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A sensitive phase for the development of olfactory preference in ferrets (*Mustela putorius* f. furo L.)[1]

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Receipt of Ms. 20. 2. 1978

Abstract

Studied olfactory reactions in the ferret to establish their importance for prey searching. 28 prey naive animals were reared differently. Their behavioral reactions towards known and unknown prey odors were tested at different age levels. During their third month of life ferrets respond most readily to odors with searching. Adult ferrets respond reliably with searching behavior only when the odor of a prey is offered with which the animals had been fed between their second and fourth month of life.

Introduction

All predators have to discriminate their prey from nonprey, even if they accept a wide range of different prey objects. Yet, detailed analyses of the external stimuli eliciting hunting reactions in a particular predator are still scarce. In general, it is assumed that prey is recognized by movement, size, sound, or scent; these stimuli may be working either alone or in combination (Curio 1976).

The importance of acoustical and especially optical stimuli for eliciting hunting behavior is well established in many species (e. g. Bristov 1941; Kramer 1941; Schneider 1954; Leyhausen 1956; Payne 1962; Etienne and Howland 1964; Ingle 1971). However, there is comparatively little known about the effects of olfactory cues on the elicitation of prey catching reactions.

Prey catching behavior of mustelids has been studied by several authors, e. g. Apfelbach and Wester (1977), Eibl-Eibesfeld (1956, 1963), Goethe (1940, 1964), Gossow (1970), Räber (1944), Wüstehube (1960). These studies revealed that optical and acoustical stimuli are certainly important for eliciting hunting behavior in polecats and ferrets. Yet, both sensory modalities are surpassed in importance by the olfactory system in this species.

Working with odors from different types of prey, Apfelbach (1973) found that young polecats (*Mustela putorius* f. furo) exhibit a preference for the odor of a prey on which they had been fed. Preferences were the more marked the longer individuals had fed upon the prey in question. From these experiments it could be concluded that scent serves as a sign stimulus for prey selection in this carnivore.

The present study was undertaken to clarify the question whether the preference to a specific prey odor is due to the length of prior feeding experience or due to exposure during a certain age.

[1] This study was supported by a grant of the Deutsche Forschungsgemeinschaft.

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Z. Säugetierkunde 43 (1978) 289—295
© 1978 Verlag Paul Parey, Hamburg und Berlin
ISSN 0044—3468/ASTM-Coden ZSAEA 7

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Material and methods

The experimental part of the present study was done during the years 1974—1977. The subjects were 16 male and 12 female ferrets (*Mustela putorius* f. furo) taken from seven different litters. The ferrets were divided into three groups consisting two times of 11 and of 6 animals. Until their third month of life the young animals lived with their mothers. Then they were seperated and kept either in pairs or individually. All animals lived under natural light and temperature conditions.

Feeding method of groups 1 and 2

The animals of group 1 were fed with chicks the first twelf months of their life. From that time on they received mice only for the following six months; after that they again were fed with chicks for another six months period. The animals of group 2 were fed with mice only.

Feeding method of group 3

The animals of group 3 received chicks except during their third month of life when they were fed with mice exclusively. The behavior of the growing ferrets toward known and unknown odors was quantified at different age levels (Table). For an experiment, a ferret was placed onto a round observation table (2 m diameter). The table (Fig. 1) was divided into four sections by white markings so that the position of the ferret could be recorded.

Table

Testing procedure of the reactivity toward known and unknown odors of groups 1 and 2

Odor	Month of life					
	2	4	8	12	18	24
Chick	*	*	*	*	*	*
Mouse	*	*	*	*	*	*
Geraniol	*	*		*		
Methyl acetate		*		*		

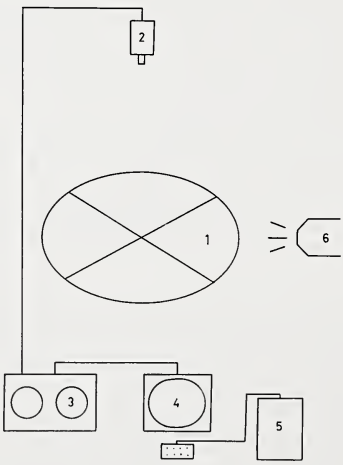

Fig. 1. Experimental setup. 1 = Testing arena; 2 = TV camera; 3 = Video recorder; 4 = Monitor; 5 = Event recorder; 6 = Fan

A fan was blowing air (4 m/sec) over the table. The reactions of the animals toward the air and to different odors added to it were tested by comparing the time an animal spent in the section of the observation table closest to the source of smell before and after presentation

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of the odor. The experiments were observed some distance away on a TV screen. The observations could be transfered by the observer directly on an Esterline Angus event recorder and/or stored on a tape recorder for later analysis.

