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Title of Entry: Morgan's Canon

Author identification: Roger K. Thomas, Ph.D.

University of Georgia

Athens, GA

rkthomas@uga.edu

Synonyms: Morgan's principle

I: Introduction

"Perhaps the most quoted statement in the history of comparative psychology is Lloyd Morgan's canon" (Dewsbury (1982, 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" (Thomas, 1998, p. 158). Conwy Lloyd Morgan (1852-1936) did not refer to it as a "canon" but as a "principle." However, it quickly became known as "Morgan's canon," and that is how it will be identified here, unless Morgan is being quoted. Morgan's canon was intended to guide choice among alternative explanations of animal behavior. This entry emphasizes at least 12 decades of misrepresentation of Morgan's canon as a guide and provides fundamental guidelines for constructing the best explanations in animal cognition and psychological science.

II: Morgan's Canon

The most cited version of Morgan's canon is in his *Introduction to Comparative Psychology* (Morgan, 1894, p. 53).

> 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.

Realizing early misunderstanding of the canon, Morgan (1903, p. 59) refined it as follows.

> In no case is an animal activity to be interpreted in terms of higher psychological processes, if it can be fairly interpreted in terms of processes which stand lower in the scale of psychological evolution and development.

Misrepresentations of Morgan's Canon

The most frequent misrepresentation of Morgan's canon occurred as early as 1896 when Stanley equated it with Sir William Hamilton's (1788-1856) "law of parsimony." In turn, Hamilton had equated parsimony with William of Ockham's (c 1285-1349) "razor". Generally, Morgan's canon, Hamilton's law of parsimony and Ockham's razor, often incorrectly, have been interpreted as advocating that when two or more explanations are available to explain natural phenomena (including animal behavior), one should choose the simplest (see Thomas, 1998, 2001, or 2007 and the references contained within).

The second most frequent misrepresentation is that Morgan's canon opposed anthropomorphism, and the third most frequent is that it opposed the use of anecdotes to describe and explain animal behavior. Morgan's alleged opposition to anthropomorphism and using anecdotes as evidence for animal intelligence typically were linked erroneously to George John Romanes (1848-1894) and his book, *Animal Intelligence* (1882).

Ockham's Razor

The main point to be made about Ockham's (also known as Occam's) razor is that Ockham meant it to be only a methodological stricture for choosing among alternative logical formulations; that is, he did not intend that it be applied to natural phenomena. Interestingly, scholars (Moody, 1967 and others) have not located among Ockham's writings its most frequently cited version, "*Entia non sunt multiplicanda necessitaeum*" (Entities are not to be multiplied without necessity). However, comparable strictures have been found among Ockham's writings, such as, "What can be done with fewer [assumptions] is done in vain with more*."* (Moody's translations). To conclude this brief account of Ockham's razor, it would be remiss to (a) fail to note that Ockham never referred to his stricture as a "razor" or (b) fail to recognize that Ockham was not the first to suggest such a stricture. Aristotle, and others between Aristotle and Ockham, proposed similar strictures. Aristotle intended that his stricture be used to choose among explanations of natural phenomena.

Hamilton's Law of Parsimony

Sir William Hamilton equated the law of parsimony with Ockham's razor as follows.

> Without descending to details . . . there exists a primary presumption of philosophy. This is the law of parsimony; which prohibits without a proven necessity, the multiplication of entities, powers, principles or causes; above all the postulation of an unknown force where a known impotence can account for the phenomenon. We are therefore entitled to apply "Occam's razor" to this theory of causality, unless it be proved to explain the causal judgment at a cheaper rate . . . . (Hamilton,1855,

p. 580)

Pearson (1892) explained that Hamilton also extended the law of parsimony to natural phenomena. Pearson first reported that Hamilton added some scholastic axioms that were valuable as canons for economy of thought.

> When, however, Sir William Hamilton adds to them, *Natura horret superfluum,* and says that they only embody Aristotle's and Newton's dicta that God and Nature never operate superfluously and always through one rather than a plurality of causes, then it seems to me we are passing from the safe field of scientific thought to a region thickly strewn with the pitfalls of metaphysical dogma (p. 482).

III: Morgan's View of Simplicity

As noted above, Ockham's razor, Hamilton's law of parsimony and Morgan's canon in general use have in common the assumption that the simplest explanation (for example, of an animal's behavior) is preferable. However, Morgan (1894) explicitly disavowed that assumption. Immediately after stating the canon on page 53, Morgan began anticipating some objections that might be raised against it. On page 54 Morgan wrote:

> A second [anticipated] objection is that by adopting the principle in question, we may be shutting our eyes to the simplest explanation of the phenomena.. . . . But surely the simplicity of an explanation is no necessary criterion of truth.

Regarding parsimony, Morgan (1890, p. 174) had previously written, “We do not know enough about the causes of variation to be rigidly bound by the law of parcimony.” “Parcimony” is how Morgan and Hamilton spelled it.

IV: Was Morgan’s Canon Anti-anthropomorphic?

Anthropomorphism as applied to animal cognition and behavior means attributing purportedly uniquely human abilities to nonhuman animals. Early on, as will be shown below, many authors wrote that Morgan’s canon was anti-anthropomorphic. Such assertions prompted Wozniak (1993, p. x) to write:

> Even worse [than equating Morgan’s canon with the law of parsimony, Morgan’s canon] is consciously anthropomorphic and based squarely on the adequacy of the psychologist’s personal introspection.”

What was Morgan’s view? Two pages after stating his principle, Morgan (1894, p. 55) wrote.

> As we have already seen, we are forced as men to gauge the psychical level of the animal in terms of the only mind of which we have first hand knowledge, namely the human mind. But how are we to apply the gauge?”

Morgan continued on pages 56-59 to consider how to apply the gauge, and it clearly involved anthropomorphic reasoning by introspection and analogy.

IV: Was Morgan’s Canon Anti-anecdotal and Anti-Romanes?

As will be shown below, many authors erroneously believed that at least part of Morgan’s motive for the canon was to oppose Romanes’ use of anecdotes as evidence for animal intelligence.

Who was Romanes? He was, perhaps, the first to consider animal intelligence in the context of Charles Darwin's theory of evolution. They were friends, and when Darwin's editor for *On the Origin of Species* (1859) insisted that he reduce the manuscript's length, Darwin gave Romanes his chapter on "Instinct" intended for *On the Origin* of Species to use as he wished. Romanes included it as an Appendix to his book, *Mental Evolution in Animals* (1883).

