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Avoidance Learning as a Psychological Criterion of Animal's Capacity for Suffering

Nabywanie reakcji unikania jako psychologiczne kryterium zdolności zwierząt do cierpienia

Abstrakt

W artykule zaproponowano nowe kryterium oceny zdolności zwierzęcia do cierpienia, skupiając się na kryteriach psychologicznych, w szczególności uczeniu się unikania. To kryterium może umożliwić bardziej kompleksową ocenę cierpienia u różnych gatunków i w różnych sytuacjach. Teoria poziomów integracji wyjaśnia rozwój zachowań unikania i przedstawia prawdopodobny próg poznawczy dla cierpienia u zwierząt. Zwierzęta zdolne do uczenia się unikania są bardziej narażone na cierpienie, ponieważ takie zachowanie wymaga zdolności do tworzenia skojarzeń między bodźcami a działaniami i przewidywania przyszłych zdarzeń, co może prowadzić do awersyjnych stanów emocjonalnych. Proponowane kryterium oferuje obiektywny sposób oceny cierpienia bez polegania na niejednoznacznych terminach, takich jak „świadomość"

Avoidance Learning as a Psychological Criterion of Animal's Capacity for Suffering

Abstract

This article proposes a new criterion for assessing an animal's capacity for suffering, focusing on psychological criteria, particularly avoidance learning. This criterion may allow for a more comprehensive assessment of suffering in various species and situations. The theory of integrative levels explains the development of avoidance behavior and presents the probable cognitive threshold for animal suffering. Animals capable of avoidance learning are more likely to suffer, as this behavior requires the ability to form associations between stimuli and actions and make predictions about future events, which may lead to aversive emotional states. The proposed criterion offers an objective way to assess suffering without relying on ambiguous terms like "consciousness" or "sentience," providing a broader, more accurate evaluation method.

lub „odczuwanie", dzięki czemu zapewnia ono szerszą, dokładniejszą metodę oceny.

Słowa kluczowe: cierpienie u zwierząt, uczenie się, bierne unikanie, aktywne unikanie

Key words: animal suffering, learning, passive avoidance, active avoidance

Why Do We Need Psychological Criteria for Assessing Animals' Suffering

Assessing an animal's capacity for suffering is crucial in various fields, including ethics, veterinary medicine, and animal welfare legislation. While physiological and neurobiological criteria offer tangible measures, psychological criteria provide a more comprehensive understanding of suffering, emphasizing the animal's subjective experience.

There is a general agreement that the concept of suffering covers phenomena falling beyond the biological understanding of experiencing pain or nociception. According to Marian Dawkins,[1] suffering is not merely a physical phenomenon but also involves an emotional response. Therefore, psychological evaluation is essential in understanding the subjective experiences of animals, which cannot be fully captured by physiological measures alone.[2] This perspective aligns with the argument by Allen Colin and Marc Bekoff[3] that animals are sentient beings capable of emotions such as pain, fear, and distress, which are critical components of suffering.

While physiological measures, such as stress hormones, might not capture all forms of suffering, psychological criteria allow for assessing suffering in a broader range of situations. For instance, chronic stress or psychological trauma might not manifest in immediate physiological changes but have long-term psychological effects.[4] Alain Boissy et al.[5] highlight the importance of considering an animal's psychological state over time to understand its cumulative experience of suffering. Moreover, psychological criteria acknowledge the differences among species and animals. Like humans, other animals show variability in their psychological re-

[1] Marian Stamp Dawkins, "Animal Minds and Animal Emotions," *American Zoologist* 40, no. 6 (2000): 883–888, https://doi.org/10.1093/icb/40.6.883.

[2] Dawkins, "Animal Minds and Animal Emotions."

[3] Colin Allen and Marc Bekoff, "Animal Minds, Cognitive Ethology, and Ethics," *The Journal of Ethics* 11, no. 3 (2007): 299–317, https://doi.org/10.1007/s10892-007-9016-5.

[4] Alain Boissy et al., "Assessment of Positive Emotions in Animals to Improve Their Welfare," *Physiology & Behavior* 92, no. 3 (2007): 375–397, https://doi.org/10.1016/j.physbeh.2007.02.003.