In every experiment, lasting for 10 min, air was blowing for 7 min, then one of the following odors was added: chick, mouse, geraniol ($C_{10}H_{18}O$), methyl acetate ($Ch_3CO_2CH_3$). On the average all ferrets were exposed to the different types of odor five times at the different age levels; every animal was used for one experiment per day only. Hungry and satiated ferrets were tested. Analysis of data was performed using the Wilcoxon Matched-pairs Signed-ranks Test. For comparison reasons standard deviations are also given.

Under natural conditions the following behavioral reactions are typical for prey searching ferrets (Apfelbach and Wester 1977):

Search: traversing the ground whilst systematically exploring the bottom and corners of it. This is accompanied by scanning movements of the head and occasional scratching or digging movements with the fore feet. Speed of locomotion is slow.

Orientation: the point at which search ceases. A potential prey object — or the source of odor — is located and approach toward it commences. Scanning movements stop and speed of locomotion increases.

Advance: approaching and pursuing the prey object.

In our indoor study search and orientation together were termed as "search".

Results

I. Searching for prey

Ferrets are no typical hunters persuing fleeing prey but rather rummage over the ground with slow scanning movements of the head and attempts to attack prey by a sudden dash. Search behavior can be elicited by odor alone. Tracking down a prey involves either occasionally working up a track which the prey had laid down, or, the more typical case, the straight approach toward the source of odor. Motionless prey appears to be difficult to locate. Its discovery is usually preceded by sniffing the ground and air until the prey is located and identified.

In our experiments, the animals oriented themselves and advanced towards the source of odor by sniffing the air.

II. Reactions towards odors

Groups 1 and 2

From their second month of life on, young ferrets leave their nest and start to explore the immediate surroundings of it. (Some animals of that age are able to kill mice already.) In the testing arena all animals reacted to every odor with searching behavior which resulted in an increase in time spent in the section closest to the source of odor (Fig. 2). Whenever the odor of a known prey was added to the air, e. g. chicken for group 1 and mouse for group 2, this increase was significantly higher ($p = 0{,}031$) than for other smelling substances. When unknown odors were added time did not significantly increase.

During the fourth month of life young ferrets leave the litter and start to live solitarily. All animals are well able to kill prey. Both our experimental groups reacted strongly to all odors, yet the searching reactions were most significant ($p = 0{,}024$) whenever the smell of the known prey was offered (Fig. 3). All odors not associated with food were treated alike but always elicited searching in the ferrets. In the four months old animals the reaction toward odors was higher and lastet longer than in the two month old ferrets.

Eight months old ferrets physically are fully grown, however, do not yet exhibit sexual activity. All animals reacted strongly to the known odor ($p = 0{,}013$), while

