Lloyd Morgan's Canon

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"Perhaps the most quoted statement in the history of comparative psychology is Lloyd Morgan's canon" (Dewsbury, 1984, p. 187). To this it can be added that perhaps the most *misrepresented* statement in the history of comparative psychology is Lloyd Morgan's canon. Apparently a version of Morgan's canon was first published in 1892 (Dixon, 1892; Morgan, 1892). However, the most cited version of the canon is from the first edition of *An Introduction to Comparative Psychology* (Morgan, 1894): "In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale" (p. 53). In later editions, Morgan made it clear that "psychological processes" could be substituted for psychical faculties.[1]

The Misrepresentation of Morgan's Canon

Clearly Morgan's canon was intended to be a stricture to guide the interpretation of evidence pertaining to psychological processes in animals, but the misrepresentation of the canon that occurred early (e.g., Mills, 1899, p. 271; Washburn, 1908, pp. 24–25) and that continues in the present (e.g., Baenninger, 1994) is that it was a canon of parsimony or simplicity. In turn, parsimony became equated with "Ockham's razor" (e.g., Boring, 1929, 1950; Burns, 1915; Moody, 1967; Thornburn, 1915), which advocated choosing the explanation with the fewest assumptions.

In some respects, parsimony (i.e., simplicity) may have been the opposite of what Morgan intended. Addressing some anticipated objections to the canon, Morgan (1894) wrote:

> A second objection is, that by adopting the principle in question, we may be shutting our eyes to the simplest explanation of the phenomena. Is it not simpler to explain the higher activities of animals as the direct outcome of reason or intellectual thought, than to explain them as the complex results of mere intelligence or practical sense-experience? Undoubtedly it may in many cases seem simpler. It is the apparent simplicity of the explanation that leads many people naively to adopt it. *But surely the simplicity of an explanation is no necessary criterion of its truth.* (p. 54; emphasis added)

It is clear that parsimony or simplicity was not what Morgan intended by the canon. It is also interesting that he viewed "reasoning" as being a simpler process than "intelligence," given that intelligence at the time merely meant "performance [that] showed some beneficial effect of past experience" (Boakes, 1984, p. 23). Perhaps an understanding of how Morgan viewed reasoning as a simpler process than intelligence can be gained from two analogies that he cited within the same paragraph as that which included the quotation above. In one example, he cited "creative fiat" as being a simpler explanation for organic evolution than the "indirect method of evolution." In the other, Morgan cited the example of an earthquake providing a simpler explanation for the "cañon [canyon] of the Colorado" than "its formation by the fretting of the stream during long ages under varying meteorological conditions" (Morgan, 1894, p. 54).

Regarding the misrepresentation of Morgan's canon, it is interesting that Adams (1928), who vigorously opposed the canon on methodological and practical grounds, contributed to the perception that it was both a canon of parsimony and that it was not a canon of parsimony. Adams asserted that Morgan's canon was "plainly intended as an adaptation of the general Law of Parsimony," and then Adams argued that "instead of being as commonly considered, a special case of the law of parsimony, [Morgan's canon] is not related to it, and may on occasion work to exactly opposite effect" (p. 241).

Nagge (1932) observed that Morgan's canon was being misinterpreted but cited no references. Newbury (1954) and Gray (1963a) provided well-documented examinations of the misrepresentation of Morgan's canon. Gray's article was published in a journal not likely to be read by most psychologists. Newbury's was in the more widely read *Psychological Bulletin,* but both articles appear to have been largely overlooked.

E. G. Boring was certainly not the first to misrepresent the canon, but his *History of Experimental Psychology* (1929, 1950) undoubtedly led many animal psychologists astray. Boring wrote, "[T]he 'law of parsimony' . . . applied to animal psychology is often known as Lloyd Morgan's canon" (1929, pp. 464–465; 1950, p. 474), and Boring linked Morgan's canon to the law of parsimony and Ockham's razor (1929, pp. 486–487; 1950, p. 498). Boring also contributed to another misrepresentation of Morgan's canon, namely, that the canon was directed against Romanes's use of anecdotes and anthropomorphism; this will be discussed in a later section.

Morgan's Intent

What did Morgan intend by the canon and what did he conclude about animals' higher faculties? The canon was meant to be applied to an implicit hierarchy of psychological processes that had evolved according to Darwin's theory of natural selection. In accounting for an animal's action, one was supposed to choose the lowest process in the hierarchy that could account for the action, unless one had compelling evidence to suggest that the animal was both capable of using and had, in fact, used a higher process. A full appreciation of Morgan's complicated view is best gained from reading pages 55–59 and beyond of his book, for example, the following passage: "faculties have not yet been evolved from their lower precursors; and hence we are logically bound not to assume the existence of these higher faculties until good reasons shall have been shown for such existence" (Morgan, 1894, p. 59).

