

AN ABSTRACT OF THE DISSERTATION OF

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With the growing popularity of kinesiology at the undergraduate level, one would expect the field to be influential. Kinesiology, however, appears to be in a paradox. The undergraduate popularity is not reflected in the rest of academia, or even the general public, many of whom feel kinesiology is not a legitimate field. Part of kinesiology's problems may be due to the continued fragmentation among the sub-disciplines. Many prominent kinesiologists have proposed interdisciplinary research (IDR) as a viable path to the field's re-unification. Despite all of the discourse about this, however, the field appears to be stuck.

The overall objective of this dissertation was to nudge the conversation forward by exploring IDR in kinesiology. This dissertation attempted to close this knowledge gap by summarizing the body of literature on IDR, outline trends, purpose a model for IDR, describe incentives and limitations, and identify areas for further investigation within the

field of kinesiology (and possibly broader academic community). This was accomplished by using a mixed-methods approach, consisting of two separate but related studies.

The first empirical study provided a quantitative descriptive review of IDR in kinesiology and purposed a prediction model. A stratified-random sample of journal articles ($n = 552$) were selected from kinesiology-focused journals ($n = 10$) from the years 2008 to 2012. Articles were coded on a variety variables characterizing the authors and the nature of the research. Authors were primarily publishing disciplinary research (78.8%) versus IDR (21.2%). The majority of research was biophysical (67.2%), quantitative (94.5%), and funded (52.7%). Authors from kinesiology departments published just over half the journal articles (57.4%). There was little significant change in the authors or research variables across time. The prediction model for IDR selected by the step-wise regression ($R^2 = 0.52$, $p < 0.001$) had three predictor variables: behavior epidemiology framework, theoretical framework, and disciplinary focus. However, despite increased demand for IDR and kinesiology's inherent multidisciplinary nature, disciplinary research prevails in the field.

The second empirical study explored kinesiologists' perception of IDR, including perceived benefits and limitations. Themes were uncovered using a qualitative, open-coding protocol. The overarching themes were Benefits (i.e., the positive aspects to conducting IDR) and Limitations (i.e., the challenges to conducting IDR), each with eight sub-themes. The most prominent sub-themes for Benefits were New Perspectives, Better Results, and Collaboration Potential. The most prominent sub-themes for Limitations were Collaboration Problems, Challenging Methodology, and Limiting Results and

Analysis. Overall, all participants felt IDR was valuable to the field, but each had legitimate reservations, creating a somewhat contradictory environment that causes tension between the perceived benefits and limitations. Until the tension can be resolved, IDR may continue to remain on the fringes of kinesiology research.

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Breaking Silos: Interdisciplinary Research in Kinesiology

by
David P. Schary

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

David P. Schary, Author

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CONTRIBUTION OF AUTHORS

David P. Schary, M.S., M.P.H., conceptualized the studies, collected all data, conducted and interpreted data analyses, and drafted the manuscripts.

Bradley J. Cardinal, Ph.D., assisted in the development of the research design, checked thematic coding, provided editorial comments, and made suggestions on the interpretation of the findings.

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Chapter 1. General Introduction

General Introduction

With all the resources found within kinesiology, the discipline should be inspiring and influential. This appears to be true among undergraduates in the United States, kinesiology is one of the fastest growing majors, growing 50 percent from 2003 to 2008 (Wojciechowska, 2010). Fueling the popularity is the increased need for health professionals to help an aging, sedentary American population. Many undergraduates view kinesiology as a means to gain access into professional schools serving this population (e.g., medical school, physical therapy school, and other allied health professions). Despite the rise of interest among undergraduates, Wojciechowska stated that less than one percent pursues a graduate degree within kinesiology.

Kinesiology appears to be in a paradox. The popularity on the undergraduate level is not reflected in the rest of academia, or even the general public, many of whom feel kinesiology is not a legitimate field. For example, Boone (2009), a professor and chair of the Department of Exercise Physiology at the College of St. Scholastica, stated that kinesiology is a “useless” degree because “there are no financially viable or credible jobs for the graduates of these programs” (p. 10). In addition, Boone shared that a colleague from a different department bluntly asked, “do the faculty know that exercise science is little more than jargon and gibberish? This may be considered harsh, but it is reality” (p. 8).

Many have speculated about the reasons for the discrepancy between undergraduate popularity and faculty disdain, Lawson (n.d.) argued it is because kinesiology lacks economic and cultural capital. Economic capital is deficient because,

unlike other academic disciplines such as engineering or computer science, kinesiology does not produce or research material goods. Instead, kinesiologists study human movement. While tangible, human movement is not necessarily something you can package and market. In an academic world stretched thin for financial resources, kinesiology struggles to show its financial potential. Kinesiologists do produce social capital; their research is tangible and offers a benefit to society at large, but it largely goes unnoticed (Lawson, n.d). Kinesiology then appears as an immature field, lacking a central vision and leaving fellow academics, administrators, and the general public struggling to understand its unique purpose (Lawson, n.d.). Thus, leading to the view of kinesiology as “little more than jargon and gibberish”.

Such struggles are not new for those in kinesiology, only exacerbated by changing social conditions, including a disinvestment by government in higher education (White, 2010). The field has long attributed the problems of identity to the fragmentation among the sub-disciplines (Gillis, 1987; Henry, 1978; Hoffman, 1985; Park, 1991, 1998; Rikli, 2006). Many prominent kinesiologists have proposed interdisciplinary research as a viable path to the field’s re-unification (Gill, 2007; Kretchmar, 2005; K. M. Newell, 2007; Rikli, 2006). However, it appears the field is stuck, as there has been little research examining interdisciplinary research in kinesiology.

To help address this gap in the literature, the overall objective of this dissertation is to explore interdisciplinary research in kinesiology. The guiding motivation is to help kinesiology strengthen its image and credibility in order to maximize its positive impact on health, society, and quality of life. Fulfilling this desire is beyond the scope of any

single project, but my hope is that this dissertation will nudge the conversation past its current stalled state. Specifically, the dissertation will summarize the body of literature, outline trends, propose a model for interdisciplinary research, describe incentives and limitations, and identify areas for further investigation regarding interdisciplinary research within the field of kinesiology (and possibly the broader academic community).

This will be accomplished by using a mixed-methods approach, consisting of two separate but related studies. The aims are:

Study (1): To provide a descriptive review of interdisciplinary research in kinesiology.

Study (2): To explore the incentives and barriers of interdisciplinary research in kinesiology.

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Chapter 2. Review of Literature

Learning From the Past to Reunite the Present: Interdisciplinary Research in Kinesiology

Abstract

With the growing popularity of kinesiology at the undergraduate level, one would expect the field to be influential. Kinesiology, however, appears to be in a paradox. The undergraduate popularity is not reflected in the rest of academia, or even the general public, many of whom feel kinesiology is not a legitimate field. Part of kinesiology's problems may be due to the continued fragmentation among the sub-disciplines. Many prominent kinesiologists have proposed interdisciplinary research as a viable path to the field's re-unification. Despite all of the discourse about this, however, the field appears to be stuck. The lack of action could be due to the lack of clarity surrounding interdisciplinary research, an often misunderstood and misapplied concept with deep philosophical roots. This paper will explain interdisciplinary research and show its importance to the future of kinesiology. In addition, the paper will give examples of interdisciplinary research projects.

I do not claim to have originated any new principle or doctrine. I have simply tried in my own way to apply the eternal truths to our daily life and problems...The opinions I have formed and the conclusions I have arrived at are not final. I may change them tomorrow. I have nothing new to teach the world. (Gandhi, 2001, p. 306)

Gandhi (2001) often spoke that his approach to truth and nonviolence was not something new. He discouraged people from labeling the movement “Gandhism”, humbly stating that the ideas he championed, while powerful enough to topple the British Empire, were not his own. Gandhi learned from the past, listened to the many that came before him, and used his spirituality to unleash the largest, most powerful acts of nonviolent resistance in history.

