

3. The importance of thinking about others' motives and cognitions in planning teaching and in research. What's in the mind of the learner as he or she sits in a lecture hall? What's in the mind of the teacher in planning and carrying out a lesson? What's in the mind of the research subject who participates in an experiment?

4. The importance of thinking and caring about teaching, teaching teaching, and research on teaching.

5. The value of optimism—the eternal hope that the next class will be even better, that the next group of teaching assistants will be even more outstanding, that the next research project will have clearer results than the last one.

I begin my 41st year of teaching psychology this fall. I hope to keep teaching for at least another decade, and I look forward to continued learning and satisfaction.

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Notes

1. This article is based on an invited address presented by the recipient of the 1985 Distinguished Teaching in Psychology Award at the meeting of the American Psychological Association, Washington, DC, August 1986.
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The Nature and Role of Comparative Psychology in the Teaching of Psychology

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This article describes a comparative psychology course that attempts to demonstrate the power of the comparative method for a complete understanding of psychological phenomena typically taught from a human-oriented perspective. A description of methodological goals and the traditional roles of comparative psychology precede the course description. These include research strategies for relating group differences to specific processes and

for inferring the evolutionary and developmental histories of behavior.

A survey of the status of comparative psychology (Demarest, 1980) revealed that the field has no clearly focused identity. Comparative and noncomparative psychologists seemed to differ in their evaluation of this subdiscipline's

significance to psychology as a whole and in how they perceived the nature of comparative psychology. Despite the difficulties comparative psychologists have in defining their field, they are likely to agree that they represent a minority perspective within an increasingly anthropocentric discipline.

Evidence for the primarily human orientation of our parent discipline is seen in the interests of our students and in the structure of many undergraduate psychology programs. Typically, students at my college decide to major in psychology because of their interest in the richness and complexity of human behavior. Many of these students hope eventually to apply their knowledge and skills in a human services career, and an increasing number of them plan to do so without continuing their formal education in psychology. Over the past 10 years, the number of our majors going on to graduate school has decreased from 85% or more to about 50%. Similar patterns of student interests and career paths are probably familiar to readers in similar institutions. Given the current and projected funding and career opportunities in psychology, our students might be making reasonable and pragmatic decisions.

In most undergraduate psychology programs, there is also an implicit, if not explicit, emphasis on human psychology despite course and textbook titles that describe psychological phenomena and categories common to all living systems. For example, at my college, courses in cognitive psychology, experimental social psychology, and sensation and perception are really courses in human cognition, human social behavior, and human sensation and perception. A cursory examination of the typical textbooks and primary reading materials for these courses reveals a similar emphasis on human-oriented research and theory.

Given the current context, answers to the question of what is the nature and role of comparative psychology in the teaching of psychology are critically important. They will shape future perceptions of our field by students, departmental colleagues, and administrators who must remain persuaded that our area contributes significantly to general psychology in particular and to liberal education in general.

The ultimate viability of comparative psychology hinges on how others perceive the field. How then does one identify and underscore the value of comparative psychology to undergraduate education, especially the psychology curriculum? In this article, I present what I believe are the essential pedagogical objectives of an undergraduate course in comparative psychology and then describe my own course in which I attempt to meet these objectives.

General Goals of a Comparative Psychology Course

The current patterns of student interests and trends in curricula development have convinced me of the need to reaffirm the connection and importance of comparative psychology to its parent discipline. I believe the most important pedagogical function of comparative psychology is to demonstrate the power of the comparative method by focusing on topics from content areas in which students are likely to be taught from an anthropocentric perspective.

An alternative viewpoint is to regard comparative psychology as synonymous with the study of animal behavior. I have argued strongly against this approach (Thompson, 1983) because I believe it ultimately reinforces the attitudes that comparative psychology lies outside mainstream experimental psychology and is not especially germane to the interests and activities of psychologists except those who specifically study animal behavior.

