Study of animal behavior and welfare of miniature pigs in France

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STUDY OF ANIMAL BEHAVIOR AND WELFARE OF MINIATURE PIGS IN FRANCE

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ABSTRACT

Animal welfare is a core concept for animal ethics issues related to humane treatment of animals having a close relationship with humans such as companion animals, farm animals as well as animal models in research. The increasing debate within society in Europe on the animal welfare has promoted wide scientific research to define this concept and to assess the impact of management conditions on the behavioral and neurophysiological responses of animals. The welfare concept refers to the subjective state of an individual towards its internal and external environment, sustained by cognitive and emotional processes. There is also a consensus amongst animal welfare scientists to postulate that this concept is a complex and multidimensional phenomenon. Indeed, research on animal welfare issues encompasses different scientific expertise domains, from biological to social sciences, to give a broad insight on this topic, and to provide scientific, social and livestock management outcomes and applications. Research on pig welfare was initially focused on ethological approaches to assess their behavioral needs and how they cope with the environmental constraints. Most research has been focused on European conventional breeds, whereas little is known on miniature pigs used for biomedical research. Minipigs dedicated to research were selected mainly on body weight, morphology, hair color and litter size, without any selection on the temperament. A review of the behavior of pigs illustrates phenotypic variability between breeds and how they cope with management constraints, highlighting different behavioral strategies. Moreover, the application of research on animal welfare is illustrated with regard to its contribution to the debate within society on animal protection, as a basis for the development of guidelines at the European or international level, and for supporting scientists and farmers in achieving their respective goals with specific attention to animal welfare in their herds or laboratories.

Key words: Animal welfare, Behavior, Minipig

INTRODUCTION

The animal welfare concept is central to issues of animal ethics in relation to thoughts about the humane treatment of animals (Fraser, 2008). It applies to the whole range of animals with close links with humans such as companion animals, farm animals, animals living in zoos or used for experimental research. The increasing debate within society on animal welfare, since the publication in 1964 of the book Animal Machines (Harrison, 1964) in the UK, has

promoted wide scientific research to define this concept and to assess the impact of management conditions on the behavioral and neurophysiological responses of animals. Moreover rules have been set up over time in European legislation to improve the living conditions of farm and laboratory animals, in response to social concerns for ethics and animal production (Directive 2010/63/UE, 2001/88/CE, 2001/93/CE). Research on pig welfare has been initially focused on ethological approaches to assess their behavioral needs and how they cope with the environmental constraints. Investigations have been carried out mainly on European conventional breeds for animal production issues, and little is known about minipigs used as laboratory models for human biomedical research. Behavioral investigations on minipig breeds concerned mostly the Göttingen minipig (Sondergaard *et al.*, 2007), with limited attention on the temperament and behavioral traits, as well as their genetic or phenotypic variability. The objectives of this paper were to define the animal welfare concept, its application to the minipig breeds through studies conducted in France on their emotional and cognitive abilities, to assess their suitability for laboratory research and selection purposes.

ANIMAL WELFARE CONCEPT

Definitions

Although animal welfare is a widely used term, it is inappropriate to draw a unique definition for it, as this concept includes many facets. There is, however, a consensus amongst animal welfare scientists to postulate that it is a complex and multidimensional phenomenon. During the past decades, various definitions have been proposed to define the animal welfare concept, depending on the scientific approaches and ethical debate about animal welfare, as well as on cultural and societal views on the relationships between humans and farm animals. Amongst them, we can identify definitions referring to:

- The fulfillment of the animal's needs related to the "five freedoms" published by the Farm Animal Welfare Council (1992): freedom 1/ from hunger and thirst, 2/ from discomfort, 3/ from pain, injury, and disease, 4/ to express normal behavior, 5/ from fear and distress. These principles are used by the European legislator to surround the welfare concept for implementation in farm and laboratory animals (EU http://europa.eu.int);
- The harmony between the individual and its environment, where animal welfare is a complete mental and physical state (Hughes, 1976), underlying the satisfaction of needs or motivation for certain aspects of the environment (space, food resources, social partners), the attainment of physiological behaviors and social development (Hughes and Duncan, 1988);
- The adaptation concept where the well-being of the animal is associated with a condition that requires the least effort for the animal to adapt to its environment, with a continuum between very good in ideal conditions to very poor in a detrimental environment (Broom, 1993);
- The subjective experience, negative and positive feelings (Boissy *et al.*, 2007).

