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A New Invasiveness Scale: Its Role in Reducing Animal Distress

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We have recently developed a rating scale of invasiveness (Shapiro & Field, 1987) that has a number of potential uses in promoting the welfare of laboratory animals. The scale rates published experiments from 0 (little or no invasiveness) through 5 (highest level of invasiveness, suffering, pain or lasting harm). The scale points and their definitions are presented at the end of this article. This is one of several recent rating scales designed to measure pain and suffering in research with animals (Obrink, 1982; Ross, 1981; Orleans, 1987). All of these scales measure cost to the animals without entering the more indeterminate region of possible benefits of the study. In the present scale, the scale points are highly detailed and specific, focusing especially on behavioral and psychological research, not just biomedical research.

The invasiveness scale has been shown to have adequate interrater reliability (.80 with trained raters: Shapiro & Field, 1987). This means that the ratings are not merely a subjective impression, since independent raters can agree in judging experiments as more or less invasive. In short, the ratings are reasonably objective. The authors make no claim for the scale in regard to predictive validity as no clearcut criteria are available and as the intent of the scale is the less ambitious one of providing a shorthand aid to understanding research reports. However, there is already some data that provides construct validity for the scale (correlations with three other scales: Shapiro & Field, 1987). Research is underway that could add further construct validity by establishing a network of findings of relations that make sense in terms of invasiveness construct, egs. comparisons between surgical labs/naturalistic or ethological studies or drug/nondrug research.

How can this kind of rating scale promote animal welfare? Where and how should it be used? First, in teaching: We feel that students should be sensitized to the ethical dimensions of scientific research. A useful exercise would be to have them rate the invasiveness in reports of a variety of different animal research projects: some observational, some learning, some involving drugs, surgery, curare, addiction, etc. This would rapidly give them an appreciation of the diversity of animal research, ranging from quite innocuous to quite harmful to the animal. Students would be sensitized to issues concerning various minority groups as a result of various forms of social pressure, recommendations, guidelines, etc. Students would find that perfectly legitimate research can be done with observational or minimally intrusive techniques, and the honorific implications of terms like "scientific" and "research" are not limited to invasive procedures. Some students would later choose careers in noninvasive or helping approaches to animals, without feeling compelled to adopt manipulative methods.

Another useful exercise would be to have students rate the invasiveness of animal studies in introductory psychology textbooks, a project that we are currently working on. It may be instructive to discover whether certain authors persistently enliven their texts by recounting the highly invasiveness warhorses of the animal literature, such as Harlow's maternal deprivation studies, Brady's "executive" monkeys, Seligman's learned helplessness, or Richter's drowning rats, to give examples. Do these same texts imply a vote of confidence for these methods by failing to inform readers about naturalistic or minimally intrusive studies, or research focusing on the animal-human bond? The invasiveness scale can be an aid in content

analysis of college psychology texts, helping to reveal unspoken mechanistic or manipulative assumptions about the place of animals.

Second, in monitoring research: one potential use of this scale would be in rating published research to demonstrate the rise and fall of invasiveness over time. We have conducted an unpublished survey of animal research published in American Psychological Association journals over the last 40 years, and have found that invasiveness has not stayed constant over this period. Indeed, there is some evidence of a lessening of the overall invasiveness in recent years. Is this due merely to internal exigencies of scientific progress, or could this be related to the development of more liberal social attitudes in many cultural spheres, including the animal rights movement of the last 10 years or so? This same kind of monitoring function could also be applied by relating invasiveness to various background factors, including the place of origin, auspices, and sponsorship of the research.

A related use of the scale is by institutional review boards, notably the IACUC's (institutional animal care and use committees). Such boards review and pass on a large volume of proposed animal research, and might find their task made easier by use of a simple, reliable, quantitative measure of animal distress. This in turn would exert pressure on researchers to attempt to answer their questions in the least intrusive or stress-producing ways. Overall statistics could eventually be available showing the average invasiveness of research at the institution. Such statistics would not necessarily point fingers of blame - in fact, they could rebut charges of undue invasiveness, although on the other hand they might also pave the way for needed changes. Social pressure of this kind may already have contributed to a reduction in the number of laboratory animals used in recent years and to the interest in substituting computer simulations or tissue cultures in place of live animals. Correlations can also be sought between invasiveness and type of animals used. For example, it is possible that research on " expendable" mice and rats will turn out to be more invasive than that conducted on less expendable primates.

