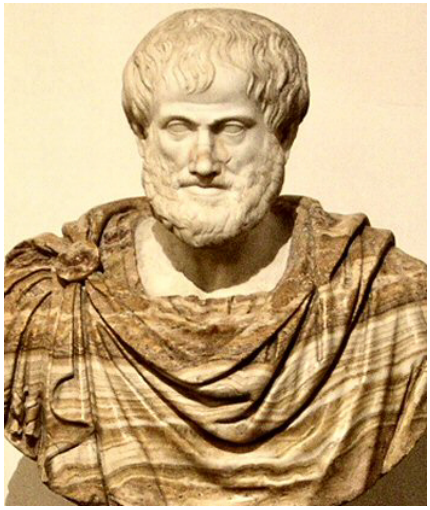
Specificity Part 1: An Historical Perspective



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Abstract

Henry (1958) proposed the Specificity Hypothesis of Motor Learning, suggesting that the underlying abilities within a task or skill were specific to that task or skill and not transferable. The purpose of this paper was to review the historical basis for the development of the Specificity Hypothesis. Earlier historical perspectives include Plato's perspective on introspection, Aristotle's view of empiricism, and Decartes contribution to Neurophysiological learning theories. Of special interest is a discussion on the notion of Generality in intelligence through the formal discipline approach to learning, and how the concept influenced Motor Behavior Research. Finally, Henry (1958) is introduced and the extent of his contribution to our current understanding of Specificity, and to the field of Exercise science itself are analyzed.

Early Notions of Learning

Motor Behavior research has its historical roots in Learning Psychology. Some of the earliest notions of learning were provided by Plato. He felt that everything in the physical world had an idea which caused its existence (Cornford, 1968). When the idea was turned into the physical many of its components were lost. In this context, he suggested that true knowledge could not be obtained through the senses. In fact, he posited that humans were born with total knowledge of all, and that through introspection alone could this knowledge be obtained. Introspection can be defined as mental questioning. This would include asking an individual what they thought as they viewed a certain picture. Aristotle, a student of Plato's knew much about reason

and introspection, however he felt that its place must be in accordance with sensory data (Barnes, 1995). Indeed, he posited that we learned through sensory experience followed by mentally contemplating that data to find its true meaning. Currently, much of Psychology is a mixture of the study of cognitive processes through, inference using observation or the senses as Aristotle suggested. Aristotle also developed the laws of association. These include the law of similarity which suggests that present experiences will arouse similar memories, the law of contiguity which suggests that an experience or memory will arouse other memories which occurred along with past similar experiences or memories. He also introduced the law of frequency, which is fundamental to all learning theory. It posits that the more frequently two experiences occur together, the greater the probability that they will arouse each other upon a future experience or memory of that experience. So powerful were Aristotle's contributions that Weimer (1973) suggested that 'Aristotle's doctrines are the heart of contemporary thought in the psychology of learning…not one single learning theory in this century has failed to base its account on associative principles.'

Descartes (1596-1650) also provided great insight to learning (Hergenton and Olson, 2005). His method of inquiry can be seen in his statement ' I doubt everything, except one thing, and that is the very fact that I doubt. But when I doubt I think, and when I think I must exist.' With this Descartes concluded ' I think therefore I am.' Through his method of inquiry he proposed some of the earliest theories of motor control. For example he suggested that our mind could control the pineal gland to release animal spirits which traveled down channels to skeletal musculature. The spirits would fill the musculature, resulting in their swelling during movement and contraction. Today, science suggests that we initiate movement from our motor cortex, in which neurological impulses travel down to relevant musculature. However, the fundamental approach led to much research. Descartes also encouraged dissection of the body to gain a greater understanding of its physiology. This approach is perhaps the basis of current Neurophysiological theories of learning, which attempt to integrate learning theory into actual neurological structures.