Yet, nothing could be farther from the truth. Admittedly, most of our graduates will never need to compare different species, which is the traditional subject variable in comparative psychology. However, we can reasonably assume that many students will have careers in which they must evaluate comparative animal research and infer from its results the implications for public policy or private practice. In many human service occupations, our graduates will need to compare groups varying along other major subject variables such as age, intellectual potential, occupation, race, and gender. Thus, it is surely in everyone's interest that we teach our students to understand and how to deal with the methodological issues and problems associated with the design, analysis, and interpretation of comparative research in the broadest sense.

Methodological Goals of Comparative Psychology

One of the better contemporary discussions of comparative methodologies is provided by Cole and Means (1981) in their book, *Comparative Studies of How People Think*. These authors emphasized that students must learn from the outset that comparative research violates the major assumption of standard inferential logic that all other things are equal. If subjects can differ on any number of dimensions, what are we to make of performance differences across groups? Are we simply to restrict our conclusions to statements about correlations between variables rather than causal relationships? If not, we need to teach our students how to wrestle with practical design problems, such as how one obtains comparable groups or provides equivalent treatments for different groups. How valid and pragmatic are subject-matching procedures, the systematic variation of experimental conditions for different groups (Bitterman, 1975), and phylogenetic calibration (Gossette, 1970) by which the range of a variable's effects is established?

One solution to these problems is simply to compare within-group qualitative performance patterns across groups and avoid comparing quantitative performance levels altogether. But students of comparative psychology should also gain some experience with the various strategies used to relate group differences to specific processes. Among the comparative research strategies discussed by Cole and Means (1981) is the group-by-task interaction approach in which groups are each presented with two or more tasks. The control and experimental tasks are the same except that the former, but not the latter, can be accomplished without the specified process or prior experience. This strategy assumes that group performances on both tasks will be affected equally by extraneous task-irrelevant variables that differ across groups. Group performances that are the same in the control condition but different in the experimental condition support the hypoth-

esis that the existence or use of the specified process differs across groups.

Use of the group-by-task approach necessitates an a priori component analysis of the tasks used in the control and experimental conditions. The traditional approach to this problem has been to establish converging operations from the results of multiple experiments in which variables are manipulated extensively in a standard subject preparation. However, an increasingly popular alternative strategy for analyzing task components, which Cole and Means (1981) discussed extensively, is the model-based approach. All four of the model types described by these authors involve comparing a subject's performance on a task to an explicit theoretical model of the hypothetical processes derived, for example, from a computer simulation or formal mathematical modeling.

Unfortunately, Cole and Means's (1981) treatment of comparative methodologies does not extend to questions concerning evolution and ontogeny. Their failure to address these issues is consistent with perceptions of contemporary mainstream psychology as being overly process oriented and concerned almost exclusively with concurrent causal relations (cf. Demarest, 1984; Dewsbury, 1984; Domjan, 1985). Discovering the specific relationships between the past and the present is a particular concern of comparative psychologists, who may provide the only exposure students have to psychology as an historical science.

Third and fourth generation computers notwithstanding, organisms differ fundamentally from inanimate objects with respect to their origins. Behavioral processes, as much as any other organismic trait, are the product of descent by evolution through natural selection. The process of selection starts again with a new individual, but individuals do not begin from scratch. Consequently, our comparisons of different species and larger taxonomic groups will reveal uniform basic (i.e., generalized) patterns of behavioral adaptation and developmental processes as well as their modification in response to changing environmental demands (cf. Aronson, Tobach, Rosenblatt, & Lehrman, 1972; Rumbaugh, 1985). If our students hope to infer what was from what is, they need to be exposed to methodologies that differ radically from those presented in standard design texts.

Students interested in studying macroevolutionary patterns of stasis and change need to be familiar with cladogenetic and anagenetic modes of analysis. In the former process, patterns are interpreted in terms of the relative recency of common ancestry (Eldredge & Cracraft, 1980), whereas in the latter they are explained in terms of inferred improvement, that is, the increased efficiency in design of a specified adaptive process (cf. Capitanio & Leger, 1979; Gottlieb, 1984; Yarczower & Hazlett, 1977).

