INDIVIDUAL VARIATIONS IN THE DEVELOPMENT OF MOTOR ACTIVITY OF RABBITS IN THE EARLY POSTNATAL PERIOD

D. B. Malakhovskaya

Laboratory of Development of Nervous Activity of Animals in Ontogenesis (Head—Cand. Biol. Sci. A. V. Voino-Yasenetskii), I. M. Sechenov Institute of Evolutional Physiology (Director—Corresponding Member AN SSSR E. M. Kreps), of the AN SSSR, Leningrad
(Presented by Active Member AMN SSSR D. A. Biryukov)
Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 56, No. 9, pp. 13-17, September, 1963
Original article submitted July 13, 1962

In the course of the study of the motor activity of rabbits [4] we paid attention to the fact that in these animals the development of one motor act differed from that of another. This fact has also been described in the literature [2,6].

This article describes a study of the character of the individual variations revealed by observations on the development of motor activity in rabbits between the ages of 5 and 75 days. The experimental technique was described in detail in a previous paper [4]. We may mention here simply that we investigated both spontaneous movements and movements evoked by stimuli, and that we were particularly interested in specialized movements of the washing, scratching, licking, and shaking types.

Observations made on spontaneous specialized movements in 20 animals showed that during the first 2 weeks of life young rabbits left alone perform many movements, more especially scratching in type, subsequently replaced by licking movements, which remain the predominant form of spontaneous specialized movements until the end of the period of observation. This general pattern varied from one rabbit to another. In some cases the replacement of scratching by licking movements took place on the 11th-12th day (Fig. 1a), and in others on the 22nd-25th day or even later (Fig. 1b). In some animals the change from scratching to licking took place more rapidly, while in others it took several days, in the course of which first one, and then the other form of movement predominated (Fig. 1c).

The individual variations in the development of reflex movements evoked by stimulation were still more marked. Observations were made of the reflex movements produced from a single receptor zone, the posterolateral surface of the neck. This is the most active zone for eliciting a scratching reflex [2].

Our previous observations [4] showed that the posterolateral surface of the neck is reflexogenic for the scratching reflex roughly until the 18th-20th day of life; subsequently stimulation of the same zone begins to evoke other specialized movements, mainly shaking in type. However, the replacement of scratching movements by others does not take place to the same extent in all rabbits. In some cases the scratch reflex is replaced at once by shaking movements, while in others scratching is replaced at first by licking and later by shaking. In some rabbits scratching is replaced by another reflex at an early period, in others later, while in individual animals scratching is not superseded by another reflex but continues to occur together with shaking or licking until the end of the period of observation.

Analysis of the individual variations led to the recognition of two types of development of reflexes: the first, with a more or less rapid replacement of scratching by shaking movements, and the second, with prolonged retention of scratching movements, competing until the end of the period of observation with licking or shaking.

It is clear from Fig. 2 that the relationship between the forms of specialized reflexes in rabbits varies in animals whose reflex activity develops along different lines. In one rabbit (Fig. 2a) the relative number of scratching reactions decreased at the end of the 3rd week, to be replaced by shaking movements, which thereafter remained the predominant form of reaction. The development of the reflexes in this rabbit followed the pattern of the first type. In another rabbit (Fig. 2b) the number of scratching movements remained at a relatively high level throughout the period of investigation. The scratching reflex in this case was not replaced by another: after the 4th week two reflexes—scratching and licking—were almost equally marked.

