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Genetic analysis of the individual pig behaviour in backtests and human approach tests

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ABSTRACT

The most recent development in pig production has focused increasingly on the well-being of the individual pig and animal-friendly housing conditions, i.e. the launch of the group housing of sows in the EU. In this regard, however, standard procedures which may be stressful to the animals and thus have an impact on their health and welfare (i.e. mixing, iron injections, vaccinations) are undertaken in all commercial farm production. Therefore, there is a need to assess individual pig behaviour in such situations and furthermore to take into consideration differences related to age. Hence, in this study, pigs were evaluated for their response to two standardised stress situations—the backtest and the human approach test. The data were collected on one research farm using German Landrace, Large White and crossbred pigs. The backtest ($n = 1382$) was performed on pigs at 12 and 19 days of age and the number of escape attempts (NEA), the duration of escape attempts (DEA) and the latency to the first escape attempt (LEA) were recorded. Additionally, the human approach test was performed four times with weaned pigs ($n = 1317$) and once with gilts ($n = 272$) while recording the latency (LC) of the pigs to touch the human. The heritabilities of the different traits were estimated univariately and correlations between all observed variables were obtained from bivariate analyses with the average information-restricted, maximum-likelihood procedure as implemented in the DMU software package. The random litter effect had the largest impact on the LEA backtest variable (15%). Smaller values for NEA and DEA were obtained. The LEA backtest variable and the LC variable of the human approach test of weaned pigs and gilts were not influenced by the litter effect. The highest heritability was estimated for LEA ($h^2 = 0.29$) and NEA ($h^2 = 0.19$), followed by DEA ($h^2 = 0.10$) and the heritability of the human LC approach test variable of weaned pigs was similar with $h^2 = 0.20$. However, the heritability of the LC of gilts was low ($h^2 = 0.03$) but the estimation provide no reliable values due to the small number of gilts. The genetic correlations between LEA and DEA were very high ($r_p = -0.88$). Also, the first and second backtests for all variables were highly genetically correlated ($r_p = 0.69–0.90$). This means that the variables and the first and second backtests shared the same genetic base. Therefore, performing just one backtest is sufficient for practical breeding purposes. The genetic correlations between four LC human approach test variables of the weaned pigs were very high ($r_p = 0.65–0.87$) especially between consecutive tests. Hence, under practical conditions, the performance of one human approach test might be sufficient since the behaviour shown in all the human

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approach tests with weaned pigs depended on the same genetic base. The genetic correlations between backtest variables and human approach test variables of weaned pigs and gilts were very low, which indicates that both tests partly measure different behavioural patterns and that the reactions of the pigs in the tests were not related.

1. Introduction

Commercial pig production includes routinely stressful situations such as weaning, cross-fostering or the mixing of unacquainted pigs after the suckling period, in growing herds or in the breeding area (Ismayilova et al., 2013). These stressful situations, which effect the animals systematically, influence physiological, neuroendocrinological and behavioural changes (van Erp-van der Kooij et al., 2000). Murani et al. (2010) stated that these differences in behaviour are based on the brain and transmitted by the neuroendocrine system of the individual animal and are therefore characteristic for the individual pig. The reaction of the pigs to such stressful, challenging situations and effects is called coping (Koolhaas et al., 1999). The backtest based on Hessing et al. (1993) measures the reaction of the pig to social isolation and handling. The second behavioural test used in this study was the human approach test, in order to reveal individual differences in social group situations (Thodberg et al., 1999). Both tests were indicated as measurements of the individual pig to cope with stressful situations (e.g. Hessing et al., 1993; Ruis et al., 2000; van Erp-van der Kooij et al., 2002; Bolhuis et al., 2005). With the knowledge of these reactions of the individual pigs, it is possible to suggest improvements in housing conditions or the selection of pigs. Therefore, the genetic aspects of the backtest and the human approach test are needed to understand the individual stress reactions of the pigs. Velie et al. (2009) estimated moderate to high heritabilities of backtest variables of 0.31–0.53. Moreover, Rohrer et al. (2013) estimated heritabilities of one backtest with 975 pigs at age of weaning. But these values were on a lower level with $h^2 = 0.15–0.19$. Hence in literature, the values of the heritabilities of the backtests are not consistent between studies. Hemsworth et al. (1990) in a 5-min human approach test estimated a heritability of 0.38 for the individual pig without conspecifics in the test area. In contrast to this, Velie et al. (2009) found that the latency of growing pigs to touch the experimenter was not heritable. The relationship between the backtest and human approach test has been investigated by different authors which found ambiguous results (Ruis et al., 2001; van Erp-van der Kooij et al., 2002; Cassady, 2007). Genetic relationships between the backtest and human approach test are less well documented. Therefore, the heritabilities of variables representing the behaviour of pigs in these two tests and the genetic relationships between these test variables were inconsistent but necessary to evaluate the use of these tests in further studies.

Hence, the aim of the present study was to examine the heritabilities of the backtest and social human approach test variables at different ages with standardised experimental conditions in order to examine the less well documented behaviour of animals of different ages especially in a social human approach test. Phenotypic and genetic correlations were analysed between the same tests at different times and across the different behavioural tests to access the changes or stability of reactions in test over time. Genetic relationships between the backtest and human approach test should indicate whether the behaviour of such social and non-social stressful tests have the same genetic base.

2. Materials and methods

2.1. Animals and housing

Data were recorded on the "Hohenschulen" research farm of the Institute of Animal Breeding and Husbandry of the University Kiel (Germany) from December 2010 to August 2012. Purebred and crossbred pigs of the German Landrace (DL) and Large White breeds were used in the investigation. The piglets from 139 litters (16 sows per batch) were kept in farrowing pens for the suckling period of 26 days. The conventional farrowing stable consisted of four compartments each with eight pens (2.2 m × 1.7 m) with a tiled and metal base floor with no substrate. A piglet feeder was open from the first week after farrowing. The sows received commercial lactating feed in accordance with the German norm (GfE, 2006). Water was available ad libitum from nipple drinkers. At the first day of age, each live born piglet was individually marked and weighed (average weight 1.54 ± 0.3 kg). Within the first three days the piglets were cross-fostered to standardise the litter sizes of all sows in the batch (litter sizes before cross-fostering 12.6 ± 4.0 piglets). Male piglets were castrated before the 7th day of age.

After the suckling period, the pigs were weighed individually again (average weight 8.8 kg), weaned and rehoused in flatdeck pens. The four compartments consisted of 10 pens each. One pen measured 2.05 × 1.36 m and had a concrete and metal base floor with no substrate. In each pen, two nipple drinkers were accessible for non-stop use. The pigs in flatdeck were fed ad libitum with solid pellet feed (GfE, 2006). The temperature in the compartment was pre-set to a minimum temperature of 24 °C. The pigs were re-mixed and sorted first to obtain the smallest degree of familiarity and second order for the pigs in one pen to have a nearly equal weight after weaning. At 44 ± 2 days of age, the pigs were weighed (average weight 8.8 ± 1.6 kg), weaned and rehoused in flat deck pens in groups of 8–10 pigs.

The growing pigs were re-mixed in groups of 20–25 animals. The pens (3.25 × 2.40 m) had a half-slatted and half-solid floor. Water was accessible ad libitum from two