# Consequences Of Selection For Social Genetic Effects On ADG In Finishing Pigs – A Pilot Study

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## Introduction

In the present livestock sector artificial breeding schemes for production traits are based on the classical animal model, selecting only on direct genetic effects of individuals. In practice, some traits show a lack of response when selecting for individual performances while group selection yields a positive response (Craig and Muir 1996; Muir 2005). This might be related to social interactions within a group, such as competition. Previous studies have shown that including social genetic effects into breeding value estimates may increase response to selection (Griffing 1967; Muir 2005). Griffing (1967) provides a model that includes both direct and social genetic effects. Application of this model to laying hens by Bijma *et al.* (2007b) suggested a threefold greater predicted response to selection for survival days than obtained with the classical animal model (Ellen *et al.* 2008). Also in pigs social genetic effects have been estimated (Arango *et al.* 2005; Chen *et al.* 2008). Results of Bergsma *et al.* (2008) indicated that heritable variation for growth rate and feed intake of pigs in a social interactions model was up to three-fold greater compared to classical estimates. These studies suggest a profound effect of social interactions on production traits. This would imply that performance of individual animals is affected by the behaviour of their group members. By including social genetic effects in breeding value estimates, changes might occur in both production traits and behaviour. However, in practice the consequences of selecting for social effects are unknown in pigs. Therefore, a single generation pilot selection experiment was carried out, where boars were selected based on their estimated Social Breeding Value (SBV) for Average Daily Gain (ADG) during the finishing period. Focus was on the effect of a high versus low paternal SBV on ADG and aggression in offspring groups of finishing pigs.

## Material and methods

**Breeding value estimation.** Breeding values for ADG during finishing were estimated using the social interactions model of Bergsma *et al.* (2008). Breeding boars from a synthetic line were selected solely based on SBV. As a result, a group of five boars with on average a Direct Breeding Value (DBV) of +44.6 g ADG and a SBV of +9.6 g, was bred with sows with a relatively high SBV. Four boars with on average a DBV of -3.7 g and average SBV of -1.2 g ADG were crossed with relatively low SBV sows. Hence, selection of boars based on SBV also created a correlated selection differential on DBV. Because selection on sow SVB

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was marginal this was not taken into account in further calculations. Based on the estimated contrast between the boars for DBV and SBV and, on the number of pen mates (on average 8.6 pigs/pen), the expected phenotypic contrast between both offspring groups equaled $0.5(48.3 + 7.6\times10.8) = 65$ g ADG.

**Animals and housing**. Twenty-two crossbred sows were inseminated with nine different boars with either high or low SBV. Parity of the sows (mean 3, range $2^{nd}$ – $7^{th}$ parity) and litter size (14.4 ± 3.1) did not differ between the high and low SBV group. At start of the finishing period, offspring litters were mixed into groups of 8 – 11 pigs. Pens were assigned to either restricted or *ad libitum* feeding and separated by SBV group and gender (Table 1). There were twelve pens with offspring from high SBV sires and thirteen pens with offspring from low SBV sires.

**Table 1: Number of pens per SBV group, between brackets number of finishing pigs.**

| | High SBV | | Low SBV | |
|---|---|---|---|---|
| | Boars | Gilts | Boars | Gilts |
| Fed restricted | 4 (33) | 5 (41) | 6 (48) | 4 (33) |
| *Ad lib.* | 1 (10) | 2 (21) | 2 (19) | 1 (11) |

**Measurements and observations.** Body weight was recorded at start and end of the finishing period to calculate ADG. Turner *et al.* (2006) found skin lesion scores to be heritable and related to post-mixing aggression in pigs. Skin lesions were counted on the anterior, middle and posterior of the body at 24 h post-mixing and six weeks thereafter. Lesion scores were counted as 0 – 6, where >5 lesions were denoted as 6. Backfat thickness was measured at the end of fattening. Carcass information was obtained from the slaughterhouse.

**Statistical analysis.** Analyses were performed using SAS (version 9.1.3). ADG, backfat thickness, muscle depth and lean meat percentage were analyzed with a mixed model (Model 1). SBV, sex and feed system were fixed effects. Litter (within SBV) and group (within SBV, feed system and sex) were included as random effects.

Model 1: ADG = SBV + sex + feed system + litter + group + SBV*sex + SBV*feed system + ε

Lesion scores were square root transformed and analyzed with a generalized linear mixed model with a multinomial distribution and cumlogit link (Model 2). Group was included as random effect within SBV, feed system and sex.

Model 2: Lesions = SBV + sex + body weight + feed system + group + SBV*sex + SBV*feed system + body weight*sex + ε

## Results and discussion

**Production traits.** SBV had no significant effect on ADG of finishing pigs, backfat thickness, muscle depth and lean meat percentage (Table 2).