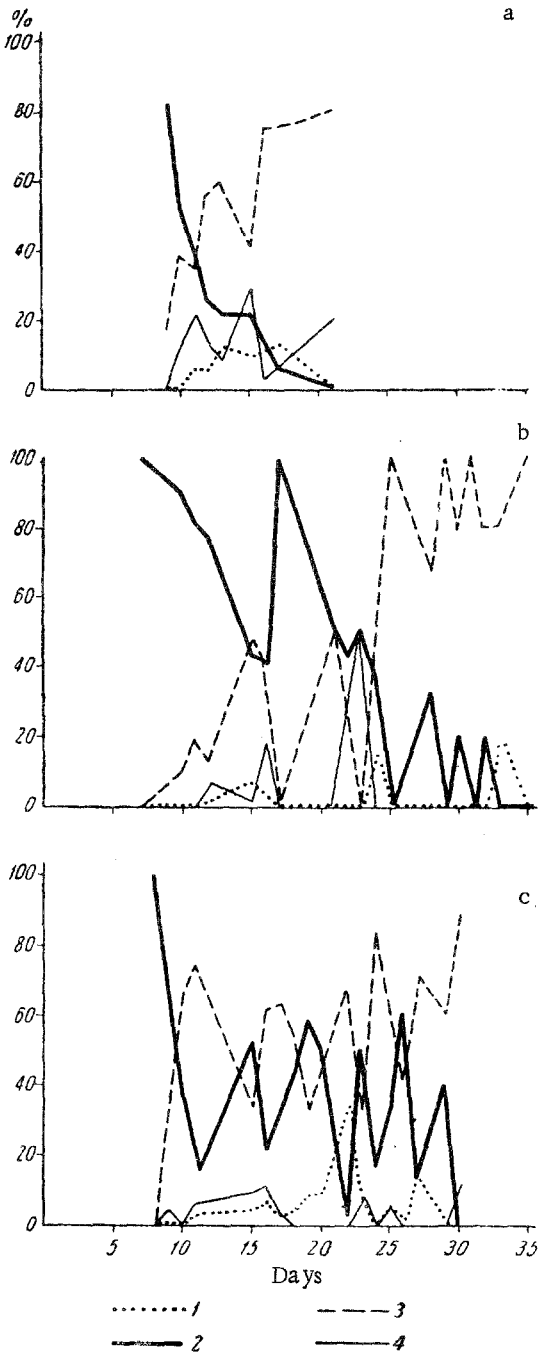

Fig. 1. Individual variations in the development of specialized spontaneous movements. a) Rabbit No. 24; b) No. 75; c) No. 80; 1) washing movements; 2) scratching; 3) licking; 4) shaking.

In 22 of the 27 rabbits investigated, the development of reflexes followed the first type and in only 5 rabbits the second pattern.

In the rabbits with the first type of development the change from the scratching to the shaking reflex took place on the average on the 19th day. However, significant variations were observed: in some animals this change occurred at the beginning of the 3rd week of life, and in others at the end of the 4th or even at the beginning of the 5th week.

Besides the differences in the character of development of the reflexes, the rabbits with the first and second types of development also showed differences in the total number of specialized movements. The second type was characterized not only by prolonged preservation of scratching movements, but also by a greater number of specialized movements in the course of the observation period. The increased excitability characteristic of young rabbits during the first 2-3 days of life, which was subsequently depressed in the rabbits with the first type of development by the activity of the higher divisions of the central nervous system, persisted in the rabbits with the second type of development until the age of 1.5-2 months.

The types we have distinguished thus indicate the individual variations in the development of specialized reflexes elicited from the posterolateral surface of the rabbit's neck. It is not yet clear whether there is any connection between these two types and the types of the higher nervous activity.

The presence of variations in the pattern of development of reflexes may be explained by inequalities in the strength of subordination of the various divisions of the nervous system in different rabbits. As A. V. Voino-Yasenetskii [1] showed, the degree of subordination between various divisions of the nervous system is not identical in all individual animals: in some the higher divisions maintain a strong controlling influence over the function of the lower divisions, while in others the subordination is looser and is more easily abolished.

According to A. A. Volokhov [2], of the specialized reflexes which we examined, the scratching reflex is the first to appear in the ontogenesis of the rabbit, followed by the licking, and later still by the shaking reflexes. It is possible that the arc of the scratching reflex is closed in lower divisions of the central nervous system than the arc of the licking and shaking reflexes.