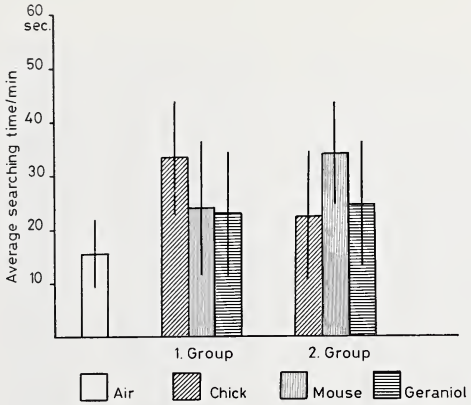

Fig. 2. Second month of life

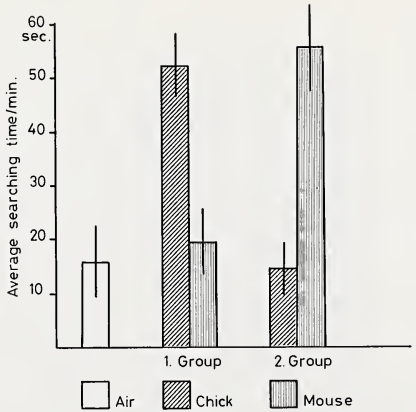

Fig. 4. Eighth month of life

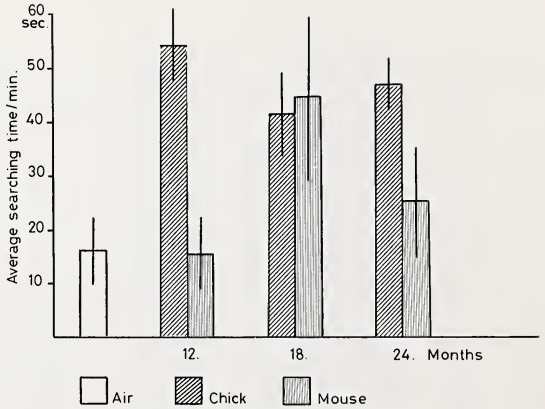

Fig. 6. Group 1. The average time spent in the section closest to the source of smell of 12, 18 and 24 months old animals before and after presentation of the odor

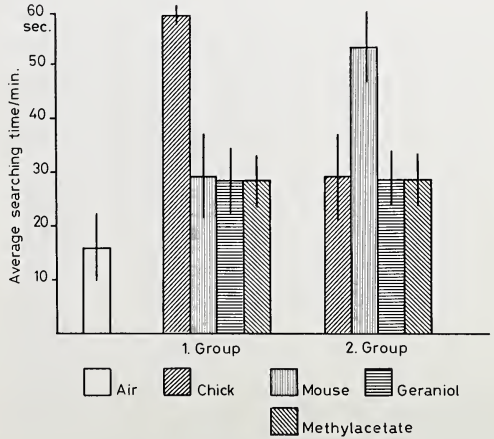

Fig. 3. Fourth month of life

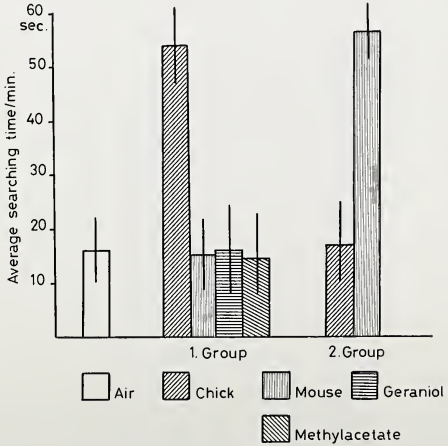

Fig. 5. Twelfth month of life

Fig. 2—5. The average time spent in the section closest to the source of smell before and after presentation of the odor. Vertical lines represent one standard deviation of the mean

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completely ignoring the unknown one (Fig. 4). The reaction to the known odor was statistically as strong as in the four months old animals. But there was no indication that the unknown odor caused any sign of searching; it was treated like the control air.

At the age of twelf months the ferrets were retested. Animals of that age are able to reproduce. All animals of both groups showed search reactions only when the known odor was offered (p = 0,013). The unknown odor of a natural prey and also smelling substances were ineffective in eliciting any visible behavioral reaction (Fig. 5). Comparing the average searching time of four, eight and twelf months old animals toward the known odor no difference could be detected. The same was true for the reactions toward unknown odors of eight and twelf months old animals. After a starvation period of three days the response toward the known odor seemed to increase (no statistical proof); however, unknown odors still did not cause any reaction in the animals.

After the twelfth month of life, animals of group 1 received mice instead chicks for the next six months. Then they were retested. The odor of chick still elicited in all ferrets searching behavior definitely. In addition the animals reacted strongly to mouse odor (Fig. 6).

Six months later the ferrets were retested after they had been fed with chicks only. As in the prior testing situations the odor of chick caused searching behavior in the section closest to the source of smell. They also responded to odor of mouse but to a lesser extent (p = 0,021).

Group 3

Animals of group 3, being fed with chick for the first weeks of their lives, were tested after the second month for the first time. The reaction to the odor of chick was significantly stronger (p = 0,043) than to the odor of mouse (Fig. 7). During the third month of life all ferrets were fed with mice exclusively. Then retesting took place. This time the reaction to mouse odor was stronger (Fig. 7; p = 0,024).

During their fourth month of life, the ferrets again received chicks only. The following tests revealed that the odor of mouse still caused a strong increase in searching behavior, however, the odor of chick clearly elicited this behavior too (Fig. 7). Statistically, the odor of mouse was still more effective than the odor of chick (p = 0,041).