Mental Evolution in Animals was Romanes' major theoretical work, and he based it primarily on data from *Animal Intelligence* (Romanes, 1882). As few experimental data were available, Romanes had to rely mostly on published anecdotes. Romanes was aware of the pitfalls of anecdotes, and in the Preface to *Animal Intelligence* (p. vii), he wrote:

> If the present work is read without reference to its ultimate object of supplying the facts for the subsequent deduction of principles, it may well seem but a small improvement upon the works of anecdote-mongers. But if it is remembered that my object in these pages is the mapping out of animal psychology for the purposes of a subsequent synthesis [viz., *Mental Evolution in Animals*], I may fairly lay claim to receive credit for a sound scientific intention, even if the only methods at my disposal may incidentally seem to a minister to a mere love of anecdote.

Also, in the Preface to *Animal Intelligence*, Romanes included a rigorous set of guidelines to be followed in selecting anecdotes. His main misstep was that he felt an obligation to quote observers' anecdotes as fully as possible, which usually included the observers' interpretations of the observed behavior. Such interpretations were rarely

ones that Romanes accepted. Most of the observers were amateurs devoid of formal education in scientific methods.

For example, Romanes wanted to establish the fact that some ant colonies bury their dead. Romanes quoted several observers (including Sir John Lubbock, the eminent author of *Ants, Bees, and Wasps*, 1882) who reported seeing ants bury dead ants, which was all that Romanes wanted from the observations. However, in his perceived duty to quote observers' accounts fully, when feasible, he often also quoted their interpretations. One observer suggested that ants burying ants was a form of a funeral including a funeral procession; another observer's interpretation was that some ants killed ants that shirked their duties and then buried them. Romanes' interpretation (*Animal Intelligence*, 1882) was, "This habit [ants burying ants] . . . is no doubt due to sanitary requirements, thus becoming developed as a beneficial instinct by natural selection" (p. 89). This is a reasonable interpretation, as sanitary colonies likely had better survival and reproductive rates than unsanitary ones.

Nevertheless, prominent early psychologists such as Margaret Washburn in her book, *The Animal Mind* (1908), cited and ridiculed the interpretation that ants hold funeral processions to bury their dead. Similarly, Wilhelm Wundt, the acknowledged founder of experimental psychology, in his *book Human and Animal Psychology* (translated from German to English in 1894) criticized Romanes' as follows:

> While we admire the diligence with which the author [Romanes] has observed and collected the observations of others, we cannot but notice the unfortunate absence of the critical attitude in a field where it is especially desirable. Turn to the chapter on ants . . . . (p. 343)

It seems clear that neither Wundt nor Washburn read Romanes' Preface to *Animal Intelligence* or his explanation of ants burying ants on page 89.

Regarding Morgan's opinion of using anecdotes, in his book, *Animal Life and Intelligence* (1891, p. 362) he wrote:

> I do not propose to bring forward a number of new observations on the highly intelligent actions which animals are capable of performing . . . Mr. Romanes has given us a most valuable collection of anecdotes on the subject in his volume on *Animal Intelligence*.

Following Romanes death in 1894, Morgan gave a eulogy for Romanes before the Royal Society of London in 1895 that included the following:

> . . . by his patient collection of data, by his careful discussion of these data in the light of principles clearly formulated . . . . Mr. Romanes left a mark in this field of investigation and interpretation which is not likely to be effaced.

His choice or words showed clearly that Morgan had read and respected Romanes' Preface to *Animal Intelligence*. It is ironic that Romanes' name would be effaced as a result of the misuse of Morgan's canon.

V: How Morgan's Canon Has Been Perceived by Historians of Psychology

Leading the pack, the most eminent 20th century historian of psychology, E. G. Boring, best known for his *A History of Experimental Psychology* and using the same words in both editions (1929, p. 464; 1950, p. 473) wrote: "For this reason [Romanes' alleged tendency to anthropomorphize] . . . . the anecdotal method of Romanes has not only been discarded, but has become a term of opprobrium in animal psychology."

Thomas (2007) reviewed 32 history of psychology textbooks published from 1991-2005 (including multiple editions of a few of them), and he found that 18 misrepresented Morgan's canon as a canon of parsimony. Some of these and others misrepresented Morgan's canon as being anti-anthropomorphic and/or anti-anecdotal always referring to Romanes' use of anecdotes. Combining all three types of misrepresentation (or four if one counts being anti-Romanes separately), Thomas found only three textbooks (including two editions of one of them) among the 32 examined that provided generally accurate coverage of Morgan's canon. Additionally, Costall (1998, p. 18) wrote, *"The extent to which the intentions of Morgan's canon have been misinterpreted is astonishing." Wozniak (1993, pp. ix) wrote, "It would be an interesting study in itself to trace the distortion of Morgan's views, in particular the attribution to Morgan of the principle of parsimony."*

VI: A History of Misrepresentation of Morgan's Canon

Thomas (2001) conducted a study such as Wozniak suggested, and the main results are shown below. Intended to be representative and not exhaustive, this section includes quotations from researchers spanning at least 12 decades who misrepresented Morgan's canon (full references for these quotations may be found in Thomas (1998, 2001, or 2007). Section VII which follows has quotations from researchers spanning nine decades who tried to correct the misrepresentation of Morgan's canon. These sections may seem unduly tedious, but it is important to emphasize by examples the persistence and variety of misrepresentations of Morgan's canon as well as the largely disregarded efforts of scholars to correct the misrepresentation of Morgan's canon.

Stanley (1896, p. 541)

"His [Morgan's] caution is also admirable, but we do not think the law of parsimony is positive proof as he seems to urge."

Mills (1899, p. 271)

[In the context of Morgan's canon Mills wrote:] "Nor can I agree with those who maintain that we must always adopt the simplest explanation of an animal's action."

Washburn (1908, p. 25)

[After quoting Morgan's canon . . .] "In other words, when in doubt take the simpler interpretation."

Holmes (1911, p. 159)

". . . it is well in general to be guided by the principle enunciated by Lloyd Morgan, which is a sort of special case of the law of parsimony."

