

THE IMPORTANCE OF COMPARATIVE PSYCHOLOGY TO AFRICA: SOME REFLECTIONS AND SOURCES

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ABSTRACT: *Following opening comments, citations are provided in several areas all with the goal of stimulating students and professionals to develop comparative psychology courses and/or incorporate comparative psychology principles and activities into existing psychology courses such as experimental psychology, and the psychology of learning. The material can be used as part of a reading list for a course in comparative psychology or as independent readings. It can also be used to shape a reasoned argument why comparative psychology should become a central part of a student's training in psychology. Sections include books, citations on the history of comparative psychology, general issues related to comparative, teaching, and ancillary material such as websites, journals, videos and a free app for android phones that teaches students how to observe behavior.*

KEYWORDS: Comparative Psychology, Experimental Psychology, Teaching, Ancillary Material, How to Observe Behavior, Africa

INTRODUCTION

Comparative psychology is one of the oldest areas in psychology and perhaps one of the least well known. If we consider 1879 as the founding of experimental psychology (Heidbreder, 1933), the use of the phrase “comparative psychology” appeared as early as 1858 (Weinland, 1858) – 21 years before the formal founding of psychology as a scientific discipline. Moreover, three years before the founding of psychology, Spencer (1876) published “*The comparative psychology of man.*” Furthermore, the first comparative psychological society was started by Mills in 1885 (Mills, 1887) just six years after the formal founding of psychology as a scientific discipline and five years before the founding of the American Psychological Association.

The senior author (CIA) defines comparative psychology as the “Application of the comparative method to problems in psychology.” Defined in this way, the world is literally our laboratory and no psychological problem – whether applied, basic and/or theoretical – is beyond our scope (Abramson & Lack, 2014). We have a unique set of experimental and philosophical skills (Muckler, 1963) which can be applied to any research question including the search for “universal rules of behavior” – certainly a noble enterprise.

The purpose of this article is to make professors and students in Africa aware of comparative psychology. In an internet search of comparative psychology in Africa we could not find any university that offers a course in comparative psychology. Another search was conducted of graduate programs in comparative psychology and related fields and revealed no such programs in Africa (Woodruff, Noonan, Martinez, Walker, Miranda, De La Fuente, Hill, &

Abramson, 2018). Moreover, a search of 26 universities in South Africa while revealing courses in animal behavior, have no courses in comparative psychology.

Comparative psychology can serve as a means to connect the natural and social sciences (Papini, 2008) and in doing so promote multidisciplinary investigations. Yet, these investigations are inhibited as there exists a stern demarcation between the natural and social sciences in South African Universities, for example (Simbayi, 1991). This entails that biologically inclined courses (e.g. animal behavior) are hosted by the faculty of natural sciences (taught in biology and zoology courses), rather than being taught in the faculty of social sciences (where psychology departments are situated) (Simbayi, 1991). This is, for example, the situation at the junior author's place of work (PK) – Nelson Mandela University in South Africa.

We believe that there is much to recommend comparative psychology as a course of study in Africa. Students learn how to make proper comparisons and expose improper ones, develop critical thinking skills, and acquire a unique set of experimental design skills – among many other skills. Students in comparative psychology can contribute to areas as diverse as cross-cultural psychology, political science and cultural anthropology. Moreover, the skills of a comparative psychology student will be of value to any employer. For example, training in comparative psychology is useful in animal-human interactions such as pet litigation, equitation science, and the training of farm animals for agricultural improvement (Abramson & Black, 2017; Abramson & Kieson 2016; Kieson & Abramson, 2017).

Furthermore, comparative psychology can contribute to conservation efforts (Snowden, 2003). The illegal poaching of rhinos in Africa is threatening the existence of the species to such an extent that it has been classified as endangered. Breeding these animals in captivity would require an understanding of their behaviour in their natural environment. Ensuring the conservation of endangered species, providing improved conditions for farm animals, and providing the proper care of companion animals necessitates a thorough comprehension of animal behaviour (Snowden, 2003) that can be explored and explained via comparative studies. The study of animal behaviour also has an economic impact (Snowden, 2003) on a developing country like South Africa. Wildlife reserves in South Africa are a favorite tourist attraction for people all over the world and contributes to the growth of the local economy. The well-being of the animals (found in these reserves) and the sustainability of the reserves depends on a thorough understanding of animal behaviour that comparative studies can provide.

Moreover, the knowledge gained from animal behaviour studies (conducted on animals housed in reserves) serves as an educational tool to promote the welfare and understanding of these captive animals, among visitors to wildlife reserves. South African society is fraught with violence and racial division. In an attempt to understand this situation Snowden (2003) states that animal behaviour can serve as a vehicle to understand human society and to provide explanations for the causes of societal problems. Research on chimpanzees indicates the significance of cooperation and reconciliation in social groups and can give a new perspective into reducing aggressive behaviours among humans (Snowden, 2003). It can therefore be said that comparative psychology can provide value to society in addressing its challenges. Snowden (2003) suggests that comparative studies of behaviour should include a variety of species to provide new perspectives of human behaviour in an attempt to improve it.

In addition to practical applications, comparative psychologists have a way of thinking that is different than other psychologists and a way of doing science that is distinctive. Comparative psychologists routinely use concepts such as homologies, analogies, and systematic variation when considering our results and maintain a focus on replication. If a reader would like evidence for this latter assertion one need go no further than to read the article by the Open Science Collaboration (2015). An international group of scientists sought to replicate some of the more well-known findings of selected social and cognitive psychology experiments and could not do so for 50% of the cognitive experiments and 75% of the social experiments. Their paper has been cited over 1,500 times. All one has to do is search Google using the phrase “problems of replication in psychology” and, if this can be believed, 42,000,000 items are listed.

As mentioned above, our unique way of approaching a topic allows us to contribute to areas as diverse as cultural anthropology, political science, neurobiology, computer engineering, app development, cross-cultural psychology, animal – human interactions, law, agriculture, enrichment, philosophy, mathematical modeling, history of science, learning, perception, and a host of others. A recent special issue in *The International Journal of Comparative Psychology* on the intersection between comparative psychology and clinical psychology illustrates the influence of comparative psychology on today’s advancements in clinical psychology (https://escholarship.org/uc/uclapsych_ijcp_Vol_30). Comparative psychology is also useful for those studying developmental psychology (Liebal & Haun, 2012).