[5] Boissy et al., "Assessment of Positive Emotions in Animals," 375–397.

sponses to the same stimuli.[6] This variation means that a generalized approach based on physiological or neurobiological measures might be inadequate. The use of psychological criteria is also supported by advancements in animal cognition research. Studies have shown that many animal species have complex cognitive and emotional capacities.[7] For example, elephants exhibit behaviors indicative of grief, and rodents show empathy-like responses.[8] These findings suggest that considering cognitive and emotional abilities is important for a comprehensive assessment of suffering.

Therefore, while physiological and neurobiological criteria provide valuable information, psychological criteria may offer a more comprehensive and discerning approach to understanding an animal's capacity to suffer. This approach recognizes the subjective component of suffering, the importance of emotional and mental states, individual variability among animals, and the advances in our understanding of animal cognition and emotions. However, selecting the objective and universal criterion to assess an animal's suffering capacity is not an easy task. When we try to define complex concepts, such as "sentience," "consciousness," and "pain," we encounter significant ambiguity. These terms often lack widely accepted definitions, leading to difficulties distinguishing or interpreting specific behaviors as indicators of suffering. This lack of clarity makes it challenging to establish an objectively verifiable criterion that could serve as a tool for distinguishing organisms unlikely to possess the capacity for suffering from those that are likely to generate mental states of suffering. Therefore, it would be highly beneficial to establish a criterion that allows for the assessment of suffering without relying on the use of these ambiguous terms.

How Do We Find Objective Psychological Criteria for Assessing Animals' Suffering

Introductory Remarks

The list of prerequisites for creating the psychological states that may be categorized as suffering is difficult to construct. The seminal book on the subject by Neville

[6] Michael Mendl and Elizabeth S. Paul, "Consciousness, Emotion and Animal Welfare: Insights from Cognitive Science," *Animal Welfare* 13, no. S1 (2004): S17–S25, https://doi.org/10.1017/S0962728600014330.

[7] Frans B. M. De Waal, "Fish, Mirrors, and a Gradualist Perspective on Self-Awareness," *PLOS Biology* 17, no. 2 (2019): e3000112, https://doi.org/10.1371/journal.pbio.3000112.

[8] De Waal, "Fish, Mirrors, Gradualist Perspective on Self-Awareness."

Gregory[9] includes a list of important aspects when attempting to define the animal's capacity for suffering. Among them, we find two weighty statements: "1. The forms of suffering that can be experienced by 'lower' life forms are narrower than those experienced by 'higher' life forms, and so it is helpful to specify the form of suffering when discussing capacity for suffering. 2. Cognition is a prerequisite for mental suffering. In some cases, the inability to learn can be an indication of limited cognitive capacity. However, learning can be a subconscious activity, and so, in 'lower' life forms, an ability to learn does not necessarily demonstrate cognitive capacity or capacity to suffer." These indicators direct us toward the area of animal learning, as an important factor for defining the criterion.

This approach also points to the notion of a hierarchy of phenomena in the form of a complexity ladder where animals at lower levels may lack the capacity for suffering. In contrast, those positioned at the higher rungs of the ladder are more likely to possess this capacity with greater certainty. A useful theoretical framework applicable in this context is the theory of integrative levels.[10] This theory emphasizes a hierarchical organization of events and systems, where each level exhibits distinct properties and relationships with adjacent levels. The key principles of this framework are as follows:

- Each higher level organizes the level(s) below it but adds new quality.
- Higher levels depend on the functioning of lower levels, but disturbances at higher levels do not necessarily disrupt the stability of lower levels.
- The mechanism driving the organization of any system lies at the level below, while its purpose or function is determined by the level above.
- Higher levels cannot be reduced to lower levels without losing the unique properties that define them, underscoring the non-reducibility of complex systems to simpler components.

In accordance with Neville Gregory's second recommendation,[11] we propose to derive the criterion from the broad category of learning processes. Given the diversity of learning processes, we will focus on a particular form of associative learning: avoidance learning. Acquired avoidance, especially active avoidance, is a complex behavioral faculty that includes the simultaneous, coordinated cooperation of many lower-level faculties and, therefore, seems to be a promising predictor for higher cognition development.

[9] Neville G. Gregory, *Physiology and Behaviour of Animal Suffering*, 1st ed. (Wiley, 2004), 10, https://doi.org/10.1002/9780470752494.