Warden (1927, p. 155)

"The canon of Morgan...was an attack against the prevailing anthropomorphism . . . . The canon is merely the law of parsimony applied to animal psychology. "

Adams (1928, p. 241)

[After quoting Morgan's canon . . . .] "This is plainly intended as an adaptation to the problems of animal psychology of the general Law of Parsimony . . . ."

Boring (1929, pp. 464-465)

> [Morgan] " . . . who undertook to offset the anthropomorphic tendency in the interpretation of the animal mind by an appeal to the 'law of parsimony.' This law applied to animal psychology is often known as 'Lloyd Morgan's canon.'"

Pillsbury (1929, p. 283)

“He [Morgan] is deserving of credit for urging what he calls the law of parsimony in the interpretation of mental phenomena in animals . . . .”

Flugel (1933, pp. 123-124)

> The reaction started with Lloyd Morgan, who, in the [eighteen] nineties, endeavored to combat the dangers of the anecdotal method by the ”law of parsimony”, according to which we must always explain animal behavior in terms of the simplest mental processes that will account for the facts.

Waters (1939, p. 534)

> Morgan’s canon was offered as just such a check [against the use of anecdotes and anthropomorphism]. Its immediate effect was to outlaw at once any description of animal behavior as due to mental processes.

Harriman (1947, pp. 225-226; 255)

[These definitions appeared in Harriman’s, *The New Dictionary of Psychology*.]

> Morgan’s canon: C. Lloyd Morgan’s axiom to the effect that the simplest explanation of all known facts is the best hypothesis or theory. It is a restatement of the principle expounded by William of Occam (c. 1325) and known as Occam’s razor.
>
> parsimony, law of: Lloyd Morgan’s statement (1900) that animal behavior should be described in the simplest possible terms. It is an application of Occam’s razor to animal psychology. Occam (1280-1349) had said that entities should not be multiplied beyond necessity [sic]; and Morgan accepted this view, indicating that anecdotes, attribution of human

> mental activities to animals, and projection of introspections have no place in animal psychology.

Munn (1950, pp. 1-2)

"Lloyd Morgan . . . advocated a curb on anthropomorphic speculation . . . His well known principle of parsimony for students of animal behavior read as follows: . . . ."

Caldwell (1960, p. 401)

Morgan gave comparative psychology his interpretation of the law of parsimony, which curbed the tendency of observers of animals to anthropomorphize.

Dewsbury (1973, p. 9)

> He proposed a law which has been variously termed Occam's razor, the law of parsimony, and Lloyd Morgan's canon . . . . Lloyd Morgan's canon seems applicable today. If alternative explanations appear truly equal, the simpler is to be preferred until data require postulation of more complex processes.

Dewsbury (1978, p. 10)

> Morgan is best known for opposing unbridled anthropomorphism. According to the often-cited "law of parsimony" or "Lloyd Morgan's canon . . . " The admonition that we should strive to accept the simpler of two equal alternative explanations is certainly good advice for many situations.

Denny (1980, p. 4) "C. Lloyd Morgan, author of the famous Canon of Parsimony, dealt explicitly with animal behavior."

Griffin (1981, p. 118)

[Below and elsewhere (p. 99), Griffin accepted the interpretation that Morgan's canon is a canon of parsimony. However, Griffin (p. 131) also accepted Miller's view (1962) that the canon was not anti-anthropomorphic.]

> This [Morgan's canon] has been widely interpreted as requiring that complex functions should not be postulated if a simpler explanation will suffice. That is the widely accepted principle of parsimony . . .

Boakes (1984, p. 40)

> The canon can be seen as simply the application of the general law of parsimony to explanation of behavior. Nevertheless, Morgan did not justify it on these terms but on the grounds of evolutionary theory.

Dewsbury (1984, pp. 188)

"The law of parsimony and Morgan's canon are two closely related principles."

Epstein (1984, pp. 122-123)

> Morgan was a British psychologist and biologist who, in *An Introduction to Comparative Psychology*, published in 1894, challenged the tendency of some naturalists of his day to attribute human characteristics to animals . . . . Morgan was no less a mentalist than Romanes, but he took a more conservative stand. Just as evolution had produced organisms that varied from the simple, to the complex, he argued, so must it have produced minds that varied from the simple to the complex. It would therefore be presumptuous of us to infer higher mental activities in animals where simpler ones would do. He expressed this in his famous Canon,

sometimes called the Canon of Parsimony.

Grier & Burk (1990, p. 52)

> Among his other contributions, he rejected anecdotalism and undisciplined anthropomorphism in the interpretation of behavior in other animals. He called for a principle of theoretical parsimony (i.e., the simplest explanation) which became known as Morgan's canon . . . .

Baenninger (1994, p. 805)

[Baenninger's was a book review titled "A Retreat before the Canon of Parsimony." The book being reviewed was Donald R. Griffin's book, *Animal Minds*.]

"C. Lloyd Morgan's Canon of Parsimony is not mentioned in the index but it casts a long shadow over this important book."

Barrows (1995)

[Barrows' quotations appear in his book, *Animal Behavior Desk Reference*, which may be compared to a dictionary or an abbreviated encyclopedia. Relevant to the present work were the entries for "Morgan's canon," "Ockham's razor," and "law of parsimony." The citations of Dewsbury were Barrow's.]

> [p. 308] Morgan's canon. [after quoting the canon, the entry continued] . . . . that is, one should interpret data using the most parsimonious explanation (Dewsbury, 1978, 10) . . . Syn. Law of parsimony, (Lloyd) Morgan's canon (Dewsbury 1978, p. 10). See law: law of parsimony. Cf. Ockham's razor. [p. 358] Ockham's razor. [included] Cf. Law: Law of

> parsimony; Morgan's canon; simplicity. [p. 385] law of parsimony.
>
> [included] Cf. Morgan's canon, Ockham's razor.

Bekoff & Allen (1997, p. 326)

[After quoting Zabel et al. who wrote, "One must be cautious about inferring complex cognitive processes when simpler explanations will suffice," Bekoff and Allen considered Zabel et al.'s statement to be equivalent to Morgan's canon. With the aid of an anonymous reviewer, Bekoff and Allen tried to distinguish Morgan's canon from parsimony, but they did not acknowledge that the anonymous reviewer was wrong.] The statement by Zabel et al. is a paraphrase of Morgan's (1894)

> Canon . . . . It is possible that Morgan's Canon which is concerned with the complexity of processes should be distinguished from parsimony which is concerned with the number of processes needed to explain a given behavior (as an anonymous reviewer noted).