Chapter III, in which Morgan introduced and first discussed the canon, is largely abstract and devoid of empirical data. He did not purport to know which faculties (higher or lower) various animals possessed. For example, addressing the anticipated objection that the canon was "ungenerous" to animals, Morgan asked rhetorically, If we are willing to attribute higher faculties to explain our human neighbor's behavior, why not attribute higher faculties to the animals? To this, Morgan replied:

> In the case of our neighbours we have good grounds for knowing that such and such a deed may have been dictated by either a higher or lower motive. If we had equally good grounds for knowing that the animal was possessed of both higher and lower faculties, the scientific problem would have been solved. (pp. 53–54)

In other words, Morgan advocated a conservative course, namely, when existence in an animal of a higher faculty or process is as yet unknown, it is most appropriate to attribute to the animal a lower process whose existence in the animal is known.

After chapter III (in which Morgan introduces the canon, discusses its meaning, and addresses possible objections to it), the remaining chapters in *An Introduction to Comparative Psychology* may be characterized as Morgan's effort to address several types of psychical faculties or psychological processes and to ask whether animals possessed them.

Morgan began the discussion of the psychological processes in chapter IV with the "laws of association" (contiguity, similarity, etc.), and in the next nine chapters he discussed fundamental processes such as memory, sensory, and motor processes. By chapter XIII Morgan addressed a higher process, "the perception of relations," and in chapter XIV he asked, "Do animals perceive relations?" He addressed "conceptual thought" in chapter XV, and with the title of chapter XVI, Morgan asked, "Do animals reason?" The last four chapters concluded with chapter XX, "The Psychology of Man and the Higher Animals Compared."

How did Morgan answer the question, Do animals perceive relations? "[W]e must reply that all the ordinary activities of animals can be explained on the supposition that they do not" (1894, p. 260; 1914, p. 260). How did Morgan answer the question, Do animals reason? "[T]he probabilities are that animals do not reason" (1894, p. 304; 1914, p. 308). That the passages in the 1894 and 1914 editions were identical demonstrated the continuity of Morgan's views.

Morgan ended *An Introduction to Comparative Psychology* as follows:

> [L]et me say as a last word, first, that in denying to the animals the perception of relations and the faculty of reason, I do so in no dogmatic spirit, and not in support of any preconceived theory or opinion, but because the evidence now before us is not, in my opinion, sufficient to justify the hypothesis that any animals have reached that stage of mental evolution at which they are even incipiently rational; and, secondly, that I have all along based my discussion on the canon of interpretation considered in the latter part of the third chapter. If good reason can be shown for the rejection of that canon, the logical foundation of my argument will be destroyed, and the argument itself will fall to the ground. (1894, p. 377; 1914, p. 381)

Whether Morgan's canon has utility today is worthy of consideration. However, it will first be useful to address the relationship between Morgan, the canon, Romanes, and issues concerning the use of anecdotes and anthropomorphism. In addition, given the general misconception that Morgan's canon was a canon of parsimony and that parsimony meant Ockham's razor, the latter two principles will be addressed as well.

Morgan, Romanes, and the Use of Anecdotes

Morgan's canon was often used as a basis for criticism of Romanes's use of anecdotes and anthropomorphism. For example, Boring wrote that "the anecdotal method of Romanes has not only been discarded but has become a term of opprobrium in animal psychology" (1929, p. 464; 1950, p. 473). Boring also characterized Morgan's early works, including *An Introduction to Comparative Psychology*, as representing a "reaction against Romanes," specifically, the "anecdotal method" and the "anthropomorphic tendency" (1929, p. 465; 1950, p. 474). Morgan's canon was not formulated as a reaction against Romanes, and Romanes did not deserve this historical assessment.

As Dewsbury (1984; pp. 39, 185) observed, Romanes was aware of the difficulties associated with anecdotal evidence, and he formulated three conservative principles to guide his and others' use of anecdotes. Dewsbury also noted, "Like Darwin and others of his time, Romanes was forced to rely heavily on anecdotes as the empirical basis for his writings on animal behavior" (p. 39).