**Table 2: Production traits of finishing pigs diverging in SBV (Lsmeans).**

| | High SBV | Low SBV | s.e.d. | P |
|---|---|---|---|---|
| ADG (g/d) | 826.5 | 815.8 | 25.2 | 0.68 |
| Backfat thickness (mm) | 14.9 | 14.3 | 0.6 | 0.32 |
| Muscle depth (mm) | 58.1 | 57.9 | 1.7 | 0.93 |
| Lean meat (%) | 57.4 | 57.9 | 0.4 | 0.31 |

s.e.d. = standard error of the difference between the two SBV groups.

The expected phenotypic difference between the two SBV groups was 65 g ADG. With an estimated standard error of 25 g ADG, the experimental set-up was expected to have sufficient power to significantly detect this difference. The observed contrast in the offspring however, was only 10.7 g ADG and not significantly different from zero. The loss of phenotypic contrast may indicate that breeding values were overestimated. Besides the data generated in this experiment, there was no new data available for re-estimating the breeding values of the selected sires. Overestimation of sire breeding values could, therefore, not be investigated based on independent data. Furthermore, breeding value estimates were based mainly on information from gilts and barrows, while 50 percent of the offspring used in the experiment were intact boars. This may have affected expression of social genetic effects.

**Behaviour.** Skin lesions did not differ significantly between the high and low SBV group, though pigs from the low group tended to have more lesions with a trend for more posterior lesions at 6 w post-mixing (Table 3).

**Table 3: Lesion scores of finishing pigs diverging in SBV (Lsmeans).**

| | 24 h post-mixing | | | 6 w post-mixing | | |
|---|---|---|---|---|---|---|
| | High SBV | Low SBV | P | High SBV | Low SBV | P |
| Anterior | 4.2 ± 0.4 | 4.5 ± 0.4 | 0.61 | 1.4 ± 0.3 | 1.7 ± 0.4 | 0.51 |
| Middle | 2.8 ± 0.4 | 3.3 ± 0.5 | 0.43 | 1.5 ± 0.4 | 2.1 ± 0.4 | 0.32 |
| Posterior | 1.5 ± 0.3 | 1.4 ± 0.4 | 0.86 | 1.1 ± 0.2 | 1.7 ± 0.2 | 0.10 |
| Total | 8.5 ± 1.0 | 9.2 ± 1.0 | 0.59 | 4.0 ± 0.8 | 5.5 ± 0.9 | 0.25 |

At 24 h post-mixing most lesions were observed at the anterior and middle parts of the body, likely reflecting mutual fighting to establish a social hierarchy. SBV did not affect immediate post-mixing aggression as assessed by lesion scores. However, in the present study all lesion numbers above five were denoted as 6. This reduced the available information on lesions scores 24 h post-mixing, where 60% of the animals showed a score of 6. Turner *et al.* (2006) reported a mean total body score of 27 lesions per pig, suggesting that there may have been considerable variation between the individuals with score 6. At six weeks post-mixing, in a stable social situation, low SBV pigs tended to have more posterior lesions (P=0.10). Posterior lesions likely reflect unilateral bullying and biting, which can be triggered by e.g. frustration or discomfort (e.g. Bolhuis *et al.*, 2005). Results at 6 w post-mixing are in accordance with tendencies found in previous studies of Canario *et al.* (2008, unpublished) and De Vries (2008, unpublished), where under stable social conditions high SBV pigs had less lesions than low SBV pigs. The underlying causes provoking these aggressive behaviours in low SBV pigs merit further research.

Theoretical models of Griffing (1967), Muir (2005) and Bijma *et al.* (2007a), suggest that response to selection would increase when accounting for associative effects. This expectation was confirmed by selection experiments in laying hens (Craig and Muir 1996), but results of the present study did not. Social genetic effects are thought to be related to behaviour. For a selection trait as growth, in which the causality of differences may be multifactorial and cannot be ascribed to behavioural effects exclusively, it may be more difficult to find the exact mechanisms underlying social genetic effects. Confirmation of social genetic effects in pigs, therefore, probably requires more elaborative research.

Generating a clear response in a single generation selection experiment has proven difficult. For a follow-up experiment the authors would recommend to increase power by including a larger number of sires and offspring groups, to minimize between-pen variance and, to study a wider set of behaviours. Starting from mid 2010 this pilot will be repeated at a large scale, taking into account the authors' recommendations.

## Conclusion

Offspring groups of sires diverging in estimated SBV did not differ in ADG, backfat thickness, muscle depth and lean meat percentage. Also, the level of aggression as assessed by skin lesion scores, did not significantly differ between SBV groups. The observed loss of contrast might be due to overestimation of SBV variances. A large scale repetition of this pilot is expected to reveal more of the mechanisms underlying social genetic effects in pigs.


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