Knoll (1997, p. 20)

> Those with a fondness for neatly organized historical eras might say that Morgan's Canon, as it is called, marks the end of the anthropomorphic strategy in psychology and the beginning of twentieth century behaviorism. [Paragraph break] However, Morgan's Canon is a double-edged sword....It can cut up as well as down....if we cannot anthropomorphize the animals, we cannot anthropomorphize ourselves either.

Macphail (1998, p. 80)

> What animal psychology needed, then, was . . . the theoretical discipline to interpret the results in as parsimonious a way as possible - a discipline crystallized by the British psychologist Conwy Lloyd Morgan (1852-1896) in his well known canon . . . .

Dewsbury (2000, p. 751)

> In his classic textbook, Morgan (1894) outlined his famous canon that an animal's behavior should be interpreted in terms of the psychologically simplest processes consistent with the data. Morgan's canon, and its related concept, parsimony, spread widely during this period.

VII: A History of Efforts to Correct the Misrepresentation of Morgan's Canon

Again, intended to be representative and not exhaustive, Thomas (2001) presented quotations across nine decades by those who tried to correct the misrepresentations of Morgan's canon (quoted here from Thomas, 2001, where, again, references for the quotations may be found). In a few instances, the following were modified slightly when appropriate to fit the present context.

Adams (1928, pp. 241-242)

[Given the Adams' (1928) quotation in the previous section, this may be a dubious example of an effort to correct the misrepresentation of Morgan's canon.]

> Morgan's canon, however, instead of being as commonly considered, a special case of the law of parsimony, is not related...and may on occasion work to exactly opposite effect . . . . Here is Morgan trying to

> adapt the law of parsimony to psychology and violating it in the same breath by 'multiplying entities' making quantities of unnecessary assumptions.

Nagge (1932, p. 492-493)

[Nagge appropriately explained the canon and also addressed issues related to the law of parsimony. The phrases "undergone a transformation" and "come to be known . . . as the law of parsimony" was seen by Nagge as misrepresenting Morgan's canon.]

> Lloyd Morgan...has laid down a canon of interpretation which has come to be known to psychologists as the law of parsimony . . . . This canon seems to have undergone a transformation in general psychological usage until it might now be tentatively expressed thus: of any possible number of explanations of an animal act the simplest possible explanation should be employed . . . .

Newbury (1954, p. 73)

[Before concluding as quoted below, Newbury cited 10 references where the canon had been misinterpreted as a version of the law of parsimony, 7 references (including 5 of the parsimony-10) interpreted the canon as a doctrine of simplicity, and 4 (all in the parsimony-10) related Morgan's canon to Occam's razor. Newbury also cited other forms of misinterpretation, and he provided a detailed analysis of how Morgan's canon should be interpreted.]

> Aside from their historical inaccuracies, many current misinterpretations of Morgan's Canon have *sui generis* failed to take advantage of possible logical developments. Without contending that Morgan's methodology

represents the last word, one can recognize in it some of the essentials for integrating modern introspective and comparative psychology. Whether this gain through historical continuity can be realized depends upon an accurate and significant interpretation of that methodology, including the Canon.

Miller (1962, p. 214-215)

Subsequent generations of psychologists have called this Lloyd Morgan's canon and have assumed that what he must have meant was that anthropomorphism - attribution of human characteristics to gods or, as in this case animals - is unscientific. A glance into Morgan's books, however, is enough to refute this assumption. Like all of his contemporaries, Morgan took it for granted that since the only psychical faculties we can know anything about directly are our own, "introspection must inevitably be the basis and foundation of all comparative psychology."[3]

[Footnote 3 is Miller's, and it referred to "Morgan (1894, p. 37)."] Any human introspection would necessarily be anthropomorphic; all that Morgan hoped for were a few reasonable rules for playing the game.

Gray (1963, pp. 221-222)

[Gray provided a reasonable analysis of what Morgan intended, identified some of the misinterpretations of Morgan's canon, and ridiculed them as follows.]

Boring, Flugel, and Skinner have referred to the Canon as a law of parsimony. Had it been such a law, surely it would have reduced Morgan's entities; instead, it was compatible with their multiplication.

> [Paragraph break] Likewise, Thorpe's assumption that the Canon is related to Occam's razor is merely gratuitous. [Paragraph break] Waters' statements [e.g., Waters, 1939, in previous section] are not only are contrary to historical fact, but are also incorrect.

Singer, 1981, p. 268)

[Singer's parenthetical "*Animal Behavior*" below referred to Morgan's book with that title published in 1900. Unfortunately, Morgan's emendation of Morgan's canon in *Animal Behavior* has been almost totally ignored, and errors of one kind have been replaced by errors of the other.]

> Some workers took this principle too seriously and would not allow any interpretation of an advanced process, even if suggested by the evidence, and in 1900 Lloyd Morgan was obliged to add the following rider to his canon: 'To this it may be added - lest the range of the principle be misunderstood - that the canon by no means excludes the interpretation of a particular act as the outcome of higher mental processes if we already have independent evidence of their occurrence in the agent (*Animal Behavior*).

Costall (1993, pp. 116-117)

[Costall's entire paper, listed among the references here, is a discussion of the misrepresentation of Morgan's canon. Hence, selecting excerpts to quote is difficult. Please consult Costall for footnotes omitted from the following quotations.]

> Later commentators have consistently represented this [Morgan's canon] as an appeal to Occam's razor, a principle of parsimony; they have taken it as an outright prohibition against treating animals as anything other

> than mechanical automata; and they have characterized it as a rejection of anthropomorphism. [Six paragraphs later.] Morgan's canon as currently misconstrued has very much the character of a myth. Indeed, many of those wishing to counter the implications of this myth have themselves managed to perpetuate the myth itself. It has evidently been highly resistant to several attempts at correction. Indeed the two most informative recent accounts of Morgan's work make no attempt to question the accepted view of the canon.