A major problem for anyone interested in the evolution of behavior is identifying the sources of perceived similarity between species and other taxonomic categories. If the similarities exist by virtue of common descent from an ancestor sharing the trait, they are homologous. Traits shared by different species for reasons other than common descent (e.g., independent convergence induced by selection factors) are homoplastic. Even if students accept the validity of applying the concept of homology to behavior (cf. Atz, 1970;

Plotkin, 1983), they still need to know the criteria by which homologous characters can be recognized and what parametric designs can assess the sources of observed similarities stochastically (e.g., Hailman, 1976). A comprehensive introduction to conceptual and methodological issues in the study of evolution and behavior is provided in two related volumes edited by Masterton, Hodos, and Jerison (1976) and Masterton, Bitterman, Campbell, and Hotton (1976).

Traditional Roles of Comparative Psychology

Ideally, students should become proficient in using comparative methodologies by being actively involved in research activities coupled with traditional instruction such as lectures, readings from primary and secondary sources, discussions, and demonstrations. The latter didactic approaches are especially important for exposing students to three traditional roles of the comparative method in psychology. The first of these is to address questions concerning the historical—both phylogenetic and ontogenetic—antecedents of behavior. The second role is to develop valid animal models for elucidating the mechanisms and processes underlying performance, while recognizing and identifying the inherent limitations and constraints imposed on the models by historical, structural (morphogenetic), and ecological factors. A third role for comparative psychology is to test the adequacy and generality of psychological principles and theories. Dealing with these traditional roles of comparative psychology should lead students to appreciate both the convergence and diversity of mechanisms, processes, and structures that have evolved in living systems.

Ratner (1972, 1980) developed a useful conceptual framework for methodologically integrating the traditional roles of comparative psychology. This approach involves six sequential stages of comparative analysis. Stage 1 consists of acquiring formal and informal information to gain a broad perspective of the phenomena and subjects of interest. Stage 2 entails developing a behavioral taxonomy for descriptive purposes and functional classification. Stages 3 and 4 are characterized, respectively, by the identification and development of research preparation followed by the study of variables that affect the behavior in question. In Stage 5, comparisons across species or other groups are used to reveal relationships among behavior classes from which general mechanisms may be postulated in the final Stage 6.

The value of comparing similarities and differences across species when teaching comparative psychology is, I hope, self-evident from the foregoing, but perhaps it deserves further emphasis. Cross-species generalizations are fundamental to all comparative research (Suomi & Immelmann, 1983), and they are necessary in any systematic study of homologous, analogous, and divergent evolutionary patterns of adaptation. In addition, students cannot be taught to appreciate the significance of different integrative levels of organization without cross-species comparisons (see Greenberg, this issue; Greenberg & Tobach, 1984). The comparative method can be profitably employed using within-species comparisons like culture, but such subjects are groups nested within groups. Hence, any cross-group generalizations and limitations must lead to more limited

explanatory principles than those derived from the more inclusive between-species group comparisons.

Students completing a comparative psychology course of the type I have described would probably agree with Staddon's (1983) comment that "people are interesting all right, but the prospect of finding out something of enduring value by studying only people seems to me to be remote" (p. xi).

The Comparative Psychology Course

I now describe my own course in which I attempt to meet the objectives that have been outlined. Comparative psychology at Franklin & Marshall College is an advanced-level course. It is one of a group of courses from which students choose three as electives. The comparative course has a research requirement, as do most courses in the psychology curriculum. We believe that, without research experience, courses in science become courses about science. The consensus among our psychology faculty is that the best way to learn a science is to experience directly the modes of thinking and action that have produced the subject matter. To deny undergraduates these opportunities is to deny them an intellectual experience that is essential to understanding both the particular subject matter of a given science, such as psychology, as well as scientific reasoning in general (E. R. Wist, personal communication, September 30, 1976).

Prerequisites for the comparative psychology course include an experimental design and statistics course and at least one course from an intermediate core grouping of Learning, Cognition, Psychobiology, and Sensation and Perception. These prerequisites are intended to ensure that students in the comparative psychology course will have been exposed to at least one core area in some depth and will be familiar with the standard designs and methods of experimental psychology.

