

# BIOMECHANICS: PAST, PRESENT, AND FUTURE PERSPECTIVES

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## INTRODUCTION

The purpose of this paper is to answer three questions pertaining to the biomechanics discipline: 1) Who were the great scientists and philosophers credited for founding biomechanics? 2) What are the philosophical issues of biomechanics? 3) What are the future directions of biomechanics? The perspectives presented in this paper are categorized as historical, technical, philosophical, and futuristic.

## HISTORICAL PERSPECTIVE

Biomechanics is a relatively new branch in the discipline of kinesiology in that it has been recognized as an individual field of study for approximately 30 years. However, the building blocks forming the entire foundation from which the discipline has emerged can be traced back to the time of Aristotle (384-322 B.C.). Aristotle introduced the world to the art of observation for developing an understanding of human movement. Archimedes (287-212 B.C.) developed principles which provided a basis for today's sport of swimming. Leonardo da Vinci (1452-1519) has been deemed an originator of biomechanical thought regarding anatomy and mechanics because of his talents as an artist, biologist, and engineer. Throughout the fifteenth, sixteenth, and seventeenth centuries, Galileo (1564-1642), Newton (1642-1726), and Borelli (1608-1679) were instrumental in providing key elements for understanding today's biomechanical concepts due to their experimentations with and explanations of natural laws and mechanics (Adrian and Cooper, 1989).

There is no question regarding the contributions made by these and other scientists. But, what about the great philosophers and their influences upon science? Who are the great philosophers and scientists in biomechanics today? And are today's biomechanists creating new theories, concepts, and scientific methods, or are they merely proffering that old ones are still applicable?

## TECHNOLOGICAL PERSPECTIVE

In biomechanics, basic methodologies have been improved due to the incorporation of engineering, physics, computer, and mathematical concepts applied to human movement patterns. Keeping up with the computer age has become a major focus in the world of biomechanics. However, it should be noted that biomechanists may have become more involved with the technological aspect of their field than the theoretical and philosophical aspect. Should biomechanists use the current technology to answer research questions or should they answer research questions by building more equipment?

## PHILOSOPHICAL PERSPECTIVE

Biomechanics has often been criticized for not being a strong stand alone discipline. This implies that the study of biomechanics is simply a tool for other disciplines and cannot offer useful information on its own. It is true that biomechanics does

enhance and embrace other disciplines. However, this does not mean that biomechanics will never be a self-sufficient field of study. It should not be forgotten that this field is still relatively young. Definitions and descriptive understandings need to be formed in order to create a working foundation for a discipline to become strong and advance in a positive direction. If there is no base to work from, then only chaos and disjointed opinions are left as building blocks.

One way to strengthen the foundation of biomechanics may be to combine descriptive specifics with philosophical thought. The discipline is typically known for providing specific descriptions for various types of movement. However, it may be missing the combining philosophical aspects and applicable generalities that may be the key to gaining respect from other professions, and making biomechanics the stand alone type of discipline that it has the potential to be.

The introduction of philosophical thought requires certain amounts of creativity and theorizing. Traditionally biomechanists have been more involved with providing specific descriptive types of information instead of well-based theoretical frameworks and conceptualizations. Perhaps some of the on-going philosophical issues are those related to defining coordination and balance, and providing explanations of various movement functions that can be applied more generally instead of specifically. It is true that in order to arrive at general conclusions, specific types of information need to be gathered and assimilated. However, this assimilation process is not always completed and therefore, the information remains specific. Many times this type of specific information is used only once and then tossed aside to make room for more studies.

The underlying question here may be if these specific descriptive types of study alone add to the undiscovered knowledge base of biomechanics or do they simply fulfill requirements of publication and graduation?

Currently, the design of kinesiology lists biomechanics as a sub-discipline along with other areas such as sports psychology, sports sociology, exercise physiology, motor learning and development, and adapted physical education. Does the design of tomorrow find biomechanics as a main discipline with sub-discipline areas of animal, sport, clinical, developmental, educational, micro, and ergonomics?

## FUTURE PERSPECTIVES

There are several issues concerning biomechanics that are inevitable. These include the continuation of descriptive types of biomechanical analyses, continued modification and improvement of equipment, continued invasion of the discipline by other professions, and hopefully a realization of the need for biomechanics to become multidisciplinary, incorporating other movement sciences such as exercise physiology, motor development, motor learning, and human factors engineering. These issues are too obvious to any biomechanist concerning the future of their profession. Therefore, the futuristic outlook of biomechanics should be characterized by a set of goals describing the needs of the profession, not just accepting those issues most likely to occur.

The following set of goals is presented as a preliminary phase of developing a strategic plan for the biomechanics discipline. Five goal areas have been formulated with attached objectives.

Mission Statement: The mission of the discipline of biomechanics is to teach, develop, and produce individuals who can combine scientific principles with philosophical thought to understand the mechanics of all living bodies and to enhance the quality of

life.

1. Historical Perspectives Goal: To develop a descriptive historical background of the biomechanics discipline.

Objectives:

- 1.1 To describe a scientific and philosophical history of biomechanics.
- 1.2 To create a family tree of biomechanists.

2. Theoretical and Philosophical Perspectives Goal: To construct a theoretical and philosophical framework for the biomechanics discipline.

Objectives:

- 2.1 To assimilate specific biomechanical information for the creation of theories.
- 2.2 To combine descriptive specifics in biomechanics with philosophical thought to strengthen the foundation of biomechanics.

3. Research Perspectives Goal: To promote research opportunities and applications to strengthen the biomechanics discipline.

Objectives:

- 3.1 To expand interpretations of results of biomechanical studies.
- 3.2 To apply biomechanical information to a more general rather than specific populations.
- 3.3 To use inductive as well as deductive reasoning for research efforts.
- 3.4 To combine qualitative research with quantitative research methodologies.
- 3.5 To answer the ever present question applied to all scientific research results — So what?

4. Technical Perspectives Goal: To implement technological aspects of the biomechanics discipline.

Objectives:

- 4.1 To construct research questions using current technology.
- 4.2 To devise additional equipment to answer research questions.

5. Professional Perspectives Goal: To formulate role definitions for the biomechanist in contemporary society.

Objectives:

- 5.1 To determine the characteristics separating the biomechanist from other related professions.
- 5.2 To develop more defined sub-disciplines of biomechanics that reflect the different topics of application of these same sub-disciplines.

## SUMMARY

From the past, present, and future perspectives, one may conclude that biomechanics needs to expand its knowledge base perhaps more from a theoretical standpoint than from a scientific one. It should be noted that biomechanists have provided very important information regarding movement patterns, force production, and injury prevention tactics, to name a few examples. There are still many unanswered questions to be solved and a great deal of knowledge yet to be obtained. In order for the discipline to continue to grow and find its place in tomorrow's society, we need to evaluate the

discipline of today.

#### REFERENCES

Adrian, M. J. and Cooper, J. M. (1989). The Biomechanics of Human Movement. Indianapolis: Benchmark Press Inc.