Gandhi never overtly spoke on the importance of physical activity, but his wisdom appears to be just as applicable within kinesiology in terms of respecting the past. With regards to sub-discipline fragmentation or interdisciplinary research (IDR) in kinesiology, I have nothing new to share. One just needs to glance through the last fifty years of literature to see that kinesiology suffers from over-specialization and fragmentation (e.g., Henry, 1978; Hoffman, 1985; Kretchmar, 2005; K. M. Newell, 1990, 2007; Rikli, 2006). Similarly, one just needs to overhear university administrators to know that IDR is rapidly becoming the norm (Rhoten & Parker, 2004). Yet, I feel that something is still missing.

Many prominent kinesiologists have spoken on this topic before, but there are many parts that have not been put together. For example, kinesiologists often discuss IDR

as important, yet never define or operationalize IDR. In addition, while individuals in kinesiology know the history of fragmentation and understand the popularity of IDR, little research has been done to show how the two together can help rectify the slippery problem of reuniting kinesiology back under a single identity. I feel this is partially due to a lack of understanding of how the pieces are woven together, seeing how the philosophical nature of IDR can help illuminate the problems and bridge disciplinary fragmentation. By learning from the past, listening to those who have come before, and respecting the nature of each sub-discipline, kinesiology can come together.

The aim of this review is to evaluate the literature pertaining to IDR and its importance within the field of kinesiology. First, I will try to clarify the abstract notions of interdisciplinarity (ID) and IDR, distinguishing both from related concepts. I will then describe the history of specialization and fragmentation within the field of kinesiology. I will end by showing the importance of IDR in kinesiology, and give examples of successful collaborations.

Interdisciplinarity

As illustrated in the *Chronicle for Higher Education* (Basken, 2012a, 2012b; Jacobs, 2009; Ruse, 2010), IDR discourse fills the halls of academe and it is required in National Science Foundation (NSF) grant applications. Despite all the chatter, ID remains mysterious to academics and administrators, often ambiguous and misunderstood. Thus, before delving into the importance of IDR in kinesiology, one needs a clear understanding of ID, and its subsequent role in research.

What exactly is ID? The answer depends on whom you ask. Currently, among academic scholars, there is no agreed upon definition or application. Instead, there are numerous, often competing, classifications in operation (Klein, 1990; Lattuca, 2001; Moran, 2010). For example, ID:

- involves two or more academic, scientific, or artistic disciplines ("Interdisciplinarity," n.d.).
- suggests forging connections across the different disciplines, but it can also mean establishing a kind of undisciplined space in the interstices between disciplines, or even attempting to transcend disciplinary boundaries altogether (Moran, 2010, p. 15).
- is direct or indirect use of knowledge, methods, techniques, devices (or other products) as a result of scientific and technological activities in other fields (Tijssen, 1992).
- is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice (Committee on Science, Engineering, and Public Policy, 2005, p. 2).

Klein (1990) explained much of the confusion is due to ID's philosophical nature, which in turn, is affected by the conflicting opinions of its origin. Some scholars argue that ID has ancient roots, extending back to "interdisciplinary thinkers" like Plato, Aristotle, Rabelais, Kant, and Hegel, who each in their own way, viewed knowledge as unified and/or relational (Klein, 1990; Lattuca, 2001). Others dismiss the relevance of tracing ID back to the ancient Greeks because individual disciplines were not common until the nineteenth century (Lattuca, 2001). W. T. Newell (1998) even suggested distinguishing between ID and predisciplinarity because, "the interdisciplinary motivation to seek perspective would have little urgency prior to the distinctive worldviews of reductionist disciplines" (p. 533). Scholars like W.T. Newell view ID as a

modern phenomenon, beginning in the twentieth century (i.e., 1930s) as a strategy to reform higher educational systems by promoting disciplinary integration (Klein, 1990; Lattuca, 2001). Thus, depending on one's historical stance, ID can be seen as either the purest form of knowledge (i.e., ancient perspective) or as a tool to enhance, organize, and understand disciplinary knowledge (i.e., modern perspective; Moran, 2010).

While the arguments muddy the definition(s) of ID, there are identified common characteristics. Klein (1990) explained that ID integrates material from multiple fields of knowledge into a new, single, coherent entity. Lattuca (2001) simply stated that ID is the interaction of different disciplines. Moran (2010) added ID centers on problems that cannot be addressed or solved with only disciplinary knowledge; there is a need for an all-inclusive synthesis. These authors all suggest that interdisciplinary projects emphasize integration over discrete disciplinary studies. This is an important distinction from multidisciplinary (MD), which also involve multiple fields but in an additive instead of integrative manner (Klein, 1990). While it is frequently used interchangeably with ID, MD makes no attempt to combine knowledge; rather the collaboration is a series of separate parts joined under a common title. Rossini and Porter (1984) likened ID as a seamless woven garment that stands in contrast to the patchwork quilt that is MD.

Fueled by the proliferation of disciplines and scholarship, other terms similar to ID have become popular. Cross-disciplinarity (CD) is when scholars work in unidirectional cooperation, explaining aspects of one discipline with another (Klein, 1990). Cross-disciplinary subject areas are often considered "sub-fields" of a parent discipline, for example, biochemistry, history of science, and psychology of exercise.

Transdisciplinarity (TD) is an idealized and abstract form of ID, far more comprehensive in scope and vision than any other previous forms of knowledge discussed. It extends beyond traditional discipline boundaries to create an overarching synthesis that transcends any known paradigm or framework (Klein, 1990; Lattuca, 2001). Finally, intradisciplinary (ITD) has been suggested to refer to the synthesis of sub-disciplines within a broader discipline (Reeve, 2007), thus emphasizing the relatedness of the sub-disciplines. However, ITD has not been mentioned elsewhere in the literature.

Recently, scholars have challenged the arguments surrounding ID, feeling the traditional concept of ID, may no longer be adequate (Klein, 2000). This is partially due to the increase in communication technology that has made collaboration easier among different areas (i.e., academic disciplines, technological fields, and private sectors; Spirduso, 2009). Yet this expansion seems to have created even more ambiguity. Trying to move away from defined labels, ID now focuses more on the integration of different bodies of knowledge, rather than emphasizing the merging of disciplinary boundaries (Committee on Science, 2005). Not having to worry about definitional boundaries allows for greater, albeit subtle, flexibility, which allows ID to vary in the way it is organized and conducted.

Interdisciplinary research. Interdisciplinary research applies ID to scholarly research. It is challenging to translate the philosophical theory into practice, regardless of the ID definition chosen, because the concepts are not typically based on real-world observations (Lattuca, 2001). Despite the difficulty, there have been several scholars who

have suggested operationalized, “working definitions” of IDR by combining characteristics of several theoretical definitions.

Following a systematic review of 14 different separate definitions, Aboelela et al. (2007) created a definition of IDR, which was then examined by 12 experts in science and health IDR. The following working definition is the result of their work:

Interdisciplinary research is any study or group of studies undertaken by scholars from two or more distinct scientific disciplines. The research is based upon a conceptual model that links or integrates theoretical frameworks from those disciplines, uses study design and methodology that is not limited to any one field, and require the use of perspective and skills of the involved disciplines throughout phases of the research process. (Aboelela, et al., 2007, p. 341)

The definition is similar to the Committee on Science, Engineering, and Public Policy’s (2005) definition quoted in the previous section. However, the Committee’s definition acknowledges an individual’s ability to conduct IDR. The Committee’s definition was part of a larger report on IDR that also consisted of a thorough review of the current definitions, strengths, and challenges of IDR. The authors concluded that IDR is an integral part of research and academic training, and while there are challenges, the Committee felt IDR was beneficial for students, faculty, and the greater researcher community (e.g., funders, government agencies). The report was also reviewed by a panel of experts, and has since been adopted by the NSF.