Historical Basis for Generality and Specificity Paradigms in Learning Psychology

One of the most critical proposals to this paper concerns Thomas Reid (1710-1796). Reid suggested that humans were born with 27 faculties in the mind (Brooks, 1997). A faculty could be thought of as an underlying ability, such as the ability to think logically or reason. Fran Gall (1958-1828) expanded on this concept by positing that if a faculty was developed it would show up as a protrusion on the skull that could be palpated (Hergenton and Olson, 2005). He even devised a chart which outlined where each faculty was. It was also suggested that these faculties could be strengthened with practice. Therefore, a human could improve his general artistic ability by painting, and this ability would transfer to all other artistic abilities. This is known as the formal discipline concept (Hergenton and Olson, 2005), and suggests that there are general types of intelligences that are transferable in nature. This concept of general intelligence still pervades today in constructs such as the IQ test.

Edward L. Thorndike is regarded by many as the greatest learning theorist of all time. Upon his death in 1949 he had written over 507 journal articles, books, and monographs, and reportedly by the age of sixty had invested over twenty thousand

hours studying scientific literature (Hergenton and Olson, 2005). Of importance to this series is Thorndike's work on what he called 'transfer of training.' Thorndike spent a great deal of time investigating what the transfer or benefit of training in one situation would be to a different situation. He proposed the Identical Elements Theory of Transfer, which suggests that the amount of transfer or benefit training in one situation would have on another, would be determined by the number of elements that the two situations had in common. This theory would spur one of the greatest dynamic duos in the history of science. Thordike would team up with Woodworth, a man credited for first formally investigating the speed accuracy trade off, as well as the classification of the time needed to process and react to visual stimuli (Woodworth, 1899).

Thorndike and Woodworth (1901) utilizing statistical evidence correlated various tests and fields of study in over 8, 564 high school students. For example, they would correlate improvement in multiplication skills with certain verbal memory skills or certain mathematical skills such as geometry with Calculus skills. If there were high correlations, it would indicate a large degree of generalization or similarity between intelligence tasks. However, low correlations would indicate that the tasks had low commonality or that they were specific in nature. Further, a high correlation between several intelligence tests would also indicate that intelligence was a general ability. Low correlations would indicate a number of sub intelligences that are task specific. After investigation, they found very little correlation between any two tests, which suggested that training should primarily focus on the specific situation needed to obtain a specific goal. In a recent commentary, Hergenton and Olson (2005) stated that ' Thorndike believed that learning will transfer from the classroom to the environment outside only insofar as the two situations are similar.' This evidence was devastating to the formal discipline approach to learning, and its implications wide spread, as it suggested that learning was specific to the task performed and had little transfer.

The Specificity Hypothesis in Motor Behavior Research

Motor Learning research diverged from psychological learning research theories. Further much of the thought that a general intellectual ability existed was transferred onto Motor Research as well. For example a major Military effort in response to world war II was the development of the U.S. Army Air Force's Psycho-Motor Testing Program. The program had the assumption that it could test for general abilities related to the selection of military personal. However, it was found that the tests had low predictability. Research after the war continued for a short time, but unfortunately began to fade. Schmidt and Lee summarize:

'Motor Research was dead, or so the psychologists thought; but they did not consider a man named Franklin Henry, trained in psychology and working in the Physical Education department at Berkeley, who had a continuing interest in motor behavior research. Fittingly acknowledged as the Father of motor behavior research in physical education, he advocated an approach using psychological techniques, laboratory tasks, and careful measurement.'

With a background in experimental Psychology, Henry (1958) was familiar with studies involving the specificity of intelligence and challenged the idea that a General Motor Ability existed. He therefore proposed the Specificity Hypothesis of Motor Learning, which suggests that the underlying abilities of a motor skill or task are

specific to that skill or task and not transferable (task-specific) (Sawyer, 2005). Through numerous correlation tests, Henry provided overwhelming evidence for Specificity (see article two of this series for a more in depth discussion).

