bath”) in a consumer-demand design (Mason et al., 2001). Additionally, the removal of a water bath caused a short-lasting increased level of urinary cortisol (Mason et al., 2001; Korhonen et al., 2003).

Therefore, the present study aimed to measure anticipatory activity and stereotypical behaviour in farmed mink in the presence, absence and after the removal of swimming water. In line with the findings of Van der Harst et al. (2003), it was expected that the mink housed in the presence of a swimming bath would show the least amount of anticipatory activity and the least amount of stereotypical behaviour. As anticipatory behaviour on the one hand (e.g. Kas et al., 2004) and stereotypical behaviour on the other (e.g. Mason, 1991; Willemse et al., 1994) appear to share a common neurobiological, opioid-dopamine basis (see also Vinke et al., 2004, p. 147), we decided to correlate the levels of anticipatory and stereotypical behaviour. It has been argued (see Spruijt and Van den Bos, *in press*) that a stress-induced sensitisation of the reward system, due to e.g. inadequate housing and expressed by strongly increased levels of anticipatory behaviour, may develop into increased levels of stereotypical behaviour, leading to an expected positive correlation between the level of anticipatory and stereotypical behaviour.

## 2. Material and methods

All experiments were performed in adherence to the legal requirements of The Netherlands Animal Experimentation Act, 1977 and have been approved by the Ethical Committee of the Research Institute of Animal Husbandry, Animal Science Group, Wageningen University and Research Centre, The Netherlands.

### 2.1. Subjects and housing conditions

All mink were housed in long roofed standard sheds, the walls of which were left open. Each shed contained two parallel rows of about 200 standard cages with a nest box. At the start of the study, 56 wild coloured (i.e. brown) American mink (*Mustela vison*) families were housed under standard Dutch farm conditions (for a detailed description, see Vinke et al., 2002) at the research centre Het Spelderholt in Beekbergen, The Netherlands. These mink were housed in wire-mesh cages and reared in family groups, i.e. mother and her kits. As soon as the kits were born, each family was housed in three connected standard cages (each cage measuring: 85 cm L × 30 cm W × 45 cm H), with, in each cage, one straw-filled nest box (dimensions: 15 cm L × 15 cm W × 15 cm H), one platform (dimensions: 30 cm W × 10 cm L) and one plastic cylinder (diameter 12 cm, length 15 cm). Juveniles were weaned at the age of 14 weeks. Drinking water was available *ad libitum* and all mink families were fed twice per day in summer at 08:00 and 15:30 h with commercial mink food (Flevo BV, Putten, The Netherlands). In winter the solitary animals were fed once a day at 16:00 h without restriction. As a standard procedure, the kits were vaccinated in their 7th and 12th weeks, respectively, against botulism (BioCom-P<sup>®</sup>) and distemper (Distemink<sup>®</sup>).

For the experiment, half of these 56 families had additional access to swimming water (W group,  $N = 28$ ). The other half of the families was housed with standard enrichments, such as mentioned above, but without swimming water (C group,  $N = 28$ ). The extra facilities of the water bath were connected to the standard cages when the kits were about 6 weeks of age (i.e. age that mink kits start to leave the nest and explore their surrounding, see Kuby, 1982). The swimming facilities were created in 14 aluminium baths, wherein two wire-meshed cage constructions (dimensions per construction: 103 cm L  $\times$  75 cm W  $\times$  75 cm H) were placed next to each other in one of the aluminium baths, with a partition between the wire-meshed cages. The water level in the bath was 45 cm high. The mink families could not see each other as the partition (screen) visually separated the families. Mink were given access to the baths via a wire-meshed tunnel of about 40 cm of length, and an entry-platform. For hygienic purposes, the water contained five chloride tablets (Henkel-Ecolab BV, Nieuwegein, The Netherlands) and was refreshed every 2 or 3 weeks. The mean litter size for the W- and C-group was 6.10 ( $\pm 2.39$  S.D.) kits and 6.25 ( $\pm 1.71$  S.D.) kits, respectively. The mean ambient temperature during the whole observation period was 24.0 °C ( $\pm 3.8$  S.D.).

