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Relationship between behavioural tests and agonistic interactions at different age levels in pigs

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ABSTRACT

Fighting among pigs is a normal behavioural pattern to establish a stable rank order. Enhanced aggressive behaviour in pigs in groups lead to increasing stress and injuries especially in mixing situations used as a common procedure in modern pig production systems. In such systems, it is usually not possible to avoid re-housing with unacquainted conspecifics. Hence, due to the lavish analysis of direct or video observations of the agonistic interactions in such mixing situations, there is a necessity to receive easy measurable and practical indicators for predicting individual agonistic behaviour. Possible indicators are standardised behavioural tests such as the backtest and the human approach test. The backtest was performed twice. In each test, the pigs were laid on their backs and held loosely for one minute ($n = 1382$). The number of escape attempts (NEA) was recorded. In addition to this test, a human approach test was performed four times with weaned pigs ($n = 1318$) and once with gilts ($n = 272$). Here, the stockperson recorded the latency of the pigs to approach and touch the person, i.e. the latency count (LC). The agonistic interactions were recorded in a video observation period of 17 h while the traits number of fights (NF) and number of initiated fights (IF) were recorded in mixtures of weaned pigs ($n = 1111$), growing pigs ($n = 446$) and gilts (n = 279). The estimations of phenotypic and genetic correlations between these different traits were carried out with animal models in bivariate analyses. The IF trait of weaned pigs and NEA were slightly positively correlated ($r_g = 0.18$). Pigs which initiated more fights after weaning had more escape attempts in the backtests. However, there were negative genetic correlations between the agonistic interactions traits NF and IF traits and the NEA backtest trait of growing pigs ($r_g = -0.14$ and $r_g = -0.28$). The genetic relation between the agonistic NF and IF traits of weaned pigs and the human approach test LC trait of weaned pigs were on a medium level ($r_g = -0.50$ and $r_g = -0.45$). The genetic correlations between IF and NF of growing pigs and gilts and the human approach test LC trait in weaned pigs were lower but also negatively correlated. Hence, pigs with more NF and IF in mixing had shorter latencies during the human approach tests. Concluding, the backtest and the human approach test might be able to predict the agonistic behaviour of pigs in mixing situations. Nevertheless, the reliability of the predictions of the behavioural tests depends on the age of the pigs at mixing and the previous experiences of these animals.

1. Introduction

Focussing on animal welfare aspects, individual pig behaviour in standard situations of commercial pig production is becoming more and more important. In the daily routine work of pig farms, the mixing of unacquainted pigs is a common occurrence (Ismayilova et al., 2013). To establish a stable rank order in the group, the pigs fight each other. The stable hierarchy is usually achieved at the third day after re-housing and is needed to prevent permanent stress in the groups (Meese and Ewbank, 1973). However, the specific fighting behaviour of pigs shows a large variation between individuals. Here, animals with enhanced aggressive behaviour can influence the health, welfare as well as the weight gain of especially low-ranking pigs (Tan et al., 1991; Tuchscherer and Manteuffel, 2000). Former investigations had estimated moderate heritabilities of aggressive and submissive traits (Løvendahl et al., 2005; Turner et al., 2008,2009; Stukenborg et al., 2012). Therefore, knowledge regarding the behaviour of pigs in agonistic interactions gives the opportunity for breeding of calm and less aggressive animals (Kanis et al., 2005; D'Eath et al., 2009). However, agonistic interactions at different ages are not easy to measure due to the time-consuming and lavish observation methods mostly by video

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techniques. Behavioural tests could be used as easy measurable indicators to predict agonistic interactions such as the non-social backtest and the social human approach test (e.g. Hemsworth et al., 1990; Hessing et al., 1993; Thodberg et al., 1999; Ruis et al., 2000b). In the backtest, the animals were put on their backs and the number of escape attempts was recorded (after Hessing et al., 1993). The human approach test measures the latency of the pigs to approach and touch the stockperson (Thodberg et al., 1999). The results in literature concerning aggressive behaviour in relation to the backtests or the human approach test showed divergent results (e.g. Hessing et al., 1993; Thodberg et al., 1999; Ruis et al., 2000b; O'Connell et al., 2004; Bolhuis et al., 2005; Lawrence et al., 1991; Forkman et al., 1995; Jensen et al., 1995; Spoolder et al., 1996; D'Eath and Burn, 2002; Janczak et al., 2003). Furthermore, so far, an ontogenetic approach with standardised behavioural tests and standardised recording of aggression with a high number of animals has not been investigated. Therefore, the aim of the present study was to clarify the questions if behavioural tests performed at different ages could predict the agonistic behaviour of pigs in different mixing situations. Hence, in this study, the phenotypic and genetic correlations between behavioural test traits and agonistic interaction traits at different ages were estimated for implementation in selection strategies. Environmental effects and heritabilities of the behavioural tests and the agonistic interactions were reported in Scheffler et al. (2016).