Wozniak (1993, ix-x)

[After quoting examples where Skinner (1938), Griffith (1943), and Harriman (1947); see previous section) associated Morgan's canon closely with the law of parsimony, Wozniak wrote:]

> One thing is virtually certain - neither Skinner, nor Griffith, nor Harriman could ever have read Lloyd Morgan. Even if one set out deliberately to distort the meaning of Morgan's canon, it would be virtually impossible to do so with greater success. Morgan's canon is not a principle of parsimony, it was not formulated as a guide to the description of behavior, it does not dispense with mental faculties, it is not an appeal to the observable, and it is not meant to be specific to animal psychology. Although earlier writings may also have misinterpreted Morgan in this fashion, it seems likely that Boring [Boring, E. G. (1929). *A history of experimental psychology.* NY: Century] was one of the more influential culprits. See especially pp. 464-465.

Costall, Clark, & Wozniak (1997, p. 66)

> Morgan's canon has been consistently overinterpreted. It was not a

> prohibition against the application of intentionalistic descriptions to animals, but rather an attempt by Morgan to put ‘anthropomorphism’ on a more secure scientific footing (Costall, 1993).

Costall (1998, p. 18)

> When Morgan realized his intentions were being misinterpreted, he added the clarification that “the Canon by no means excludes the interpretation of a particular activity in terms of the higher mental processes, if we already have independent evidence of the occurrence of these higher processes in the animal under observation (Morgan, 1903, p. 59). Nor, contrary to most accounts, was the canon, in any simple sense, an appeal to the principle of parsimony - an invitation to be economical with the truth . . . . His serious point was that there were very good Darwinian reasons for supposing that animals should vary in the nature of their mentality. The canon was, therefore, Morgan’s attempt to put “anthropomorphism,” the psychological approach to animals, on a secure scientific footing (Costall, 1993). [Paragraph break.] The extent to which the intentions of Morgan’s canon have been misinterpreted is astonishing.

Thomas (1998, p. 156)

> 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 that canon that occurred early . . . and that continues in the present...is that it was a canon of parsimony or simplicity.

VIII: A Proper Approach to Use Morgan's Canon

As noted earlier, Morgan realized early that his intended use of the canon was being misunderstood, so in 1903 he revised it for clarification. It is useful to repeat it here.

> In no case is an animal activity to be interpreted in terms of higher psychological processes, if it can be fairly interpreted in terms of processes which stand lower in the scale of psychological evolution and development.

"Higher" and "lower" meant 'newer' and 'older' respectively, in terms of the evolutionary development of psychological processes. Unfortunately, Morgan was not clear about what the components of scale of psychological processes were. One may get weak hints from some of his chapter titles (identical in the 1894 and 1903 editions) and the order in which they appear. However, other chapter titles [e.g., "Memory" and "The Sense-Experience on Animals" are mixed among the ones that give the best hints of a scale of processes, namely, chapters IV "Suggestion and Association", XII "Instinct and Intelligence", XIII "The Perception of Relations," XIV "Do Animals Perceive Relations", XV "Conceptual Thought," and XVI "Do Animals Reason?" In 1894 and 1903 Morgan appeared to have concluded that the evidence then did not show that animals perceived relations, had conceptual thought, or were capable of reason. However, he acknowledged that future research may provide confirming evidence for one of more of these, as is the case (e.g., Thomas, 1996).

Meanwhile, Romanes' *Mental Evolution in Animals* (1883) included a foldout chart that shows his self-admitted, tentative construction of "The Psychological Scale"

as well as “Products of Emotional Development” and “Products of Intellectual Development.” Each of these headed a column with many rows with content entries (more below). The chart also includes an illustrative “tree” that is too complex to summarize here. The column headed “Products of Intellectual Development” has 17 numbered categories where 1 was intended to be the earliest and 17 was intended to be the most recent in evolutionary development. A few examples will be listed below in order of their numbers in the chart from the column headed “Products of Intellectual Development” together with examples from the adjacent row in column headed “The Psychological Scale.” The latter consisted of Romanes identification of representative animal classes, orders or, in some cases, examples of animals that he believed to have achieved a particular level in the scale of “Products of Intellectual Development.” Following are a few examples:

08. Association by contiguity - Molusca

10. Association by similarity – Fish and Batrachia [Amphibia]

13. Communication of ideas – Hymenoptera

16. Use of tools – Monkeys and Elephant

If 13 seems generous, recall that later research showed that bees use the “waggle dance” to communicate distance and location of sources of nectar.

Romanes’ foldout chart follows the Table of Contents, and one must read the book to better understand his reasons for the entries he made in the chart. Boakes reproduced Romanes’ chart in his book, *From Darwin to behaviorism: psychology and*

the minds of other animals (1984) as did Murray (1989) in his *A history of western psychology*. Murray wrote:

> Romanes . . . book, *Mental Evolution in Animals*, is now being recognized as one of the most important books in the history of psychology because it attempted to unify all the research on animal instincts and animal intelligence into a single evolutionary scheme (p. 263).

Morgan (1891) commented on Romanes' chart in a footnote on page 478 as follows.

> I ought not pass over without notice the "psychological scale" which Mr. Romanes introduces to a table prefixed to "Mental Evolution in Animals." It would be unjust to criticize this too closely, for it is admittedly provisional and tentative. If such a scheme is to be framed, I would suggest that the various phyla of the animal kingdom be kept distinct. I question, however, whether anyone can produce a scheme which any other independent observer will thoroughly endorse.

IX. A Modern Role for Morgan's Canon?

Karin-D'Arcy (2005) provided critical discussion of modern roles for Morgan's canon as seen by numerous well-known contemporary researchers, and she provided commendable recognition of the history of the misrepresentation of Morgan's canon. Risking over-generalization here, most modern roles for Morgan's canon as reported by Karin-D'Arcy are reasonably consistent with Morgan's and Romanes' views in section VIII here pertaining to the evolutionary development of a psychological scale of intellectual processes. However, some modern investigators insist on a role for simplicity even when they acknowledge that was not what Morgan meant by the canon.

The view here, to be documented in the next section, is that **determining simplicity** is so fraught with pitfalls and limitations that it is useless in psychological science.