## 2.2. Experimental methods and treatments

The study started with the behavioural observations of the kits in the family, reared and housed in either the W or C group. The results of the behaviour of the mink kits are presented in Vinke et al. (2005). After the observation of the kits, all experimental subjects were weaned at the age of 14 weeks (each family provided one experimental female subject) and housed in two standard cages whereby each subject stayed in exact the same housing conditions, W of C group ( $N = 28$  for each experimental group), wherein they were previously reared. In fact, the subjects stayed in their rearing condition and the remainder of the family was removed. Subsequently, two tests were carried out to measure anticipatory activity when the subjects were 16 and 22 weeks of age, respectively. In February–March 2002, all subjects were observed for the performance of stereotypical behaviour. For these observations, the W group was split into two subgroups in October 2001: half of the W group had permanent access to swimming water (W+,  $N = 14$ ), whereas the other half were deprived of their swimming water by removing the water but leaving the empty water bath (W–,  $N = 14$ ). The conditions of the C group ( $N = 28$ ) remained unchanged (see Table 1 for an schematic overview of the experiments and observations).

### 2.2.1. Procedures on measuring anticipatory behaviour

All experimental subjects were tested two times for anticipatory activity: once in the rearing condition (anticipation Test 1: unchanged conditions; subjects 16 weeks of age) and once after a 2.5 weeks removal of the experimental elements of the rearing condition, i.e. removal of swimming water while an empty bath remained for the W group; conditions of the C group remained unchanged (anticipation Test 2: subjects 22 weeks of age). The training procedures of the subjects were as follows:

All experimental mink had to learn to associate a conditioned stimulus (CS, 5 s buzzer bell) with an oncoming reward (unconditioned stimulus, US i.e. cat food, Sheba fish flavour) by pairing (Pavlovian paradigm). One complete anticipation test period covered 8

Table 1

Time schedule of the year cycle of mink farming, experimental treatments and observations per experimental group

Year cycle	Age (weeks)	Anticipation training	Observation stereotypies	Treatments		
				Group W		Group C
Birth kits	6			Access to swimming water		Standard control
	7–11					
	12–13					
	14					
	15					
	16	X(1)				
	17	X(1)				
	18	X(1)				
	19			Removal of swimming water:		Standard control:
	20–21			access to empty bath		no changes
	22	X(2)				
	23	X(2)				
	24	X(2)				
	25			Access to swimming water		Standard control:
	26					no changes
	Pelting	27–28				
	Pelting	29				
		30				
		31				
	32		Group W+:	Group W-:	Group C:	
	33–34		permanent access to swimming water	removal of swimming water: access to empty bath	standard control: no changes	
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42				X	
	43				X	
	44				X	
Mating	45					

days training during a 2.5 week period, including weekends, with 3 or 4 training trials randomly per day (28 trials in total). During the training period, the interval between CS and US was gradually extended from 5 s to 4 min (see for a training schedule for mink: [Vinke, 2004, p. 152](#)).

To control whether the US was paired to the CS during the training, half of the subjects of each experimental group received a food-reward after the CS (trained subjects: cue plus food reward;  $N = 14$ ) and the other half of the subjects did not receive a food-reward after the CS (non-trained subjects: cue without food reward;  $N = 14$ ). All subjects were trained in their home cage. Trained and non-trained subjects were visually separated; thus, could not be visually influenced by each other. Food rewards were delivered on small spoons by

the experimenter after the training interval was passed. For each trial, the food rewards were randomly distributed over the trained subjects, which took about 20 s in total. Before the anticipation test started, all subjects were habituated to the procedures of the video recording in order to minimize effects of external disturbances.

Three training trials of each subject were recorded on videotape. The first video recording was during a 4 min interval at the start of the training (Test 1, trial 1), which was the baseline control when the animals did not learn yet (no association between CS and US). The second video recording was during a 2 min interval between CS and US during the training period (Test 2) and the third video recording registered a 4 min interval at the end of the training period (Test 3, trial 28).

With respect to the analysis of the data of the anticipation test, it was first determined whether the subjects were conditioned to the CS, since only these animals are of interest to compare. Therefore, the frequency of “nose pokes around the feeding area” (place where the food rewards were delivered after the bell had rang) was counted in trained and non-trained subjects during the interval between CS and US (see also Section 2, van den Bos et al., 2003 and Vinke et al., 2004). Subsequently, the number of behavioural transitions of trained subjects was compared to non-trained subjects. It was reasoned that trained animals that had learned the association between CS and US, would show more “nose poking” behaviour and behavioural transitions after the CS than non-trained subjects and that they would show an increase in the number of behavioural transitions during training in the anticipation test. Thus, more transitions in Tests 2 and 3 as compared to Test 1 (i.e. baseline test, see above).