In addition, the National Institutes of Health (NIH) recognizes IDR as an important aspect of the advancement of knowledge, making it a priority in its recent Roadmap, a strategic plan for future NIH funding (<http://nihroadmap.nih.gov/interdisciplinary/>). The NIH acknowledges that many scientific questions cannot be answered by a single discipline, thus a goal of NIH's IDR program is to shift the academic culture towards interdisciplinary approaches and diverse scientific teams (<http://nihroadmap.nih.gov/interdisciplinary/>). However, the NIH requirements have been vague, requiring clarifying statements on the Request for Applications (Huerta et al., 2005). Regardless, the NIH's support and grant money available for IDR has helped to elevate IDR as a necessity in scientific research (Freeman, 2012; Giacobbi, Buman, Romney, Klatt, & Stoddard, 2012).

The previous working definitions describe IDR, but they do not specify the degree of IDR. Recognizing this gap after an extensive literature review, Lattuca (2001) developed an IDR typology scheme. The typology categories were also informed by Lattuca interviews with 38 faculty members, selected for their research and teaching characteristics. Lattuca asked the participants to describe their own accounts of IDR and teaching. From this plethora of information Lattuca developed a four category IDR typology: 1) Informed Disciplinarity, 2) Synthetic Interdisciplinarity, 3) Transdisciplinarity, and 4) Conceptual Disciplinarity. While the categories are distinct, the typologies might be better conceptualized as a continuum, from less interdisciplinary (i.e., Informed Disciplinarity) to virtually discipline-less (i.e., Conceptual Disciplinarity).

Interestingly, Lattuca (2001) noticed that the participants approached IDR in similar fashion to research design, their research question(s) determined the appropriate IDR method. By examining the research question, Lattuca could more easily classify the research.

Interdisciplinary research typologies. Informed Disciplinarity is similar to cross-disciplinarity, the research question is discipline-based but may be supplemented and informed by concepts or theories from a different discipline (Lattuca, 2001). For example, an exercise psychologist may measure societal or environmental barriers to help understand an individual's motivation to be physically active. While it draws from outside of the discipline, the borrowed tools are only being used in the context of psychology.

Synthetic Interdisciplinarity is similar to multi-disciplinary, the research question links disciplines together (Lattuca, 2001). Questions are found at the intersections or gaps of multiple disciplines. Continuing with the previous example, a Synthetic Interdisciplinarity approach examines both the complexities of an individual's social capital and its potential influence on motivation to participate in physical activity. This moves up the IDR continuum, connecting together theories and conceptual models from multiple disciplines, instead of just borrowing variables. In addition, Synthetic Interdisciplinarity can be done in research teams, where each member makes a disciplinary contribution.

According to Lattuca (2001), transdisciplinarity is similar to interdisciplinary. These research questions apply theories, concepts, or methods across disciplines with the

intent of developing an overarching synthesis. It differs from the previous two typologies because it is not borrowing from one discipline and applying it to another, but rather combining frameworks in a unique way that transcends any individual discipline. A Transdisciplinarity approach might strive to combine societal and cognitive factors together, like social capital and motivation, forming a new single social-psychological framework to examine an individual's participation in physical activity.

Conceptual Interdisciplinarity is similar to the originally described transdisciplinary (as opposed to Lattuca's [2001] Transdisciplinarity typology), conducting research without any disciplinary basis. It also resembles Grounded Theory (Glaser & Strauss, 1967), where research is approached without any predetermined lens or theoretical basis. Yet, this type of research often implies a critique of disciplinary contributions, as most scholars employ a postmodernist, feminist, and/or cultural studies approach (Lattuca, 2001). In practice, Conceptual Interdisciplinarity appears difficult to apply, in fact, Lattuca (2001) did not have any specific examples. Thus, it appears that Conceptual Interdisciplinarity is an ideal mindset towards research, whereas the previous three typologies are operationalized approaches.

Lattuca's (2001) typologies label most research as IDR, but the categories do cover all of the mentioned characteristics of interdisciplinary, crossdisciplinary, multidisciplinary, and transdisciplinary. By viewing all IDR research as a continuum such work is easier to comprehend and classify.

The Structure of Kinesiology

It is necessary to explain kinesiology's structure and history, before the importance of IDR in kinesiology can be fully understood. According to Hoffman and Harris (2013), the field of kinesiology has seven main sub-disciplinary areas: Biomechanics, History of Physical Activity, Motor Behavior, Philosophy of Physical Activity, Physiology of Physical Activity, Sport and Exercise Psychology, and Sociology of Physical Activity. Although others recognize the existence of additional sub-disciplinary areas (e.g., Kinesmetrics [Zhu, 2010], Pedagogy [Freeman, 2012], Physical Activity Epidemiology [Dishman, Heath, & Lee, 2013], and Sport Management and Administration [Zeigler, 2003]). Cardinal and Lee (2013) also categorized 14 different sub-disciplines from the Research Consortium's (RC) annual program from 1992-2011. In addition to the sub-disciplines previously described, Cardinal and Lee (2013) listed dance, leisure and recreation, and interdisciplinary as sub-disciplines on the RC program. However, some sub-disciplines appeared relatively recently, Physical Activity Epidemiology (2011) and Sport Management and Administration (2000). Cardinal and Lee (2013) also observed that certain sub-discipline categories changed over time to be more inclusive (e.g., "Exercise Physiology and Fitness" [2000-2011] versus "Exercise Physiology" [1992-1999]).

The sub-disciplines reflect the areas of specialization within kinesiology. In kinesiology, specialization refers to the use of content and methodologies of a "parent discipline" (e.g., biomechanics, physiology, psychology, statistics) to the study of physical activity (Henry, 1964; Hoffman, 1985). Specialization is important because it

allows kinesiologists to explore and understand the intricacies of physical activity from the macro (societal) to the micro (genetics) levels. In addition, specialization within kinesiology is responsible for the continued production of a body of knowledge, which is necessary for legitimacy in higher education (Henry, 1964, 1978). Each sub-discipline's body of knowledge provides a distinctive lens through which to view physical activity, thereby uniquely contributing to the overall understanding of physical activity.

The growing number and increasing diversity of the sub-disciplines reflects the complex, dynamic nature of kinesiology (Hoffman & Harris, 2013). Although physical activity is not a new phenomenon, it continues to be studied by more individuals, who in turn, generate new knowledge. This new knowledge increases the prospect of new sub-disciplines, focal points within sub-disciplines (i.e., sub-disciplines within sub-disciplines), and/or even professional applications stemming from the evolution of the knowledge base. It is widely believed that kinesiology will continue to grow and become more specialized in the coming years (Hoffman & Harris, 2013).

Kinesiology: Problems with Fragmentation

Due to the variety of subject areas represented by the sub-disciplines, kinesiology by definition is multidisciplinary (Bories & Swanson, 2005; Spirduso, 2009). The sub-disciplines different bodies of knowledge all contribute separately to the understanding of physical activity. Ideally, the sub-disciplines would interact often, combining disciplinary knowledge through the different types of IDR described in the previous section. However, the sub-disciplines instead seem to isolate themselves in silos making basic communication, let alone cohesion, challenging. This has shaped kinesiology into a set of

narrowly focused sub-disciplines, which is reflected in research production and graduate program preparation (Thomas, 1987). Thus, kinesiologists struggle with weaving together the specializations into a broader physical activity framework (Thomas, 1987).