Over the years the senior author has been asked by many people both in the United States and abroad to provide a general list of articles and materials that may be of use in stimulating interest in comparative psychology. While we could not find any courses on comparative psychology in Africa, a student can create their own major and/or course of study. Such a student and their faculty advisor may not have an idea where to start – this article may help. As another example, a faculty member seeing the importance of comparative psychology may wish to integrate some material into their classes – this article will help. The material presented in this article will also be of use for those trying to convince their department to offer a course in comparative psychology.

The article presents several categories including teaching activities, books, and articles of general interest; selected websites are also listed. The material cited in this article is not exhaustive but it does contain material that the senior author has found useful over the years. Some of the material comes from the *International Journal of Comparative Psychology (IJCP)*. Recently, the senior author has edited a special issue of IJCP on the current status of comparative psychology (Abramson & Hill, 2018). The reader can find many useful articles in this special issue including a list of comparative psychology programs, general interest articles, teaching related articles, and research articles (<https://escholarship.org/uc/item/0mn8n8bc>).

Unlike many publishing houses such as the American Psychological Association, scientists without access to a library are not charged fees to look at an article. The *IJCP* plays an important role as access to its articles are free world wide and the authors of the papers are not required to pay open access fees.

If any reader would like to learn more about comparative psychology and/or would like to incorporate any of the materials cited in this paper, we would be glad to help.

- Abramson, C. I. & Black, T. E. (2017). Importance of comparative psychology in pet industry litigation. *Journal of Social Sciences*, 13, 118-123. doi: 10.3844/jssp.2017.
- Abramson, C. I. & Kieson, E. (2016). Conditioning methods for animals in agriculture: A mini- review. *Ciência Animal Brasileira*, 17, 359-375. doi: 10.1590/1089-6891v17i341981.
- Abramson, C. I. & Lack, C. W. (Eds.) (2014): *Psychology gone astray: A selection of the racist and sexist literature from early psychological research*. Hampshire, U.K: Onus Books.
- Abramson, C. I. (2005). Learn by doing. In: T. Benson, C. Burke, A. Amstadter, R. Siney, B.
- Abramson, C. I. (2006). Charles Henry Turner: Pioneer of comparative psychology. In: D. A. Dewsbury, L. T. Benjamin, Jr., & M. Wertheimer (Eds.). *Portraits of pioneers in psychology: Volume VI*. Hillsdale, N.J.: Lawrence Erlbaum Associates (pp. 37-49).
- Abramson, C. I. (2015a). A crisis in comparative psychology: Where have all the undergraduates gone? *Frontiers in Psychology*, 6, 1500. doi: 10.3389/fpsyg.2015.01500
- Abramson, C. I. (2015b). A crisis in comparative psychology: Where have all the undergraduates gone?: Additional comments. *Innovative Teaching*, 4,7. doi: 10.2466/10.IT.4.7
- Abramson, C. I., & Hill, H. M. (2018). The State of Comparative Psychology Today: An Introduction to the Special Issue. *International Journal of Comparative Psychology*, 31. Retrieved from <https://escholarship.org/uc/item/0mn8n8bc>
- Beins, & W. Buskist (Eds.). *Teaching of psychology in autobiography: Perspectives from exemplary psychology teachers* (pp. 1-7). Washington, DC: American Psychological Association.
- Bitterman, M. E., & Schoel, W. M. (1970). Instrumental learning in animals: Parameters of reinforcement. *Annual Review of Psychology*, 21, 367-436.
- Dickinson, A., & Mackintosh, N. J. (1978). Classical conditioning in animals. *Annual Review of Psychology*, 29, 587-612.
- Domjan, M. (2005). Pavlovian conditioning: A functional perspective. *Annual Review of Entomology*, 56, 179-206.
- Gershman, S. J., & Daw, N. D. (2017). Reinforcement learning and episodic memory in humans and animals: An integrative framework. *Annual Review of Psychology*, 68, 101-128.
- Harris, A. H., & Brady, J. V. (1974). Animal learning – Visceral and autonomic conditioning. *Annual Review of Psychology*, 25, 107-133.
- Heidbreder, E. (1933). *Seven psychologies*. New York: Appleton-Century-Crofts, Inc.
- Kieson, E. & Abramson, C. I. (2017). Equines as tools vs partners: A critical look at the uses and beliefs surrounding horses in equine therapies and argument for mechanical horses. *Journal of Veterinary Science and Animal Husbandry*, 5(1):107. doi: 10.15744/2348-9790.5.107.
- Krasne, F. B., & Glanzman, D. L. (1995). What can we learn from invertebrate learning. *Annual Review of Psychology*, 46, 585-624.
- Liebal, K., & Haun, D. B. M. (2012). The importance of comparative psychology for developmental science. *International Journal of Developmental Science*, 6, 21-23. doi: 10.3233/DEV-2012-11088.

- Mills, T. W. (1887). Comparative psychology: Its objects and problems. *The Popular Science Monthly*, 30, 651-660.
- Muckler, F. A. (1963). On the reason of animals: historical antecedents to the logic of modern behaviorism. *Psychological Reports*, 12, 863 – 882. doi: 10.2466/pr0.1963.12.3.863
- Open Science Collaboration (2015). Estimating the reproducibility of psychological science. *Science*, 349, 943. <http://dxidoi.org/10.1126/science.aac4716>.
- Papini, M.R. (2008). *Comparative psychology: Evolution and development of behaviour* (2nd ed). New York, NY: Psychology Press.
- Roitblat, H. L., & Von Fersen, L. (1992). Comparative cognition: Representation and process in learning and memory, *Annual Review of Psychology*, 43, 671-710.
- Scarborough, E., & Furomoto, L. (1989). *Untold lives: The first generation of American women psychologists*. New York: Columbia University Press.
- Simbayi, L.C. (1991). Teaching and Research in Animal Behaviour in South African Universities: A Survey. In *International Journal of Comparative Psychology*, 5(1), pp. 36-42.
- Snowdon, C.T. (2003). Significance of Animal Behavior Research. In *Encyclopedia of Animal Behavior* (Vol. 1)(Ed. M. Bekoff), pp. 156-161.
- Spear, N. E., Miller, J. S., & Jagielo, J. A. (1990). Animal memory and learning, *Annual Review of Psychology*, 41, 169-211.
- Staddon, J. E. R., & Cerutti, D. T. (2003). Operant conditioning. *Annual Review of Psychology*, 54, 115-144.
- Timberlake, W. (1993). Animal behavior: A continuing synthesis, 44, 675-706. *Annual Review of Psychology*, 44, 675-706.
- Weinland, D. F. (1858). A method of comparative animal psychology. *Proceedings of the American Association for the Advancement of Science*, 12, 256-266.
- Woodruff, M., Noonan, M., Martinez, A., Walker, R. T., Miranda, J., De La Fuente, E., Hill, H. M., & Abramson, C. I. (2018). Appendix A. *International Journal of Comparative Psychology*, 31.