X: Simplicity in Philosophy

Emblematic and representative of articles and books by philosophers of science on the subject of simplicity as a basis for choosing between or among alternative explanations, theories, etc., 50+ years ago was Bunge's (1963) *The myth of simplicity: Problems of scientific philosophy.* For psychological science, perhaps, the most recurring problem with simplicity as a criterion for choosing among alternative explanations is that most explanations involve unrecognized or hidden assumptions that confound being able to determine which is the simplest explanation. Bunge's view that simplicity was a myth or, at least, that simplicity is almost forbiddingly capable of being defined or applied continues 50+ years later. For a recent example, Fitzpatrick (2015, pp. 39-40) wrote:

> The putative role of considerations of simplicity in the current practice of science gives rise to a number of philosophical problems, including the problem of precisely defining and measuring theoretical simplicity, and the problem of justifying preferences for simpler theories. As this survey of the literature on simplicity in the philosophy of science demonstrates, these problems have turned out to be surprisingly resistant to resolution, and there remains a live debate amongst philosophers of science about how to deal with them.

Scorzato (2013, p. 2867) addressed some problems associated with assumptions and language that prohibit the ability to decide which explanation is simplest.

> Simple assumptions represent a decisive reason to prefer one theory to another in everyday scientific praxis. But this praxis has little philosophical justification, since there exist many notions of simplicity, and those that can be defined precisely strongly depend on the language in which the theory is formulated. The language dependence is a natural feature – to some extent – but it is also believed to be a fatal problem. . . . . in fact, the concepts that enable a very simple formulation, are not necessarily measurable . . . . precisely those concepts that make the theory extremely simple are provably not measurable.

If Fitzpatrick's and Scorzato's observations and conclusions are not enough to make a working behavioral scientist dizzy with uncertainty about using parsimony or simplicity as a criterion to choose among alternative explanations of behavior, Sober's (2015) *Ockham's Razors: A User's Manual* should persuade behavioral scientists to surrender completely any attempt to use simplicity to choose among alternative explanations.

XI. Simplicity Aside: How to Approach Explanation in Animal Cognition Research

As mentioned above, mere perusal of a few issues in 2018 of the journal, *Animal Cognition*, revealed that researchers are studying animals ranging from insects to apes, and I am confident that further perusal will reveal research on animals taxonomically lower than insects. In that quick perusal, topics being investigated included "vigilance decrement" (spiders), "boldness" (fish), "jealous behaviors (dogs), "causal reasoning" (crows), "facial recognition" (monkeys), and "intuitive optics" (chimpanzees) to mention only a few.

Sir Francis Bacon's (*Novum Organum*, 1620) consideration of "idols of the market place" showed the hazards for science that are inherent in the fallibilities of language, and Gregory Bateson (*Steps to An Ecology of Mind*) wrote critically about "linguistic muddling." If they were alive, they would be overwhelmed by the linguistic morass that psychological science has created. It may be hopeless, but to begin to hope to reduce this morass, the following are recommended.

Understanding Intervening Variables (IVs) and Hypothetical Constructs (HCs)

An important article that all psychological scientists should read and incorporate into their understanding regarding concepts and explanations is McCorquodale and Meehl (1948). Seventy years later it seems apparent that most psychological scientists do not understand their distinction between IVs and HCs. Here is a fundamental quotation.

> *At present the phrases 'intervening variable' and 'hypothetical construct' are often used interchangeably, and theoretical discourse often fails to distinguish what we believe are two rather different notions.* (p.106)
>
> [Later] . . . . *the only rule for intervening variable is that of convenience, since they have no factual content surplus to the empirical functions they summarize . . . . In the case of the hypothetical constructs, they have a cognitive, factual reference in addition to the empirical data, which constitute their support.* (p. 107)

Elsewhere in the article, it is clear that the meaning of an IV is limited to observables, and as concepts or explanations, an IV's meaning is no more or less than the observations that support an IV's existence as a concept. At most, IVs are shortcut

terms invented or adopted from common language whose meanings are defined by a multiplicity of observables. On the other hand, a HC as an explanatory concept implies something beyond the observables, something that is presumed to exist. Atomic and subatomic particles in physics are HCs, and a good example in biology was the "gene." The HC "gene" came into use in 1909, long before its physical make-up as DNA had been determined.

One is challenged to identify any concept in animal cognition research that is not an IV**.** As such and despite common practice, IVs cannot be reified. For example, they cannot be causes or effects, because their existence is limited to the observables that define them. Examples, used here for illustrative purposes of IVs in animal cognition research, "boldness," "causal reasoning," and "facial recognition" (chosen among several others listed in first paragraph of Section IX) were gathered via a quick survey of a couple of 2018 issues in the electronic journal *Animal Cognition*. Other IVs *ad nauseum* may be seen in *Animal Cognition* and other contemporary journals that publish research in animal cognition.

The Brain and Intervening Variables (IVs)

Close study of functional neuroanatomy textbooks (e.g., the several editions of Alf Brodal's *Neurological Anatomy* or Malcolm B. Carpenter's *Human Neuroanatomy;* over the years Brodal had a successor and Carpenter had coauthors and a successor), other textbooks in functional neuroanatomy, and articles such as Diamond (1979) should result in the conclusion that all brain functioning reduces to three fundamental types of processing: sensory, memory, and effector**. All other processes reduce to one or combinations of these three**. These three processes interact continuously in

the brain, and effect physico-chemical changes in the brain. The brain is never exactly the same physico-chemically from moment to moment, nor are the associated IVs exactly the same from moment to moment

Figure 1 shows how IVs exist only as short-hand terms to summarize each IV's associated antecedent and consequent observables.

Figure 1 here.

Figure 2 emphasizes that the brain and the IVs used in this example (and all other IVs) are never exactly the same from moment to moment.

Figure 2 here.

Strictly speaking, a radical behaviorist might insist correctly that the precise meaning of each IV is limited to the antecedents and consequents associated with a specific experiment or controlled observation. However, to cite but one example, we know that many IVs (e.g., "fear") may be used more generally based on many different experiments or controlled observations involving different observables. Such different uses of "fear" have in common antecedents and consequents associated with potential bodily harm or death. Of course, one does not have to be bitten by a poisonous snake to fear being bitten by a poisonous snake, because memories associated with learning about the experiences of others provide us with sufficient information to be fearful of being bitten by a poisonous snake. It cannot be iterated enough that an IV's meaning is limited to the observable antecedents and consequents that define it and that IV's can

never be reified as causes, effects, or have any other characteristics of entities that have material existence.