[10] James K. Feibleman, "Theory of Integrative Levels," *The British Journal for the Philosophy of Science* 5, no. 17 (1954): 59–66, https://doi.org/10.1093/bjps/V.17.59; cf. also Wojciech Pisula, "Integrative Levels in Comparative Psychology – The Example of Exploratory Behavior," *European Psychologist* 3, no. 1 (March 1998): 62–69, https://doi.org/10.1027/1016-9040.3.1.62.

[11] Gregory, *Physiology and Behaviour of Animal Suffering*.

Avoidance Learning

To understand avoidance responses, it is essential not to equate them with escape responses.[12] An escape response is a behavior that occurs in reaction to an aversive stimulus that appears in the animal's environment, such as a rodent rapidly fleeing from a compartment when exposed to an aversive electric shock in a shuttle box paradigm. In contrast, an avoidance response is a learned behavior performed to prevent or evade an aversive stimulus before it occurs. For instance, in a conditioned taste aversion study, a rat may learn to avoid a specific flavor associated with nausea by refraining from consuming that flavor when it is presented.[13] Avoidance responses can only manifest following a process of avoidance learning, during which the subject learns to associate an unpleasant unconditioned stimulus (e.g., an electric shock or a noxious taste) with a conditioned stimulus (e.g., a specific tone or visual cue signaling the impending shock or taste).[14] This learned association enables the animal to anticipate the aversive event and engage in behaviors to avoid it.

Active avoidance learning requires higher cognitive processing abilities than passive avoidance. The minimal requirements for active avoidance learning in animals include[15]:

1. Ability to perceive and distinguish between different stimuli and possess the ability to receive/perceive a stimulus which subjectively may be assigned the status of aversive or nociceptive.
2. Ability to perform a motor action that allows the animal to withdraw from contact with aversive/nociceptive stimulus.
3. All forms of learning require the ability to memorize, remember, and recall past experiences.
4. The animal must be capable of forming associations between its motor behavior and environmental consequences resulting from this behavior (instrumental conditioning).
5. The animal must be capable of forming associations between unconditioned and conditioned (context) stimulation (classical conditioning).

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[12] James H. Reynierse, "Differentiation of Escape and Avoidance Responding in Rats," *Journal of Comparative and Physiological Psychology* 79, no. 1 (1972): 165–170, https://doi.org/10.1037/h0032558.

[13] Linda Parker, "The Role of Nausea in Taste Avoidance Learning in Rats and Shrews," *Autonomic Neuroscience* 125, nos. 1–2 (2006): 34–41, https://doi.org/10.1016/j.autneu.2006.01.010.

[14] Richard J. Servatius et al., "Rapid Avoidance Acquisition in Wistar–Kyoto Rats," *Behavioural Brain Research* 192, no. 2 (2008): 191–197, https://doi.org/10.1016/j.bbr.2008.04.006.

[15] Tami M. Ball and Lisa A. Gunaydin, "Measuring Maladaptive Avoidance: From Animal Models to Clinical Anxiety," *Neuropsychopharmacology* 47, no. 5 (2022): 978–986, https://doi.org/10.1038/s41386-021-01263-4.

Decades of research have provided substantial evidence demonstrating the capacity for active avoidance in various vertebrate (mainly amniote) species (e.g. rats[16]; hamsters[17]; degus[18]; rabbits[19]; cats[20]; birds[21]). Procedural and technical developments made it possible to detect active avoidance also in fish.[22] There is also some evidence for active avoidance behavior in reptiles.[23] Moreover, active avoidance behavior was observed in some species of amphibians. For example, toads (*Bufo arenarum*) can learn a one-way avoidance response motivated by immersion in the highly hypertonic solution.[24] In vertebrates, an increase in heart rate is a physiological reaction to an unconditioned aversive stimulus. If this acceleration of heart rate occurs as a conditioned response, it demonstrates that the toads have formed an expectation of the upcoming unconditioned stimulus. However, data on the capacity for active avoidance learning in reptiles and amphibians is limited, and some studies show variability in responses to aversive stimuli among individuals within the same species, leading to inconsistencies in the observed behavioral patterns.[25] Moreover, there is no unanimous, convincing evidence of avoidance learning across various invertebrate taxa. Some studies have

[16] David C. Riccio et al., "Developmental Aspects of Passive and Active Avoidance Learning in Rats," *Developmental Psychobiology* 1, no. 2 (1968): 108–111, https://doi.org/10.1002/dev.420010208.

