

Assessing Sow State of Being Objectively: Genetic Implications

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After thorough meta-analyses of the world's available literature on the state of being engendered by two common keeping systems for pregnant sows and gilts, an international, multidisciplinary team of scientists recently concluded: "*Although individual studies found significant housing system effects, subjected to the overall evidence from adequately designed studies, meta-analyses revealed that gestation stalls (non-tethered) or well-managed pens generally (but not in all cases) produced similar states of welfare for pregnant gilts or sows in terms of physiology, behavior, performance, and health.*" (J. J. McGlone et al., Prof. Anim. Scient. 20:105-117, 2004).

Despite this and other similar conclusions (e. g., Barnett et al., Aust. J. Agric. Res. 52:1-28, 2001), continuing political pressure by animal protectionists nowadays is causing North American producers, animal scientists, and veterinarians alike to ask: *How should we go about optimizing sow state of being?*

A series of at least seven decisions will have to be made as we go about answering this question. In what follows, we'll explore those topics and offer our opinions as to how we should be moving forward in these matters at this time.

First Decision: Animal Rights or Animal Welfare?

The philosophical concept of *animal rights* holds that animals have certain *inalienable rights* and that humans have an absolute moral responsibility to honor those rights. This is a case of right/wrong, black/white, trump/no trump. Taken to its logical extreme, the concept of animal rights would mean that no animal would be used by any human for any purpose whatsoever. We think it's unlikely that an absolute approach such as this would make much sense to most citizens.

In contrast to this, the concept of *animal welfare* acknowledges a continuum of goodness/badness in terms of animal state of being, from very well to very ill. It also recognizes that animals should be granted what might be called *entitlements* by the humans who keep them such that, realistically, they can experience wellness most of the time, fairness some of the time, and illness as infrequently as possible. This means that we must draw lines somewhere along that scale of goodness/badness in terms of humans' moral responsibilities in all respective aspects of caring for the animals we keep. Of course, in diverse, pluralistic cultures, individuals will come to these decision processes carrying different biases, experiences, knowledge, and opinions. Consequently, there predictably will be—and *certainly is right now*—much ado in that process of deciding just where to draw those lines.

To make the task even more difficult at present is the fact that, until our understanding of what comprises animal wellness and how that should be measured is more complete, scientifically informed input into these decisions will be somewhat inadequate. Nevertheless, *animal welfare* is the route we should be taking.

Second Decision: Objective Criteria or Subjective Criteria?

Heretofore, typically, both *objective criteria* (based on science) and *subjective criteria* (based on beliefs and values) have been used when characterizing animal state of being. On the dichotomy between science and values, Ross Konig has observed: “*The scientific method is based upon evidence rather than belief. This distinguishes science from faith. A scientist is suitably skeptical of anything but good evidence.*” James Randi added: “*Science is best defined as a careful, disciplined, logical search for knowledge, obtained by examination of the best available evidence and always subject to correction and improvement upon discovery of better evidence. What’s left is magic. And it doesn’t work.*”

If we want to make progress in ensuring and improving sow state of being, we think we should deal in *objective criteria of a sow’s state*.

Third Decision: Feelings Approach or Performance Approach?

Most scientists who consider themselves to be animal-welfare experts are applied ethologists—i. e., specialists in animal behavior, cognition, or both. Many espouse the idea that the correct approach to assessing animal state of being should be based on *animal feelings*. “*Animal welfare has all to do with how the animal feels,*” they say. But others don’t agree. Instead, for the present at least, we advocate an approach based on *animal performance* (S. E. Curtis, forthcoming). Indeed, recently, with specific reference to keeping systems for dry sows, after thorough consideration, *the performance (or functional) approach was favored over the feelings (or mind) approach* by a multidisciplinary team of Australian scientists (J. L. Barnett et al., Aust. J. Agric. Res. 52:1-28, 2001).