One possible use for the invasiveness scale is in litigation about animal abuse in the laboratory. In the hands of an expert witness it could be an aid in demonstrating objectively how a particular laboratory or institution compares with others in invasiveness, either in the scientific questions it chooses to ask or the ways in which it tries to answer them. A related use of the invasiveness scale would be in screening proposals by granting agencies and foundations; in fact, the mere knowledge that a scale of invasiveness would be part of a rating package would inevitably have a salutary effect on the kinds of proposals submitted. In short, this would provide an incentive to the scientific community to design research that is as low in invasiveness as possible, consistent with the problem to be studied. As we have noted before (Shapiro & Field, 1987) this approach could also rebut vague claims in support of painful research based on highly subjective cost-benefit ratios.

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SCALE OF INVASIVENESS

0. Field studies involving virtually no pain/distress or harm:
 - a. Observations of wild or captive populations in natural or semi-natural settings.
 - b. Studies involving capturing an animal for tagging followed by immediate release in species relatively unstressed by such handling.
 - c. Studies involving environmental manipulation in settings similar to the species natural habitat.

1. Laboratory experiments involving little or no pain/distress or harm:
 - a. Procedures involving monitoring or simple measurements such as EEG monitoring, blood pressure, heart rate, simple blood test, venipuncture injection, voluntary injection of non-harmful substance.
 - b. Procedures involving simple behavioral tests such as perceptual discrimination, preference testing, handling or petting.
 - c. Procedures involving anesthetized animals with little or no post-operative pain/distress or harm.
 - d. Positive reinforcement in behavioral learning experiments involving no reduction in weight below free-fed levels; conditioned responses that involve little or no pain/distress or harm.

2. Laboratory experiments and certain field studies involving mild pain/distress and no long-term harm:
 - a. Procedures that involve mild pain or distress such as frequent blood sampling or orbital blood sampling; intramuscular injection, skin-scraping, some manipulations of sensory experience such as brief visual deprivation or alteration through nonsurgical means.
 - b. Negative reinforcement, punishment, or any mild or escapable noxious stimulus. (E.g., mild electric shock, taste aversion, environmental manipulation such as temperature change; brief cold water immersion.)
 - c. Food deprivation for lengths of time that keep animals close to free-fed weight (e.g., deprivation in rats that result in not less than 90% free-fed weight); water deprivation slightly exceeding particular species' requirements (e.g. deprivation in rats of less than 18 hours).
 - d. Procedures involving anesthetized animals with mild post-operative pain/distress and no long-term harm.
 - e. Field studies involving capturing an animal for tagging followed by immediate release, in species stressed by such handling.

3. Laboratory experiments involving moderate pain/ distress and little or no long-term harm:
 - a. Surgery or other procedures involving anesthetized animals, such as electrode placement (CNS recording or stimulation), CNS lesion, cannulation, cardiac puncture - that cause little or no long-term harm.
 - b. Negative reinforcement, punishment, or inescapable noxious stimuli that cause moderate pain/distress.

- c. Food deprivation for lengths of time moderately exceeding the species' requirement (e.g., deprivation in rats that results in 80-90% free-fed weight); water deprivation for lengths of time moderately exceeding the particular species' requirement (e.g., deprivation in rats of between 18 and 24 hours); other nutritional deprivations (e.g. salt, milk) resulting in comparable pain/distress and harm.
- d. Administration of drug or toxic agents that cause moderate pain/distress and little or no long-term harm.
- e. Environmental deprivation that causes moderate pain/ distress and little or no harm, (e.g., reared in environment impoverished for particular species' needs with respect to manipulation or novelty).
- f. Social isolation for moderate lengths of time relative to species' needs (e.g., in canine pups or infant macaques, for hours).
- g. Physical immobilization for several hours causing moderate pain/distress.
- h. Sleep deprivation for a limited time.

