# Grooming Parameters in Rat Ontogenesis

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The term "grooming" is applied to specific skin reflexes (washing, scratching, shaking off, licking, nibbling) aimed at cleaning the body surface by rhythmic movements of the limbs or head. The rhythmic and monotonous pattern of grooming movements makes them a good model for studies of the mechanisms of automated motor activity. An ontogenetic approach in accordance with L. A. Orbeli's concept helps understand the regularities in the development of a function [3]. The spinal reflex arch is known to close in rat fetuses on days 15-16 of prenatal development, that is, almost six days before the animals are born [14]. Specific skin reflexes start developing from the very first days of life and by the moment the young rats open their eyes these reflexes are formed [1,2,11]. The sensitivity of the midbrain reticular formation to sensorimotor stimuli is particularly high in the course of the development of grooming movements [13]. The reflexogenic zones of the skin from which grooming movements are evoked are widening during this period [11], and medial thalamus reactivity increases. The afferent flow increase appear to be aimed at facilitation of grooming rhythmic component development, that is, at the development of grooming generators in the CNS. Sensory stimulation is known to exert a potent effect on the function of the immature CNS [4,13].

A previous investigation using graphic recording of grooming movements [2] has revealed that grooming rhythms are the parameter determining the time of attainment of maturity of various grooming movements. In accordance with this criterion, washing movements attain maturity on day 3 of life, scratching on day 15, shaking on day 16, licking on day 12, and nibbling the fur on day 16-17.

The present research was aimed at a comprehensive analysis of all grooming movements in the course of rat ontogenesis, both during grooming formation (before the animals open their eyes) and after it in the course of maturation and activation of the catecholaminergic, serotoninergic, and cholinergic systems, making use of graphic recording of grooming movements in free young rats [6,9].

## MATERIALS AND METHODS

White male rats were used in the experiments. Motor activity of free young rats was recorded starting from the first day of life over the first month and then at the age of two and three months during one hour. The animals were placed in a plastic actograph of corresponding size with piezoprobe installed in the bottom. Mechanical oscillations of the actograph bottom caused by animal movements were transformed by the probes into electrical oscillations which were then amplified and recorded by an ink-writing electroencephalograph [2]. The actograms showed: 1) the total number of all grooming movements; 2) the number of each type of grooming movements in one hour; 3) the duration of individual grooming movements; 4) the rhythm of paw or head movements during the performance of these movements. Analysis of parameters 3 and 4 proved possible only due to the graphic recording. We also ana-

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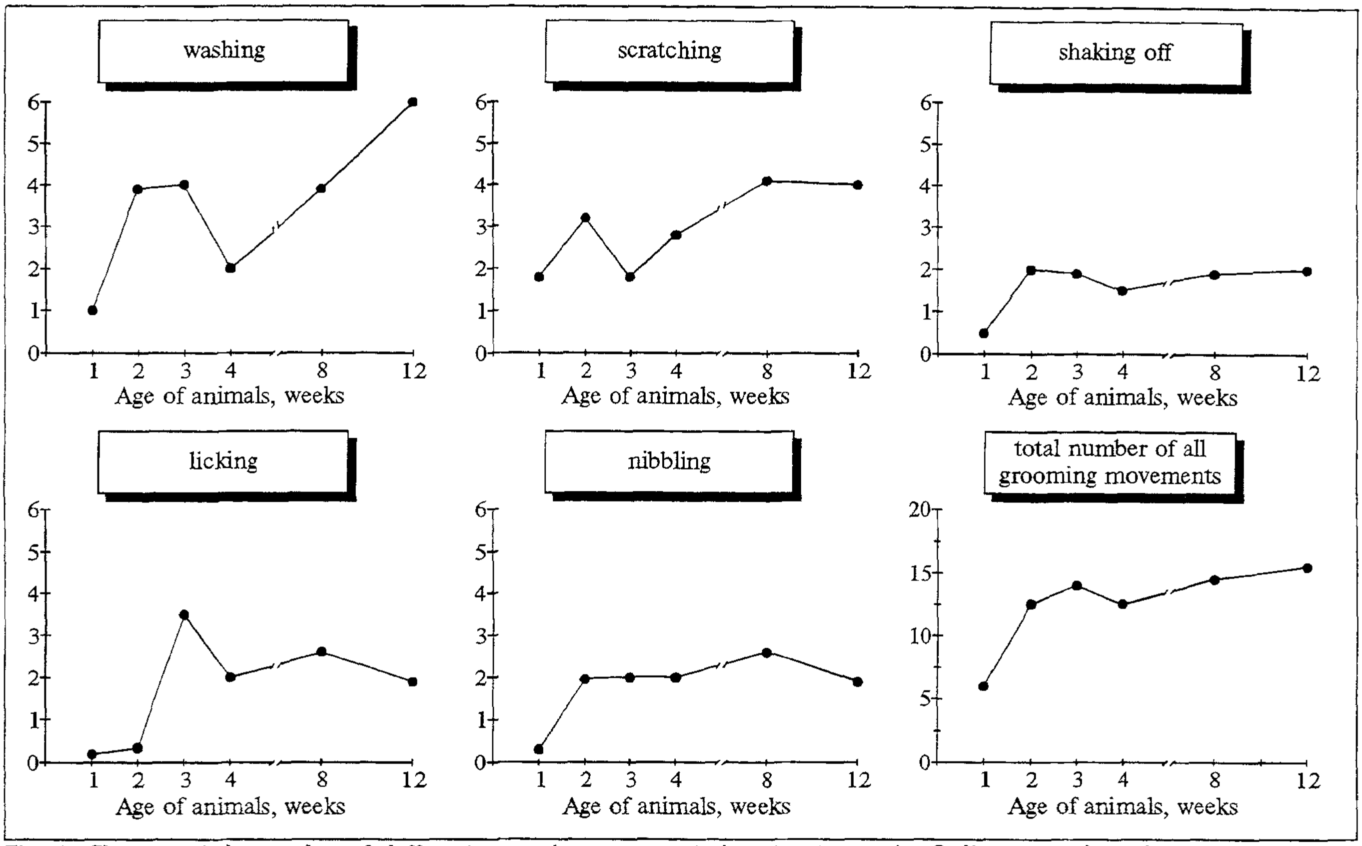