One important reason for our favoring the *performance approach* is that, as management guru Peter Drucker adroitly put it: “*You can’t manage what you can’t measure.*” On the one hand, at present, everybody—even every applied ethologist—agrees that right now we can’t even define animal feelings, let alone measure them. And neither can we accurately estimate the depth of any suffering an animal may be experiencing when it gives behavioral signs of emotional disturbance. How much is a piglet suffering, e. g., when it squeals upon being picked up?

On the other hand, well-understood biologic mechanisms underlie measurable changes in productive and reproductive performance. Homeokinetic responses to environmental stimuli can deleteriously affect animal performance in several ways, including:

- ▶ diverting nutrients and other bodily resources from supporting productive and reproductive processes to supporting stress responses and other maintenance processes;
- ▶ altering functions involved in productive processes, reproductive processes, and homeokinetic responses alike;
- ▶ intentionally reducing productive and reproductive processes as part of the homeokinetic response;
- ▶ increasing and otherwise changing the nature of inter-individual variation in productive- and reproductive-performance variables; and
- ▶ altering immune and other defenses against infectious microbes.

Decrements in performance comprise early, sensitive, valid indicators of changes in an animal’s state of being. Truth be told, however, mainstream public discourse on both sides of our international border clearly emphasizes feelings (or mind) rather than performance (or function). Alas, to our way of thinking,

- ▶ an incredible leap faith is required just now for anyone to presume or claim to understand animal feelings,

- ▶ beliefs are not necessarily truths, and
- ▶ it's not always in their best interests to follow anthropomorphic notions and otherwise well-meant musings as to how best to care for animals.

There won't be opportunity here to explore reasons for the foregoing cardinal conclusions (but that's been done elsewhere [S. E. Curtis, forthcoming]). Let it suffice now to say that we think holding out any hope or promise that sometime soon we'll understand animal feelings well enough to use them as sound bases for husbandry recommendations and keeping-system comparisons would comprise wishful thinking.

Digression: The Performance Axiom

Recently, an axiom has been put forth (S. E. Curtis, forthcoming) that follows from the core premise that *performance constitutes today's best indicator of animal state of being*:

The Performance Axiom

For a constitutionally fit animal of any kind, in the continuing absence of an adequate scientifically informed understanding of its conscious feelings, the best single set of measurable—hence, manageable—indicators of that animal's state of being will be its rates of productive and reproductive performances relative to its predicted potential to perform. Body condition index and rates of culling, morbidity, and mortality will provide valuable additional information on animal state of being.

If the *performance axiom* is ever going to supplant the *feelings axiom* as the primary guide for assessing animal state of being in North America, the group of scientists who consider themselves to be animal-welfare experts needs to expand to include more of those specializing in animal variables other than behavioral and cognitive ones. When that happens, scientific input into the public debate as well as scientific conclusions and political decisions about animal state of being will be more complete and more rational.

But for now, with regard to the dry sow in particular, two questions loom large:

- ▶ Where does this put us with respect to objective assessment of a sow's state of being?
- ▶ What role should genetics play in the development of a sensible approach to that assessment?

These questions will be addressed in what follows.

Fourth Decision: Environmental-Design Standards or Animal-Performance Standards?

Two different routes could be taken in assessing a sow's state of being in a commercial production setting.

▶ The one would rely on *environmental-design standards*. This approach assumes that, if some consensus checklist of environmental measures in the sow house (e. g., temperature, aerial ammonia, crate dimensions) proves to have been fulfilled, then it necessarily follows that the respective individual sows will be enjoying a high state of being. There is good reason to believe that taking this route as the primary approach would be to shinny up the wrong tree, as will be discussed later.

▶ The other route—which relies on *animal-performance standards*—recognizes that:

▶ A sow can experience wellness over a range of environmental conditions. This is the crux of Dennis Hardwick's concept of the *state-of-being plateau*—as the environment improves, the point of diminishing returns eventually will be reached, and further improvement will result

in an inconsequential increase in animal state of being. At and beyond that point, to improve the environment further would be unnecessary in terms of morality and foolish in terms of business.