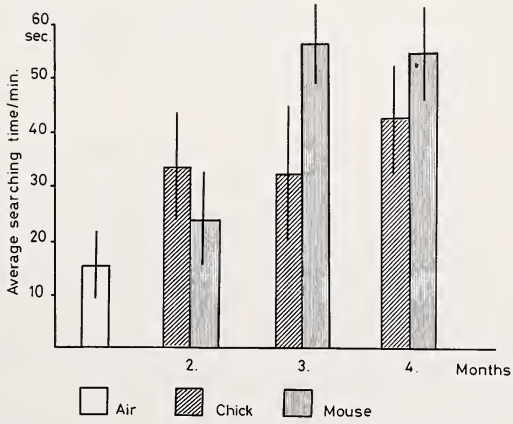

Fig. 7. Group 3. The average time spent in the section closest to the source of smell of 2, 3 und 4 months old animals before and after presentation of the odor.

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Discussion

The phenomenon of imprinting has been described for many different behavioral situations. There are indications that imprinting processes also may play an important role in forming food preferences (e. g. Burghardt and Hess 1966; Hess 1964). One of the best investigated examples was found in rats (Shapiro and Salas 1970; Leon and Moltz 1971, 1972; Leon 1975).

In ferrets acoustical, optical and olfactory cues are important for hunting. In spite the fact that in this carnivore searching for prey can be elicited by odors alone, innate olfactory recognition of prey does not exist. The results suggest rather, that ferrets have to learn how their prey smells. There seems to be an innate age dependent readiness to react to olfactory stimuli with searching behavior. This readiness is most marked in three months old ferrets (Fig. 8), the age when the young animals leave the mother family and start to live solitarily.

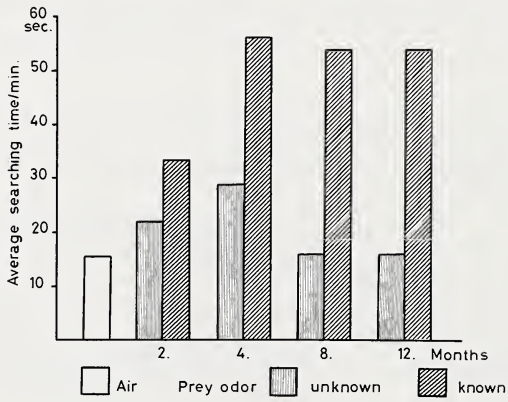

Fig. 8. Age dependent reactivity toward known and unknown odors

When being exposed to prey during this sensitive phase, an imprinting-like process takes place which results in a readiness to respond to this specific prey odor with search behavior throughout the whole life. In this way food preference might become established in ferrets, a phenomenon comparable to that found in e. g. rats.

In adult ferrets, searching behavior can be elicited only by familiar prey odors, unknown odors are not reacted to. The reactions to even two familiar odors are not necessarily the same; preference to a specific prey odor is less due to the length of prior feeding experience but rather due to exposure during a sensitive phase during ontogeny.

Zusammenfassung

Eine sensible Phase für die Entwicklung olfaktorischer Beutebevorzugung beim Frettchen (Mustela putorius f. furo L.)

Die vorliegende Arbeit sollte klären, ob beim Frettchen (*Mustela putorius* f. furo L.) die Bevorzugung eines bestimmten Beutedufts abhängig ist von der Länge der vorhergehenden Fütterungsdauer mit dieser Beute, oder ob dafür der Kontakt während einer sensiblen Phase im Laufe der Ontogenie verantwortlich ist.

Insgesamt wurden 28 Tiere, eingeteilt in drei Gruppen, untersucht. Auf bestimmten Altersstufen wurden die Verhaltensreaktionen jeder Gruppe gegenüber den folgenden Düften überprüft: Küken, Maus, Geraniol, Methylacetat.

Drei Monate alte Frettchen reagieren auf alle Duftstoffe mit Suchverhalten. Füttert man sie in diesem Alter mit einer bestimmten Beute, entwickelt sich eine Beutebevorzugung. Als ausgewachsene Tiere reagieren sie zuverlässig auf eben diesen bestimmten Beutegeruch mit Suchverhalten. Unbekannte Beutedüfte bleiben dagegen unbeachtet.

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Zeitschrift/Journal: Mammalian Biology (früher Zeitschrift für Säugetierkunde)

Jahr/Year: 1977

Band/Volume: 43

Autor(en)/Author(s): Apfelbach Raimund

Artikel/Article: A sensitive phase for the development of olfactory preference in ferrets {Mustela putorius f. furo L.) 289-295