[17] Bruce E. Sandler and George G. Karas, "Acquisition of a Jumping Avoidance Response in Hamsters," *Psychonomic Science* 10, no. 5 (1968): 191–192, https://doi.org/10.3758/BF03331475.

[18] Andreas Abraham and Michael Gruss, "Stress Inoculation Facilitates Active Avoidance Learning of the Semi-Precocial Rodent Octodon Degus," *Behavioural Brain Research* 213, no. 2 (2010): 293–303. https://doi.org/10.1016/j.bbr.2010.05.018.

[19] Stephen Marenet al., "Basolateral Amygdaloid Multi-Unit Neuronal Correlates of Discriminative Avoidance Learning in Rabbits," *Brain Research* 549, no. 2 (1991): 311–316, https://doi.org/10.1016/0006-8993(91)90473-9.

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[21] Richard Dafters, "Active Avoidance Behavior Following Archistriatal Lesions in Pigeons," *Journal of Comparative and Physiological Psychology* 89, no. 10 (1975): 1169–1179, https://doi.org/10.1037/h0077181.

[22] Stephanie Yue et al., "Investigating Fear in Domestic Rainbow Trout, Oncorhynchus Mykiss, Using an Avoidance Learning Task," *Applied Animal Behaviour Science* 87, nos. 3–4 (2004): 343–354, https://doi.org/10.1016/j.applanim.2004.01.004; Xiaojuan Xu et al., "Active Avoidance Conditioning in Zebrafish (*Danio rerio*)," *Neurobiology of Learning and Memory* 87, no. 1 (2007): 72–77, https://doi.org/10.1016/j.nlm.2006.06.002.

[23] Gordon Burghardt, "Learning Processes in Reptiles," *Herpetologica* 2 (1977): 175–196.

[24] Florencia Daneri et al., "Common Toads (Bufo Arenarum) Learn to Anticipate and Avoid Hypertonic Saline Solutions," *Journal of Comparative Psychology* 121, no. 4 (2007): 419–427, https://doi.org/10.1037/0735-7036.121.4.419.

[25] Frank T. Crawford and James W. Langdon, "Escape and Avoidance Responding in the Toad," *Psychonomic Science* 6, no. 3 (March 1966): 115–116, https://doi.org/10.3758/BF03327984.

shown the presence of avoidance learning in cephalopods,[26] arthropods,[27] and even annelids.[28] The very nature of this type of learning is far from being sufficiently understood.

Avoidance Behavior through the Theory of Integrative Levels

Avoidance behavior is a key survival strategy found in a wide range of species, from basic reflexes to more complex, learned responses in higher vertebrates. To understand how avoidance behavior evolves and varies across different species, it is important to explore how cognitive complexity develops at different levels of biological organization. The theory of integrative levels provides a useful framework for this, as it suggests that behavior emerges from the interaction of processes across multiple levels – starting from reflex behaviors and extending to higher cognitive functions (see Figure 1).

As shown in Figure 1, the basic level of behavioral regulation in response to nociceptive stimulation consists of various responses, which may be categorized as "withdrawal."[29] Withdrawal behaviors are tightly linked to the nervous system's ability to detect and process nociceptive (pain-related) signals. These signals trigger motor responses, often before higher cognitive processing occurs, enabling the animal to react quickly to potential harm.[30] This level of behavior regulation is found as early in terms of an organism's complexity as protozoans and is shared across all animal taxa, although its physiological mechanisms may vary in species at different levels of cognitive organization. It is unconditional, reflexive in nature, and mostly automatic level of behavioral regulation.

[26] Alexandra K. Schnell et al., "How Intelligent Is a Cephalopod? Lessons from Comparative Cognition," *Biological Reviews* 96, no. 1 (2021): 162–178, https://doi.org/10.1111/brv.12651.

[27] Laura Maria Velásquez-Díaz et al., "Arthropods: Associative Learning," in *Encyclopedia of Sexual Psychology and Behavior*, ed. Todd K. Shackelford (Cham: Springer International Publishing, 2024), 1–6, https://doi.org/10.1007/978-3-031-08956-5_208-1.