► In the same sow house at the same time, some individuals may be well while others are fair or ill. Thus, correlations between environmental variables and animal variables must be made on an individual-animal basis.

We think we should be taking the *animal-performance-standards* route to assessing sow state of being. This involves ascertaining (a) where certain health and performance variables in individual sows fall with respect to acceptable respective ranges of state of being and (b) on any given day, what fraction of the sows might acceptably be expected to be less than well.

Fifth Decision: Inter-Herd Comparison or Intra-Herd Improvement?

Results of a Danish study (P. F. Johnsen et al., Acta Agric. Scand., Sec. A, Anim. Sci. 51 [Supp.30]:26-33, 2001) indicate that the appropriate approach to state-of-being assessment depends on the goal of the exercise: “To discuss the merits of a given method it is necessary to look at the goal it is intended to serve. Some methods compare production systems well. Others are better used in assisting the individual farmer to improve the welfare of animals within his production system.” The former refers to the goal of inter-herd comparison, the latter to the goal of intra-herd improvement.

The Danish team concluded that measuring the environment (*environmental-design-variable approach*) is useful when troubleshooting environmental problems, especially useful in achieving the goal of intra-herd improvement. But the existence of those environmental problems in the first place ought to be determined by ascertaining whether or not most of the animals’ health and performance variables fall within acceptable ranges (*animal-performance-variable approach*), which holds for either goal. We concur in their conclusion.

Sixth Decision: Base Assessment on Intuition, Empirical Data, or Theory?

A team in the Netherlands studied the development of decision support systems to assess sow state of being (M. B. M. Bracke et al., Acta Agric. Scand., Sec. A, Anim. Sci. 51(Supp. 30):17-20, 2001). They concluded that:

► *intuitive assessment* was inappropriate because, although it may be and sometimes is valid, it also may be and sometimes is erroneous;

► too few *empirical data* (especially regarding behavioral variables) exist to be useful; and

► although more-or-less-accepted *theoretical bases* do have inherent weaknesses, they are at present the preferred approach to developing state-of-being assessment schemes.

The Dutch researchers found it difficult to arrive at a state-of-being assessment system that, in terms of variables to be included and their respective weightings, yielded bottom-line state-of-being indices across production systems that accorded with expert expectations. In view of this, we think that, for the present, *empirical data*, *theoretical premises*, and *expert opinions* should be the bases upon which state-of-being assessment systems are based.

Seventh Decision: To Weight Variables or Not?

The great difficulty with regard to weighting the respective variables is exemplified by a pertinent, seemingly straightforward case. One relatively simple question the Dutch scientists (loc. cit.) struggled with was: *Which is more important for the state of being of an individually kept sow, the opportunity to turn around or to have social contact?* *Turning-around* was seen as having four advantages:

- ▶ orienting toward danger;
- ▶ preparing a nesting place;
- ▶ exploring the microenvironment; and
- ▶ perhaps increasing leg muscle mass and strength and bone strength.

Social contact was seen as having *all four of those advantages plus two additional ones*:

- ▶ establishing a dominance order and
- ▶ huddling in a cool environment,

as well as *one potential disadvantage*:

- ▶ being vulnerable to injury by aggressive groupmates.

A simple unweighted aggregation of number of advantages followed by a simple unweighted reduction by number of disadvantages would yield a composite value favoring a keeping system that allows social contact (5 versus 4). But we think such an approach is unrealistic in terms of a sow's state of being. Here's why:

Enter the Mixed Model of Motivation

An approach to assessing an animal's behavioral needs suggested by Barry Hughes is to determine whether or not a given need is *motivated externally or motivated internally*, and if it proves to be a need that arises regardless of the environment the sow is in (i. e., an *internally* driven need), then, on moral grounds, it ought to be accommodated by the environment in which she is kept. In other words, e. g., if a sow is internally motivated to wallow in mud for sheer recreation, then we should provide a wallow in her environment. But if she wallows only when externally motivated to do so (because environmental temperature has exceeded some point), and if the temperature is expected never to rise above that point, then there would be no need to furnish the sow with a wallow.