It is important to note that specialization itself does not automatically insinuate isolation; rather, fragmentation causes isolation. According to Thomas (1987) fragmentation refers to, “a part that is broken off or detached from the whole” (p. 115). Fragmentation occurs within an academic discipline when individuals become so specialized within a sub-discipline that they view their interests as distinct, removed of any perceived commonalties with other sub-disciplines (Edwards, 1989). In other words, specialists in kinesiology have lost the understanding of how their area of concentration fits within the larger physical activity framework (Thomas, 1987). For example, a researcher might identify as a physiologist studying the effects of exercise, instead of a kinesiologist who focuses on the physiological aspects of physical activity.

The language of fragmentation may appear subtle, but it alludes to the valuing of the parent discipline’s body of knowledge over kinesiology, further separating individuals from different sub-disciplines (Edwards, 1989). Rikli (2006) even stated that “few kinesiology faculty, it seems, are paying attention to the ‘big picture’ overall purpose and mission of the field, especially to its initial purpose of promoting ‘physical activity for the good of the masses’” (p. 292). This lack of attention to the importance of physical activity constrains communication between faculty in different sub-disciplines (Gillis, 1987). It also undermines the strength of kinesiology’s MD by chipping away at

the centrality of physical activity, the unifying thread connecting the sub-disciplines together.

At this point, it is necessary to clarify additional vocabulary. Within the literature, many scholars refer to the *profession* of kinesiology as different from the *discipline* of kinesiology. Corbin (1993) defined the discipline as the study and production of the body of knowledge, whereas the profession refers to the application of knowledge (e.g., practitioners, programs, clients, methods). However, both the discipline and the profession fall under the general *field* of kinesiology (Corbin, 1993). A field is the combination of “disciplinarians and professionals each fulfilling different important roles while working toward common goals” (Corbin, 1993, p. 88). The sub-disciplines are specializations of the discipline, and sub-specializations are specializations of the sub-disciplines. Regardless of the categorization, everyone associated with the field of kinesiology should be working towards the common goal of understanding and promoting physical activity. Fragmentation occurs when the common goal is lost among the disciplinarians and/or the professionals.

Fragmentation, however, is not a new problem within kinesiology. McCloy (1930) stressed the importance of integration in physical education (from which kinesiology evolved) by recommending all scientific research begin with a well thought out philosophy, defined as an endeavor to present an *integrated* whole that must be adequately explained. Henry (1964) is credited with jump-starting specialization within the field. Henry (1964, 1978) argued that specialization was needed for kinesiology to increase credibility and legitimacy within academia. An organized academic field solely

devoted to the study of physical education and activity was needed because, while other scientific disciplines (e.g., anatomy, physiology, psychology) studied humans, none specialized in physical education or activity (Henry, 1964). Increasing the specialized knowledge would help legitimize the field of physical education within academia. However, Henry (1964, 1978) adamantly warned against aligning with the parent discipline over the centralizing focus of physical activity. Such a view would diminish the common thread binding the sub-disciplines together. Henry (1964) insisted the emphasis stay on physical activity and understanding its different components, thereby maintaining a central focus or mission.

The field quickly responded to Henry's (1964) challenge to become more academically focused (often separating the profession and the disciple). Sub-disciplines quickly began to organize and specialize, however Henry's (1964) warning about discipline loyalty was seemingly disregarded, even when it was repeated several years later (Henry, 1978). Fragmentation quickly spread through departments as each sub-discipline aligned itself more strongly with the parent discipline at the expense of physical education (Henry, 1978; Hoffman, 1985).

An identity crisis: Problems associated with fragmentation. Without physical activity as the central focus, kinesiology is left without a clear general purpose or guiding objectives (Rikli, 2006). Thus, kinesiology appears to be experiencing an identity crisis. Within higher education, the identity crisis has made kinesiology an attractive target for restructuring, downsizing, or even elimination (Rikli, 2006). For example, over the past two decades, 12 kinesiology programs on the west coast of the United States were either

eliminated or significantly downsized (Rikli, 2006). Administrative “restructuring” was typically not due to a lack of skilled faculty or productivity. Scanlan (1998) described the demise of the Kinesiology Department at the University of California, Los Angeles, admitting that the department had brilliant physiologists and neuroscientists, but strayed dramatically from the central mission of human movement, leading faculty to drift towards the parent disciplines. This eventually led to the administration dissolving the department.

Park (1998) cautioned that without the ability to show a significant, relevant, and integrated body of knowledge (similar to engineering or computer science), kinesiology will struggle to secure a continued presence on university and college campuses. In addition, Knudson (2005) echoed that the absence of clear research outcomes and effectiveness of services provided by kinesiology professions have eroded support for kinesiology undergraduate and graduate programs.

Fragmentation has not been limited to the sub-disciplines; it has also created a split between the profession (i.e., practitioners) and discipline (i.e., researchers). However, instead of losing sight of physical activity’s importance, practitioners view kinesiology’s academic research as unhelpful or irrelevant to their role within the field (K. M. Newell, 1990, 2007). This is worrisome because the practitioners are often the public face of the field; if they are disconnected from the discipline, then it may negatively affect the public’s image of the entirety of kinesiology. To bridge this gap K. M. Newell (1990, 2007) suggested several changes to reunite the field back under the common umbrella of physical activity (e.g., centrality of physical activity, emphasize

similarities between sub-disciplines, enhance lifespan emphasis). Similar to Corbin (1993), if both researchers and practitioners see themselves as students of physical activity, then a common, shared language can be developed. Closing the gap would only strengthen kinesiology's influence and status within academia and the public, helping to strengthen the legitimacy of both researchers and practitioners. The details of achieving this challenging task are still vague, but unifying the sub-disciplines could help.

Park (1998) expanded that if the prominent leaders within the sub-disciplines could agree on a unifying focus and identity, kinesiology could show its value as a distinct discipline, increasing its influence within academia and the public. This was not to discredit the sub-disciplines' individual contributions or importance, as each uncovers different aspects of physical activity. In fact, Edwards (1989) notes that "both approaches [specialization and generalization] are mutually beneficial and serve to move the profession forward" (p.79). Without a common focus for the entire field, however, the innovations and research discovered by the sub-disciplines can get lost or misconstrued as another discipline. This dilutes kinesiology's identity as the leader in physical activity and exercise. Thus, similar to Hoffman's (1985) warnings a decade before, Park (1998) cautioned that if kinesiology did not decide to become the leader in physical activity, another field would at the expense of kinesiology.

Unfortunately, Park's (1998) prophecy is being fulfilled. Knudson (2005) described that of many the "discoveries in applied research in physical activity are made in other allied health fields (i.e., fitness boom of the late 20th century, associations between physical activity and morbidity/mortality, and the current epidemic of obesity

and diabetes), it appears that kinesiology faculty are on the sideline and not major players in addressing these health issues” (p. 215). Knudson blamed this outcome on prestigious academic journals over-emphasizing the importance of theoretical over applied research, shifting academic prestige and tenure towards the former at the expense of the latter. Without highlighting the importance of both ends of the research spectrum (applied to basic/pure science), kinesiology professionals risk being left out of important public health policy and programmatic decisions.

It appears that Henry’s proclamation in 1964 of nearly five decades ago has fallen on deaf ears. Despite continuous warning over the dangers, kinesiology continues to struggle to balance specialization without fragmentation.

Interdisciplinary Research in Kinesiology

Despite the vast amount of commentary and worry on kinesiology’s specialization and fragmentation, Rikli (2006) argued there has been “little evidence in the literature of a proposed strategy or a recommended plan of action to accomplish this goal” (p. 295). While there is no formal plan, many prominent kinesiologists have suggested IDR as a viable solution to reconnect the field. K. M. Newell (1990) first promoted cross-disciplinary research or IDR as a way to help close the growing chasms and reunite the field. Park (1991) also argued that kinesiology should focus its *collective* strengths and devote more time to fostering research that can benefit the entire field, not just one component.