2. Material and methods

2.1. Animals and housing

The data collection was from December 2010 till August 2012 on the research farm "Hohenschulen" of the Institute of Animal Breeding and Husbandry of the University Kiel (Germany). The pigs were pure-bred and cross-bred animals of the breeds German Landrace (DL) and German Edelschwein (DE). The piglets from 139 litters (16 sows per batch) were kept in conventional farrowing pens for the suckling period of 26 days postpartum. Each live born piglet was marked and weighted individually (average weight 1.54 kg) at the first day of life. The piglets were cross-fostered for a standardisation of the litter size for each sow until the third day. All male piglets were castrated (for more details see Scheffler et al., 2016).

At weaning the pigs were again weighted individually (average weight 8.8 kg) and then housed in flatdecks. There were four compartments with 10 pens each. The pigs were re-mixed and sorted by the smallest level of familiarity and by nearly equal weight. Eight to ten pigs were housed in one pen and no pig knew another pig from the farrowing pens. The pigs stayed in the flatdecks on average for 44 days.

After these weeks in the flatdeck, the pigs were re-mixed and re-housed in the growing stable in groups of 20–25 animals. The pigs were sorted by the smallest level of familiarity and by nearly equal body size. In the pens, maximal two pen mates already knew each other from the previous pens.

In the 22th week of age, the gilts were re-mixed and housed in the pen in the breeding area (arena pen) in groups of 17–28 sows. All gilts were sorted by the smallest level of familiarity. Hence, maximal five gilts knew each other from the growing pens.

2.2. Backtest

At the age of 12 and 19 days, all piglets ($n = 1382$) were subjected to a backtest. The piglets were put on their backs in a special y-shaped device. The stockperson held the piglet loosely with his left hand and restrained it in this supine position. The test began when the piglet lay still and ended after the test time of one minute. During this time, the number of escape attempts (NEA) was recorded.

2.3. Human approach test

The human approach test was performed with pigs which had also been used in the backtest. The human approach test was carried out four times (at age of 6–9 weeks) in the flatdeck ($n = 1317$) and once (22 weeks of age) with gilts ($n = 272$). The gilts were analysed in the arena pen. During the test time of one minute the stockperson noted which pigs made physical contact with him or her. Additionally, the experimenter recorded the latency to touch the stockperson (LC).

2.4. Behavioural observations

The video observations started circa at 12:00 h immediately after re-housing and re-mixing in the flatdeck, growing stable or arena pen and recorded the behaviour of the pigs for four days. Due to the high number of animals in the study, the period used for the analysis was limited to 17 h (day of re-housing: ca. 12:00–18:00 h; 2nd day: 07:00–18:00 h). All pigs of a pen received a unique number on their backs and their behaviour could be observed in the whole pen. Data from 1111 weaned pigs, 446 growing pigs and 279 gilts were used in the statistical analyses.

Recorded parameters were the start and end of the fight, the initiator or receiver and the winner or loser of an agonistic interaction. If the aggressor/receiver or the winner/looser was not clear, the fights were recorded with unclear starter/finisher or as stand-off fights. Thus, six traits were obtained: number of fights (NF), duration of fights (DF), number of initiated fights (IF), number of received fights (RF), number of fights won (FW) and number of fights lost (FL). A fight was defined as a physical contact longer than one second with aggressive behaviour initiated from one pig to another and which ended in the submissive behaviour of an involved pig, i.e. the loser of the fight (Tuchscherer et al., 1998; Langbein and Puppe, 2004).

2.5. Statistical analysis

The NEA backtest trait (number of escape attempts), the LC human approach test trait of weaned pigs and gilts and the NF and IF traits (number of total fights and number of initiated fights) were statistically analysed. These traits had been obtained in previous studies (Scheffler et al., 2014a,b) as the most suitable ones for the description of the pig behaviour in the behavioural tests or the agonistic behaviour. None of the traits were normally distributed. Therefore, the data were analysed regarding the underlying distribution.

NEA is a count variable following a Poisson distribution. The latencies of the human approach tests of two different ages (weaned pigs and gilts) were defined as binary traits (LC = 0: touched the person; LC = 1: did not touch the person). A threshold model was specified for this binomially distributed trait. The number of fights (NF) and the number of initiated fights (IF) of the agonistic interactions were log-transformed ($Y = \log_e$ (1+ observation value)) for reducing skewness and curtosis. After this transformation, the agonistic behavioural traits NF and IF were approximately normally distributed, which was also be observed by the visual inspection of the residual plots.

Model fit was evaluated by Akaike's information criterion corrected (AICC) (Hurvich and Tsai, 1989) and the Bayesian information criterion (BIC) (Schwarz, 1978) implemented in the SAS procedure GLIMMIX (SAS, 2008). The model which minimised the AICC and BIC was superior and was chosen for further analyses. Effects which had no impact on the model fitting were not used in