So it's important to recognize that, in this case highlighted by the Dutch workers, we shouldn't need to be morally concerned about a sow's *opportunity to turn around* if

- ▶ no danger is present;
- ▶ no nest is to be built;
- ▶ all of the sow's needs are provided, so she has no need to explore the microenvironment in seeking resources such as food and water;
- ▶ increasing muscle mass and strength and bone strength are of undetermined importance to sow state of being;

and we shouldn't need to be concerned about a sow's *opportunity to have social contact* if

- ▶ sows are kept individually and therefore have no need to establish a dominance order and
- ▶ environmental temperature is such that it does not drive the sows to huddle.

Hence, in our analysis of this case, the bottom line becomes *no pertinent advantages* for either system and *a single disadvantage* for a system where sows can have social contact (hence inverting the bottom-line index contrast: -1 social contact versus 0 turn-around [instead of 5 versus 4]).

Variable-Weighting Factors

We think, as this example demonstrates, that strategies for weighting respective variables indicative of state of being will be very important as decision-support systems are developed. Developing a scheme of *variable-weighting factors* will require multidisciplinary input, and it is going to be no simple task.

Incidentally: The Turn-Around Crate

The swinging-sided turn-around gestation crate introduced in the early 1990s by Moorman Manufacturing Company (MoorComfort System) meets all of the sow's needs as just listed. If and when manufactured, installed, and operated as its original designers and manufacturers intended it to be, it does an extremely effective job of keeping a sow individually (and thus protected) while at the same time giving her the advantages of considerable mobility as well as opportunities to huddle and otherwise socialize. We think the swinging-sided turn-around gestation crate is an invention that nowadays ought to be receiving more serious consideration by pork producers.

Midstream Recapitulation

So far, we've identified and briefly discussed several decisions that must be made when developing a rational system of assessing the state of being of a sow. To recapitulate at this intermediate point, we have concluded the following:

- ▶ the concept of *animal welfare* should be followed, not animal rights;
- ▶ *objective criteria* of evaluation should be employed, not subjective criteria;
- ▶ an approach based on *animal performance* is favored, not animal feelings;
- ▶ the *performance axiom* is espoused, not the feelings axiom;
- ▶ *animal performance standards* should be the rule, not environmental design standards;
- ▶ *different goals* for assessment—e. g., inter-herd comparison or intra-herd improvement—dictate different approaches;
- ▶ *theoretical constructs* will still serve better than intuition (often flawed) or empirical data (not enough at hand);
- ▶ respective evaluation criteria should be subjected to a *weighting scheme* as the final composite index of state of being is formulated (although developing such strategies is proving to be a difficult task); and
- ▶ the *mixed model of motivation* should serve as a guide when developing a *variable-weighting scheme*.

Whither Next?

From this list of conclusions, it is fair to further conclude that, with respect to assessing sow state of being, we are today in a position to *commence developing* a useful system of assessment. We'll now

proceed, based on the premises given above, to outline our notion of one such system that we think makes sense from all pertinent points of view.

Assessing Sow State of Being

In the Dutch study discussed above, an intermediate version of their decision-support system involved 600 so-called *welfare-relevant variables*! Those researchers soon found that this was an unwieldy amount of information, and reduced the number to 37. Following Occam's Razor even further, we believe that the number can be substantially reduced even more without sacrificing any power of the evaluation.

At this time, we think that—once appropriately weighted and aggregated—a selection of 11 variables as employed by the PigCHAMP® system plus two body-condition variables—a total of 13 variables—should suffice as a valid method for inter-herd comparison and intra-herd assessment of sow state of being.