Romanes apparently felt a special obligation to record the anecdotes *verbatim*, unless he believed an anecdote might benefit from "condensation" (G. J. Romanes, 1883, see p. xi). Such verbatim accounts often confounded observation with interpretation. In some instances for which Romanes was criticized, it seems clear that he endorsed the observation without endorsing the accompanying interpretation (see following paragraphs). However, he usually did not disavow the interpretation, which may have implied to many that he accepted it. Nevertheless, had Romanes's critics read carefully the preface and introductory chapter to *Animal Intelligence* (1883), Romanes's most criticized work, they might have tempered some of their careless criticism.

Washburn (1908, p. 9) criticized Romanes for what she apparently believed was his acceptance of an informant's interpretation, when a reasonable conclusion is that he intended only to endorse the informant's observation. Because Washburn's example illustrates how others may have misrepresented Romanes, it will be instructive to examine the anecdote cited by Washburn and how Romanes used it.

Romanes had expressed confidence in a Mrs. Hutton's report that she had seen some ants bury some other ants. She also reported that she had seen some of the ants kill some of the other ants, because "they had attempted to run off without performing their share of the task of digging" (G. J. Romanes, 1883, p. 92). Romanes had earlier accepted Lubbock's finding that ants were "very careful in disposing of the dead bodies of their comrades" (p. 89); Lubbock was a respected, published naturalist (see, e.g., Lubbock, 1882). However, a missing fact of paramount importance to Romanes was

a direct observation to confirm that "disposing" meant burying. It seems clear from the paragraph preceding Romanes's use of Mrs. Hutton's anecdote that he cited it only to verify that ants had been seen to bury ants. Romanes immediately followed Mrs. Hutton's anecdote with a corroborative one from a Reverend White that did not mention ants being killed, much less for shirking their duty, but only that he had "seen some ants burying their dead by placing earth above them" (G. J. Romanes, 1883, p. 92). Romanes himself offered a reasonably conservative explanation, namely, that ants might bury other ants "due to sanitary requirements, thus becoming developed as a beneficial instinct by natural selection" (p. 89).

Nevertheless, on occasion Romanes may have been too liberal in his acceptance or postulation of some interpretations associated with anecdotal observations. An example might be Romanes's attributions of mechanical understanding and skill to cats in opening latches, etc. With the advantage of being able to look back in light of laboratory data such as Thorndike's (1898a), many today would agree with Thorndike's denouncement of Romanes in conjunction with this example.

It is true that Morgan often disagreed with Romanes, as did Romanes with Morgan (Gray, 1963b). However, this was in the context of a friendly public debate, and it should be acknowledged that Romanes provided the pioneering ideas to which Morgan could react. Only 4 years Morgan's senior, Romanes died 42 years before Morgan. Romanes's developing views were cut short, and Gray (1963b) noted that "his objectivity was sufficient that, had he lived, he could have coped with even the iconoclastic Thorndike" (p. 225).

Direct evidence of Morgan's opinion of Romanes's use of anecdotes and interpretation can be found in a tribute to Romanes upon Romanes's death:

> [B]y his patient collection of data; by his careful discussion of these data in the light of principles clearly and definitely formulated; by his wide and forcible advocacy of his views; and above all by his own observations and experiments, Mr. Romanes left a mark in this field of investigation and interpretation which is not likely to be effaced. (E. Romanes, 1902, p. 202)

That Morgan emphasized the points that he did refutes those who suggested that Morgan's canon was a reaction to Romanes's use of anecdotes and anthropomorphic interpretation. Elsewhere Morgan wrote: "The death of Romanes since this too brief acknowledgment of all that I owe him was written and printed has entailed a loss to Science which is irreparable, and a loss to his personal friends that lies too deep for words" (Morgan, 1894, p. x). As Gray (1963b) observed, "Morgan came to look upon Romanes as friend and mentor, and it seems disrespectful to both men to forget what their relationship to each other actually was" (p. 228).

Morgan's Anthropomorphic Views

According to Boakes (1984), "For both Romanes and Morgan, understanding the mind of animals could be achieved only by making inferences based on analogies with the human mind" (p. 51). Morgan's view would likely please the most liberal-minded researcher in the field of animal cognition today. It will be worth quoting him at some length.