Books

In this section books related to comparative psychology are listed. Of special interest are the early textbooks in comparative psychology. It is quite interesting to read these books and note how the field has changed over the years. Some of these books can be found on the internet by doing an on-line search and downloading them for free. These texts, and other books cited here, often contain histories of comparative psychology – especially those by Dewsbury (1984a,b; 1990) Some excellent historical information can also be found in Tobach (1987). Readers interested in an Aristotelian – Thomistic view of comparative psychology can find much material in Augros and Stanciu (1987) and Wallace (1996). The encyclopedias edited by Bekoff (2004, 2007) represent just one of the many ways material can be used to stimulate interest in comparative psychology. Books are also listed containing selected papers of comparative psychologists such as Theodore C. Schneirla (Aronson, Tobach, Rosenblatt, & Lehrman, 1972) and the African American Charles Henry Turner (Abramson, Jackson, & Fuller, 2003). For those readers interested in material on the “application of the comparative method to problems in psychology “can find much in Bornstein (1980). The book by Wenner and Wells (1990) describes how their careers were almost destroyed because they did not agree that the experimental evidence supported the dance language of the honey bees. This

controversy continues to the present day. An interesting book that is seldom mentioned is Vance Packard's (1950) *Animal IQ*. Packard is perhaps best known for his work on the psychology of persuasion (*The hidden persuaders*, 1957, New York: David McKay). Another interesting book is *The naked ape* written by Desmond Morris (1967). Morris has a number of books on animal behavior.

It is also important to note that one stumbling block to comparative studies is the cost of equipment. Varnon and Abramson (2018) provide a monograph on how to use a micro-controller for comparative experiments. With this device and assorted components researchers and students in Africa can literally hold a comparative psychology laboratory in the palm of their hand.

We would like to note that the classic three volume set on comparative psychology written by Warden, Jenkins, and Warner, (1935, 1940) seems to have a misprint in the senior author's copy where the year of publication of volume 3 (1936) supersedes the year of publication of volume 2 (1940).

- Abramson, C. I. & Lack, C. W. (Eds.). (2014). *Psychology gone astray: A selection of the racist and sexist literature from early psychological research*. Hampshire, U.K: Onus Books
- Abramson, C.I. (1990). *Invertebrate learning: A laboratory manual and source book*. Washington, D.C.: American Psychological Association.
- Abramson, C.I. (1994). *A primer of invertebrate learning: The behavioral perspective*. Washington, D.C.: American Psychological Association.
- Abramson, C.I., & Jackson, L. D., & Fuller, C. (Eds.). (2003). *Selected papers and biography of Charles Henry Turner (1867-1923), Pioneer of comparative animal behavior studies*. Lewiston, NY: The Edwin Mellen Press.
- Abramson, C.I., Shuranova, Z. P., Burmistrov, Y.M. (Eds.). (1996). *Russian contributions to invertebrate behavior*. Westport, CT: Praeger.
- Amsel, A., & Rashotte, M. E. (Eds.). (1984). *Mechanisms of adaptive behavior: Clark L. Hull's theoretical papers with commentary*. New York: Columbia University Press.
- Aronson, L. R., Tobach, E., Rosenblatt, J. S., & Lehrman, D. S. (Eds.). (1972). *Selected writings of T. C. Schneirla*. San Francisco: CA W. H. Freeman and Company.
- Augros, R., & Stanciu, G. (1987). *The new biology*. Boston, MA: New Science Library.
- Bekoff, M. (Eds.). (2004). *Encyclopedia of animal behavior* (volumes 1-3). Westport, CT: Greenwood Press.
- Bekoff, M. (Eds.). (2007). *Encyclopedia of human-animal relationships: A global exploration of our connections with animals* (volumes 1-4). Westport, CT: Greenwood Press.
- Bornstein, M. H. (1980). *Comparative methods in psychology*. Hillsdale, NJ: LEA.
- Brown, D. E. (1991). *Human universals*. New York: McGraw-Hill Education.
- Catania, A. C., & Harnad, S. (Eds.). (1988). *The operant behaviorism of B. F. Skinner: Comments and consequences*. Cambridge, UK.: Cambridge University Press.
- Denny, M. R., & Ratner, S. C. (Eds.). (1970). *Comparative psychology: Research in animal behavior*. Homewood, Il.: Dorsey Press.
- Dewsbury, D. A. (1978). *Comparative animal behavior*. New York: McGraw-Hill.
- Dewsbury, D. A. (1984a). *Comparative psychology in the twentieth century*. Stroudsburg, PA.: Hutchinson Ross