Yet for such a critical and much discussed resolution, little research has been done to truly advance or evaluate solutions (Park, 2011). For example, within the field of

kinesiology, it is currently unknown how much IDR is being produced, who is producing IDR, and the challenges or barriers relating to IDR.

Kinesiology, however, should not only focus on IDR within the subdisciplines. This would limit IDR to one end of Lattuca's (2001) IDR continuum (i.e., Informed Disciplinarity and Synthetic Interdisciplinary). By partnering with researchers in other fields, kinesiologists could expand research IDR beyond its sub-disciplinary silos, and move up the IDR continuum. Partnerships between fields can transcend individual field limitations, which is necessary to help solve some of the world's complex, multifaceted public health and social problems (e.g., increasing sedentary behavior; Gill, 2007). Although it must be noted that there are potential pitfalls when such approaches are pursued. For example, partnering with other fields may increase the possibility of losing physical activity as a central focus (Gill, 2007; Rikli, 2006).

Examples of interdisciplinary research in kinesiology. While the research surrounding IDR is vague, there have been examples of collaborations in kinesiology. The following are by no means exhaustive lists of all IDR in the field; instead, they are meant to serve as examples, a sampling of the possibilities available with IDR. The examples will show IDR in the discipline, profession, and the field.

In their review of RC abstracts, Cardinal and Lee (2013) found evidence that all but one of the highest visible researchers on the RC program during the 20-year timespan 1992-2011 were bridging sub-disciplines to present physical activity research outside their "home" sub-discipline. The average was presenting research across 5.62 ($SD = 2.75$) sub-disciplinary areas, with the range being 1-12. Moreover, several of those involved in

presenting research across sub-disciplinary areas were also leading researching within a given sub-disciplinary area or two (Cardinal & Lee, 2013). While it is unknown the degree of the IDR, it is promising that highly visible and productive kinesiologists are branching out into other sub-disciplines, either independently or through collaboration. This could influence others to follow, increasing IDR throughout the field. This concept has been further promoted through the thematic (vs. sub-disciplinary) approach to conference programming since 2007 (Cardinal, 2007).

Focusing on bridging the gap between theory and practice through research, Knudson (2005) suggested that the National Strength and Conditioning Association (NSCA) is a leader in the field. The NSCA sponsors several levels of publications from peer-reviewed, applied science journals to a web-based magazine for the public (Knudson, 2005). This allows credible information to be disseminated to both academic and professional audiences. The NSCA's model is similar to the publication model of the American Alliance of Health, Physical Education, Recreation, and Dance (AAHPERD), which also offers a number of different types and levels of peer-reviewed journals (Cardinal, 1995). However, the NSCA falls short by not stating IDR in the mission statement of their journals; whereas AAPERD's *Research Quarterly for Exercise and Sport* emphasizes the journal's multi-disciplinary approach in its mission statement (<http://www.aahperd.org/rc/publications/rqes/index.cfm>). Regardless, sponsoring several different types of journals helps to make research relevant to the practitioner, helping to strengthen the tie between the profession and the discipline.

The most impactful examples combine IDR in the discipline and the profession, helping to increase the impact of IDR through closing the gap between knowledge and application. The Sports, Play, and Active Recreation for Kids program (SPARK) is one of the more successful examples of IDR and practical application. In a review of SPARK's history and development McKenzie, Sallis, and Rosengard (2009) explained that SPARK is an evidence-based PE program designed to increase activity levels through both health-fitness based and motor skills activities; it was originally developed in 1989 with a seven-year NIH grant. In addition, the original SPARK curriculum had teacher training and taught self-management strategies (now referred to as lifelong wellness skills), such as: behavioral contracting, self-monitoring, goal-setting, and decision making (McKenzie, et al., 2009). The program design implemented knowledge from multiple kinesiology sub-disciplines, especially motor behavior, physiology, pedagogy, and psychology. The developers drew heavily on Social Cognitive Theory (Bandura, 1977) to guide development, implementation, and dissemination (McKenzie, et al., 2009). In addition, many of the research studies evaluating SPARK used Public Health interventions and dissemination techniques (McKenzie, et al., 2009).

While the SPARK curriculum has gone through modifications since its inception, the curriculum has had success in multiple areas, including, physical activity in PE, physical fitness, motor skill development, enjoyment, and academic success (McKenzie, et al., 2009). The SPARK program was originally developed for elementary schools, but there has been some success in increasing physical activity in middle schools using this approach too (McKenzie, et al., 2009). Research continues on the curriculum, but the

program is now commercialized and disseminated through SPORTIME, a publicly traded company (McKenzie, et al., 2009). The success and longevity of the SPARK program shows the power IDR when it is carefully designed and implemented.

Interdisciplinary research can involve individuals outside of an academic setting, too. For example, Martin-Ginis (2012) summarized a community-university partnership approach to help individuals with spinal cord injuries (SCI) become more physically active. SCI Action Canada is a community-research partnership; it promotes physical activity knowledge and participation among individuals living with SCI. The project is an alliance of 16 organizations and 15 investigators from across Canada with a “common mission of developing and mobilizing evidence-based strategies that inform, teach, and enable people living with SCI to initiate and maintain a physically active lifestyle” (Morten-Ginis, 2012, p. 191). The group created “The SCI Action Canada Research and Knowledge Translation Program”, an operationalized blueprint for constructing knowledge, and subsequently, translating that knowledge in a careful, deliberate way. The blueprint included the following five principles: 1) Know you audience, 2) Identify credible messengers, 3) Create audience-specific messages and practices, 4) Select methods of delivery and implementation to targeted audiences, and 5) Evaluate implementation effectiveness. The researchers shared responsibilities with each other and the community members, giving everyone involved a greater sense of ownership. Although this was not a traditional IDR project, no original data was collected and analyzed; the structure of SCI Action Canada reveals the importance of IDR partnerships. It shows that complex problems need teams from a multitude of areas, and not just from

within the academic setting. The projects goal was to help future SCI research become successful, but these principles can be used by anyone wanting to pursue IDR with the community. In addition to explaining the plan and partnership, Martin-Ginis shared some insights into working with diverse research teams, mentioning that bringing together different groups and researchers together presented challenges, but the relationships that developed were priceless, both academically and personally.

Call to Action: Fear Inaction, Not Failure

Following his proclamation of not introducing anything new into the world, Gandhi continued:

All I have done is to try experiments in [nonviolence and truth] on as vast a scale as I could do. In doing so, I have sometimes erred and learnt by my errors. Life and its problems have thus become to me so many experiments in the practice of truth and nonviolence. (Gandhi, 2001, p. 306)

There is nothing left for those in kinesiology to do but begin experimenting.

The field's problems are known and solutions have been offered. Interdisciplinary research has been shown to be successful in producing effective programs that help make positive changes in society. The future will determine if IDR can reunite kinesiology, but we will never know unless we try on a much larger scale. Thus, our fears should not be in failure, as we can always learn and improve from unsuccessful projects. Rather, we should fear inaction, for only that will guarantee our field's inability to reunite and make society a better place.

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Chapter 3. Manuscript 1

Uncovering the Patterns of Interdisciplinary Research in Kinesiology

Abstract

Purpose: Interdisciplinary research (IDR) has been proposed as a strategy for strengthening the field of kinesiology, a strategy to unite the fragmented sub-disciplines. Yet little is actually known about IDR in kinesiology. This study provides a descriptive review (audit) of IDR in kinesiology, and it further proposes an initial model of IDR in kinesiology. **Method:** A stratified-random sample of journal articles ($n = 552$) were selected from kinesiology-focused journals ($n = 10$) from the years 2008 to 2012. Articles were coded on a variety variables characterizing the authors and the nature of the research. Acceptable inter-rater reliability ($\kappa = 0.72 - 1.0$) and intra-rater reliability ($\kappa = 0.82 - 1.0$) ensured accurate coding. **Results:** Authors were primarily publishing disciplinary research (78.8%) versus IDR (21.2%). The majority of research was biophysical (67.2%), quantitative (94.5%), and funded (52.7%). Authors from kinesiology departments published just over half the journal articles (57.4%). There was little significant change in the authors or research variables across time. The prediction model for IDR selected by the step-wise regression ($R^2 = 0.52, p < 0.001$) had three predictor variables: behavior epidemiology framework, theoretical framework, and disciplinary focus. **Conclusions:** Despite increased demand for IDR and kinesiology's inherent multidisciplinary nature, disciplinary research prevails in the field.