Course Description

I begin the course by defining comparative psychology from an historical perspective and identifying its relationships with other content areas and methodological approaches in psychology, as well as other sciences that use the comparative method. The students end up having no doubt about my personal biases and agenda for comparative psychology, but they also become familiar with a broad range of other viewpoints (e.g., Demarest, 1984; McAndrew, 1984; Snowdon, 1983).

The second major section of the course is devoted to the contributions comparative psychology has made in furthering our understanding of the historical antecedents of behavior and the analysis of continuity and change at the phylogenetic and ontogenetic levels. These topics are dealt with early in the course because, with rare exception, psychology students have not been taught the significance of distal as opposed to proximate mechanisms. They typically do not appreciate the fact that recent patterns of behavior in individuals or populations are modifications of older patterns.

By the end of this section, students should understand the ways in which a comparative approach can promote our understanding of behavioral functional adaptations within and across various phylogenetic lineages. They should also be comfortable using the methods and logic of comparative psychology to discern evolutionary trends and discontinuities in organizational patterns of behavior. They will also appreciate the way evolutionary processes are constrained by both structure and developmental mechanisms (e.g., Reif, Thomas, & Fischer, 1985). A discussion of how developmental processes might causally influence evolution prefaces the section dealing with behavioral ontogeny. The nature-nurture issue in behavioral ontogeny is dealt with from an historical perspective, and considerable time is devoted to the methods and logic of behavioral genetics and epigenetic approaches to the study of behavioral development. Perhaps, not surprisingly, it is here that even the most human-oriented students begin to appreciate the relevance of comparative psychology for understanding many human societal problems.

In the section on behavioral development, students learn the value of animal-based research for addressing fundamental theoretical issues and for providing the empirical foundation needed to understand and resolve those inequities stemming from differential prenatal and postnatal experiences. On the one hand, students usually agree that causal analyses of deprivation and enrichment effects during development are necessary for promoting human welfare and mitigating human suffering. On the other hand, they also believe that direct intervention with human subjects is ethically unacceptable. The questions raised next revolve around the practicality and validity of available research alternatives (Gallup & Suarez, 1985) such as the use of tissue rather than whole organism preparations. Most students conclude that animal models are necessary, but they do so with a heightened appreciation of the ethical and conceptual framework within which they arrived at this position.

The remainder of the course is spent applying the comparative method to topics from core areas of empirically based psychology. These core areas typically include sensation and perception, learning, cognition, communication, language and thought, interpersonal and social processes, and reproductive behavior. The specific topics in each of these categories may be as broad as infantile attachment or gender differences and as narrow as a theoretical analysis of the serial position effect in working memory or sound localization in mammals. I encourage students to see the interrelatedness of the diverse phenomena falling under the various headings. For example, consideration of learning as an adaptive process for individual adjustment is shown to follow naturally from a discussion of stereotypic species-typical behavioral patterns. Similarly, an understanding of language leads to a consideration of other symbol manipulating activities, yet presupposes an understanding of communicative systems in general and the sensory capacities underlying them. The evidence for complex perceptual phenomena, such as natural categorization, raises questions concerning the nonassociative computational and representational capacities of organisms. Evaluating the functional significance of these latter phenomena and processes

from an ecological perspective can lead to a comparative analysis of social processes, the evolution of culture, and even the prerequisites of political behavior (de Waal, 1982).

In recent years, I have not used a textbook, but instead required students to read primary sources. This strategy involves them directly with the relevant historical and contemporary literature. But be forewarned that instructors adopting this approach have the added responsibility of giving students the sense of continuity and focus traditionally provided by a textbook.

The required readings include selections not only from psychology but also from ethology and, in some cases, anthropology, sociology, and even paleontology, provided they address issues in the psychological domain. Paleontology provides particularly useful examples of how functional adaptation can be deduced from an a priori knowledge of form alone (e.g., Clarkson, 1966). This approach, which may be said to provide an escape from the adaptive teleology, is an instructive counterpoint to the strategy with which students typically are more familiar, namely, beginning with a suspected if not known function and then seeking correlations with structure and process.

