Reliance on Behavior as a Metric of Animal Welfare

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Summary

Observable behavior is often the primary metric by which animal welfare is gauged. The benefits of this approach include the ease of collecting data and the commonly understood concept that the expression of abnormal behavior likely reflects reduced animal welfare. However, defining normal behavior for a research animal may not be straightforward, as normalcy may depend not only on the age, sex, and experience of the animal but also its experimental use. Some behaviors may be more meaningful indicators of good welfare than others. The skill level of the observer is critical to the appropriate use of behavior to assess an animal's welfare. Biases in observers must be mitigated for the observations to be useful. Challenges to conducting adequate observations are posed by the large numbers of animals (i.e., mice) at many institutions and new caging technologies, such as individually ventilated cages. A practical approach to using behavior as a primary tool for welfare assessment is to implement a team approach to data collection and interpretation.

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A first-tier method of assessing an animal's welfare is often a judgment based on observable behavior. The reasons for this are numerous, including the ease of conducting behavioral observations; the fact that most observations may be conducted in a noninvasive manner, thereby minimizing any potential negative impact on the animal resulting from the observation method; and the generally accepted premise that the expression of atypical behavior implies reduced welfare (and thus the corollary that the expression of normal behavior indicates good welfare). However, several factors may confound the observation and interpretation of the animal's behaviors, which could result in missed opportunities to implement the Three Rs, especially refinements. Alternatively, the refinements initiated to address a perceived problem may not correlate with the actual issue because of misinterpretation of the observed behaviors. Thus, while it is logical to use behavior as an initial welfare assessment tool, this should be done with an awareness of the limitations of this approach.

The skill level of the individual making the observations must be considered in a system that relies primarily on behavior to detect welfare issues. The knowledge and experience of the observer will influence the accuracy of data recorded and interpretation of those data. The observer should avoid an all-too-easy "me-centric" bias (i.e., primary reliance upon one's own experience and opinions, rather than supplementing personal knowledge with information published in peer reviewed literature) in conducting the observations. Also, any tendency toward anthropomorphizing the behaviors observed should be avoided to ensure correct and objective interpretation of the behaviors expressed by the animal. The potential for the observer to have a perceived or real conflict of interest in making the observations and resulting judgments regarding animal welfare should be avoided. It is important to note that subtle behavioral changes indicative of declining welfare may be difficult to observe and thus the animal's welfare state may be significantly reduced before a change in behavior is noticeable. This concern may be addressed, in part, by the skill of the observer. Typically, research animals are observed during standard working hours while routine activities are ongoing in the animal room. Yet the benefits and limitations to assessing animal welfare via behavioral observations made at this time have not been analyzed across species.

Interpretation of an animal's welfare status based on its behavior relies in large part upon the definition of the "normal" behavior of the animal and species, as well as understanding whether deviations from normal are meaningful to the animal and whether the atypical behaviors are related to the experimental use of the animal. The relevance of a behavior in assessing an animal's welfare should be determined a priori. Perhaps most importantly, the expression of normal behavior may vary among individual animals as well as with species, age/maturity, sex of the animal, physiological and pathological state, the environment in which the animal lives, phase of response to an experimental treatment, and other factors.

As an illustration of this point, macaques that are free ranging in cities (e.g., in India), on islands (e.g., Cayo Santiago), or in the wild may express different behavioral repertoires from each other and from macaques living in zoos or in the research environment. Thus the habitat or housing environment will shape the range of behaviors expressed and may result in the expression of novel behaviors in an animal as it lives in a more artificial environment. In addition to the

physical environment in which the animal is kept, the social environment will influence the range of behaviors expressed. Overlaying the living context, the animal's "demographics" will significantly influence what may be considered normal for the animal. For example, an aged macaque may be arthritic and have reduced visual capabilities such as cataracts or glaucoma (Leary et al., 1985), conditions that would likely affect the animal's mobility and general activity level. A healthy juvenile macaque, however, is very active and makes use of the three-dimensional space in its enclosure, climbing, leaping, and playing. What is "normal" for one animal may not be for another animal of the same species. Therefore, any tendency to extrapolate assessment criteria among individual animals, strains, and species is potentially riddled with flaws.