Writing at the cusp of World War II, Virginia Woolf argued against the traditional, autocratic, and sexist nature of English higher education:

The aim of the new college, the cheap college, should be not to segregate and specialize, but to combine. It should explore the ways in which mind and body can be made to cooperate; discover what new combinations make good wholes in human life (Woolf, 1952, p. 62).

Woolf's vision for a college focused on creating a new learning environment, a place where academics could come together to explore life's greatest mysteries. Decades removed from Woolf's writings, collaboration is becoming a reality as higher education is increasingly incorporating interdisciplinary goals into research, teaching, and funding expectations (Basken, 2012a, 2012b; Jacobs, 2009; Ruse, 2010). For example, Severin (2013) explained that several prominent universities in the United States have begun "cluster hiring", or hiring multiple faculty into interdisciplinary research (IDR) centers, to help address complex problems (e.g., global climate change, food security, health care). Sevrin suggested that cluster hiring, and by association IDR, reflects the expectations of an increasingly collaborative world.

Despite the growing importance of IDR in academia, it is rarely explained or operationalized. This is understandable because there is no agreed upon definition or application for IDR. Instead, there are numerous, and often competing, classifications (Klein, 1990; Lattuca, 2001; Moran, 2010). This is because the concepts are philosophical in nature and not typically based on real-world observations (Lattuca, 2001).

Despite the difficulty, there have been several scholars who have suggested operationalized, “working definitions” of IDR by combining characteristics of several theoretical definitions (Aboelela et al., 2007; Committee on Science, 2005; Lattuca, 2001). Lattuca (2001) developed a four category IDR typology based on a study’s research question(s): Informed Disciplinarity (i.e., discipline-based but may be supplemented and informed by concepts or theories from a different discipline), Synthetic Interdisciplinarity (i.e., links disciplines together, questions are found at the intersections or gaps of multiple disciplines), Transdisciplinarity (i.e., applies theories, concepts, or methods across disciplines with the intent of developing an overarching synthesis), and Conceptual Disciplinarity (i.e., no disciplinary basis). It should be noted that Conceptual Disciplinarity is an ideal framework for research, and thus, might be hard to operationalize. The typologies can be conceptualized as a continuum, from less interdisciplinary (i.e., Informed Disciplinarity) to virtually discipline-less (i.e., Conceptual Disciplinarity).

Conceptualizing IDR can help reveal its applicability to a given academic field. Within kinesiology, IDR has been discussed as one viable solution to the field’s fragmentation (Gill, 2007; Kretchmar, 2005; Newell, 2007; Reeve, 2007). Unlike Woolf’s vision, kinesiology is not operating as a collaborative, unified body. Similar to other academic fields, there are deep divisions among, and even within, sub-disciplines. Yet, perhaps ironically, kinesiology is multidisciplinary by nature (Bories & Swanson, 2005), with sub-disciplines in the physical sciences (e.g., biomechanics, physiology), social/behavioral sciences (e.g., psychology, sociology), and humanities (e.g., history,

philosophy). This gives the appearance, at least superficially, of an IDR “cluster” similar to that described by Severin (2013).

Unfortunately, the sub-disciplines often operate in isolation, creating individual knowledge silos, causing fragmentation and making cohesion challenging. To further aggravate the situation, fragmentation causes researchers to remain more loyal to their sub-discipline and/or parent-discipline rather than to the broader field of kinesiology (Edwards, 1989). As a result, kinesiology lacks a central, unifying mission directing its purpose and clarifying its objectives to outsiders (Park, 1998; Rikli, 2006), creating a de facto identity crisis, a challenge other IDR clusters may also face. Within higher education, kinesiology’s lack of identity has made the field a target for restructuring, downsizing, or even elimination (Hoffman, 1985; Rikli, 2006). For example, Rikli noted that over the past two decades, 12 kinesiology programs on the west coast of the United States were either eliminated or significantly downsized.

It is important to note that sub-discipline fragmentation is not a new problem for those in kinesiology. Since at least the time of McCloy (1930) and accelerating since Henry (1964, 1978), kinesiology has struggled to develop a common identity among its sub-disciplines. Many kinesiologists reinforced Henry’s views, expressing their own concerns about the fragmentation. For example, Bressan (1979) argued that kinesiology had to refocus the sub-disciplines, fixing the schisms that had been artificially created. Similarly, Hoffman (1985) worried about field’s ability to survive without a more holistic approach to producing knowledge and training graduate students.

Yet, for such a critical and much discussed topic there has been little done to understand IDR in kinesiology, it is not even known if IDR is beneficial for kinesiology. This gap between the hypothetical and reality must be bridged before IDR can be promoted as a way to help kinesiology's fragmentation. This daunting task cannot be started before a preliminary survey (or audit) of IDR in kinesiology has been completed. Currently, in kinesiology, it is not known what IDR is being done and what it entails (e.g., study designs, populations, sub-disciplines involved, theories).

Rhodes and Nasuti (2011) made an initial step toward this goal by capturing research trends in physical activity psychology from 1990-2008. Relating to IDR, the authors showed significant growth in multi-theory and environmental approaches to research questions. Despite the promising signs of IDR, however, Rhodes and Nasuti's study was restricted to only one kinesiology sub-discipline. In addition, neither Rhodes and Nasuti nor anyone else has purposed a model of what factors significantly predict IDR in kinesiology.

Similar to Rhodes and Nasuti's (2011) study, a descriptive assessment of IDR over time for all of kinesiology can help identify important characteristics and trends, helping to clarify IDR's role and inform future research. In addition, the results might help other IDR clusters that face similar challenges. Thus, the purpose of this study was to (1) begin addressing the gap in the literature by providing a descriptive review of IDR in kinesiology and (2) to propose an initial model of IDR in kinesiology.

Method

Sample. As shown in Table 1.1, articles were selected from kinesiology-focused journals ($n = 10$) published from 2008 to 2012. Journals were included on the basis of their interdisciplinary or multidisciplinary editorial mission statement (Appendix A). To ensure the selected journals fulfilled the desired requirements, an expert panel composed of five diverse kinesiology faculty members who were not affiliated with the study reviewed the journals (Appendix B). The panelists have 157 total years of experience ($M = 31.4$ years of experience) from across a range of disciplinary areas, academic ranks, and administrative levels of experience. They represent different regions of the USA and two different countries (Canada and USA), as well as different levels of institutions (i.e., private liberal arts, regional comprehensive, and major research university). Both men and women were included on the panel. They also each have some degree of interdisciplinary in their academic preparation, teaching, and/or scholarship. In addition, a journal had to be indexed in at least one major database (e.g., PubMed, MEDLINE, SPORTDiscus). While not representative of all kinesiology journals, the sample had both domestic and international journals, as well as journals with research- and/or applied-foci. Finally, the journals deliberately varied in number of years published (8-83 years), annual issues published (4-16), and 2012 impact factors (N/A-4.475).

