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Untersuchungen zum visuellen Diskriminationslernen von Zwergziegen. Kognitive Leistungen und Auswirkungen kognitiver Herausforderungen auf Verhalten und Physiologie.

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SUMMARY

In an intensive husbandry, farm animals have to deal with various changes in their environment. In addition to new housing systems, this also includes the confrontation with new types of food or the regrouping with unknown conspecifics. However, the increasingly enhanced automation of animal husbandry leads to higher cognitive demands on farm animals. During these changes, learning processes of the animals are of particular importance, as they reduce the uncertainty in new situations, increase the predictability of the environment and repeatedly stimulate the rewarding system. By enhancing the understanding of cognitive learning efficiencies of farm animals, the housing systems could be adapted to the specific sensory capabilities and thus positively influence animal welfare. This study investigates two different aspects of animal husbandry using the example of Nigerian dwarf goats (*Capra hircus*). In a first assessment the cognitive abilities of dwarf goats were investigated under natural housing conditions (experiment 1 and 2). In a second assessment the effects of different forms of enrichment on learning efficiency, behaviour and physiology of dwarf goats were determined (experiment 3).

For the cognitive enrichment of goats, an automatic learning device, integrated in the normal housing conditions, was made available 24 hours to the animals during all experiments. By successfully accomplishing of visual four-choice discrimination tasks, presented by the learning device, the goats received water as a reward. Water was only available at the device. Unlike the most learning studies, where animals have to perform a predefined number of choices in an artificial environment, during this study the goats had unlimited access to the device and therefore individual conditions for learning in their usual social environment without human disturbance. With this experimental setup it was possible to examine the individual learning behaviour of larger groups of goats simultaneously.

Experiment 1 investigated the capability of dwarf goats to develop open-ended categories (categories, potentially containing an unlimited number of stimuli) by means of artificial symbols. The animals were trained for eight different discrimination tasks, each one consisting of four different symbols. The symbols used could allocate two different categories: the selection of solid black symbols remained unrewarded, whereas choosing a symbol with an open centre was rewarded. The general capacity to establish categories, and the skills for generalising also new symbols to be classified in the right category, was tested in a subsequent transfer-test. It was shown that on the basis of artificial visual symbols dwarf goats are able to establish open-ended categories and to generalise on new symbols. The results indicate that the goats did understand the categories already after three training tasks. The animals had difficulties to discriminate some symbols. However, the overall learning efficiency in the transfer-test clearly confirmed the acquisition of the categories.

Experiment 2 dealt with the social learning capacity of dwarf goats. It was sought to verify if the animals were able to respond to visual discrimination tasks with increased learning efficiency when they had the possibility to observe experienced demonstrators. Goats could observe experienced conspecifics while these performed two different discrimination tasks in the learning device. It was distinguished if the observations took place directly through a perspex disk or if the choices of the demonstrators were transferred real time on a monitor situated in the home pen. The control group had no possibility to observe any demonstration. Generally, there were only very few observations of the demonstrators. In the first discrimination tasks there were no differences between the experimental groups and the control group. In discrimination task 2, the goats with the possibility to observe on a monitor showed higher learning success than goats which observed directly or animals of the control group. There were no differences between learning of the two latter groups. However, the increased learning success was not related to the amount or duration of observations. Thus, based on the results of this experiment, we did not find indications suggesting social learning in dwarf goats.

The more practical **experiment 3** examined the impact of structural and cognitive enrichment on the learning performance in visual discrimination tasks, the spatial learning in a maze and the behaviour as well as the physiological stress response in an external loading situation (open-field/novel-object test). For structural enrichment a huge amount of litter and several opportunities for activity were introduced. Different discrimination tasks presented by the learning device represented the cognitive enrichment. The results showed that prolonged structural enrichment positively affected the learning performance of dwarf goats. Both structural and cognitive enrichment improved different aspects of the behavioural competence of goats in external loading situations. Whereas the general activity was positively influenced by structural enrichment, cognitive enrichment led to an increased confrontation towards unknown objects. However, both forms of enrichment had no influence neither on cortisol concentrations in the saliva in the external loading situation nor on the spatial learning performance of the goats in a maze. Possibly the open-field/novel-object test was insufficient as a stressor to cause modifications or the enrichment was not offered long enough.

Due to automatic systems in animal husbandry, which were adapted to the sensory abilities of the particular animals, stress and frustration of farm animals could be avoided. In addition to the improvement of the management, adequate and solvable challenges provide the animals a certain control over some aspects of their environment. As a result the cognitive capabilities were demanded and the lack of excitement reduced. On the other hand, repeated positively-affected conditions in conjunction with successful coping promote animal welfare. This study contributes to fundamental research on cognitive capabilities of farm animals and furthermore shows the positive impacts of enrichment in animal husbandry. Therefore, it is proposed to implement challenges and enrichment into housing systems of farm animals in order to increase animal welfare.