Fig. 1. Changes of the number of defferent grooming movements in rat ontogenesis. Ordinate: number of movements in one hour.

lyzed the various combinations of grooming movements - the so-called "chains" in the course of ontogenesis. At least ten records of young or adult rats per term were analyzed. The data were statistically processed. Since thermoregulation of the young rat body is imperfect [5], the temperature in the chamber into which the actographs with the infant rats were placed was maintained at 33-36°C during the first ten days of life and then gradually lowered to 20°C. The stage of specific skin reflexes is assumed to start from day 7 of life, after prolonged tonic muscular contractions suddenly cease on the 6th-8th day [11]. However, the rats can wash and scratch during the very first days of life, but they do it lying down, for they cannot lift the abdomen and stand on their hind paws until day 10-13, because the formation of the tonic influences on the sceletal muscles is completed only in the second week of postnatal development [5]. Starting from this time young rats can assume the required posture when performing grooming movements without losing their balance.

## RESULTS

The experimental data indicate that the changes recorded in the total number of grooming movements coincide with those observed visually [7,11]. The number of grooming movements in the first week of life is low: approximately 3 movements during an hour under experimental conditions. Other grooming movements appear during the second week: shaking off, licking, and nibbling, and the total number of movements increases twofold. When the animals open their eyes in the third week, the total number of grooming movements is maximal (Fig. 1, *f*). The increase in grooming during the second and third weeks of life coincides with activation of the catecholaminergic effects on the motor, (mainly locomotor) activity of young rats [6,7]. During the fourth week of life the animals show a tendency to reduce the total number of grooming movements. This may be caused by enhanced serotoninergic and cholinergic effects on motor activity durng this period [6,7]. Washing and scratching (42.4 and 48.4%, respectively) predominate among grooming movements during week 1. The number of shaking off movements increases during weeks 2-3, licking during week 3, and nibbling movements during week 4. Hence, grooming movements in the course of ontogenesis are aimed at first at cleaning the surface of the head and anterior part of the body (washing and scratching) and later at cleaning the fur on the whole body