> We are now in a position to see clearly what is the distinctive peculiarity of the study of mind in beings other than our own individual selves. Its conclusions are reached not by a singly inductive process, as in Chemistry or Physics, in Astronomy, Geology, Biology, or other purely objective science, but by a doubly inductive process. . . . First, the psychologist has to reach, through induction, the laws of the mind as revealed to him in his own conscious experience. Here the facts to be studied are facts of consciousness, known at first hand to him alone among mortals; the hypotheses may logically suggest themselves, in which case they are original so far as the observer himself is concerned, or they may be derived, that is to say, suggested to the observer by other observers; the verification of the hypotheses is again purely subjective, original or derived theories being submitted to the touchstone of individual experience. This is one inductive process. The other is more objective. The facts to be observed are external phenomena, physical occurrences in the objective world; the hypotheses again may be original or derived; the verification is objective, original, or derived theories being submit-

ted to the touchstone of observable phenomena. Both inductions, subjective and objective, are necessary. Neither can be omitted without renouncing the scientific method. And then finally the objective manifestations in conduct and activity have to be interpreted in terms of subjective experience. The inductions reached by the one method have to be explained in the light of inductions reached by the other method. (Morgan, 1903, pp. 47–49)

To compare Morgan's and Romanes's similar views, as well as to appreciate the rigor and care with which Romanes argued for the means to study animal intelligence and "mind," see Romanes's introductory chapter in *Animal Intelligence* (1883).

Exactly how and when Morgan's canon came to be viewed as a canon against anthropomorphism is an interesting question. Certainly, Thorndike (e.g., 1898a, 1898b) was instrumental. Romanes provided a convenient target against which Thorndike could contrast his views, and Morgan's writings could be adapted equally conveniently to suggest an apparent "ally." Later writers addressed the issue of anthropomorphism (e.g., Roberts, 1929; Waters, 1939), but neither Roberts nor Waters cited any references. Roberts (1929) provided a spirited defense of anthropomorphism, and Waters (1939) considered it "inevitable that anthropomorphism must be used" (p. 539).

A Curious Anomaly

In view of the tributes to Romanes by Morgan that were cited before, it is ironic that Romanes's effacement occurred, if not directly by the hand of, then in the name of Lloyd Morgan. Most of the criticism of Romanes that was coupled to Morgan's canon occurred during Morgan's lifetime. It remains to be determined what attempts, if any, Morgan made to correct the misrepresentations that were being made about both his canon and his views concerning the use of anecdotes and anthropomorphism. Morgan's 1932 autobiography included two passing but respectful references to Romanes (pp. 247, 248) and a similarly passing reference to the canon (p. 262), none of which support the view that the canon was a reaction against Romanes. Perhaps Morgan was content to enjoy the recognition that he had gained from the canon, or perhaps an early critic's assessment of Morgan was correct: "But Professor Morgan is more and more in sympathy with the destructive school [a reference to Thorndike], so that he now seems willing to surrender anything to all and sundry who may ask him to stand and deliver" (Mills, 1899, p. 271). However, upon reading Morgan's autobiography, it would be difficult to conclude anything except that he was an honest, conscientious, and deeply committed scholar for whom the welfare of the science of psychology was paramount.

Ockham's Razor and the Law of Parsimony

Despite Morgan's intentions regarding the canon, it has been most used as animal psychology's equivalent of the law of parsimony. The law of parsimony and Ockham's razor have been inextricably linked and have been used more or less interchangeably (Burns, 1915; Pearson, 1892; Thornburn, 1915). They differ, however, in that parsimony appears to have been meant to refer to simplicity or economy in the physical world (a dogma that Pearson attributed to both Aristotle and Newton) as well as to economy of thought or explanation, whereas Burns (1915) argued that Ockham "was very careful with his original razor to make it cut *only hypotheses*" (p. 592).

As with the history of Morgan's canon, there appears to have been a history of misrepresentation associated with Ockham's razor. Thornburn (1915) noted:

> Nearly every modern book on Logic contains the words: *Entia non sunt multiplicanda, praeter necessitatem* [Entities are not to be multiplied without necessity]: quoted as if they were the words of William of Ockham. . . . My own fruitless inquisition for the formula, in those works of Ockham which have been printed, has led me to doubt whether he ever used it to express his Critique of Entities. (p. 287)

Thornburn cited seven ways that Ockham expressed or indicated, in Thornburn's words, the "Law or Paricmony [*sic*]" (p. 288). Burns (1915) confirmed Thornburn's view that the "Entia non sunt . . ." formulation was of questionable existence in Ockham's writings, although both acknowledged that such a formu-

lation may yet be discovered. A more recent Ockham scholar also questioned the existence of the "Entia non sunt . . ." formulation (Moody, 1967).