- Dewsbury, D. A. (1984b). *Foundation of comparative psychology*. New York: Van Nostrand
- Dewsbury, D. A. (Ed.). (1990). *Contemporary issues in comparative psychology*. Sunderland, MA: Sinauer Associates.
- Gray, P. H. (1966). *Introduction to general psychology: A self-selection textbook. The comparative analysis of behavior*. Dubuque, IA: W. C. Brown Company Publishers
- Greenberg, G., & Haraway M. M. (Eds.). (1998). *Comparative psychology: A handbook*. New York: Garland Publishing, Inc.
- Greenberg, G., & Haraway, M. M. (2002). *Principles of comparative psychology*. Boston: Allyn & Bacon.
- Holmes, S. J. (1911). *The evolution of animal intelligence*. New York: Henry Holt and Company.
- Hutchins, M. (Ed.). (2004). Grzimek's animal life encyclopedia: Volume 1 Lower metazoans and lesser deuterostomes 2nd edition. Detroit: Thomson Gale. (Note: This is a multi-volume set published over a number of years.)
- Leroy, C. G. (1870). *The intelligence and affectability of animals from a philosophic point of view, with a few letters on man*. London: Chapman and Hall.
- Lester, D. (1973). *Comparative psychology: Phyletic differences in behavior*. New York: Alfred Publishing Company.
- Lombardi, L. (2011). *Animals behaving badly*. New York: Perigee Book.
- Lubow, R. E. (1977). *The war animals*. New York: Doubleday & Company, Inc.
- Maier, N. R. F., & Schneirla, T. C. (1935/1964). *Principles of animal psychology*. New York: Dover.
- Marston, D. C., & Maple, T. L. (2016). *Comparative psychology for clinical psychologists and therapists: What animal behavior can tell us about human psychology*. Philadelphia, PA: Jessica Kingsley Publishers.
- Morgan, C. L (1894). *An introduction to comparative psychology*. London: Walter Scott, Limited.
- Morris, D. (1967). *The naked ape*. New York: McGraw-Hill.
- Moss, F. A. (Ed.). (1942). *Comparative psychology* (revised edition). New York: Prentice-Hall, Inc.
- Packard, V. (1950). *Animal IQ: The human side of animals*. New York: The Dial Press.
- Papini, M. R. (2002/2008). *Comparative psychology: Evolution and development of behavior*. Upper Saddle River, NJ: Prentice Hall.
- Pavlov, I. P. (1957). *Experimental psychology and other essays*. New York: Philosophical Library.
- Pitt, F. (1927). *Animal mind*. New York: Frederick A. Stokes Company.
- Ratner, S. C., & Denny, M. Ray (Ed.). (1964). *Comparative psychology: Research in animal behavior*. Homewood, IL: Dorsey Press
- Razran, G. (1971). *Mind in evolution: An east-west synthesis of learned behavior and cognition*. Boston: Houghton Mifflin.
- Reinhold.
- Romanes, G. J. (1898). *Mental evolution in animals*. New York: D. Appleton and Company.
- Stone, C. P. (Ed.). (1951) *Comparative psychology* (3rd ed.). Westport, CT: Greenwood Press.

- Thorndike, E. L. (1911). *Animal intelligence: Experimental studies*. New York: The MacMillan Company.
- Thorpe, W. H. (1956). *Learning and instinct in animals*. London: Methuen.
- Thorpe, W. H. (1979). *The origins and rise of ethology: The science of the natural behaviour of animals*. London: Heinemann Educational Books Ltd.
- Tobach, E. (Ed.). (1987). *Historical perspectives and the international status of comparative psychology*. Hillsdale, NJ: LEA.
- Tolman, E. C. (1951). *Purposive behavior in animals and men*. Berkeley, CA: University of California Press.
- Varnon, C. A., & Abramson, C. I. Varnon, C. A., & Abramson, C. I. (2018). *The Propeller Experiment Controller*. *Journal of Mind & Behavior*, 39, 1-2.
- Vauclair, J. (1996). *Animal cognition: An introduction to modern comparative psychology*. Cambridge, MA: Harvard University Press.
- Wallace, W. A. (1996). *The modeling of nature: Philosophy of science and philosophy of nature in synthesis*. Washington, D. C.: The Catholic University of America Press.
- Warden, C. J. (1928). *An outline of comparative psychology*. London: Kegan Paul, Trench, Trubner & Co., Ltd.
- Warden, C. J., Jenkins, T. N., & Warner, L. H. (1935). *Comparative Psychology – A comprehensive treatise: Vol. 1. Principles and methods*. New York: Ronald Press.
- Warden, C. J., Jenkins, T. N., & Warner, L. H. (1936). *Comparative Psychology – A comprehensive treatise: Vol. 3. Vertebrates*. New York: Ronald Press.
- Warden, C. J., Jenkins, T. N., & Warner, L. H. (1940). *Comparative Psychology – A comprehensive treatise: Vol. 2. Plants and invertebrates*. New York: Ronald Press.
- Washburn, M. F. (1908). *The animal mind: A text-book of comparative psychology*. New York: MacMillan.
- Waters, R.H. (Ed.). (1960). *Principles of comparative psychology*. New York: McGraw-Hill.
- Watson, J. B. (1914). *Behavior: An introduction to comparative psychology*. New York: Henry Holt and Company.
- Wenner, A. M., & Wells, P. H. (1990). *Anatomy of a controversy: The question of a “language” among bees*. New York: Columbia University Press.
- Yerkes, R. M. (1907). *The dancing mouse: A study in animal behavior*. New York: Macmillan.

Articles on the History of Comparative Psychology

Here, articles are cited on selected aspects of the history of comparative psychology. These articles cover a wide range of subjects including biographies of both American and Russian comparative psychologists such as Frank Beach (Dewsbury, 1990), Leonard T. Hobhouse (Tolman, 1987), Boris Iosifovich Khotin (Malakhovskaya, 1992), T. Wesley Mills (Murray, 1990), Douglas Alexander Spalding (Gray, 1962), Charles Henry Turner (Abramson, 2009), V. A. Wagner (Krementsov, 1992), and Robert Mearns Yerkes (Wight & Smith, 1998). Of interest is an article on the work of James McConnell (Rilling, 1996). McConnell was one of the early pioneers in using the planarian to understand the molecular analysis of learning.