A stratified-random sample of journal articles were selected from each journal (Table 1.2). The sampling frame included all research articles printed from the selected journals throughout the 5-year time period. Reviews, meta-analyses, commentaries, letters, editorials, conference abstracts, book reviews, notes, corrections, retractions, and

supplemental publications were not evaluated and were eliminated from the sampling frame. The total population of articles ($N = 5521$) were analyzed separately by year. Since the range of articles varied greatly, proportional allocation was used for determining the sample size of each stratum (journal), ensuring a more accurate representation of articles based on publishing rate (Lohr, 2010). Ten percent of the published articles from each journal were randomly selected for each year's sample (Table 1.3). Based on simple-random sample calculations, the sample's confidence intervals ranged from 8.3 to 9.5 percent (Table 1.3). The stratification system employed should explain additional variance not accounted for in a simple random sample, thus the actual confidence intervals were likely narrower (Lohr, 2010).

Coding. The coding protocol (Appendix C) required the coder to first determine if each selected article met the inclusion requirements. Next, the corresponding author's demographics were recorded. Following other discipline-based review studies (Rhodes & Nasuti, 2011; Sanson-Fisher, Campbell, Htun, Bailey, & Millar, 2008), a number of variables were recorded to uncover patterns in interdisciplinary research, including: (sub)discipline, region, research design, and theory (Table 1.5).

The study also used the behavioral epidemiology framework (BEF) as a way to organize and view the research (Sallis, Owen, & Fotheringham, 2000). The BEF has five phases: (1) establish links between physical activity and outcome(s), (2) develop and apply measurements, (3) identify factors that influence physical activity, (4) evaluate interventions that promote physical activity, and (5) translate research into practice. The framework provides clearly defined operational boundaries. The BEF phase was coded

using Sallis et al.'s classification scheme, and if a study fell into more than one category, the highest category was used.

Following the initial coding, the type of research was determined (e.g., interdisciplinary, multidisciplinary, disciplinary). Due to the convoluted nature of defining IDR, this study used Lattcua's (2001) four category typology described above.

Data analysis. Prior to the main analyses, and in an attempt to minimize bias, intra- and inter-rater reliability were established using Cohen's Kappa (see Table 1.4). An independent researcher examined 55 articles (approximately 10%); five articles were randomly selected from every 50 articles. For intra-rater reliability, the same 55 articles were reanalyzed by the original coder to ensure consistency and account for any "drift" over time. The Kappa range for inter-rater reliability was 0.72 – 1.0 and for intra-rater reliability it was 0.82 – 1.0.

For the main analysis, descriptive statistics were used to identify the general patterns in the articles, authors, and journals. Pearson's chi-square test was used to determine significant differences among the variables of interest across time. For variables that had low expected values ($n \leq 5$), simulation of the sampling distribution using Monte Carlo methods was applied. Significant results ($p \leq 0.05$) were followed up with univariate chi-square analyses.

Finally, as this study is exploring potential factors related to IDR, step-wise linear regression was used to find an initial prediction model for IDR using the other study variables of interest (i.e., authors, sex, kinesiology affiliation, region, methodology, disciplinary focus, behavioural epidemiology framework, theoretical framework, and

funding source). Since this is exploratory in nature, machine learning techniques were used to help increase model accuracy. Following the methods described in Hastie, Tibshirani, and Friedman (2009), training error, test error, and *K*-fold cross-validation was calculated for the prediction model. The data was randomly split into a training dataset (70% of data) and test dataset (30% of data). The model was selected using the training dataset and subsequently tested using the test dataset. The *K*-fold cross-validation used the selected model on the entire dataset. All analyses were conducted using R 2.14 (R Research Team, 2011).

Results

Study characteristics. Study characteristics of the authors are presented in Table 1.5. Almost all of the reviewed articles had more than one author (97.6%), with five authors being the most common (19.0%). The authors were primarily from Europe (35.7%) or North America (27.7%), but every inhabitable continent was represented. The corresponding author was most likely to be male (63.6%) and from the field of kinesiology (57.4%).

Study characteristics of the articles are presented in Table 1.6. The majority of articles were classified as biophysical (67.2%) and in phase 3 (i.e., identify factors that influence physical activity; 62.2%) of the BEF. Table 1.7 shows that *European Journal of Sport Science*, *International Journal of Behavioral Nutrition and Physical Activity*, and *Journal of Physical Activity and Health* were the only journals to include all five phases of the BEF. In terms of methodology, almost all of the articles employed quantitative methods (94.5%), with quasi-experimental (33.2%) and cross-sectional (25.7%) being the

most frequently used study designs. Interestingly, Table 1.8 shows that the *International Journal of Behavioral Nutrition and Physical Activity* was the only journal to include all research methodologies. In addition, most articles did not explicitly state a theoretical framework (64.7%). Just over half of the articles identified one or more funding sources (52.7%).

As seen in Table 1.9, IDR was not common in the reviewed journals, with the majority being informed disciplinary (78.8%). The *International Journal of Sports Medicine* was the least interdisciplinary (94%) and the *International Journal of Behavioral Nutrition and Physical Activity* was the most interdisciplinary (54.2%, including 6.3% as Transdisciplinary). No study was seen as having achieved conceptual disciplinary. Women were the corresponding author on almost half (48.7%) of the IDR studies; furthermore, 28.3% of research with a woman corresponding author was IDR compared to 17.1% with men as the corresponding author, which was significantly different ($\chi^2 = 7.7991$, $df = 1$, $p = 0.01$, OR = 1.54).

Author characteristics across time. Variations in the author characteristics from 2008 to 2012 are presented in Table 1.10. Neither the corresponding author's sex nor discipline significantly varied over time. Similarly, the discipline and region of all authors did not significantly differ over time.

Article characteristics across time. As seen in Table 1.6, the methodology did not significantly differ between the reviewed years. There was a marginal, but significant increase in funding ($p = 0.03$). Univariate analysis, however, showed it was limited to

2008 to 2009 in articles that reported funding ($p = 0.003$). The BEF approached significance ($p = 0.06$). Finally, there were no significant differences in IDR across time.

Step-wise linear regression. The model selected by the step-wise regression (AIC = -843.88) had only three predictor variables: behavior epidemiology framework, theoretical framework, and disciplinary focus. A four factor model, however, which included the three variables above plus sex, was a potential fit (AIC = -842.01). The training error for the selected model, or its misclassification rate on the training dataset, was 12.8%. The test error was 15.9%, but the K -fold cross-validation error rate was 10.8%.

The results from the regression model are seen in Table 1.11; overall the model explained over half the variance, adjusted $R^2 = 0.52$, $F(12, 373) = 33.93$, $p < 0.001$. Each observed discipline was significantly ($p < 0.001$) different from the reference group, behavioral. The only significantly different BEF phase was phase 5 ($p < 0.001$). Interestingly, not stating a theory was not significantly different than the reference group, but having more than one theory was significantly different ($p < 0.001$).

Discussion

The primary purpose of this study was to review the status of interdisciplinary research in a collection of articles from kinesiology journals whose mission statements were explicitly multi- and/or inter-disciplinary in focus. The study strengths include a longitudinal assessment, a large sampling frame selected with stratified-random sampling, and a quantitative analysis of the findings.

Approximately three quarters of the articles were not interdisciplinary, a pattern that did not change over the five-year time-span assessed. In terms of absolute volume, men served as the corresponding author on journal articles more than did women, a pattern which others have observed (Cardinal & Lee, 2013; Schuiteman & Knoppers, 1987). However, the IDR publication rate favored women over men. Future research should more thoroughly explore gender differences overall and with regard to IDR in particular.

Regardless of gender, authors are publishing primarily disciplinary-focused research in journals with multi- and interdisciplinary missions. Four of the journals had no transdisciplinary articles at all. This pattern might insinuate that the journals are not as concerned about the interconnections of the research, rather about publishing work across the spectrum of kinesiology sub-disciplines. This brings into question whether the journals are truly maximizing their editorial missions. Unquestionably, journals are dependent on the submissions received from the authors, limiting an editor to select from a finite pool of research. In addition, there is also a chance that IDR gets published in fragments (i.e., salami or piecemeal publications). Regardless of the reasoning, the current study's results support the long-held belief that kinesiology is a fragmented discipline (Edwards, 1989; Hoffman, 1985; Park, 1998; Rikli, 2006). Unfortunately, this study did not explore reasons behind the lack of interdisciplinarity. If IDR is one possible strategy for strengthening kinesiology, it is still largely untested, at least as reflected by contemporary research published in these 10 journals.