### 2.2.2. Stereotypical behaviour

All 56 experimental subjects were observed for the performance of stereotypical behaviour in winter 2002. This was the period after a 2.5 month removal of swimming water in the W– group. The deprivation was conducted by removing the water from the bath while the empty bath remained. The W+ group had permanent access to the swimming bath, and the conditions of the C group remained unchanged. Observations were carried out 3 days a week during a 3 weeks period in February–March 2002 (see Table 1). Data were collected using an instantaneous sampling method, five scans per minute per subject, with three sessions per day (session 1: 9:00–10:30 h; session 2: 11:00–12:30 h; session 3: 13:00–14:30 h; in total 135 scans per subject). A circulation scheme was used to randomise the order of the observations over the 56 subjects for each observation session. The subjects were observed from the central path between the two parallel rows of cages in their “own” shed. From this position, the observer could observe the behaviour of the subjects both in the cage, in the nest box as well as in the water bath.

A stereotypy was registered, when a movement was repetitive, invariant, fixed in orientation and place, and without an obvious goal or function (see e.g. Mason, 1991; Stolba et al., 1983): a three times repetition when the movement was confined to one place of the cage (e.g. repetitive licking the wire-mesh, repetitive hatch scratching, jumping in one corner or head-twirling around the drink nipple) and two times repetition for movements over the full length of the cage (e.g. longitudinal movements: running up-and-back the full length of the cage; see e.g. Mason, 1993).

Next to stereotypical behaviour (S), non-stereotypical active (A) and inactive behaviour (R) were observed. One observer carried out all observations. The observed behavioural

patterns were mutually exclusive. To control for differences in body weights during the winter-observations, all subjects were weighted in November, January and in February.

### 2.3. Data analysis and statistics

Statistics were calculated using the statistical package SPSS for Windows (Version 9.0). All data were first tested for a normal distribution (1-sample Kolmogorov–Smirnov analysis).