4. Laboratory experiments involving an extended period of pain/distress or moderate long-term harm*

- a. Surgery and other procedures involving anesthetized animals, such as CNS lesions that cause an extended period of pain/distress or moderate long-term harm.
- b. Negative reinforcement, punishment, or inescapable noxious stimuli that cause an extended period of pain/distress or moderate long-term harm (e.g., certain models of psychopathology).
- c. Food deprivation for lengths of time greatly exceeding the particular species' requirement (e.g., deprivation in rats that results in between 70 and 80% free-fed body weight); water deprivation for lengths of time greatly exceeding the particular species' requirement (e.g., deprivation in rats of between 24 and 48 hours); other nutritional deprivation (e.g., salt, milk) resulting in comparable pain/distress and harm.
- d. Administration of drug or toxic agents that cause an extended period of pain/distress or moderate long-term harm (e.g., in rats, use of anxiogenic drugs).
- e. Environmental deprivation (e.g., reared in total darkness) or environmental exposure (e.g., radiation) that causes an extended period of pain/distress or moderate long-term harm.
- f. Social isolation for extended length of time relative to species' needs (e.g., in canine pups or infant macaques, for days).
- g. Extended physical immobilization (days).
- h. Extended or "chronic" sleep deprivation.
- i. Bum or wound studies on anesthetized animals allowed to recover.
- j. Forced addiction or addiction with withdrawals.

*In judging long-term harm, ignore whether the animal is euthanized, i.e., score for any animal that is allowed to "recover" from the surgical or other experimental procedure.

5. Laboratory experiments involving an extended period of extreme pain/distress or severe long-term harm.*

- a. Surgery and other procedures involving anesthetized animals, such as CNS lesions that cause an extended period of extreme pain/distress or severe long-term harm.

- b. Negative reinforcement, punishment, or inescapable noxious stimuli that cause an extended period of extreme pain/distress or severe long-term harm (e.g., certain models of psychopathology).
- c. Food deprivation for lengths of time grossly exceeding the particular species' requirement (e.g., deprivation in rats that results in less than 70% free-fed body weight); water deprivation for lengths of time grossly exceeding the particular species' requirement (e.g., deprivation in rats of more than 48 hours); other nutritional deprivation (e.g., salt, milk) resulting in comparable pain/distress and harm.
- d. Administration of drug or toxic agents that cause an extended period of extreme pain/distress or severe long-term harm (e.g., in rats, use of bradykinin).
- e. Environmental deprivation (e.g., reared in "total" sensory isolation) or environmental exposure (e.g., radiation) that causes an extended period of extreme pain/distress or severe long-term harm.
- f. Social isolation for extended periods of time relative to species- needs (e.g., in canine pups or infant macaques, for weeks).
- g. Prolonged physical immobilization (weeks).
- h. Terminal sleep deprivation.
- i. Burns or wound studies on unanesthetized animals.
- j. Addiction with withdrawal and convulsions.
- k. Use of paralytic or curariform drugs on unanesthetized animals.

*In judging long-term harm, ignore whether the animal is euthanized, i.e. score for any animal that is allowed to "recover" from the surgical or other experimental procedure.

Scale of Invasiveness: Supplemental Scoring Form

1. Reference (journal, yr, vol, pages) _____
2. Rater (circle one) 1. DH 2. PF
3. Species
 - 0. Mice, rats
 - 1. Hamsters, rabbits, gerbils, guinea pigs
 - 2. Cats, dogs
 - 3. Monkeys, apes
 - 4. Others
4. Number animal subjects: _____
5. Death of animal subjects?
 - 0. None died
 - 1. Some died

2. All died

3. No information

6. Anesthesia or analgesia used?

0. No - animal fully aware

1. Yes, reduction of pain or distress

2. Yes, unconsciousness

7. Were drugs or toxic agents used? (Do not count anesthetics)

0. No

1. Yes

8. Did surgery take place? (Do not count injections)

0. No

1. Yes

9. Overall rating of invasiveness (number and letter): _____