[28] Allan L. Jacobson, "Learning in Flatworms and Annelids," *Psychological Bulletin* 60, no. 1 (1963): 74–94, https://doi.org/10.1037/h0046468.

[29] Susan J. Raines and Gary Greenberg, "Approach/Withdrawal Theory," in *Comparative Psychology: A Handbook*, eds. Gary Greenberg and Maury M. Haraway (New York, NY: Garland Publishers, 1998), 74–80.

[30] Henry Railo et al., "Rapid Withdrawal from a Threatening Animal Is Movement-Specific and Mediated by Reflex-like Neural Processing," *NeuroImage* 283 (2023): 120441, https://doi.org/10.1016/j.neuroimage.2023.120441.

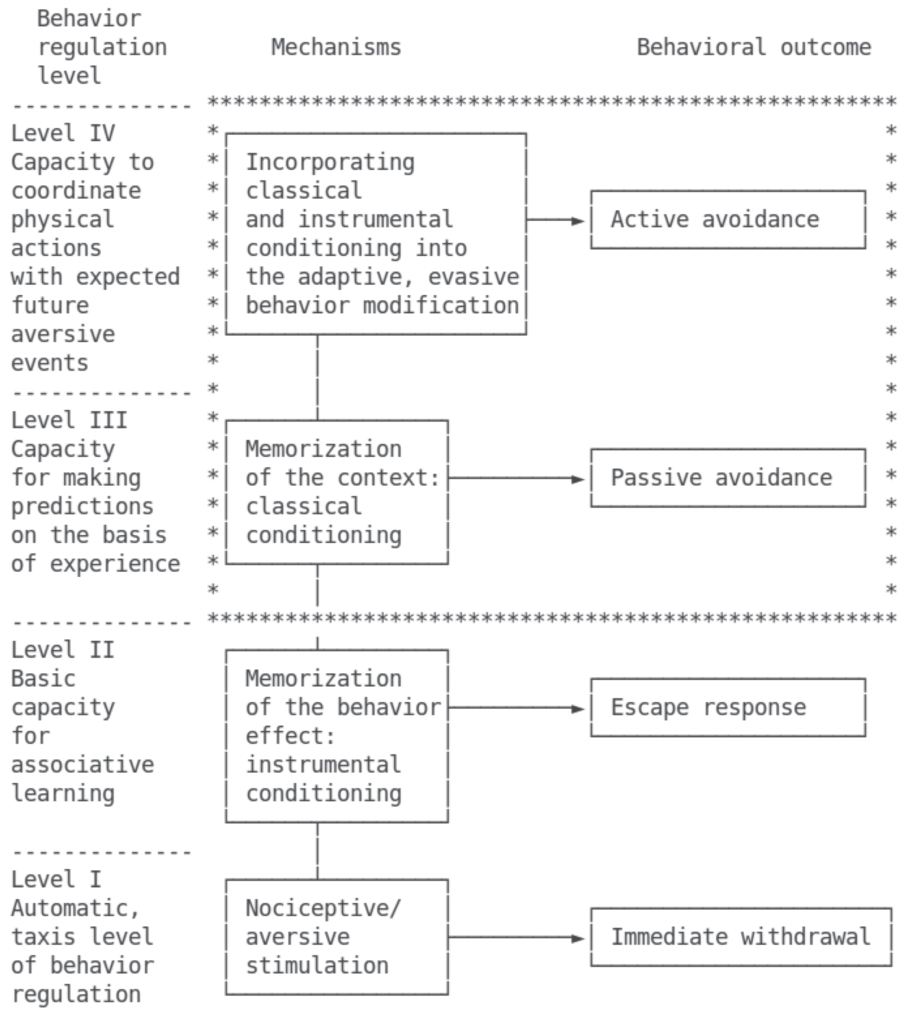

Figure 1. The outline of the development of avoidance behavior described in the theory of integrative levels framework (note that lower levels are at the bottom of the figure)

The higher level of behavior involves a form of associative learning: instrumental conditioning. Instrumental or operant conditioning is a learning process where behavior is modified through consequences.[31] These consequences, further named "reinforcements," change the probability of the behavior's re-occurrence. It requires the capacity to build associations between motor actions (response-R) and the stimulation changes resulting from the motor actions (stimulus-S).