- Abramson, C. I. (2009). A study in inspiration: Charles Henry Turner (1867-1923) and the investigation of insect behavior. *Annual Review of Entomology* 54, 343-359. doi:10.1146/annurev.ento.54.110807.090502
- Aleksandrova- Howell, M., Abramson, C. I., & Craig, D. P. A. (2011). Coverage of Russian psychological contributions in American psychology textbooks. *International Journal of Psychology*, 47, 76-87. doi: 10.1080/00207594.2011.614618.
- Bodson, L. (1996). Some of Aristotle's writing about bird behavior and issues still current in comparative psychology. *International Journal of Comparative Psychology*, 9, 26-41.
- Dewsbury, D. A. (1990). Frank A. Beach's unpublished textbook on comparative psychology. *Journal of Comparative Psychology*, 104, 219-226.
- Dewsbury, D. A. (1992). Triumph and tribulation in the history of American comparative psychology. *Journal of Comparative Psychology*, 106, 3-19.
- Dewsbury, D. A. (1997). Edward Bradford Titchener: Comparative psychologist? *American Journal of Psychology*, 110, 449-456.
- Dewsbury, D. A. (1998). A note on the early editorial policies of the *Journal of Comparative Psychology*. *Journal of Comparative Psychology*, 112, 406-407.
- Dewsbury, D. A. (1998). Animal psychology in journals, 1911-1927: Another look at the snark. *Journal of Comparative Psychology*, 112, 400-405.
- Dewsbury, D. A. (2012). A history of the behavior program at the Jackson laboratory: An overview. *Journal of Comparative Psychology*, 126, 31-44.
- Gray, P. H. (1962). Douglas Alexander Spalding: The first experimental behaviorist. *Journal of General Psychology*, 68, 333-346.
- Greenwood, J. D. (2016). All the way up or all the way down?: Some historical reflections on theories of psychological continuity. *Journal of Comparative Psychology*, 130, 205-214.
- Jacobs, I. F., & Osvath, M. (2015). The string-pulling paradigm in comparative psychology. *Journal of Comparative Psychology*, 129, 89-120.
- Klopfer, P. (1994). Konrad Lorenz and the national socialists: On the politics of ethology. *International Journal of Comparative Psychology*, 7, 202-208.
- Krementsov, N. L. (1992). V. A. Wagner and the origin of Russian ethology. *International Journal of Comparative Psychology*, 6, 61-70.
- Malakhovskaya, D. B. (1992). Boris Iosifovich Khotin (1895-1950). *International Journal of Comparative Psychology*, 6, 3-4.
- Murray, D. J. (1990). A Canadian pioneer of comparative psychology: T. Wesley Mills (1847-1915). *International Journal of Comparative Psychology*, 3, 205-214.
- Rilling, M. (1996). The mystery of the vanished citations: James McConnell's forgotten 1960s quest for planarian learning, a biochemical engraving, and celebrity. *American Psychologist*, 51, 589-598.
- Schleidt, W., Shalter, M. D., & Moura-Neto, H. (2011). The hawk/goose story: The classical ethological experiments of Lorenz and Tinbergen revisited. *Journal of Comparative Psychology*, 125, 121-133.
- Somenzi, V (1994). On the origins of ethology. *Bollettino di Zoologia*, 61, S1, 13-14.
- Spencer, H. (1876). The comparative psychology of man. *Mind*, 1, 7-20.

- Tolman, C. W. (1987). The comparative psychology of Leonard T. Hobhouse: Its context and conception. *International Journal of Comparative Psychology, 1*, 85-96.
- Whissell, C., Abramson, C. I., & Barber, K. R. (2013). The search for cognitive terminology: An analysis of comparative psychology journals. *Behavioral Sciences, 3*, 133-142. doi: 10.3390/bs3010133
- Wight, R. D., & Smith, K. A. (1998). Making place for a comparative scientist: Robert Mearns Yerkes at Harvard, 1902-1917. *International Journal of Comparative Psychology, 11*, 133-143.

General Issues

This section contains a wide range of articles on general issues related to comparative psychology. Several of these articles are part of special issues. The material include problems (real or imagined) associated with comparative psychology (Lockard, 1971), applications of comparative psychology (Abramson & Black, 2017), the evolution of intelligence (Bitterman, 1965a) and the identity of comparative psychology (Beckers, DeHouwer, & Dwyer, 2016; Doré, & Kirouac, 1987; Innis & Staddon, 1989; Médioni, 1987).

- Abramson, C. I. & Black, T. E. (2017). Importance of comparative psychology in pet industry litigation. *Journal of Social Sciences, 13*, 118-123. doi: 10.3844/jssp.2017
- Agrillo, C., & Petrazzini, M. E. M. (2012) The importance of replication in comparative psychology: the lesson of elephant quantity judgments. *Frontiers in Psychology, 3*, 181 (published on-line). doi: 10.3389/fpsyg.2012.00181.
- Balci, F. (Ed.) (2015). Interval timing behavior: Comparative and integrative approaches. *International Journal of Comparative Psychology, 28* (1), (special issue).
- Barash, D. (2007). Stubborn facts call for stubborn scientists. *International Journal of Comparative Psychology, 20*, 5-7.
- Beach, F. A. (1950). The snark was a boojum. *American Psychologist, 5*, 115-124. doi: 10.1037/h0056510
- Beckers, T., DeHouwer, J., & Dwyer, D. M. (2016). Reasoning versus association in animal cognition: Current controversies and possible ways forward. *Journal of Comparative Psychology, 130*, 187-191.
- Beran, M., Parrish, A., Perdue, B., & Washburn, D. (ed.) (2014). Future directions in comparative psychology. *International Journal of Comparative Psychology, 27* (1), (special issue.)
- Bitterman, M. E. (1965a). The evolution of intelligence. *Scientific American, 212*, 92-100. doi: 10.1038/0165-92
- Bitterman, M. E. (1965b). Phyletic differences in learning. *American Psychologist, 20*, 396-410.
- Boesch, C. (2007). What makes us human (*Homo Sapiens*)? The challenge of cognitive cross-species comparison. *Journal of Comparative Psychology, 121*, 227-240.
- Bowd, A. D. (1980). Ethical reservations about psychological research with animals.
- Crawford, C. B. (1989). The theory of evolution: Of what value to psychology? *Journal of Comparative Psychology, 103*, 4-22.