All these definitions are complementary and can be reviewed in a dynamic concept combining adaptation, harmony and pain (Veissier *et al.*, 2007), with the normal functioning of the organism (absence of disease, injuries, malnutrition), the absence of suffering (hunger, thirst, pain, fear), and the existence of positive experiences (physical comfort, expression of species-specific behaviors).

Biological assessment

Whatever the definition, the concept of animal welfare refers to the subjective state of an individual towards its internal and external environment, sustained by cognitive and emotional processes. Investigations on animal welfare issues underlie different scientific disciplines, within biological and social sciences, to give a broad perspective of this topic, and open onto scientific, social and livestock finalities (Fraser, 2008). The biological research approach infers this state from the analysis of the objective expressions of the neurophysiological and behavioral responses to physical or social factors from the environment or events related to rearing conditions (housing and feeding management, human manipulations, and experimental procedures). Measures on animal welfare also include health and production performances (growth, reproduction). Practical welfare assessment was also developed with various tools, focused on resource-based criteria or combined management-based and animal-based criteria (Welfare Quality Project protocols, 2009). The identification of the main critical points is of great importance to promote welfare and guidelines for the management and housing of animals used by humans, and to help to set up welfare standards implemented by national, European and international authorities. No physiological and behavioral indicators have been specifically validated in minipigs, but common mechanisms described in coping strategies or stress responses of conventional breeds suggest that measurement validated in farm pigs should be appropriate (Ellegaard *et al*, 2010).

BEHAVIORAL RESPONSES IN MINIPIGS

A research program has been developed at the INRA of Saint-Gilles (2010-2013) in the Pitman-Moore, Vietnamese and Yucatan minipig breeds, to study the characteristics and phenotypic variability of their behavioral activity, emotional, cognitive and social reactivity. The aims were to assess their responsiveness to changes in their environment (novel events or housing design, interactions between peers, human-animal relationships) and to check their suitability for research and selection purposes. Three experiments have been carried out on weaned and adult animals in the three breeds, with comparative studies in the Pitman-Moore and Vietnamese minipigs (Chataignier *et al.*, 2011; Val-Laillet *et al.*, 2013), as well as a study in the Yucatan breed around parturition (unpublished data).

Experimental design

The emotional and cognitive reactivity was studied in experimental paradigms subjecting weaned piglets and adults to challenging conditions during successive tests performed over several days: 1/ social isolation in unknown area (Open-Field test), then confrontation with an unknown human; 2/ confrontation with familiar and unfamiliar piglets in a T-maze test; 3/ reunion with and separation from a littermate in a Y-maze test (Val-Laillet *et al.*, 2013). The experimental animals included 33 Pitman-Moore and 30 Vietnamese weaned piglets, 27 Pitman-Moore and 19 Vietnamese male and female adults, as well as 8 nursing Yucatan sows.

The behavioral activity around farrowing and during lactation was studied in Yucatan minipigs (8 sows and their litter) penned in free housing system (1.40 x 1.40 m) on slatted floor equipped with a rubber mat (96 x 58 x 1.5 cm), two heater around parturition and a hatch for the access to a heated nest area for piglets (140 x 26 cm).

Results

The comparative study performed in weaned Pittman-Moore and Vietnamese piglets (Figure 1), showed Pitman-Moore piglets systematically exhibiting more locomotion, vocalizations and exploratory behavior than Vietnamese piglets ($P < 0.0001$). They were

also more prone to initiate contact with an unknown human during the open-field test ($P < 0.05$), but less easy to catch in their home pen *($P = 0.001$).* Piglets from both breeds spent 80% of their time close to either the familiar or the unknown piglet in a T-maze, male piglets preferring the unknown conspecifics ($P < 0.05$). While piglets of both sexes spent 75% of their time near their littermate rather than an empty pen in a Y-maze test, only females spent more time near the area that was previously associated with the presence of this littermate *($P = 0.012$),* suggesting the acquisition of short-term social-conditioned place preference.