[31] John Eric Rayner Staddon and Daniel T. Cerutti, "Operant Conditioning," *Annual Review of Psychology* 54, no. 1 (February 2003): 115–144, https://doi.org/10.1146/annurev.psych.54.101601.14512.

Classical conditioning is a learning process that occurs when two stimuli are paired: a neutral stimulus and an unconditioned stimulus (such as food) that naturally triggers an unconditioned response (like salivation in dogs).[32] Over time, the neutral stimulus becomes a conditioned stimulus, capable of triggering a similar response, now called a conditioned response, even without the unconditioned stimulus, effectively substituting the original stimulus in eliciting the response. The phenomenon is sometimes called a stimulus substitution.[33] The latter form of learning is gaining more attention and significance in understanding various mechanisms (including cognition) regulating behavior. The significance of classical conditioning (S-S contingency) in shaping an animal's defensive behavior has been extensively discussed in a somewhat forgotten paper by Robert Bolles.[34] Bolles convincingly argued that building S-S associations is crucial for acquiring learned avoidance responses. Classical conditioning becomes a basis for so-called context learning, which provides the ability to predict the occurrence of the aversive unconditioned stimulus. Moreover, context learning describes the association between a specific context and the behavior reinforced within that context. Contextual cues, such as the physical environment, social conditions, or temporal patterns, are discriminative stimuli that signal when a particular behavior will yield rewards or avoid punishments.[35] Thus, classical conditioning creates a basis for a novel phenomenon, that is, making predictions.

It is unsurprising and pretty straightforward to claim that making predictions about future aversive or painful events is not a pleasant experience in itself. Therefore, when thinking about an animal's capacity for producing mental states falling within the category of "suffering," we should consider two basically different situations. Initially, an individual may experience a painful/aversive event in the present moment. Most of the animals are equipped with a capacity for motor actions that allow them to break contact with the aversive stimulus. This is shown at the bottom line of Figure 1. The emergence of associative learning opens new possibilities. However, building S-R associations solely based on the unconditioned stimulus does not involve making predictions. Therefore, the presence of the aversive experience or its representation evoked by the nociceptive stimulus is limited to the time window of exposure to the stimulus.

[32] Mark E. Bouton and Erik W. Moody, "Memory Processes in Classical Conditioning," *Neuroscience & Biobehavioral Reviews* 28, no. 7 (2004): 663–674, https://doi.org/10.1016/j.neubiorev.2004.09.001.

[33] Victor García-Hoz, "Signalization and Stimulus-Substitution in Pavlov's Theory of Conditioning," *The Spanish Journal of Psychology* 6, no. 2 (2003): 168–676, https://doi.org/10.1017/S113874160000531X.

[34] Robert C. Bolles, "The Role of Stimulus Learning in Defensive Behavior," in *Cognitive Processes in Animal Behavior*, eds. Stewart H. Hulse, Harry Fowler, and Werner K. Honig, 1st ed. (Routledge, 2018), 89–107, https://doi.org/10.4324/9780203710029-4.

[35] Bouton and Moody, "Memory Processes in Classical Conditioning," 663–674.

In fact, the emergence of the S-S associations seems to be a seminal evolutionary development of cognitive processes. Henceforth, a broad range of contextual stimuli may elicit previously memorized painful, nociceptive, or aversive experiences. The memorized content becomes gradually independent of the actual sensory input due to the general learning processes, such as generalization.[36] The generalization process, through the growing network of associations, enables the retrieval of memorized experiences in response to previously neutral stimuli. Gradually, the presence of emotional disturbance related to harmful events is independent of the actual presence of the harmful stimulus.

