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Lateralized Behavior in Domesticated Dogs

by Christine Berta

(Biology 1151)

Abstract

Lateralization, generally defined as the preferential use of one side of the body over another, is a result of certain processes being more highly developed in one hemisphere of the brain versus the other. Numerous scientific studies suggest that lateralization is most likely a defining feature in all mammals and perhaps all vertebrates. This study tested for lateralization in vertebrates by examining paw preference in a population of domestic dogs (*Canis familiaris)*. Twenty-seven dogs were randomly selected for testing. The dogs were observed over a period of one week with preference in unsolicited behaviors documented. The dogs showed a preference for sidedness, supporting the now commonly held hypothesis that lateralization is present among all vertebrates and a sign of common evolutionary origin. More tests need to be conducted to reasonably determine the strength of lateralization and how its magnitude impacts lability and heredity, if at all.

INTRODUCTION

Lateralization is generally defined as the preferential use of one side of the body over another. Preference, which can be revealed in a variety of ways physically (e.g., human handedness), is a behavioral reaction to brain development, where certain processes tend to be more highly developed in one hemisphere of the brain versus the other. The scientific community has long held the view that lateralization is uniquely human, derived from the complexity of the human brain (Halpern et al. 2005). However, numerous studies suggest that lateralization is most likely a defining feature in all mammals and perhaps all vertebrates (Wells 2003). In mice, lateralization has been linked to immunity and psychological coping mechanisms (Neveu and Merlot 2003). Sheep and lambs have shown preferential use in jaw movement during rumination and a definite laterality when avoiding obstacles in their environment (Versace et al. 2007). The common wall lizard, *Podarcis muralis*, whose anatomical structure allows for the independent use of its eyes, appears to be lateralized in such a way so as to scan for prey with a specific eye (Bonati et al. 2008). And, common lab rats have demonstrated that lateralization plays a significant role in whisker sensation and the subsequent efficacy of motor functions (Agestam and Cahusac 2007).

Numerous and distinct animal studies, including those mentioned above, have caused many to speculate that lateralization may indicate a common evolutionary origin and/or advancement (Brown et al. 2007). Given that asymmetry is recognized in species as disparate as fish and humans, it is unlikely that anything other than natural selection, like genetic drift or sexual selection, is responsible. In order for such speculation to be supported, it would follow that vertebrates must benefit from, or select for, lateralization. As a result, the scientific community has begun to focus on brain asymmetry and its relation to potential fitness of a species (Brown et al. 2007). Multipronged approaches have matured over time to more deeply study the mechanisms of asymmetry and eventually shed light on evolutionary and hereditary questions. Models include genetics of zebra fish, visual systems of birds and brain imaging of primates (Halpern et al. 2005). This study explored lateralization in domestic dogs.

Methods

Twenty-seven domestic dogs, *Canis familiaris*, were randomly selected for testing of sidedness. Behaviors examined in testing are summarized in Table 1.

The dogs were observed for a period of one week, with side preference or no preference documented from unsolicited pet behaviors. The sex of the animals and the influence of potential hereditary factors were not explored. Likewise, the extent of conditioning or habituation on the behaviors was not discriminated.

The Chi-square Goodness of Fit Test was used to test the tendency for preference in sidedness. The null hypothesis (H_o) to be tested was that dogs showed no preference for sidedness. Significance was determined at $P < 0.05$

Results and Discussion

The tendency for no preference could not be safely rejected. The study concluded that dogs showed a preference for sidedness ($\chi 2 = 20$; $P < 0.001$), supporting the argument for lateralization among vertebrates. Other studies have indicated lateralization in dogs, but preferences were studied in relation to added variables, such as sex. Results were inconclusive across studies (Wells 2003, Poyser et al. 2006). Exploring reasons behind lateralization and factors affecting its predictability, specifically in dogs, will require additional studies.

First, the relationship of sidedness to sexual distribution would be interesting to study. Other studies have shown paw preference with two distinct populations based on sex (Wells 2003). Females showed a preference for the right paw, while males showed a preference for the left. However, these results could not be duplicated in other, independent trials (Poyser et al. 2006). In Poyser's study, females showed no tendency, while males showed a tendency for left but only initially. It has been suggested that the inability to replicate a preference due to sex may be that preference in dogs is labile or weak. Indeed, different degrees of cerebral lateralization could lead to different behavior depending upon the novelty of the stimuli introduced or task animals are requested to perform (Brown et al. 2007, Reddon and Hurd 2009).

Differences in preference also could be attributed to different life experiences of the animals in question, as hypothesized by a study on the inheritance of cerebral lateralization (Brown et al. 2007). Likewise, Poyser et al. (2006) suggest difficulty in studying brain asymmetry and lateralized behavior in animals that come in regular contact with (lateralized) human beings, as in zoo, farm and laboratory environments. Future studies should account for life experiences and discriminate against learned or habitual behaviors. Given that the domestic dogs used in this study were closely linked with humans, a study with stray or abandoned pets may prove revealing.

Third, exploration of evolutionary advantages to lateralization in dogs may provide insight into constructing future studies. There is evidence from looking at other species that predatory experience and environmental adaptation may be highly correlated with the strength of lateralization. For example, wild-caught fish (i.e., *Brachyraphis episcope*) from a high predatory area were 30% more likely to be strongly lateralized than those from a low predatory area (Bonati et al. 2008). While the present study did not account for strength or weakness of preference in the population, other studies have considered magnitude with interesting results. Dogs, a highly domesticated animal with low predatory pressure, consistently demonstrated weak lateralization (Wells 2003, Poyser et al. 2006). Conversely, lambs conferred a strong link to brain asymmetry (Versace et al. 2007). It follows that smaller, weaker lambs would have stronger predatory pressure and lateralization than their parental counterparts. Greater social stability, quicker adaptability and a broader capacity to perform multiple tasks simultaneously are other explanations offered in support of evolution. Tests could be constructed around each of these hypotheses to add greater clarity on paw preference and other indicators of lateralization in dogs.

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Table 1. Behaviors used to test for sidedness among the 27 dogs examined.

Behavior
Pawing of door to go outside7
Unsolicited paw in “hand-shaking”
Fore paw extended during interaction
Fore paw used to protect food dish
Primary hind paw used to scratch
Front extended first from a stationary position to forward movement
Preference to food items placed either right or left of the dog
Leg raised by male dogs during urination
Back leg used to kick soil after urination
Preference in body position when lying down
Preference in head tilting