- Doré, F. Y., & Kirouac, G. (1987). What comparative psychology is about: Back to the future. *Journal of Comparative Psychology*, 101, 242-248.
- Epstein, R. (1987). Comparative psychology as the praxis views it. *Journal of Comparative Psychology*, 101, 249-253.
- Galef, B. G. (1987). Comparative psychology is dead: Long live comparative psychology. *Journal of Comparative Psychology*, 101, 259-261.
- Galef, Jr., B. G. (2007). Crying in the wilderness. *International Journal of Comparative Psychology*, 20, 8-9.
- Greenberg, G. (1987) Comparative psychology: An epigenetic approach. *Teaching of Psychology*, 14, 145-147.
- Greenberg, G. (1995). Anagenetic theory in comparative psychology. *International Journal of Comparative Psychology*, 8, 31-41.
- Hodos, W., and Campbell, C. B. G. (1969). Scala naturae: why there is no theory in comparative psychology. *Psychological Review*, 76, 337-350. doi: [10.1037/h0027523](https://doi.org/10.1037/h0027523)
- Innis, N. K. (1989). Introduction: The evolution of comparative psychology, *International Journal of Comparative Psychology*, 2, 141-143.
- Innis, N. K., & Staddon, J. E. R. (1989). What should comparative psychology compare? *International Journal of Comparative Psychology*, 2, 145-156.
- Kalat, J. W. (1983). Evolutionary thinking in the history of the comparative psychology of learning. *Neuroscience and Biobehavioral Reviews*, 7, 309-314. doi: [10.1016/0149-7634\(83\)90034-9](https://doi.org/10.1016/0149-7634(83)90034-9)
- Karin-D'Arcy, M. R. (2005). The modern role of Morgan's canon in comparative psychology. *International Journal of Comparative Psychology*, 18, 179-201.
- Lickliter, R., & Ness, J. W. (1990). Domestication and comparative psychology: Status and strategy. *Journal of Comparative Psychology*, 104, 211-218.
- Lockard, R. B. (1968). The albino rat: A defensible choice or a bad habit? *American Psychologist* 23, 734-742. doi: [10.1037/h0026726](https://doi.org/10.1037/h0026726)
- Lockard, R. B. (1971). Reflections on the fall of comparative psychology: Is there a message for all of us? *American Psychologist*, 26, 168-179.
- Mackenzie, B. (1989). On why there are so few comparisons in comparative psychology. *International Journal of Comparative Psychology*, 2, 189-195.
- Marston, D. (Ed.). (2017). Exploring the intersection of comparative and clinical psychology. *International Journal of Comparative Psychology*, 30 (1), (special issue).
- McBride, G. (1987). Ethology and comparative psychology. *Journal of Comparative Psychology*, 101, 272-274.
- Médioni, J. (1987). Comparative psychology as a search for invariant rules. *Journal of Comparative psychology*, 101, 275-276.
- Miller, L. J., Mellen, J. D., & Kuczaj II, S. A. (ed.) (2013). The importance of behavioral research in Zoological institutions, *International Journal of Comparative Psychology*, 26 (1), (special issue.)
- Mills, T. W. (1887). Comparative psychology: Its objects and problems. *The Popular Science Monthly*, 30, 651-660.
- Moran, G. (1987). Applied dimensions of comparative psychology. *Journal of Comparative Psychology*, 101, 277-281. doi: [10.1037/0735-7036.101.3.277](https://doi.org/10.1037/0735-7036.101.3.277)

- Muckler, F. A. (1963). On the reason of animals: historical antecedents to the logic of modern behaviorism. *Psychological Reports*, *12*, 863-882. doi: 10.2466/pr0.1963.12.3.863
- Porter, J. H., Johnson, S. B., & Granger, R. G. (1981). The snark is still a boojum. *Comparative Psychology Newsletter*, *1*, 1-13. *Psychological Record*, *30*, 201-210.
- Rasmussen, J. L., Rajewski, D. W., & Craft, H. D. (1993). Humans' perceptions of animal mentality: Ascriptions of *thinking*. *Journal of Comparative Psychology*, *107*, 283-290.
- Schank, J. C., & Koehnle, T. J. (2009). Pseudoreplication is a pseudoproblem. *Journal of Comparative Psychology*, *123*, 421-433.
- Smith, J. D., Couchman, J. J., & Beran, M. J. (2014). Animals metacognition: A tale of two comparative psychologies. *Journal of Comparative Psychology*, *128*, 115-131.
- Thompson, N. S. (1987). Natural design and the future of comparative psychology. *Journal of Comparative Psychology*, *101*, 282-286.
- Tobach, E. (2006). Identity of comparative psychology: Its status and advances in evolutionary theory and genetics. *International Journal of Comparative Psychology*, *19*, 129-150.
- Tolman, C. W. (1987). Comparative psychology: Is there any other kind? *Journal of Comparative Psychology*, *101*, 287-291.
- Tooby, J., & Cosmides, L. (1989). Adaption versus phylogeny: The role of animal psychology in the study of human behavior. *International Journal of Comparative Psychology*, *2*, 175-188.
- Viney, W., King, D. B., & Berndt, J. (1990). Animal research in psychology: Declining or thriving? *Journal of Comparative Psychology*, *104*, 322-325.
- Young, R. J. (2002). Uncloaking the magician: Contributions of comparative psychology to understanding animal training. *International Journal of Comparative Psychology*, *15*, 174-185.
- Zilski-Pineño, J. M., & Pineño, O. (2007). Should we talk to the general public about our work? *International Journal of Comparative Psychology*, *20*, 10-12.

Teaching Comparative Psychology

The senior author has spent a considerable portion of his career developing inquiry-based exercises for use in a comparative psychology course. Many of these articles are cited below. Of special interest is the use of pet stores as animal and human research centers (Abramson, Huss, Wallisch, & Payne, 1999). Many of these activities are summarized in Abramson, Curb, Barber and Sokolowski (2011). A wide range of material suitable for a class in comparative psychology can be found in *Psychological Reports* including many articles that compare two or more species in the same paper (Abramson, Curb, & Barber, 2011). A paper by Varnon and Abramson (2013) describes the adaptation of the Propeller microcontroller (Parallax, Rocklin, CA) for comparative experiments. Literally, a comparative laboratory suitable for field and laboratory-based work can be developed for under \$200.00 and be placed in the palm of one's hand. The Abramson 2015b article describes several ways in which a professor can stimulate interest in comparative psychology. In addition to these articles, there are others that discuss the importance of comparative psychology for a liberal arts education (White, 2007) and activities in early comparative courses (Kline, 1899). Two exercises that interest students is a writing exercise where students contact comparative psychologists (Abramson & Hershey,

1999) and another where comparative psychologists are turned into official United States postage stamps (Abramson & Long, 2012). Quick response codes (QR codes) can be imbedded into the stamps that lead the user, for example, to student-created websites <https://comparativestamps.wixsite.com/comparativestamps>). Other material can be found from time to time in the journal *Teaching of Psychology* and *American Biology Teacher*.