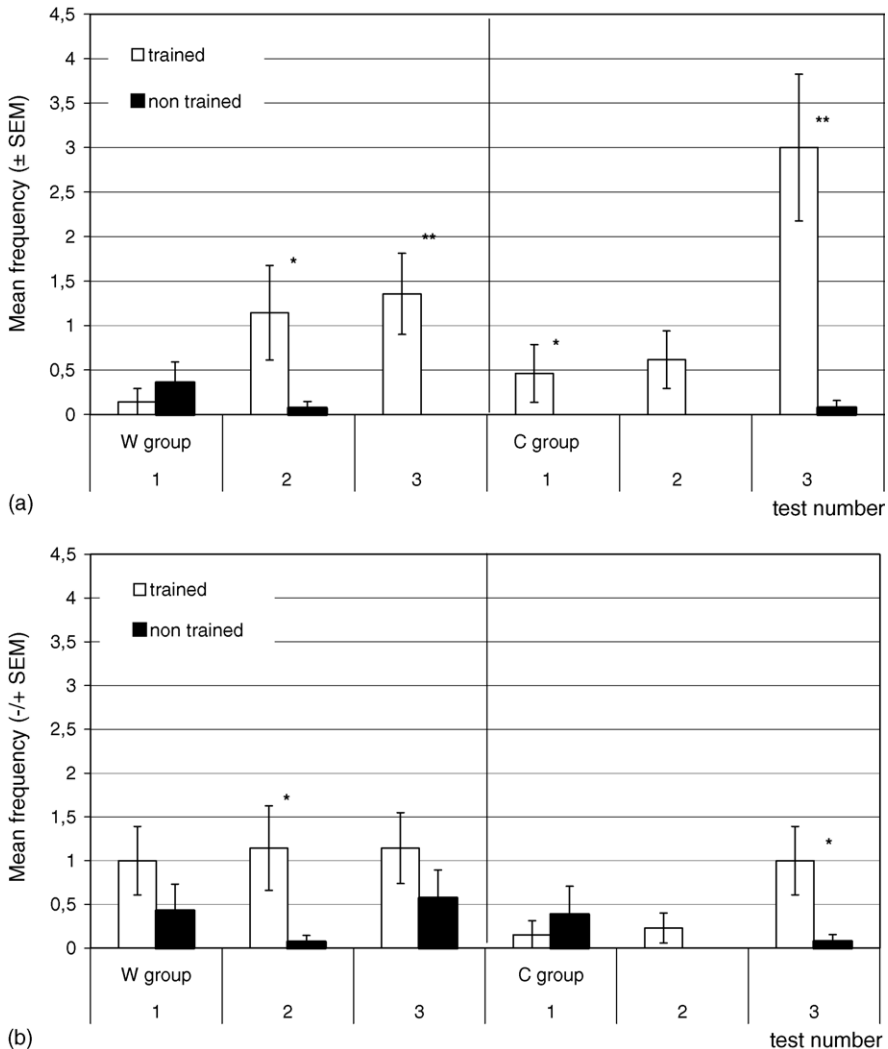


Fig. 1. Mean frequencies ( $\pm$ S.E.M.) of nose poking behaviour in trained and non-trained subjects during the interval between CS and US for the W and C group, in Tests 1–3 (i.e. 4 min interval baseline; 2 min interval; 4 min interval, respectively); in anticipation Test 1 (a) and anticipation Test 2 (b) (\* $P < 0.05$ ; \*\* $P < 0.01$ ).