There is one caveat to this proposition, and that is that we currently have at hand virtually no *genetic weighting factors* for these variables to account for genetic differences across herds, the clear need for which is discussed below.

In the meantime, for *each* of the respective variables evaluated, there will need to be:

- ▶ a set *definition and calculation and determination procedures* established by qualified experts;
- ▶ a *standard value* determined by qualified experts and based on empirical data, theoretical constructs, and a consensus of professional and scientific judgements;
- ▶ two *assessment values* determined (as above):
 - ▶ a *problem value* signifying that improvement is needed in that variable; and
 - ▶ a *minimal acceptable value* below which the variable will be assessed as not reaching an acceptable level of state of being.
- ▶ a *permissible fraction* of all of animals being evaluated that may be assessed as having a problem value or minimal acceptable value for a given variable without jeopardizing the assessment of the entire group.
- ▶ a set of *weighting factors* for respective variables established (as above) as an essential component of calculating a *composite index of state of being* of the sow herd being assessed.
- ▶ two *composite indices of state of being* determined (as above):
 - ▶ a *problem index* signifying that overall improvement needs to be made in the herd; and
 - ▶ a *minimal acceptable index* below which the herd will be assessed as not reaching an acceptable level of state of being.

Performance Variables

We propose that the following six performance variables be assessed:

- ▶ farrowing rate
- ▶ average total born per litter
- ▶ average born alive per litter
- ▶ pigs weaned per litter
- ▶ pigs weaned per mated female per year
- ▶ pigs weaned per female per year

Health Variables

We propose that the following five health variables be assessed:

- ▶ piglet preweaning mortality rate
- ▶ sow culling rate
- ▶ sow mortality rate
- ▶ average parity of sows
- ▶ distribution of parity of sows

Body-Condition Variables

We propose that the following two body-condition variables be assessed:

- ▶ body-condition score
(R. D. Coffey et al. Assessing Sow Body Condition. Univ. of Kentucky, 1999)
- ▶ skin-lesion score
(J. L. Salak-Johnson et al., forthcoming)

Genetic-Weighting Factors

Each of the variables proposed to be evaluated in an assessment of sow state of being is more or less determined by heredity. Because genotype varies considerably within the national herds, both inter-herd comparisons and intra-herd improvements will require that the genetic components of these respective variables be taken into account via adjustment of certain *standard values* for genetic realities.

The *standard values* for each of the respective variables to be evaluated presumably will be based on sows of the highest available genetic merit, and therefore sows of known lesser genetic merit for a particular variable should not be expected to perform at that standard level even in the best of environments—i. e., even under conditions that should be expected to engender a high state of being. Relatively low performance in a particular variable due to genetic inferiority (for that variable) should not be misconstrued as reflecting a diminished state of being. So, it turns out, a “one-standard-fits-all” approach is not on after all.

Genetic-weighting factors to adjust observed values for genetic makeup simply must be established. Indeed, the assessment scheme outlined above will be invalid for achieving either inter-herd comparison or intra-herd improvement goals unless and until such genetic-weighting factors have been established and can be employed.

Ancillary Variables and Situations

Several additional variables and situations known to be determined in considerable part by heredity are either directly or indirectly related to many of the 13 sow variables listed in the state-of-being assessment scheme proposed above. These include:

- ▶ longevity
- ▶ robustness
- ▶ general disease resistance
- ▶ specific disease resistance
- ▶ foot-and-leg conformation; lameness
- ▶ appropriate appetite
- ▶ behavioral fitness—handling, maternal, reproductive, temperament
- ▶ lactational performance
- ▶ relatively low homozygosity in grandparents resulting in relatively high variation among sows
- ▶ suitability of sows to benefit from available feedstuffs (e. g., forages in outdoor production systems)
- ▶ genetic conservation/minor breeds

These *ancillary variables and situations*, too, ought to be considered as a multidisciplinary team of scientists and professionals works to develop a practical, valid system for objectively assessing sow state of being.

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