- Abramson, C. I. (2013). Problems of teaching the behaviorist perspective in the cognitive revolution. *Behavioral Sciences*, 3, 55-71. doi: 10.3390/bs3010055
- Abramson, C. I. (2015a). A crisis in comparative psychology: Where have all the undergraduates gone? *Frontiers in Psychology*, 6, 1500. doi: 10.3389/fpsyg.2015.01500
- Abramson, C. I. (2015b). A crisis in comparative psychology: Where have all the undergraduates gone? : Additional comments. *Innovative Teaching*, 4,7. doi: 10.2466/10.IT.4.7
- Abramson, C. I., & Chicas-Mosier A. M (2016). Learning in plants: Lessons from *Mimosa pudica*. *Frontier in Psychology*, 7, 417. doi: <http://dx.doi.org/10.3389/fpsyg.2016.00417>
- Abramson, C. I., & Long, S. L. (2012). The use of Zazzle to turn historically important psychologists and movements into U.S. Postage stamps: the example of Charles Henry Turner. *Innovative Teaching*, 1, 5. (published on-line). doi: 10.2466/11.IT.1.5
- Abramson, C. I., Brown, E. A., & Langley, D. (2011). Use of PowerPoint to demonstrate classical salivary conditioning in a classroom setting. *Psychological Reports*, 108, 109-119. doi: 10.2466/11.23.PR0.108.1.109-119.
- Abramson, C. I., Burke-Bergmann, A. L., Nolf, S. L., & Swift, K. (2009). The use of board games, historical calendars, and trading cards in a history of psychology class. *Psychological Reports*, 104, 529-544. doi: 10.2466/PR0.104.2.529-544.
- Abramson, C. I., Curb, L. A., Barber, K. R., & Sokolowski, M. B. C. (2011). The use of invertebrates and other animals to demonstrate principles of learning: Activities developed by the laboratory of Comparative Psychology and Behavioral Biology. *Journal of Behavioral and Neuroscience Research*, 9, 1-6.
- Abramson, C. I., Curb, L., & Barber, K. R. (2011). A bibliography of articles of interest to teachers of psychology appearing in *Psychological Reports* 1955-2010. *Psychological Reports*, 108, 182-212. doi: 10.2466/11.PR0.108.1.182-212
- Abramson, C. I., Giray, T., Huang, Z. Y., & Xie, X. (2013). A note on the opportunities for collaborative research with honey bees in Turkey and China. *Bulletin of Insectology*, 66, 315-318.
- Abramson, C. I., Hilker, A. C., Becker, B., Barber, K. R., & Miskovsky, C. (2011). Cost-effective laboratory exercises to teach principles in the comparative analysis of behavior. *Journal of Behavioral and Neuroscience Research*, 9, 7-15.
- Abramson, C. I., Huss, J. M., Wallisch, K., & Payne, D. (1999). Petscope: using pet stores to increase the classroom study of animal behavior. In L. Benjamin, B. Nodine, R. Ernst, C. Blair-Broeker (Eds.). *Activities handbook for the teaching of psychology, Volume 4* (pp. 118-122). Washington, DC: American Psychological Association.
- Abramson, C. I., Kirkpatrick, D. E., Bollinger, N., Odde, R., & Lambert, S. (1999). Planarians in the psychology classroom: Habituation and instrumental conditioning demonstrations. In L. Benjamin, B. Nodine, R. Ernst, C. Blair-

- Broeker (Eds.). *Activities handbook for the teaching of psychology, Volume 4* (pp. 166-171). Washington, DC: American Psychological Association.
- Abramson, C.I., & Hershey, D. A. (1999). The use of correspondence in the classroom. In L. Benjamin, B. Nodine, R. Ernst, C. Blair-Broeker (Eds.). *Activities handbook for the teaching of psychology, Volume 4* (pp. 33-36). Washington, DC: American Psychological Association.
- Abramson, C.I., Onstott, T., Edwards, S., & Bowe, K. (1996/2000/2000). Classical-conditioning demonstrations for elementary and advanced courses. *Teaching of Psychology, 23*, 26-30. doi: 10.1207/s15328023top2301_4
- Abramson, C.I., Wallisch, K., Huss, J. M., & Payne, D. (1999). Project BETA: Biological education through animals. *The American Biology Teacher, 61*, 1-2.
- Baskin, K. E., Cushing, C. C., & Abramson, C. I. (2013). Using the labyrinth as a teaching tool in psychology. *Innovative Teaching, 2*, 10, 1-8. doi: 10.2466/07.08.it.2.10
- Candland, D. K. (1987). Unnatural selection: comment on the “teaching comparative psychology” symposium. *Teaching of Psychology, 14*, 151-155.
- Chicas-Mosier A. M., & Abramson, C. I. (2015). A new instrumental/operant conditioning technique suitable for inquiry-based activities in courses on experimental psychology, learning, and comparative psychology using planaria (*Dugesia dorotocephala* and *Dugesia tigrina*). *Innovative Teaching, 4*, 6. doi: 10.2466/09.IT.4.6
- Demarest, J. (1987) On changing the framework of psychology: Comparative psychology is what general psychology should be. *Teaching of Psychology, 14*, 147-151.
- Jaynes, J. (1966). The routes of science. *American Scientist, 54*, 94-102.
- Kieson, E., & Abramson, C. I. (2015). Exploring the relationship between animal behavior and consumer products: Developing critical awareness through classroom and home-based experimentation. *Contemporary Psychology, 4*, 23. doi: 10.2466/01.07.cp.4.23DOI
- Kline, L. W. (1899). Suggestions toward a laboratory course in comparative psychology. *American Journal of Psychology, 10*, 399-430.
- Miskovsky, C, Becker, B., Hilker, A., & Abramson, C. I. (2010). The “Fish Stick”: An easy to use student training apparatus for fish. *Psychological Reports, 106*, 135-146. doi: 10.2466/pr0.106.1.135-146
- Narcompros (Ministry of Education). *International Journal of Comparative Psychology, 6*, 5-9
- Place, A. J. & Abramson, C. I. (2006). An inquiry-based exercise for demonstrating prey preferences in snakes. *American Biology Teacher, 68*, 221-226.
- Rumbaugh, D. M. (1971). Zoos: Valuable adjuncts for the instruction of animal behavior. *Bioscience, 21*, 806-809.
- Rumbaugh, D. M. (1972). Zoos: Valuable adjuncts for the instruction and research in primate behavior. *Bioscience, 22*, 26-29.
- Stevison, B. K., Biggs, P. T., & Abramson, C. I. (2010). Using Google Earth as a source of ancillary material in a history of psychology class. *Psychological Reports, 106*, 665-670. doi: 10.2466/pr0.106.3.665-670
- Varnon, C. A., & Abramson, C. I. (2013). The propeller experiment controller: Low-cost automation for classroom experiments in learning and behavior. *Innovative Teaching, 2*, 2. (published on-line). doi: 10.2466/07.08.IT.2.2

Wagner, V. A. (1992). Comparative psychology as a course of study in the university and in other higher educational institutions. (Memorandum written by V. A. Wagner for the

White, D. A. (2007). Comparative psychology's relevance to a liberal arts education and personal development. *International Journal of Comparative Psychology*, 20, 13-19.