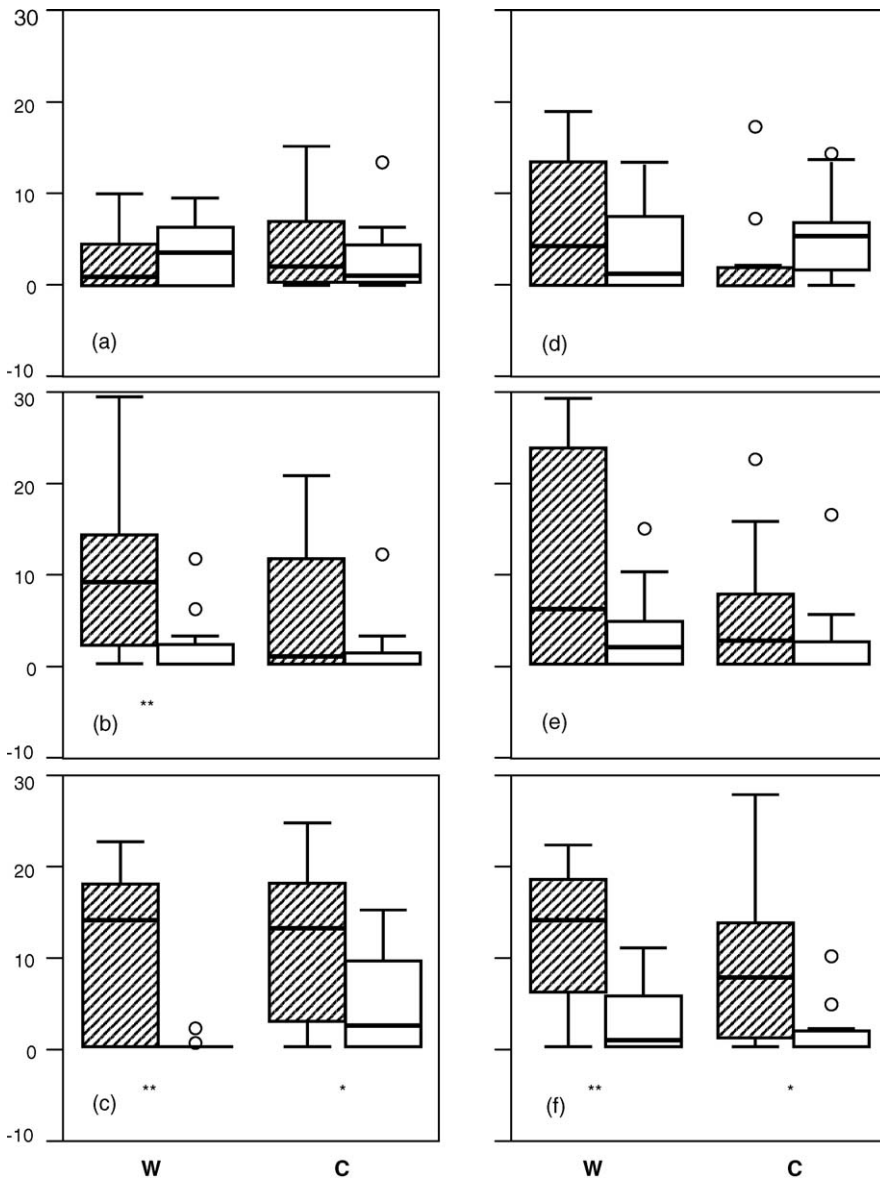


Fig. 2. Medians and interquartile ranges of the number of behavioural transitions per minute of the two experimental groups (W and C, respectively) in anticipation Test 1 (a: Test 1, b: Test 2, c: Test 3; baseline 4 min interval, 2 and 4 min interval, respectively) and 2 (d: Test 1, e: Test 2, f: Test 3; baseline 4 min interval, 2 and 4 min interval, respectively). Hatched bars, trained subjects and white bars, non-trained subjects ( $^*P < 0.05$ ;  $^{**}P < 0.01$ ).

Videotapes of the anticipation tests were analysed afterwards by one observer using a focal animal sampling method. Behaviour was scored with the help of software package The Observer<sup>®</sup>, Version 3.0, Noldus Information Technology, Wageningen, The



Netherlands. Anticipatory behaviour was expressed in the number of behavioural transitions per minute (BT/min: see von Frijtag et al., 2000; Van der Harst et al., 2003); frequencies of “nose pokes around the feeding area” were counted in addition.

The differences of the number of “nose pokes around the feeding area” and the behavioural transitions between trained and non-trained subjects and the differences between the two experimental groups (W and C group) were tested with the help of Mann–Whitney *U*-tests. The Kruskal–Wallis test (KW) was used for the comparison of stereotypical behaviour between the three experimental groups (i.e. W+, W– and C group). All statistics were two-tailed. Differences were considered to be significant if  $P \leq 0.05$ .

### 3. Results

#### 3.1. Anticipatory behaviour in summer 2001

Fig. 1 shows the mean frequencies ( $\pm$ S.E.M.) of “nose pokes around the feeding area” between trained and non-trained subjects in anticipation Tests 1 and 2, for Test 1 (baseline, 4 min interval), 2 (2 min interval) and 3 (4 min interval), respectively. For both anticipation tests, the trained subjects showed more “nose pokes around the feeding area” than the non-trained subjects at the end of the training (Test 3: MWU:  $U > 38.00$ ,  $P < 0.05$ ), with an exception of the W group in anticipation Test 2. Fig. 2 shows the medians and interquartile ranges of the number of behavioural transitions per minute in anticipation Tests 1 and 2 for Tests 1–3, respectively. Also here, trained subjects had significant more behavioural transitions compared to the non-trained subjects at the end of the training, both in anticipation Test 1 and 2 (Test 3: MWU:  $U > 32.0$ ,  $P \leq 0.05$ ). These results showed that the trained subjects learned the association between the CS and the US.

Comparing the level of anticipatory activity between the W and C group subjects, no significant differences in the number of behavioural transitions were found between these experimental groups, neither in the rearing conditions (anticipation Test 1; MWU:  $U = 82.5$ , N.S.), nor after a 2.5 weeks removal of the swimming water whereby the empty bath remained (anticipation Test 2; MWU:  $U = 83.5$ , N.S.).

#### 3.2. Stereotypical behaviour in winter 2002

##### 3.2.1. Body weights

Table 2 presents the mean body weights (in gram  $\pm$  S.D.) in November, January and February of the W+, W– and C group. No significant differences in body weights were found between the three experimental groups in November, January or in February (KW:  $\chi^2 > 0.05$ , N.S.).

##### 3.2.2. Stereotypical behaviour

For the observations of stereotypical behaviour (S), non-stereotypical active behaviour (A) and inactive behaviour (R), behavioural patterns were expressed as the mean percentage of frequencies ( $\pm$ S.E.M.) of the total number of observations. In total, thirteen subjects out of 56 showed stereotypical behaviour during the observations. As visualized in Fig. 3, the

Table 2

The mean body weights (in gram  $\pm$  S.D.) in November, January and February of the three experimental groups (W+ group: permanent swimming water; W– group: empty bath; C group: unchanged conditions), including the test statistics for body weight differences between the three experimental groups (KW test)