In conclusion, the ability to predict aversive events increases an individual's vulnerability to experiencing negative functional states and emotional distress.[37] However, it also provides an individual with the ability to avoid direct contact with the harmful event.[38] Avoidance can take the form of passive avoidance (withdrawal from the area of harmful exposure, inhibition of activity, freezing) or active avoidance. The latter takes the form of a newly emerging (learned, reinforced) activity that increases the distance from the source of harmful stimulation or prevents its exposure. This may represent a higher level of behavioral organization (level IV – see Figure 1), achieved by integrating the two faculties, namely simultaneously forming a learned response to a specific stimulus (S-R associations) and building the associations between two stimuli (S-S associations), allowing the individual to anticipate the outcome of one stimulus based on the presence of another. Although this level of behavioral regulation offers many novel adaptive responses, it also carries some risks. One of the possible costs of this emergent quality is the increased complexity of organism-environment interactions, which may lead to an increased number of frustrating outcomes (e.g., the objectively thwarted inability to execute learned adaptive responses). Memorized distressing events can further amplify sources of aversive experiences independent of any current sensory input.[39]

[36] T. Rao Laxmi et al., "Generalisation of Conditioned Fear and Its Behavioural Expression in Mice," *Behavioural Brain Research* 145, nos. 1–2 (2003): 89–98, https://doi.org/10.1016/S0166-4328(03)00101-3.

[37] Emma J. Harding et al., "Cognitive Bias and Affective State," *Nature* 427, no. 6972 (2004): 312–312, https://doi.org/10.1038/427312a.

[38] Jorge Mallea et al., "Classical Conditioning," in *Encyclopedia of Animal Cognition and Behavior*, eds. Jennifer Vonk and Todd Shackelford (Cham: Springer International Publishing, 2019), 1–16, https://doi.org/10.1007/978-3-319-47829-6_1214-1.

[39] Harding et al., "Cognitive Bias and Affective State."

Active Avoidance Learning as a Cognitive Threshold Level for Subjective Suffering

This article proposes a criterion for an animal's capacity for suffering based on its ability to form stimulus-response (S-R) and stimulus-stimulus (S-S) associations and incorporate them into a cognitive system, enabling the individual to learn avoidance behavior. The approach based on behavioral and cognitive responses to aversive stimuli provides measurable and observable evidence of suffering. The validity of this criterion can be evaluated through numerous empirical findings on animal learning, cognition, and emotional responses,[40] and can be further supported by studies on pain perception, emotional responses, and stress indicators (e.g., changes in cortisol levels[41]). The literature review shows strong similarities between the animal groups capable of acquiring avoidance responses and those taxa that are believed to be capable of suffering. Additionally, this method of assessing an animal's mental state does not need to refer to ambiguous and variably defined concepts such as awareness or consciousness.

It is important to note that this approach has its limitations. When it comes to individual animals, there can be differences in how effectively they learn to avoid certain events. This means that a single study showing a lack of avoidance response does not necessarily provide a definitive conclusion. For instance, adverse experiences during development or throughout life can hinder an individual's ability to exhibit avoidance behaviors.[42] Additionally, there are notable differences in how active avoidance is displayed among individuals of the same species.[43] However, evidence for avoidance learning in any individual of a given species suggests a high probability of experiencing suffering in the entire species or even taxon. It is also important to acknowledge that this criterion does not allow for a qualitative assessment of suffering, which can vary from mild discomfort to severe psychological and physical pain.

Nonetheless, we believe that the proposed criterion offers a measurable and observable indicator of animals' capacity for suffering across species. Animals capa-

[40] Riccio et al., "Developmental Aspects of Passive and Active Avoidance Learning in Rats," 108–111.

[41] Karin Roelofs et al., "The Effects of Stress-Induced Cortisol Responses on Approach–Avoidance Behavior," *Psychoneuroendocrinology* 30, no. 7 (2005): 665–677.

[42] Steven F. Maier and Martin E. P. Seligman, "Learned Helplessness at Fifty: Insights from Neuroscience," *Psychological Review* 123, no. 4 (July 2016): 349–367, https://doi.org/10.1037/rev0000033.

[43] M. Florencia Daneri et al., "Common Toads (*Bufo arenarum*) Learn to Anticipate and Avoid Hypertonic Saline Solutions," *Journal of Comparative Psychology* 121, no. 4 (2007): 419–427, https://doi.org/10.1037/0735-7036.121.4.419.

ble of acquiring an avoidance response might be susceptible to forming the affective/emotional and mental states widely described as suffering. Although we cannot rule out the possibility of suffering in animals that do not meet the criterion of avoidance learning, the ability to active avoidance learning makes the capacity for suffering highly probable.

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