Hazards of Emergentism in Psychological Science

In her aptly titled critique, “Clever Animals and killjoy explanations in comparative psychology,” Shettleworth (2010, p. 477) quoted Holldobler and Wilson as follows:

> *The extremes of higher-level traits may at first appear to have a life of their own, one too complex or fragile to be reduced to their basic elements and processes by deductive reasoning and experiment. But such separatist holism is in our opinion a delusion, the result of insufficient knowledge about the working parts and processes.*

This raises nicely the issue of the hazards of emergentism.

Emergentism, although not by that name, developed most strongly with the 19th century British associationist philosopher, John Stuart Mill. John Stuart Mill argued against his father, John Mill’s “mental mechanics” using a paradigm the younger Mill named “mental chemistry.” This was illustrated by John Stuart Mill’s example of water. He argued that water has emergent properties, namely, that water has properties that cannot be reduced to its constituent elements, hydrogen and oxygen. As opposed to John Mill’s ‘the whole is equal to the sum of its parts,’ John Stuart Mill asserted that ‘the whole is greater than the sum of its parts.’ If water seems to have emergent properties, it is likely because we do not yet understand the complete physical and chemical properties of oxygen and hydrogen.

That ‘the whole is greater than the sum of its parts’ was perpetuated by the Gestaltists, Max Wertheimer, Wolfgang Kohler, and Kurt Koffka beginning early in the

20th century, and has been advocated for animal cognition research in recent years by Duane Rumbaugh and colleagues among others. Thomas (1999) presented a rebuttal of Rumbaugh and colleagues in 1999 in a symposium in which Rumbaugh and two colleagues participated at the Southern Society for Philosophy and Psychology.

A quotation from Guyer (1931) used by Thomas (1999) is also useful here. It is slightly modified here as explained below, to show that "emergentism" in animal cognition is deemed parallel to the role that "vitalism" once had in biological science. Before significant progress could be made in biology, biology had to rid itself of vitalism. In the portions quoted here from Guyer **(**1931) "emergentism" or related terms have been added in brackets to make explicit the parallels between the hazards of "vitalism" for biological science and the hazards of "emergentism" for psychological science.

> Are the characteristics which mark off living from nonliving matter explainable by physics and chemistry and the known laws of matter or is there something else? . . . . Two opposing interpretations have been suggested; one known as vitalism [emergentism], the other as mechanism. By vitalism [emergentism] is meant a directive tendency beyond the inherent properties of mere molecules or chemical elements which manifests itself in and is peculiar to the living organism . . . . They [vitalists and emergentists] believe they find evidence of purpose in life-activities and that such activities are inexplicable on the basis of mere physics or chemistry. . . .
>
> . . . . admitting that many of the phenomena seen in living things are yet unexplained or are even inexplicable in terms of our present

knowledge of chemistry and physics, the mechanist points out that with our advancing knowledge in these fields many of the processes originally claimed by vitalists [emergentists] to be distinctively vital [emergent] have been shown to be physical or chemical and that continual progress is being made by mechanistic methods . . . . Mechanists believe it is simpler and more accurate to regard life as process or function rather than as a separate essence, and to consider living matter as ordinary matter so arranged as to become a metabolic mechanism . . . .

The controversy, though changing its form from time to time, has been carried on ever since the days of Aristotle and there seems no prospect of agreement in the near future. The problem may be insoluble. As our knowledge of fundamental life processes has advanced, the vitalist [emergentist] has been forced to abandon one position after another, but there is still such a great unexplained residue of facts relating to the constructive and coordinating processes of living matter that he still has abundant material for argument. As a practical working program, however, it is well to note that the science of biology has advanced mainly as it has been able to explain its phenomena in mechanistic terms, and that there is undoubtedly much yet that can be so explained. To rest content with merely attributing vital [emergent] phenomena to some sort of "vital principle" [emergent] is in effect to give up the problem, and such an attitude of mind can lead only to scientific stagnation.

(Guyer, 1931, pp. 22-23)

Concluding Remarks

It is hoped that all misrepresentations of Morgan's canon (equivalency with Ockham's razor, parsimony, and simplicity; being anti-anthropomorphic, anti-anecdote, and anti-Romanes) can now cease and rest in peace. Greater consideration of Morgan's canon's association with a study of the evolutionary development of cognitive abilities, together with Romanes *Mental Evolution of Animals*, might lead to a useful way to assess and rank cognitive abilities in animal cognition research.

Finally, it is hoped that researchers in animal cognition will pay greater heed (a) to the futility of using simplicity as a criterion to choose among alternative explanations, (b) to the importance of McCorquodale's and Meehl's distinction between intervening variables, IVs, and hypothetical constructs, HCs, and (c) to the limitations of what we can and cannot know about the brain and IV concepts in animal cognition research.