	Mean body weights ( $\pm$ S.D.) November '01	Mean body weights ( $\pm$ S.D.) January '02	Mean body weights ( $\pm$ S.D.) February '02
W+ group: permanent water	1405.07 $\pm$ 189.54	1251.86 $\pm$ 154.95	1167.21 $\pm$ 111.60
W– group: water removed	1512.50 $\pm$ 152.76	1310.21 $\pm$ 135.96	1160.93 $\pm$ 92.42
C group: no changes	1488.40 $\pm$ 197.32	1365.80 $\pm$ 154.15	1241.48 $\pm$ 129.70
KW test	$\chi^2 = 0.13$ , d.f. = 2, N.S.	$\chi^2 = 0.13$ , d.f. = 2, N.S.	$\chi^2 = 0.05$ , d.f. = 2, N.S.

subjects of the W+ group showed the lowest level of stereotypical behaviour (2.78%) compared to the other two groups, but this difference was not significant (KW:  $\chi^2 = 0.88$ , d.f. = 2, N.S.). In addition, no differences were found between the W+, W– and C group, for non-stereotypical active behaviour or inactive behaviour (KW:  $\chi^2 > 2.90$ , d.f. = 2, N.S.).

### 3.3. Correlation between anticipatory behaviour and stereotypical behaviour

No correlations were found between the number of behavioural transitions shown by the trained subjects during the anticipation tests in summer 2001 and stereotypical behaviour in February 2002 in each separate experimental group (W+, W– and C group; Spearman's Rank Correlation:  $\rho < 0.37$ ,  $N = 14, 14, 28$ , respectively, N.S.), or in total (Spearman's Rank Correlation:  $\rho = 0.31$ ,  $N =$ , N.S.).

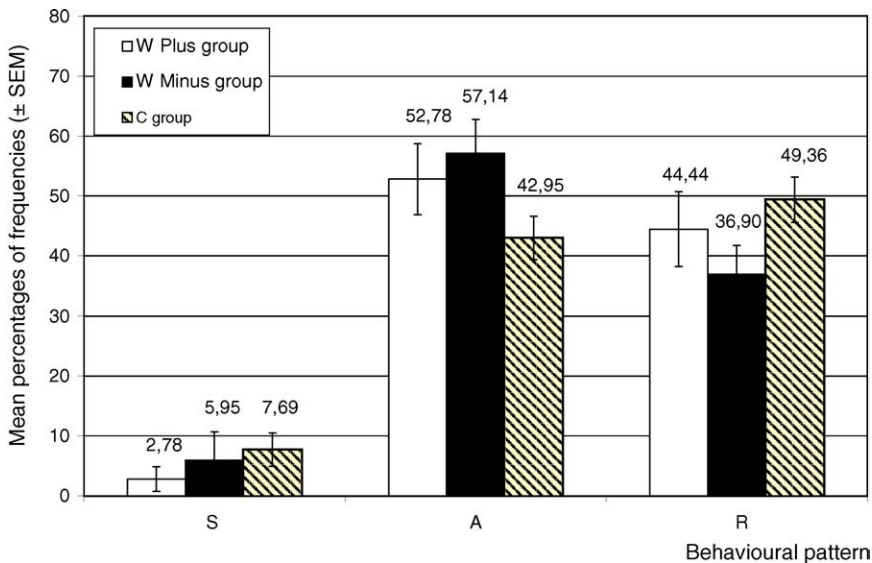


Fig. 3. Mean percentages of frequencies ( $\pm$ S.E.M.) of stereotypical behaviour (S), non-stereotypical active behaviour (A) and inactive behaviour (R) in winter in the three experimental groups (W+ group: permanent swimming water; W– group: empty bath; C group: unchanged conditions).

### 3.4. Conclusion and discussion

The present study measured the effects of the presence, absence and removal of swimming water on anticipatory and stereotypical behaviour, to give insight into the importance of swimming water for farmed mink. Deprivation of swimming water was conducted by removing the water while the empty bath remained. The major findings of the present experiments are that: (1) there was no significant difference in anticipatory behaviour between subjects reared and housed in the presence or absence of swimming water (i.e. anticipation Test 1); nor was there a significant difference in anticipatory behaviour after removing the water for 2.5 weeks (i.e. anticipation Test 2), (2) there was no significant difference in stereotypical behaviour in winter in the presence, absence and after a 2.5 months deprivation of swimming water, and finally (3) there was no significant correlation between levels of anticipatory activity and stereotypical behaviour.