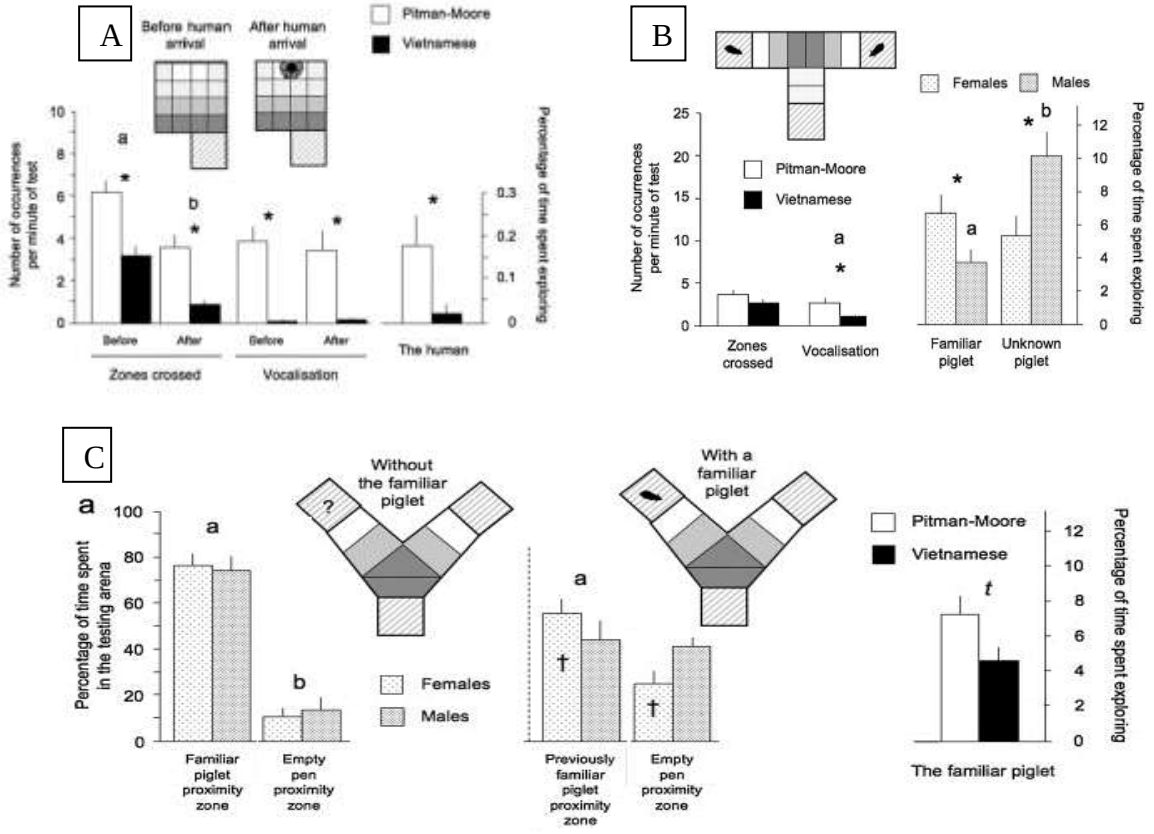

Figure 1. Behavioral responses of Pittman-Moore and Vietnamese weaned piglets subjected to three test situations: Open-Field test (A), social discrimination T-Maze test (B) and social reunion/separation Y-maze test (C).

In adults, the results showed that the Pitman-Moore moved more than the Vietnamese *($P < 0.0005$),* whatever the test situation. In both breeds, females also emitted more grunts than males (10 vs. close to 0; $P = 0.0174$). After the human's arrival, animals of both breeds spent the majority of their time far from the human ($P < 0.01$) and Vietnamese reduced more their exploration behavior that Pitman-Moore *($P < 0.0001$).* Only Pitman-Moore undertook direct contact with humans (4/16 females, 3/11 males). Unlike the weaned piglets, the adults from both breeds showed a preference for the unfamiliar conspecific in the T-Maze test, and this preference was stronger in the Pitman-Moore breed (Figure 2). This did not prevent the adults subjected to the social reunion/separation Y-maze test to spend more time near the area associated to the familiar conspecific, when this one was present but also when it was removed from the arena. These results showed the existence of an effect of breed and sex in adult minipigs, with a gender effect different from that observed in the young age. This suggested a

change in the behavioral response depending on the age or sexual maturity.