Ancillary Material

This section contains a wide variety of material including journals with the word “comparative” in the title and websites. The former is useful in showing students that the comparative method is of value across numerous disciplines. Many of the websites listed below were developed in the senior author's laboratory and highlight some of his work. An online search will uncover many others developed by other comparative psychologists. One site that helps students visualize experimental methods is the *Journal of Visualized Experiments* (<https://www.jove.com/>). There is also a web link to the obituary site of the American Psychological Association. This site provides citation information to the obituaries found in the *American Psychologist* and contains several obituaries of comparative psychologists. We have also included some YouTube videos of teaching demonstrations and research from the senior author's laboratory. One of the videos describes what we call the “Fish stick” which is a simple way of training fish. Another video shows a rattlesnake pressing a lever to regulate its temperature. A horse training video is also listed. This video is important as the experiment was controlled by the micro-controller described in Section 3. Finally, two videos are presented highlighting the importance of comparative psychology. We have also developed a free app to teach students about observing behavior. The rationale for the development of this app was to teach students how to observe behavior in aquariums, zoos, and pet stores. This app, which has been translated into English, Russian, Portuguese, and Spanish is available for android type cell phones and is free. Finally, two websites are listed where historical articles can be downloaded free of charge.

a. *Websites where historical articles and books can be download.* The first site “Classics in the history of psychology” is a resource developed by Dr. Christopher D. Green of York University in Toronto Canada. The second listing is the “Internet Archive. This was started in 1996 and has already digitized within its holdings over 11 million books and texts. The material within the website is also is freely available.

1. Classics in the history of psychology: psychclassics.yorku.ca

2. Internet archive: <https://archive.org>

b. *APA Obituary Website.* This site provides citation information to visit the *American Psychologist* for obituaries (<http://www.apa.org/about/governance/president/published-obituaries.aspx>).

c. *Journals.* Many journals publish articles on animal behavior. Some of the more well-known include *Advances in Comparative Psychology*, *Advances in the Study of Behavior*, *Animal Behavior*, *Anthrozoos*, *Behaviour*, *International Journal of Comparative Psychology*, *Ethology*, *Frontiers in Psychology*, *Journal of Comparative Psychology*, and *Journal of Experimental Psychology: Animal learning and cognition*. However, it is important to remind the reader that comparative psychology should not be restricted to the study of

animal behavior. Therefore, I would encourage you to ask students to look at journals with the word “comparative” in the title. Some that I have found useful include: *Comparative Civilization Review*, *Comparative Cognition and Neuroscience*, *Comparative Drama*, *Comparative Medicine East and West*, *Comparative Politics*, *Journal of Comparative Economics*, and *Journal of Comparative Policy Analysis*. A search on the website Web of Science Journal Abbreviation titles (http://images.webofknowledge.com/images/help/WOS/B_abrvjt.html) lists 72 journals with the word “Comparative” leading the journal’s title and 18 with the word “comparative” following the word “Journal.”

d. *The trials of life: A natural history of behaviour*. These are a series of 12, fifty-minute episodes on animal behavior hosted by David Attenborough (https://en.wikipedia.org/wiki/The_Trials_of_Life).

e. Drs. Robert Epstein and B. F. Skinner with pigeons – Part 1 (<https://www.youtube.com/watch?v=QKSvu3mj-14>)

Drs. Robert Epstein and B. F. Skinner with pigeons – Part 2 (<https://www.youtube.com/watch?v=erhmslcHvaw>)

f. Museum exhibits and Video clips. Oklahoma State University Psychology Museum (<http://psychology.okstate.edu/museum>)

The Charles Henry Turner Website:
(<http://psychology.okstate.edu/museum/turner/turnermain/html>)

Planarians in the psychology classroom:
(<http://psychology.okstate.edu/faculty/abramson/plan.html>)

Classical conditioning of proboscis extension in honey bees:
(<http://psychology.okstate.edu/faculty/abramson/beeexperiment1.html>)

The use of correspondence in the classroom:
(<http://psychology.okstate.edu/faculty/abramson/corr.htm>)

PETSCOPE: Using pet stores to increase the classroom study of animal behavior:
(<http://psychology.okstate.edu/faculty/abramson/petscope.html>)

Classical conditioning of withdrawal response in the earthworm:
(<http://psychology.okstate.edu/faculty/abramson/worms.html>)

A time-line of comparative psychology: (<http://comparativepsych.wixsite.com/mysite>)

A history of comparative psychology in stamps:
(<https://comparativestamps.wixsite.com/comparativestamps>)

Operant conditioning in goldfish (<http://www.youtube.com/watch?v=FsonPCR6EZg>)

Operant conditioning in the honey bee
(http://www.youtube.com/watch?v=KzT_qejHv3Y&feature=mfu_in_order&list=ULL)

Advice from professors in psychology programs: Comparative Psychology
(<http://www.drkit.org/psychology/>)

Operant conditioning in rattlesnakes (<https://www.youtube.com/watch?v=sT996Xz-O28>)

Water searching behavior in planarians (<https://youtu.be/OtZRAOqBdsU>)

What is Comparative Psychology? (<https://www.youtube.com/watch?v=klzmIGITntE>)

Operant conditioning in horses

(www.youtube.com/watch?v=26zKz0nbqNw&list=UUqEiHO7osHC-TMskomLvqiw)

Behavioral observation app.

(<https://play.google.com/store/apps/details?id=blindsniper.matheus.observationdemo>) (English, Portuguese, Spanish, Russian, translations)

CONCLUSION

In conclusion, this article contains material useful for anyone interested in comparative psychology. The material is not exhaustive and should be supplemented by additional information specific to the reader's interests and laboratories. I have used the materials to generate interest in comparative psychology at the both the undergraduate and graduate level. The material can also be used to craft an argument as to why comparative psychology should be returned to a place of honor. In closing, we would like to reiterate that we would be glad to assist anyone in developing a comparative program and/or implementing any of the teaching demonstrations cited.

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