The present study showed that the presence, the absence or the removal of swimming water had no effect on the level of anticipatory behaviour in farmed mink. Previous studies from our laboratory (e.g. [Van der Harst, 2003](#); [Van der Harst et al., 2003](#)) showed that differences in housing systems may be reflected in differences in the sensitivity of the reward system: poorly housed animals were more sensitive for reward than enriched housed animals. The argument would be that animals compensate for the stress related to the absence of essential (behavioural) needs ([Spruijt et al., 2001](#); [Van der Harst et al., 2003](#)). The results for the W and C group in this study, showed no measurable effects of housing with and without swimming water in the sense of reward-sensitivity. This finding is in agreement with a previous study of [Vinke and Spruijt \(2001\)](#) and suggests that: (1) mink might not experience consequences, in the sense of increased reward-sensitivity, due to the absence of swimming water when they have never experienced this incentive before, and that (2) swimming water and an empty bath such as designed in this experiment, might be equally valued incentives for mink.

An empty bath provides variability and complexity within mink's cage environment that may compensate for the absence of other incentives: the baths as designed in this experiment certainly gave a more variable and complex environment, and could evoke climbing. The effects on extra space, which is inherent to an empty bath construction, on the behaviour of mink is not entirely clear in literature ([Hansen, 1998](#); [Hansen et al., 1992, 1994](#); [Nimon and Broom, 1999](#); [Hansen and Jepesen, 2000](#); [Jeppesen et al., 2000](#); [Mason et al., 2001](#); [Mohaibes et al., 2003](#)), but this aspect may count in addition.

The findings on anticipatory behaviour are confirmed by the results of stereotypical behaviour of the present experiment, where also no significant differences were found between subjects of the W+ group (permanent water), the W- (empty bath) and the C group (control without water experiences). Thus, a continuous unchanged condition and an equally valued (compensating) condition like the empty bath, affect stereotypical behaviour in mink in the same way.

Addressing the possible relationships between anticipatory and stereotypical behaviour no significant correlations were found in this study. The same was found in an earlier study of [Vinke et al. \(2004\)](#), and suggests that levels of anticipatory behaviour are not predictive for the development of stereotypical behaviour later in life. Two things should be mentioned for a good interpretation of this result. Firstly, the number of stereotyping

subjects was 13 subjects out of a total of 56. Thus, most subjects scored a zero value for stereotypical behaviour. Too many zero-scores make a correlation meaningless for sound conclusions. Accordingly, no correlations may be expected to be found between anticipatory and stereotypical behaviour in the experimental and control-housing systems of the present study. Secondly, the results on anticipatory behaviour in this study suggest a normal activity of reward systems, whereby also high levels of stereotypical behaviour may not be expected in adulthood (see [Spruijt and Van den Bos, in press](#)). This is what we found. The use of a total impoverished inadequate control system, therefore, might be a better option to study relationships between anticipatory and stereotypical behaviour (see also Section 4: [Vinke et al., 2004](#), p. 158), but this was not within the aim of the present study.

Finally, in this study all subjects were deprived of swimming water by just removing the water while the empty bath remained, which did not result into significant changes in the levels of anticipatory and stereotypical behaviour. This finding on swimming water deprivation is in contrast with the studies of [Mason et al. \(2001\)](#) and [Korhonen et al. \(2003\)](#) who both found short-term effects of the deprivation of swimming water in mink in the sense of strongly increased levels of urinary cortisol. Additionally, [Vinke and Spruijt \(2001\)](#) found increased levels of stereotypical behaviour after 2.5 months of swimming water deprivation. In all these studies the access to the water bath was blocked by a hatch or door, which is clearly a different way of deprivation as conducted in the present study. This raises the question how mink's behaviour is affected by the different ways the access to the swimming water is manipulated in deprivation paradigms. Interestingly, [Mohaibes et al. \(2001\)](#) removed the water bath from the cage, i.e. out of sight of the animal in a first experiment, which resulted into a relative lower increase of the level of stereotypical behaviour as compared to blocking the access to the water bath as conducted in a second experiment ([Mohaibes et al., 2003](#)). However, they found no significant differences between their experimental groups, which urges to careful conclusions. Nevertheless, the effects of different ways of deprivation are worthwhile to be elucidated in future studies, as this may have general consequences for management, housing and animal welfare in practice.

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