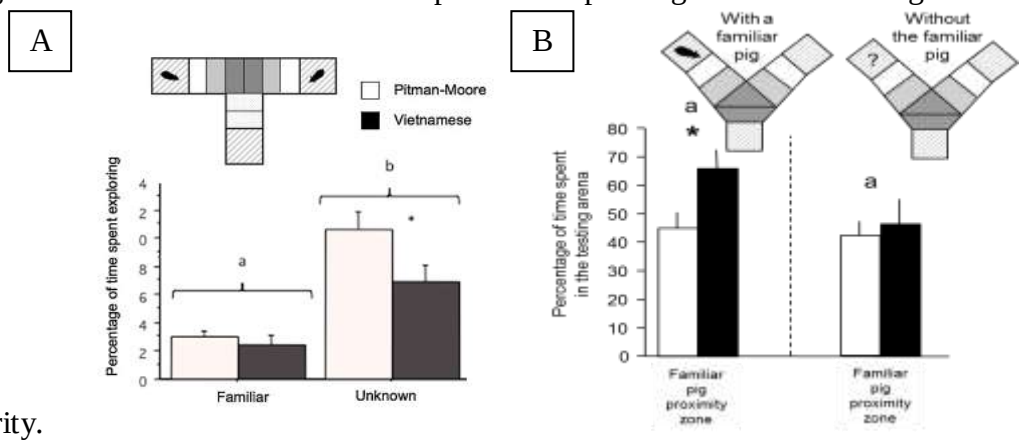

Figure 2. Time spent exploring the stimulus pigs (Familiar vs. Unknown) by Pitman-Moore and Vietnamese adult minipigs in the Social discrimination T-Maze test (A), and time spent in the area close to the familiar stimulus pig during the Y-Maze test (B).

The study on the maternal behavior of Yucatan nursing sows showed close characteristics from those reported in conventional pigs, but with some specificities, such as mostly standing and exhibiting pushing behavior towards newborn piglets during parturition. Sows subjected to the same testing situations than the Pittman-Moore and Vietnamese adults showed interindividual differences related to the maternal behavior around parturition and during lactation. More fearful sows were less active during the farrowing process and exhibited less pushing behavior towards piglets, suggesting better mothering abilities. Further studies with more animals are needed to verify this assertion. In addition, the impact on the individual maternal behavior on the emotional and cognitive abilities of the piglets will be evaluated in further analysis to assess the effects of maternal idiosyncrasies on the transmission of behavioral traits to the offspring.

CONCLUSION

The studies carried out in France on the emotional and cognitive reactivity, as well as on the behavioral activity of the Pitman-Moore, Vietnamese and Yucatan minipig breeds, described individual differences between and within breeds, between gender, and according to the growth stage. The most striking result was the higher behavioral reactivity of the Pitman-Moore compared to the Vietnamese minipigs, independently from the type of test conducted. The lack of neurophysiological measurements prevented us to verify the consistency of stress-related measures and emotional traits, and thus the consequence in terms of welfare status. Though, the results suggested that the Pitman-Moore breed might have an active strategy compared to a passive strategy in Vietnamese breed, when coping to stressful or unfamiliar events (Hessing *et al*., 1994). Moreover, Pitman-Moore expressed more curiosity towards an unfamiliar human, suggesting a more confident temperament, perhaps as the result of a trait of domestication or higher habituation to the human in piggery. If we consider the use of these breeds for laboratory purposes, the Vietnamese would be more suitable as they are less active, but they expressed higher stressful responses to novelty and cautious behavior towards humans, which would be less efficient for handling and when the housing environment changes. As suggested by Val-Laillet *et al*. (2013), the choice of the minipig model would rather depend on the scientific questions and behaviors of interest.

Age and sex effects related to social learning and/or reactivity revealed that these differences could have an impact on the outcomes of biomedical research. It is important to identify the sex- and age-dependent inclinations that would modulate the responses to experimental treatments and housing conditions. The topic of emotional and cognitive abilities of minipig breeds for laboratory purposes remains also to be explored, as well as the ontogenetic roots and the impact of maternal behavior. Minipig breeds as models for biomedical studies are really interesting, but there is a need for taking into account the breed and sex differences to design optimally the experimental paradigms. Further studies are also necessary to identify potential sub-profiles within each breed and assess the inheritance and mechanisms of such behavioral traits, as a perspective for genetic selection purposes.

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