Studies experience of pain invertabrates and crustaceans

R.W. Elwood and M. Appel, Pain experience in hermit crabs? Animal Behaviour 77 (2009) 1243-1246.

Abstract

Pain may be inferred when the responses to a noxious stimulus are not reflexive but are traded off

against other motivational requirements, the experience is remembered and the situation is avoided in

the future. To investigate whether decapods feel pain we gave hermit crabs,

Pagurus bernhardus, small electric shocks within their shells.

Only crabs given shocks evacuated their shells indicating the aversive nature of the stimulus, but fewer crabs evacuated from a preferred species of shell indicating a motivational trade-off. Some crabs that evacuated attacked the shell in the manner seen in a shell fight. Most crabs, however, did not evacuate at the stimulus level we used, but when these were subsequently offered a new shell, shocked crabs were more likely to approach and enter the new shell.

Furthermore, they approached that shell more quickly, investigated it for a shorter time and used fewer cheeped probes within the aperture prior to moving in. Thus the experience of the shock altered future behavior in a manner consistent with a marked shift in motivation to get a new shell to replace the one occupied. The results are consistent with the idea of pain in these animals.

R.W. Elwood, S. Barr and L. Patterson, Pain and stress in crustaceans? Applied Animal Behaviour Science 118 (2009) 128-136.

Abstract

We consider evidence that crustaceans might experience pain and stress in ways that are analogous to those of vertebrates. Various criteria are applied that might indicate a potential for pain experience: (1) a suitable central nervous system and receptors, (2) avoidance learning, (3) protective motor reactions that might include reduced use of the affected area, limping, rubbing, holding or autotomy, (4) physiological changes, (5) trade-offs between stimulus avoidance and other motivational requirements, (6) opioid receptors and evidence of reduced pain experience if treated with local anaesthetics or analgesics, and (7) high cognitive ability and sentience. For stress, we examine hormonal responses that have similar function to glucocorticoids in vertebrates. We conclude that there is considerable similarity of function, although different systems are used, and thus there might be a similar experience in terms of suffering. The treatment of these animals in the food industry and elsewhere might thus pose welfare problems.

R.W. Elwood (2011), Pain and suffering in invertebrates? Institute for Laboratory Animal Research (ILAR) Journal 52 (2011) 175-184.

Rapid avoidance learning and prolonged memory indicate central processing rather than simple reflex and are consistent with the experience of pain. Complex, prolonged grooming or rubbing may demonstrate an awareness of the specific site of stimulus application. Tradeoffs with other motivational systems indicate central processing, and an ability to use complex information suggests sufficient cognitive ability for the animal to have a fitness benefit from a pain experience.Availlable data are consistent with the idea of pain in some invertebrates and go beyond the idea of just nociception but are not not definitive. In the absence of conclusive data, more humane care for invertebrates is suggested.

Slot: While awaiting there results of further relevant studies, perhaps all who use invertebrates should consider the possibility that at least some might suffer pain and, as a precaution, ensure humane care for these animals.

R.W. Elwood, Evidence for pain in decapods crustaceans? Animal Welfare 21 Suppl. 2 (2012) 23-27.

Abstract

Vast numbers of decapods are used in human food and currently subject to extreme treatments and there is concern that they might experience pain. If pain is indicated then a positive change in the care afforded to this group has the potential to produce a major advance in animal welfare. However, it is difficult to determine pain in animals. The vast majority of animal phyla have a nociceptive ability that enables them to detect potential or actual tissue damage and move away by a reflex response. In these cases there is no need to assume an unpleasant feeling that we call pain. However, various criteria have been proposed that might indicate pain rather than simple nociception. Here, with respect to decapod crustaceans, four such criteria are discussed: avoidance learning, physiological responses, protective motor reactions and motivational trade-offs. The evidence from various experiments indicates that all four criteria are fulfilled and the data are thus consistent with the idea of pain. The responses cannot be explained by nociception alone but, it is still difficult to state categorically that pain is experienced by decapods. However, the evidence is as strong for this group as it is for fish but the idea that fish experience pain has broader acceptance than does the idea of decapod pain. A taxonomic bias is evident in the evaluation of experimental data.

Barry Magee and Robert W. Elwood, Shock avoidance by discrimination learning in the shore crab (Carcinus maenad) is consistent with a key criterion for pain. The Journal of Experimental Biology 216 (2013) 353-358.

Abstract

Nociception allows for immediate reflex withdrawal whereas pain allows for longer-term protection via rapid learning. We examine here whether shore crabs placed within a brightly lit chamber learn to avoid one of two dark shelters when that shelter consistently results in shock. Crabs were randomly selected to receive shock or not prior to making their first choice and were tested again over 10 trials. Those that received shock in trial 2, irrespective of shock in trial 1, were more likely to switch shelter choice in the next trial and thus showed rapid discrimination. During trial 1, many crabs emerged from the shock shelter and an increasing proportion emerged in later trials, thus avoiding shock by entering a normally avoided light area. In a final test we switched distinctive visual stimuli positioned above each shelter and/or changed the orientation of the crab when placed in the

chamber for the test. The visual stimuli had no effect on choice, but crabs with altered orientation now selected the shock shelter, indicating that they had discriminated between the two shelters on the basis of movement direction. These data, and those of other recent experiments, are consistent with key criteria for pain experience and are broadly similar to those from vertebrate studies.

Slot: In conclusion, the data from this and other studies (e.g. Elwood, 2012) go beyond the idea of crustaceans responding to noxious stimuli simply by nociceptive reflex. Instead, long-term motivational change that enables discrimination learning has been demonstrated. Perhalps such motivational changes and learning can arise without any an unpleasant experience, although that is doubted by Gentle (Gentle, 2011) for birds. However, if we accept that possibility for invertebrates, we should also accept the same possibility for at least some vertebrates.

C.M. Sherwin, Can invertebrates suffer? Or how robust is argument-by-analogy? Animal Welfare 10 (2001) 103-118.

Abstract

It is a popular notion that, compared to vertebrates, invertebrates have a reduced capacity to experience suffering. This is usually based on arguments that invertebrates show only simple forms of learning, have little memory capacity, do not show behavioural responses to stimuli that would cause 'higher' vertebrates to exhibit responses indicative of pain, and have differences in their physiology that would preclude the capacity for suffering. But, how convincing is this 'evidence' of a reduced capacity to suffer? Suffering is a negative mental state - a private experience - and, as such, it cannot be measured directly. When assessing the capacity of an animal to experience suffering, we often compare the similarity of its responses with those of 'higher' animals, conceptualized in the principle of argument-by-analogy. By closely examining the responses of invertebrates, it can be seen that they often behave in a strikingly analogous manner to vertebrates. In this paper, I discuss published studies that show that invertebrates such as cockroaches, flies and slugs have short- and long-term memory; have age effects on memory; have complex spatial, associative and social learning; perform appropriately in preference tests and consumer demand studies; exhibit behavioural and physiological responses indicative of pain; and, apparently, experience learned helplessness. The similarity of these responses to those of vertebrates may indicate a level of consciousness or suffering that is not normally attributed to invertebrates. This indicates that we should either be more cautious when using argument-by-analogy, or remain open-minded to the possibility that invertebrates are capable of suffering in a similar way to vertebrates.