Cross-References

Anecdotal Method

Aristotle

Associative Concepts

Causal Reasoning

Charles Darwin

C. Lloyd Morgan

Comparative Psychology

Concept Formation

Evolutionary Psychology

Gestalt

George Romanes

Intervening Variables

Margaret Floy Washburn

Ockham's Razor

Origin of Species

Parsimony

Reductionism

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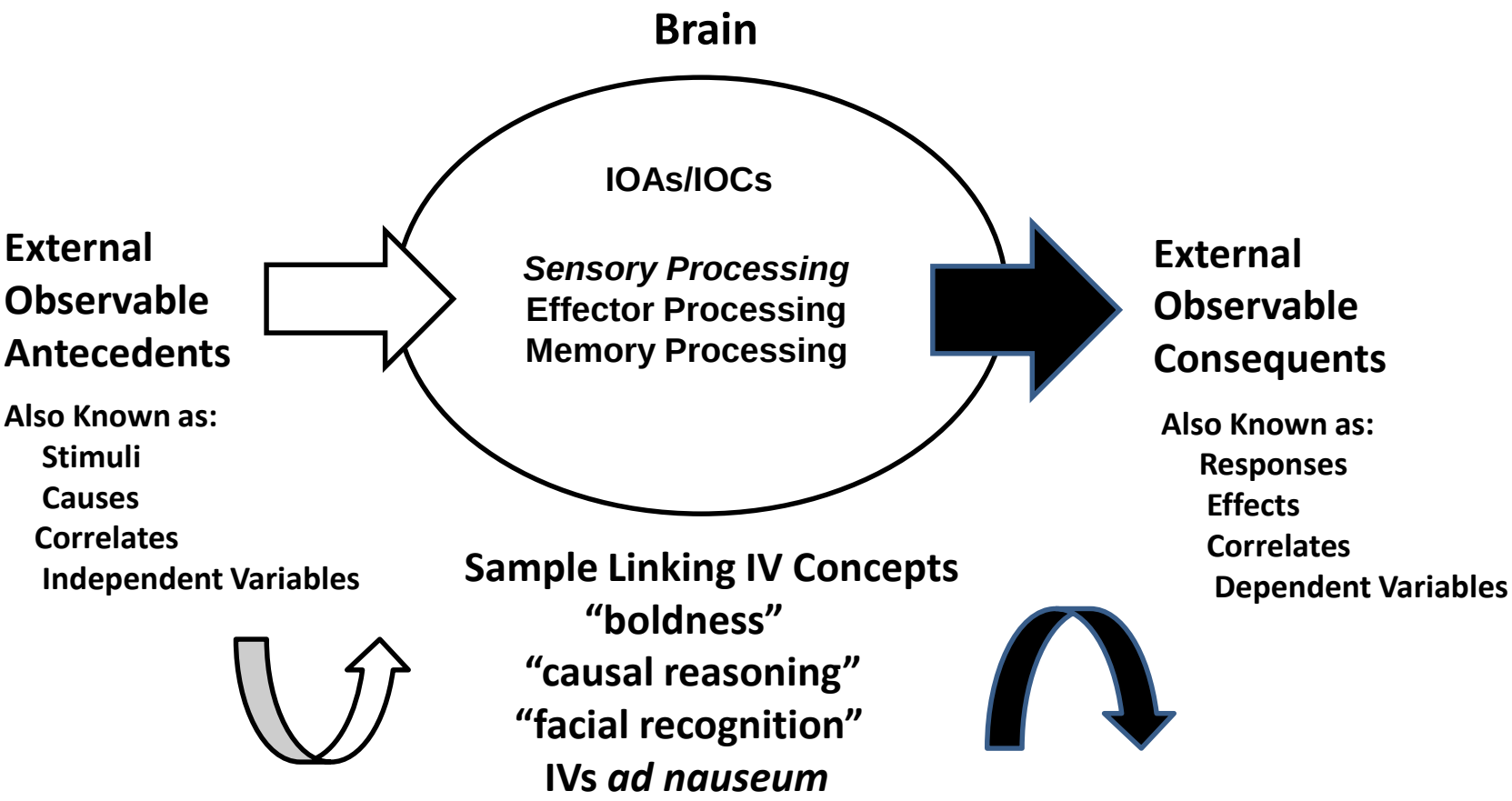

Figure 1 The brain at a moment in time when physico-chemical events associated with sensory, memory and effector processing are constantly interacting and effecting new physico-chemical changes. To an extent, these internal observable antecedents, IOAs, or consequents, IOCs, may be observed via chemical sampling, electrical recordings or brain imaging, or manipulated via chemical or electrical stimulation or targeted ablations. "Tagging along" with the brain's activity are the Linking IV Concepts.

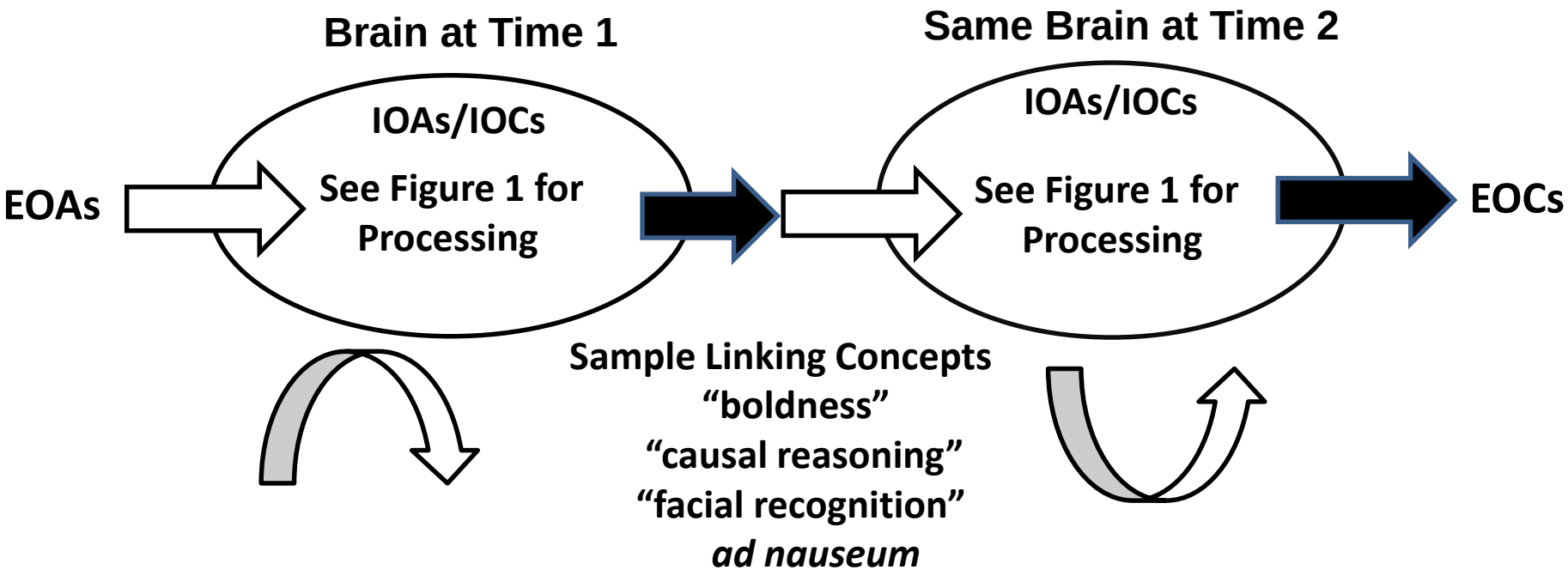

Figure 2. **A dynamic representation of the brain and its associated External Observable Antecedents (EOAs) and Internal Observable Antecedents (IOAs) symbolized as open arrows and External Observable Consequents (EOCs) and Internal Observable Consequents (IOCs) symbolized as solid arrows. As indicated, the EOCs at one moment in time become part of the EOAs at the next moment in time. The brain, physically, is never exactly the same from moment to moment, thus the meaning of linking concepts are not exactly the same from moment to moment.**