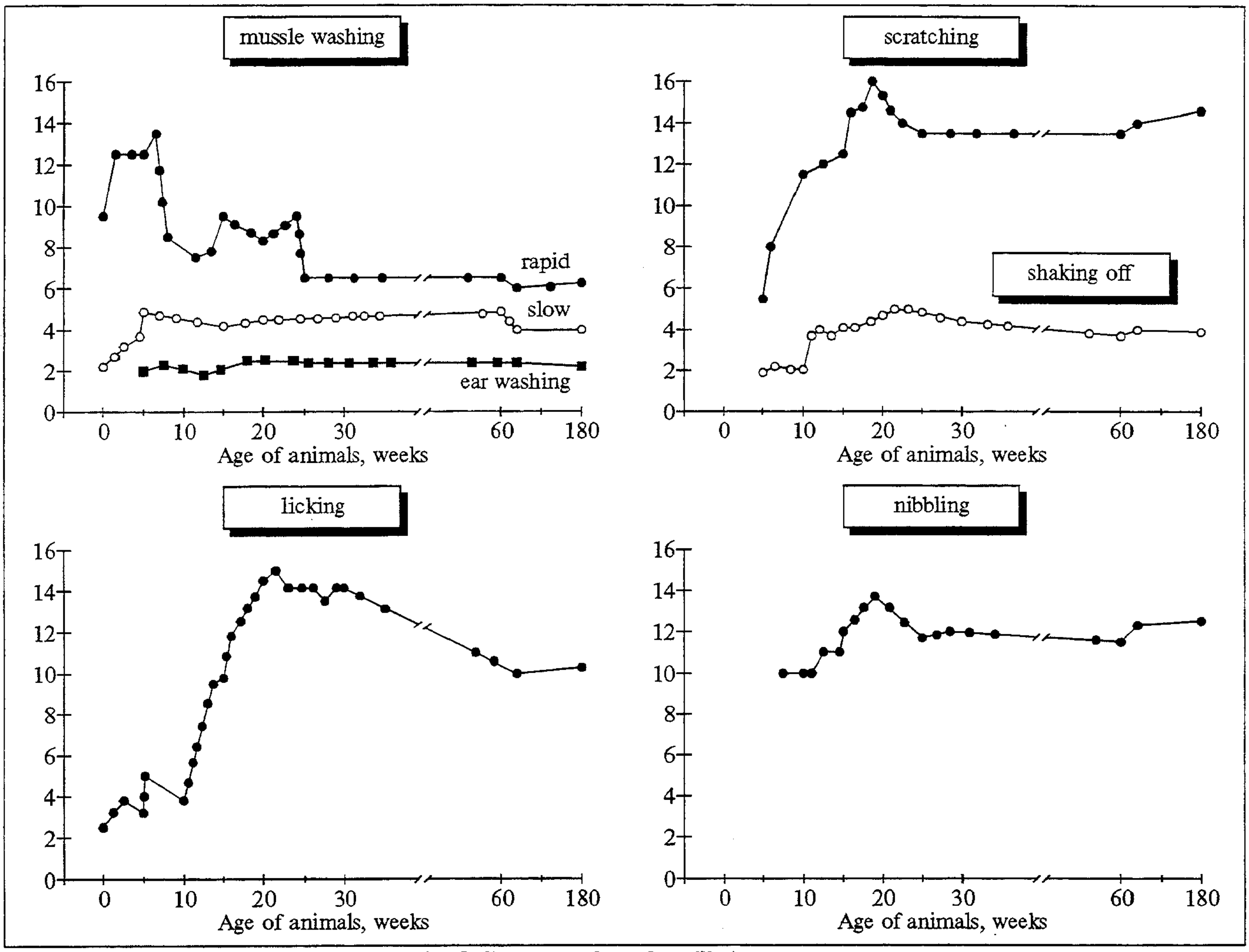


**Fig. 2.** Grooming rhythms in rat ontogenesis. Ordinate: number of oscillations per sec.

(shaking off, licking, nibbling), that is, the changes spread in the rostro-caudal direction).

The duration of all grooming movements increases in the course of ontogenesis, peaking during the fourth week, that is, in the presemce of boosted serotoninergic and cholinergic effects on motor activity [6,7]. The duration of licking and washing movements increases most of all (by 330 and 77%, respectively - see Table 1).

Grooming rhythm frequency characteristics are an indicator of the maturity and functional status of the CNS generators in the course of rat ontogenesis. The grooming rhythm generators are triggered from respective reflexogenic skin sites. Only the localization of the scratching reflex rhythm generator is known: in the lumbar enlargement of the spinal cord, in segment C1-C3. From skin receptors impulses are directed to command neurons located in the cervical region of the spine, from where the scratching generator is triggered [8,12]. In adult animals washing is characterized by three frequency components: frequency 4.0±0.4 per sec corresponds to slow washing of the muzzle and vibrissae area, frequency 7.3±0.5 per sec to rapid washing of the muzzle with a greater amplitude, and frequency 2.4±0.1 per sec to exten-