Conversely, it is easier to recognize the expression of abnormal behavior and to achieve consensus that the behavior is atypical and a reflection of poor welfare. Abnormal behaviors can be classified as either quantitative (over or under expression of a behavior) or qualitative (expression of a behavior generally not seen in an animal in a good welfare state). Repetitive locomotion by an animal in a cage or zoo exhibit and depression resulting in an animal withdrawing from environmental stimuli are examples of a quantitatively abnormal behavior; alternatively, self-injurious actions, such as self-biting, are examples of a qualitatively abnormal behavior. This mismatch between a stimulus and the behavioral response is highly suggestive that the behavior should be considered abnormal. Abnormal behaviors may help the animal cope with its environment and may be considered an adaptive mechanism (Suomi and Novak, 1991), or they may be pathological. The nonhuman primate that circles in its cage may be increasing its level of stimulation in an inadequately complex environment and thus is modifying its behavior to cope with its environment. The primate that smears its feces on the cage wall is not harming itself, but is certainly expressing a qualitatively abnormal behavior that should prompt an assessment of the animal's environment and its overall welfare. A behavior may be considered pathological if it occurs frequently (occupies a substantial portion of the animal's time budget to the detriment of other activities); if it is disruptive (i.e., interferes with biological functions, including eating, breeding, parental care); and/or it is intense (i.e., produces irritation or tissue damage). Even a behavior considered fairly innocuous can become pathological if it is expressed at a cost to the animal manifesting other species-appropriate behaviors. For example, the animal that paces in its enclosure may not have compromised welfare; however, the same animal that engages in repetitive locomotion, does not attend to changes in its surroundings, does not engage in social interactions, and otherwise has a very limited behavioral repertoire is more likely in a pathological state with reduced welfare. Bayne and Novak (1998) developed a behavioral assessment scale for abnormal behavior in rhesus monkeys that ranks atypical behavior by its potential impact on the welfare of the animal. In this way, the frequency of abnormal behaviors and the disruption they cause are a relevant marker of a disturbance to animal welfare.

As the majority of research animals are rodents, unique challenges are associated with using behavior as a metric of rodent welfare, though training tools are available for free online, such as the auto-tutorial from Newcastle University on recognizing post-operative pain in animals (see http://www.ahwla.org.uk/site/Tutorials.html). For example, there may be tens of thousands of rodents at a single institution. So the sheer number of animals to observe is overwhelming. There is an increasing trend to house rodents in individually ventilated cages (IVCs), which can impair observation of the animals in the cage without disturbing them (i.e., pulling the cage out of the IVC rack to look down upon the animals). Among the variety of animals used in research, the behaviors of some species are simply better known than others. And the behavior of new transgenic lines of rodents may not be known until the animals have been studied for some period of time. Finally, nuances of behavior are easier to observe in individual animals of some species (e.g., nonhuman primates) than other animals (e.g., mice). When considering behaviors as a metric for laboratory animal welfare, a determination should be made as to which behaviors are readily observable, whether the behaviors can be accurately observed and interpreted by personnel, and whether the behaviors are a meaningful indicator of good or poor welfare. Behaviors that result from the experimental paradigm (e.g., reduced hand coordination in primates given MPTP to model Parkinson's disease) should be considered in the development of criteria that link behavior with welfare status, thereby separating known etiologies of reduced welfare from unanticipated or unknown causes.

Facial expressions are one type of behavior that is readily observable, and the significance of various expressions is well known in some species, such as cats, dogs, and nonhuman primates. Facial expressions of fear, anger, submission, and aggression are well understood, reliable signals of subsequent behaviors (e.g., bared teeth in a dog may be followed by growling and attack). While the relationship of these facial expressions to an animal's welfare may be inconsistent across expressions, recent work on facial expressions of pain in mice appears to show a direct connection between some facial expression changes and the mouse's welfare. The Mouse Grimace Scale uses changes in the mouse's facial expression, such as a cheek bulge, nose bulge, ear position, whisker change and eye squeeze, to identify the level of pain the animal is experiencing (Langford et al., 2010). The study demonstrated a high level of observer consistency in identifying those mice in pain using these markers. While such a system may not yet be practical for daily observations of research mouse colonies that may be comprised of tens of thousands of animals, the Mouse Grimace Scale expands traditional thinking and challenges personnel to be creative when developing welfare assessment tools.

A practical approach to improving welfare based on behavioral observations will depend on personnel training and validation of the observations. Use of behavioral scoring sheets with predetermined categories will aid in standardizing the data collected and promote inter-observer consistency. A scan sampling technique, or targeting particular animals (e.g., especially fragile transgenic lines), to supplement routine daily observations will make most efficient use of staff time. Implementing a team approach to behavioral observations and welfare determinations (e.g., husbandry staff, veterinarian, and research personnel) will ensure the necessary diverse perspectives to make suitable judgments about an animal's welfare and its care. It should be determined at each institution if animal behavior is adequate as the sole assessment tool for welfare. This decision will be based, in part, on weighing the value and limitations of behavior as the exclusive measure of welfare given the observer's experience, the living context of the animal, animal demographics, and the research. Consideration should be given to an integrated approach that includes behavior, the health profile of the animal, and any challenges to its physiology, immunology, or genetics, or due to a breeding scheme or the research study. In this manner, when appropriately gathered and interpreted, behavior observations can be an important and practical tool to assess welfare and validate that refinements implemented address not only extant behavioral concerns but the underlying welfare issue.

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