The Research Requirement

The research requirement is a key for accomplishing the course's objectives. Groups of three or four students are required to design and conduct an original study. Typically, each group selects one of several topics I have provided. They then prepare a written proposal, which they must also defend in an oral examination. Students are responsible for the daily care and handling of their subjects and are expected to become familiar with the biology and husbandry needs of the species with which they work. Discussions of the ethical issues associated with the use of nonhuman subjects are supplemented with representative readings reflecting alternative viewpoints (e.g., Fox, 1986; Gallup & Suarez, 1980; Regan, 1983). The capstone of the experience is the final written report submitted in approved American Psychological Association format.

A representative, but not exhaustive, list of recent projects includes comparative studies of spatial memory in rodents, hearing thresholds in desert rodents, face recognition and categorization in primates, signtracking in cats, ontogeny of play in kittens, and mirror-usage by pigeons. In each project, the primary focus is on the utility of the comparative method for a greater understanding of the basic psychological phenomena. For example, students involved in the last of the projects just mentioned (Gelhard, Wohlman, & Thompson, 1982) were primarily concerned with current issues in the comparative analysis of self-awareness and related perceptual and learning processes in nonverbal organisms (cf. Epstein, Lanza, & Skinner, 1981; Gallup, 1983).

In addition to its value for fostering the acquisition of skills and knowledge in the use of comparative methodologies, this type of research experience allows students to pursue specific topics in more depth than is possible in the nonlaboratory part of the course. Obviously, students using comparative methodologies during one semester are not transformed into comparative psychologists. However,

the experience helps them to evaluate developments in the discipline and, most important, to appreciate how the actual doing of research is misconstrued, if not eviscerated, by the rigid intellectualized style of the literature. Students also learn the very valuable lesson described by Beach (1984) that "there are relatively few of us who could or should try to study the same behavior in a number of different species. . . . as a rule fruitful interspecific comparisons and generalizations arising therefrom depend upon synthesizing the research of many different experiments" (p. 2).

Conclusions

As indicated at the beginning of this article, the lack of a clear consensus about the fundamental nature of comparative psychology poses serious problems to anyone interested in underscoring the value of this field to undergraduate education in psychology. Comparative psychologists with different orientations will differ in what they teach their undergraduates. Therefore, one should not be surprised to discover that there is a continuum of approaches to teaching comparative psychology.

One extreme point on this continuum is represented by those who argue that the distinctions among the fields that study animal behavior are arbitrary. Demarest (this issue), for example, believes that behavior is as much a biological process as is anatomy and physiology and that, like these disciplines, it should be taught and understood from a perspective that emphasizes the synthesis between mechanistic-developmental and evolutionary-ecological influences. Demarest argues that comparative psychology has progressed further as a science than general psychology and that it would be counterproductive to limit the field to that which is traditionally psychological.

The other end of the continuum is represented by my point of view. I stress the value of cross-species comparisons for discerning, in particular, the possible from the actual with respect to strategies of functional adaptation. Contrary to Demarest's (this issue) advice, I focus on topics that are germane to traditional general psychology. I emphasize the historical and methodological ties to general psychology rather than the relationships among comparative psychology and other fields of animal behavior (e.g., ethology, behavioral ecology, and sociobiology). Our ties to these latter areas whose roots lie in zoology are important, but comparative psychologists should not neglect strengthening their connections to other psychologists (e.g., ecological psychology) who share a concern with the role of the environment in the analysis of psychological phenomena and who eschew singling out one level (e.g., physiological) or process (e.g., computational) to unify psychology (Mace, 1983; personal communication, April 4, 1986).

Greenberg (this issue) represents a point of view that is less committed to a sharp boundary between the topics studied by the different fields of animal behavior, but he views comparative psychology fundamentally as a psychological discipline concerned with the ontogeny and phylogeny of behavior. Greenberg's perspective is a developmental one that focuses on the concept of integrative levels of organization (Aronson et al., 1972). My own course shares Greenberg's concern with the central concepts of evolution

and ontogeny, but I suspect we differ in the emphasis placed on addressing from a comparative perspective topics and issues of contemporary interest in the predominantly human-oriented mainstream psychology. I also emphasize the value of the comparative method in general as an enduring and productive means for answering new questions, regardless of a student's final specialization within or outside of psychology.

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Notes

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