It may be postulated that in rabbits possessing strong subordination the higher divisions of the central nervous system, as they develop, easily suppress the activity of the lower division containing the arc of the scratching reflex. In this case scratching soon gives way to other reflexes. On the other hand, in rabbits with weak subordination, the lower divisions of the nervous system preserve their relative independence for a long time, and this is shown by the continuation of scratching.

The course of development of the reflexes in the rabbits of the same litter, notwithstanding their individual variations, was largely similar, probably as a result of the definite resemblance between the coordination relationships in the central nervous system.

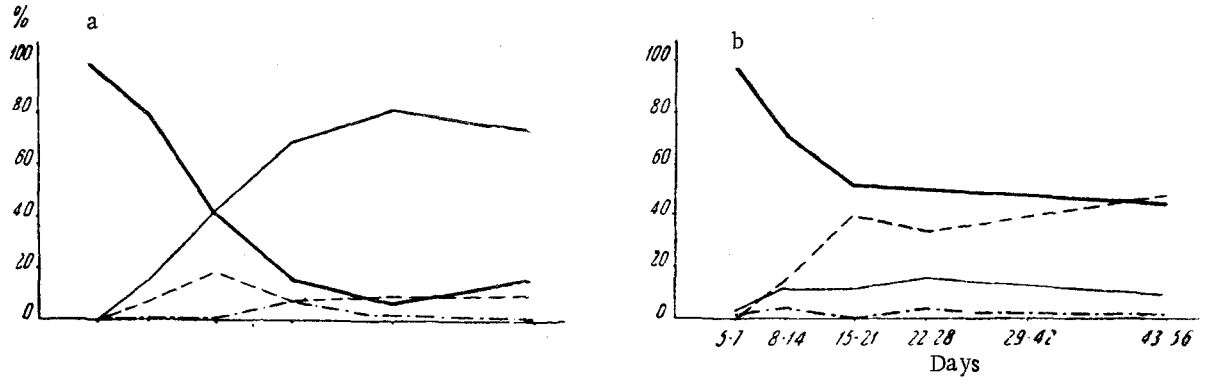

Fig. 2. Individual variations in the development of specialized reflex movements evoked by stimulation. a) Rabbit No. 41; b) No. 121. Rest of legend as in Fig. 1.

It should be pointed out that the development of reflexes in each rabbit did not proceed at a uniform pace but with fluctuations. For example, after the relative number of scratching movements began to diminish, it would increase again for a time, then fall and rise again, and so on. In most rabbits, however, the number of scratching movements gradually fell. We observed similar variations when we investigated the development of the plantar reflex in children [3].

L. A. Orbeli [5] repeatedly pointed out that the process of development from the old to the new is a conflict between the newly arising forms of function and the more primitive forms. For a time in the process of development either forms may predominate. The course of development of reflexes, in which sometimes the younger forms of reaction (the shaking reflex) begin to predominate, and sometimes the older reactions (the scratching reflex) regain their strength, is a reflection of the dialectical process of development of coordination relationships in the growing organism.

LITERATURE CITED

1. A. V. Voino-Yasenetskii, Reflection of the Laws of Evolution in the Epileptiform Reaction of Animals to the Action of a High Partial Pressure of Oxygen [in Russian], Moscow-Leningrad (1958).
2. A. A. Volokhov, Principles of Ontogenesis of Nervous Activity in the Light of the Theory of Evolution [in Russian], Moscow-Leningrad (1951).
3. D. B. Malakhovskaya, Interaction between the conditioned and unconditioned plantar reflexes in infants, Author's abstract of candidate dissertation, Leningrad (1959).
4. D. B. Malakhovskaya, Fiziol. zh. SSSR, 7, 872 (1961).
5. L. A. Orbeli, Problems in Higher Nervous Activity [in Russian], Moscow-Leningrad (1949).
6. E. P. Stakalich, Transactions of the Institute of Evolutional Physiology and Pathology of Higher Nervous Activity [in Russian], Moscow (1947), 1, 387.