The influence of Henry and his Specificity Hypothesis have been astonishing, and are commonly acknowledged by top scientific texts. For example, Weinberg and Gould (2003), perhaps the two leading sports Psychologists in the world state that:

'Franklin Henry…was largely responsible for the field's scientific development. He devoted his career to the scholarly study of the psychological aspects of sport and motor skill acquisition. Most importantly, Henry trained many other energetic educators who later became university professors and initiated systematic research programs…his students became administrators who reshaped curriculums and developed sport and exercise science or the field of kinesiology as we know it today.'

These powerful words can be expressed through the examination of great scientists such as Dr. John Ostarello, Dr. Donald Sawyer, Dr. Calvin Caplin, and Dr. Richard Schmidt. Dr. Ostarello, a student of Henry's is known as one of the founders of Biomechanics in the United states today, he has contributed greatly to kinesiology and is the current President of the esteemed Western Society for Kinesiology and Wellness, Treasurer of the Western College Physical Education Society, Program Chair of the Western College Physical Education Society in 2004, and lifetime member of the most elite organizations in exercise science. Richard Schmidt's research has been astonishing. For example his Schema Theory of learning over the past 30 years has generated an unparallel amount of research, being referenced in over 700 journal articles, and achieving the 'citation classic' award by the Institute for Scientific Information (Sherwood and Lee, 2003). Schmidt has also founded one of the most dominant resources in Motor Learning in the Journal of Motor behavior, and has authored numerous graduate and undergraduate level books. Dr. Caplan, also a student of Henrys has trained perhaps the brightest minds in the field and performed extensive research in Motor Learning and exercise physiology, including incredible research on the effect that training under fatiguing conditions has on the learning process. Dr. Sawyer is a second generation student of Henry, and stands today as perhaps the worlds leading authority on the Specificity Hypothesis. His research has challenged the credibility of some of the most powerful studies attempting to consolidate Generality. For example, Fleishman (1957, 1964, 1967, 1992, Parker and Fleishman, 1960) utilized factor analysis to examine the abilities which underlie motor skills. The statistical tool can be utilized to correlate several tests to one test. Through this correlative method Fleishman found high enough correlations to assume that there were indeed general abilities such as coordination. However, research from Sawyer and Rivenes (1999) challenged this in a study entitled 'Reexamination of the Fleishman data.' In the study Sawyer demonstrated that typically correlations are extremely low, and that the statistical methodology utilized by Fleishman artificially elevated the correlations in his study, leading to a misinterpretation of the data. Sawyer and Noel (2001) have also contributed greatly to enhancing our ability to understand the very nature of learning, and how to effectively tease out performance effects from learning. More recently, Sawyer and Ostarello et al. (2002) directly investigated the Specificity Hypothesis in football players, and generally found low correlations between tasks. However, as will be discussed in future articles, they may have found additional compelling evidence for an underlying timing modulator / mechanism within human beings. The implications of this await further research.

Conclusion

In the context of the above history, current scientists have a great responsibility to build off of the work of the above Giants in the field of Kinesiology. Further as Second Generation students of the Father of Motor learning, Franklin Henry, the current authors take this responsibility with great fervor and scientific determination as they have received their training, graduated in the field of kinesiological science underneath and had the utmost privilege to research with Dr. Sawyer, Dr. Ostarello, and Dr. Caplan. This series is dedicated to these great men of science, for their undying contributions to an understanding of science and incredible research which has advanced the field to such a great extent. As such, the purpose of this article is to provide an extensive analysis of Henry's Specificity Hypothesis. The second article in this series will discuss over a century of theoretical rationales for the Specificity phenomenon. Article three will endeavor to explain movement control theories and their application to Specificity. The fourth installment will attempt to uncover the underlying elements proposed by Thorndike and Woodworth (1901) which determine the amount of transfer of training between any two tasks. Articles five and six will extensively cover the voluminous evidence supporting the Specificity Hypothesis, as well as current violations in light of this evidence. Articles six through nine will cover conditions of practice in the context of Specificity, and how the concept of variation should be addressed. Finally a summary of practical applications will be provided so as to direct the reader to consolidate the vast material provided in this series.

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