**TABLE 1.** Duration (in Seconds) of Different Grooming Movements in Rat Ontogenesis

| Grooming movement | Age, weeks | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 12 |
| Washing | 4.8±0.8 | 5.0±0.7 | 5.0±0.5 | 8.5±0.6 | 11.7±0.8 |
| Scratching | 1.4±0.2 | 2.3±0.3 | 2.1±0.3 | 2.0±0.6 | 1.6±0.5 |
| Licking | — | 1.0±0.8 | 2.3±0.2 | 4.3±0.3 | 3.3±0.4 |
| Nibbling | — | 4.8±0.6 | 5.5±0.7 | 6.0±1.0 | 4.0±1.0 |

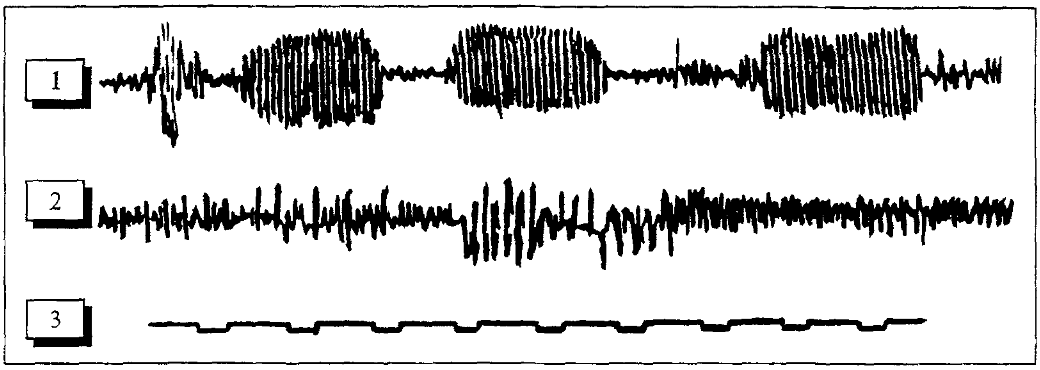


Fig. 3. Chains of different grooming movements. *1*) chain consisting of shaking off (s) and scratching (scr); *2*) beginning of a long chain starting with washing (ws — slow washing of the muzzle, we — washing behind the ears, wr — rapid washing of the muzzle) and consisting of intermittent licking (l) and nibbling (n); *3*) time mark 1 sec. Rat age: *1*) 12 days; *2*) 18 days.

sive washing of the muzzle and ears. Slow and rapid washing are both observed in infant rats from the first day of life, extensive washing appears on day 6 (Fig. 2, *a*). The slow washing rhythm attains the values in adult animals on day 4, increasing by 122%. The extensive washing rhythm attains the maturity level on day 16, increasing by 50%. The rapid washing rhythm of infant rats is higher than that of adult animals up to 24th day of life (Fig. 2, *a, 1*). In the scratching reflex one may distinguish posture (drawing the paw towards the site of irritation) and rhythmic components [8,12]. During the first few days of life the rats cannot draw their paws up high enough and they scratch "the air" with a wide amplitude and slow rhythm. The scratching movement rhythm attains the adult level by the time the rats open their eyes, on day 14-15 [1], increasing by 470%. The findings indicate an intensive increase of shaking off movements in the course of ontogenesis. Such movements first appear on day 6 of life with a rhythm of 6.0±0.05/sec and the adult rhythm is attained on day 15 - 14.0±1.5/sec, thus increasing by 133%. Rhythmic licking movements are first seen in 6-day-old rats, nibbling movements in 9-day-old animals. The licking rhythm attains the adult level on day 12, the movements increasing from 2.5±0.3 to 4.0±0.5/sec, while the nibbling movements attain the rhythm in adult animals on day 16, increasing from 10.0±0.9 to 12.0±1.5/sec, this constituting an increase of 60 and 20%, respectively.

The period of "arousal behavior" after the animals open their eyes, caused by enhanced catecholaminergic effects [6], is associated, along with an increased number of grooming movements, with activation of scratching and nibbling rhythms, whose magnitude during this period is even higher than in adults by 13 and 14%, respectively (Fig. 2). The duration of grooming movements is increasing in parallel with the increase of cholinergic effects, as was mentioned above.

Grooming becomes more complicated in the course of ontogenesis, this being manifested, among other things, by the formation starting from the second week of life of "chains" of different grooming movements. The duration of these chains varies depending on the set of grooming movements and the age of the animal. During the second week of life the chains consist mainly of scratching combined with washing or shaking off. Their duration is approximately 14.0±2.7 sec. Later longer chains are observed starting with washing and consisting of multiple intermittent licking and nibbling, the total duration of these chains being 27.5±7.0 sec (Fig. 3).

The presented grooming parameters are objective criteria of ontogenetic development of grooming forming a solid basis for the investigation of the mechanisms regulating it.

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