Differential outcomes of unilateral interferences at birth

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Behavioural modifications, including modifications of emotional reactivity, can occur following early experience such as handling (manual rubbing). Here, we investigated the effects of unilateral tactile stimulation at an early stage on emotional reactions later on. We handled newborn foals intensively on one side of their body. This early unilateral tactile experience had medium-term effects: the reactions of foals to a human approach, when they were 10 days old, differed according to the side stimulated at birth. Fewer right-handled foals accepted contact with humans, they delayed first contact longer and they evaded approaching humans sooner than did non-handled and left-handled foals. These results raise questions concerning the organization of neonatal care in animals and humans.

Keywords: behaviour; early experience; development; emotion; side bias

1. INTRODUCTION

Early age is a crucial period for animals’ neurological and behavioural development, which is strongly influenced by both individual genetic programmes and environmental conditions [1]. Brief events during early life may have strong impacts on the organization and/or development of the brain asymmetry. Early exposure of chick embryos to light prior to hatching induces lateralization of several types of visual behaviour, as revealed by pebbles–grains tasks (review in [2]). Handling rat pups for few minutes each day during their first 20 days of life influences their stress responses after weaning, by increasing their exploratory behaviour in an open-field. This procedure, coupled with left or right neocortical ablation, revealed a hemispheric dominance for responses after early interference (review in [3]). Other studies evidence lateralization of emotion processing in brain structures [4].

Motor or perceptual laterality exists in some species, even before birth [2,5,6]. Sensitivity to tactile stimulation seems to be especially high during very early stages. For instance, the side that is subject to tactile stimulation influences subsequent emotional states of human newborns [7]. The fact that early interference can induce long-lasting modifications raises questions concerning the possibility that unilateral stimulation could lead to differential reactions during development.

Here, we tested the hypothesis that unilateral stimulation at an early stage would induce different emotional responses to a stressful situation. We handled newborn foals intensively on one side of their body. Bilateral handling procedures of horses at birth have been shown to induce long-term behavioural modifications, including later reluctance to allow human approaches [8]. Similarly, bilateral forced stroking of foals aged from few hours to 5 days old decreases the acceptance of human contact when they are 15 days old [9]. Horses are an interesting model, as they show laterality patterns [10–12], among which visual laterality clearly indicates a hemispheric specialization for emotional processing [13], and standardized tests evaluating their emotionally have been developed [14].

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Rhand–control and Rhand–Lhand: $p < 0.01$; Lhand–control: $p = 0.59$; figure 1b), but the latency of avoidance response was shorter than for control foals (Rhand–control: $p < 0.05$; Rhand–Lhand: $p = 0.08$; figure 1c).

Rhand foals accepted human contact more reluctantly than did the other foals, whatever the side that was approached by human, as fewer of them could be touched (Fisher tests: Rhand–control: left and right: $p < 0.01$; Rhand–Lhand: right: $p < 0.05$; left: $p = 0.18$; figure 2a). The time required to establish contact and avoidance latency when approached on the left differed between Rhand foals and controls (Mann–Whitney U-test: contact from right or left: $p < 0.05$; avoidance from left: $p < 0.05$ or right: $p = 0.57$; figure 2b,c). Contact and avoidance latencies differed between Rhand and Lhand foals only when they were approached on their right side (Mann–Whitney U-test: contact or avoidance from right: $p < 0.05$ or left: $p = 0.11$ and $p = 0.64$; figure 2). Indeed, Lhand foals accepted human approach on the right side more readily than on the left side (avoidance latency: Wilcoxon test: right: $p < 0.05$).

The approach test was repeated every day from the 10th to the 15th day. From the 11th to the last (15th) days, Rhand foals’ reactions no longer differed from those of Lhand and control foals, both in terms of contact latencies and of avoidance latencies (see electronic supplementary material, S1).

### 4. DISCUSSION

Previous experiments had revealed that bilateral handling or forced stroking at an early stage after birth could induce avoidance of contact with a familiar or unfamiliar human, either shortly after the negative event or months later [8,9]. In the present study, foals were handled unilaterally at birth. This early tactile experience had at least medium-term effects, as the reactions of these foals to human approach when 10 days old differed according to the side of stimulation. Non-handled foals appeared to accept human approach and contact more than did right-handled foals, which were very reluctant to be touched. Left-handled foals presented intermediate reactions as they avoided human approach when it occurred on their left side. Thus, a short (1 h) early interference can impair emotional development durably. Repetition of neutral interactions (1 min of non-invasive presence) restored the alterations.

The negative effects of handling could be explained by the intense stress generated by the procedure the foals were subjected to immediately after birth (foals struggled a lot while being restrained on the floor). In addition to this stress, they were deprived of the maternal care they could expect at that time. This creates an insecure attachment to their mare that impairs their subsequent social relationships with conspecifics [8]. Forced contacts during the days following birth also has consequences on the perception a foal has of humans [9].

In our experiment, tactile stimulation was lateralized. Vision was coupled with touch as foals could see the experimenter when they were handled.
We assume that the emotional states created by vision and touch differed in relation to the side stimulated, and induced different reactions in the perception of human approaches.

Individuals of several species use either their right or their left eye in relation to what they perceive and the related behaviour. Predator avoidance differs when a predator approaches from the left or from the right [2,15]. Similarly, one eye is often preferred for conspecific or individual recognition (fishes [16], chicks [17], quail [18] and toads [19]) or for scanning situations with different emotional values [13,20]. Concerning lateralized effects of tactile stimulation, few examples exist, mainly in humans. Stimulation of newborns’ peri-oral area elicits head turning and cardiac acceleration more often when applied on the right than on the left side [7]. This reveals differential sensitivity between sides of the face.

The differential responses to human approach according to the side handled were the result of visual and tactile interferences at birth. The emotional value of each form of stimulation differs from one another, so are their behavioural consequences. Chicks’ right eyes (and left hemisphere) are involved in the elaboration of categories facilitating rapid learning of what they perceive. The left eye is attracted to novelty and learning with this eye is slow [2]. One can assume that, in our experiment, the foals rapidly associated humans and handling when it occurred on their right side, while the procedure on their left side did not induce a negative perception of humans.

To conclude, attention should be given to the symmetry of stimulation and their consequences in all experiments involving early handling. Practices around birth in humans and animals may be adjusted by taking care of the way stimulation is provided to the newborn.

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