Although many psychologists who cited Morgan's canon as being a canon of parsimony embraced its general value, Battig (1962) presented a vigorous refutation of the value and validity of the principle of parsimony for psychology and concluded "that psychologists at present would therefore be well advised to ignore considerations of parsimony and simplicity entirely in their choice of research strategy" (p. 571). Dewsbury (1984) may be typical of many other comparative psychologists who seem to take a middle ground:

> [T]he general rule of assuming neither more processes nor more complex processes than necessary unless such processes are required appears sound [but] the principle should not be overapplied. . . . The law of parsimony and Morgan's canon should guide science but should not be permitted to stifle it. (p. 189)

Does Morgan's Canon Have a Useful Future?

Since Morgan's canon has a history of being treated as a canon of parsimony or simplicity, it is appropriate first to acknowledge that simplicity as a criterion for choice among explanations or theories in science is highly controversial, both methodologically and as a general practice (Boyd, Gasper & Trout, 1991; Bunge, 1963; Harré, 1985; Sober, 1975). Thus it appears at present that as a canon of parsimony, Morgan's canon would be too problematic to apply.

Taking the restricted view that parsimony is equivalent to Ockham's razor, in which the criterion of choosing the explanation with the fewest assumptions is said to apply, the principal difficulty is that of being able to assume that assumptions are equivalent. Obviously, if two explanations could satisfactorily explain a phenomenon and if one of them had n assumptions and the other had the same $n + x$ assumptions, the one with only the n assumptions would seem to be preferable.

Here is an example of one attempt to apply the approach just described. In the context of examining Harlow's (1959) assertions that "all concepts evolve only from LS [learning set] formation [and] insightful learning through LS formation is a generalized principle [which] appears in . . . oddity learning" (p. 510), I tried (Thomas, 1989) to illustrate the difference between an LS interpretation and an oddity concept-learning interpretation to explain the results of an experiment reported by Thomas and Noble (1988). Thomas and Noble concluded that they had good evidence for LS formation but not for oddity concept learning. A parsimonious choice between an LS formation interpretation and a concept-learning interpretation to explain animals' successful performances on an oddity task might be made on the basis that the LS interpretation required the use of three memory components (one event memory, one working memory, and one reference memory; see definitions of Oakley, 1983). The concept-learning interpretation required the same three memory components plus one additional reference memory component. However, a more efficient way of choosing between the two explanations is simply to say that the concept-learning interpretation requires an additional kind of evidence that is not required to support an LS interpretation. Specifically, performance must be better than chance on trial 1 to support an oddity concept-learning interpretation, but better than chance performances on trial 2 (and beyond) are the generally accepted evidence for LS formation.

Disregarding the general and erroneous view that Morgan's canon was a canon of parsimony (akin to Ockham's razor) and using Morgan's canon instead as he apparently intended it, the problem arises that for one to apply the canon it is assumed that one knows what the psychological processes are and, further, that the processes are hierarchical. If this was the case and if an animal's behavior could be explained by a process lower in the hierarchy, then Morgan's canon would be useful, if not essential, to a good science of animal cognition.

Although he was not explicit, Morgan in essence proposed a hierarchy of processes (see Boakes, 1984, pp. 41–43) that was largely implied by his chapter titles and sequence. However, there has been no general acceptance of Morgan's hierarchy, nor is there likely to be, because his arguments for the processes were not always compelling or clear. Others have proposed hierarchies, but none has been gener-

ally accepted (e.g., see references cited by Thomas, 1980).

Romanes had a modern-sounding hierarchy in his *Mental Evolution in Animals,* and it was (1883/1891) constructed under the heading "Products of Intellectual Development." His chart depicting this has been reprinted by Boakes (1984, p. 29) and by Murray (1988, pp. 266–267). Romanes's hierarchy of psychological processes was presented together with his estimate of phyletic achievements in relation to the hierarchy.

Thomas (1980; slightly revised in Steirn & Thomas, 1990), attempted to improve upon previous hierarchies of intellectual or cognitive processes by providing a precisely stated, operationally defined, and logically arranged hierarchy, but it, too, has not gained general acceptance. Unless and until there is general acceptance of a hierarchy of psychological processes, Morgan's canon, as he strictly intended it, will not be useful.

However, to the extent that it is agreed that some processes are lower than others (e.g., rote, associative learning versus concept learning) and as long as investigators attribute "higher" processes to animals when "lower" processes can explain the animals' actions (see Thomas, 1994), then the need to apply the "spirit" as opposed to the "letter" of Morgan's canon is essential to the scientific study of animal cognition.

Note

1. The four editions cited in the "References" section were used. All are identical on pages 53–59 except for one added paragraph after the first edition, in which Morgan noted that "psychological processes" could be substituted for "psychical faculties."

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