It is important that blame not be assigned; there is still a lack of evidence even showing that IDR can strengthen kinesiology. The lack of IDR, however, should still be a concern if for no other reason than the paradoxical environment that has been created. The noticeable absence of IDR is occurring in the midst of a continued, organized effort to increase IDR within kinesiology and the academy more broadly. This includes prominent researchers advocating for its expansion and academic journals actively promoting IDR. Thus, the dialogue surrounding IDR in kinesiology is either operating under false pretenses or researchers simply do not care, or perhaps a combination of both. To fully understand this complicated situation, future research should explore the barriers and incentives to conducting IDR. This could shed light on why researchers shy away from IDR in the midst of continual discourse suggestive of support.

While it remains unclear the reasons behind conducting IDR, our exploratory regression model showed that disciplinary focus, BEF, and theoretical framework were important predictors of IDR. This is not entirely surprising because these factors help determine one's research design.

For disciplinary focus, all foci were significantly different than the reference category, behavioral. Interestingly, biophysical was the only area that was less likely to lead to IDR. Since the biophysical consists of sub-disciplines like biomechanics and physiology, it is easy to suggest that the physical sciences may be more disciplinary-focused, and less likely to conduct research spanning into different areas in kinesiology. Yet, the biophysical researchers may not be isolationists, deliberately separating themselves from other areas because the results also indicate that researchers in other

fields avoid partnering with the biophysical realm. In fact, there was no article that combined all three research foci. Instead of placing blame on one area or another, all kinesiology researchers who are charged with the task of studying human movement should evaluate their own biases toward the breadth of knowledge domains within the discipline. Since we share a common passion, just expressed in different ways, we all have something to learn from other sub-disciplinary areas. Future research should examine IDR partnerships, exploring the incentives and barriers to working with different disciplinary groups.

For the BEF, the results indicated that phase 5, when compared to the reference group, was significantly different than all the other phases in determining IDR. Phase 5 emphasizes translation of research into practice, which by its nature expands research outside of disciplinary boundaries. Although it was surprising not to see the other phases differing from each other, this could be because researchers emphasized control and manipulation of important, but disciplinary-focused, variables. Not surprisingly, the most popular BEF phases were one and three, aligning with previous research (Rhodes & Nasuti, 2011; Sallis et al., 2000). The popularity of phase one and three might be because they easily lend themselves to cross-sectional research designs, which are more cost-effective and produce faster results. Regardless, it was discouraging to see a lack of research in phase 5. Only three journals had phase 5 research, thus either kinesiology-focused translational research is not being done or it is being published in other areas (e.g., public health). Future research should examine these trends and how IDR can be incorporated into all phases of the BEF.

Having a theoretical framework was not an important predictor of IDR, but having more than one theory was significantly different. Again, this is logical because the more theories that are incorporated into a research project, the higher the likelihood of involving more disciplines. It was surprising that not having a theory was not significantly different, especially given that over half the studies did not have a stated theory. However, theory may not be equally important across the sub-disciplines, thus it is difficult to weigh theory's importance in IDR. Future research should further explore the importance of theory in each sub-discipline and in building successful IDR projects.

Perhaps more interesting are the variables not included in the model. Since both funding and kinesiology affiliation were fairly equal in their dichotomous distribution, it does suggest that IDR does not depend on financing an expensive study. This bodes well in an increasingly competitive funding environment. In addition, while each region of the world was represented, the majority of studies came from Europe and North America. Yet, region proved to be insignificant in terms of predicting IDR. This suggests that IDR is not limited to any one region; however, this may also mean that no one region finds it particularly important. Methodology also proved insignificant, although methodology is related to BEF. As previously discussed, quantitative research, especially cross-sectional analysis, was well represented. Qualitative research was not well represented, and mixed methods were virtually absent. Whether for ease, familiarity, or cost this result suggests a quantitative prejudice. In addition, gender was not significant either. The number of IDR articles significantly differed between men and women, the association may have been confounded by other variables. Finally, the number of authors failed to make the initial

model. Similar to funding, this result implies that one does not need a large team to conduct IDR.

The study has several limitations that restrict the generalizability of the results. The sample only selected original research articles from ten journals from 2008 to 2012; thus, the results may not be representative of all kinesiology-related journals and are limited to the five-year range. Scholars may have chosen to publish their IDR in journals outside of kinesiology or in journals with more singularly disciplinary focused missions; these additional avenues of publication may include IDR. In addition, the study used step-wise regression for exploratory purposes and the results should be interpreted as such. Future research should continue to build upon these results. Despite these limitations, the study captured IDR trends in kinesiology in a manner never done before. Furthermore, the study presented an exploratory model predicting IDR in kinesiology, helping guide future research endeavors.

What Does this Study Add?

Interdisciplinary research has become popular around academia, promising greater continuity among disciplines, allowing for diverse teams to find solutions to complex problems. Kinesiology has not been immune, over the last four decades prominent leaders, organizations, and journals have promoted IDR as one possible solution to the field's fragmentation. Despite the support and kinesiology's inherent multidisciplinary (or "cluster") nature, the field has made little progress in the area of IDR. The majority of research is still focused on a disciplinary agenda, but it is still uncertain as to why this occurring. Perhaps more unnerving is the fact we do not know if

IDR is even beneficial to kinesiology. Unfortunately, we are left with more questions and growing uncertainty. Future research should build upon the results, striving to understand the role of IDR in kinesiology. The journey ahead may be unclear, but with the potential to help strengthen kinesiology, it is worth every messy step.

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Table 1.1. Selected journal characteristics.			
Journal	Established	Number of Issues Per year	2012 Impact Factor
<i>European Journal of Sport Science</i>	2001	6	1.146
<i>International Journal of Behavioral Nutrition and Physical Activity</i>	2004	12	3.577
<i>International Journal of Sports Medicine</i>	1979	12	2.268
<i>Journal of Physical Activity and Health</i>	2004	8	N/A
<i>Journal of Science and Medicine in Sport</i>	1998	6	2.899
<i>Journal of Sports Sciences</i>	1983	16	2.082
<i>Medicine and Science in Sports and Exercise</i>	1969	12	4.475
<i>Research Quarterly for Exercise and Sport</i>	1930	4	1.108
<i>Scandinavian Journal of Medicine & Science in Sports</i>	1991	6	3.214
<i>The Physical Educator</i>	1940	4	N/A
<i>Note:</i> All journals must had an interdisciplinary mission statement and were indexed in at least one major academic database.			

Journal	2008	2009	2010	2011	2012	Total
<i>European Journal of Sport Science</i>	4	3	5	5	6	23
<i>International Journal of Behavioral Nutrition and Physical Activity</i>	6	8	8	12	14	48
<i>International Journal of Sports Medicine</i>	16	14	14	15	16	75
<i>Journal of Physical Activity and Health</i>	6	9	10	12	13	50
<i>Journal of Science and Medicine in Sports</i>	8	11	11	7	9	46
<i>Journal of Sport Sciences</i>	15	16	17	18	19	85
<i>Medicine and Science in Sport and Exercise</i>	25	25	27	28	29	134
<i>Research Quarterly for Exercise and Sport</i>	6	9	6	9	7	37
<i>Scandinavian Journal of Medicine and Science in Sports</i>	8	9	8	8	11	44
<i>The Physical Educator</i>	2	2	2	2	2	10
Total	96	105	107	119	125	552

Note: All articles were randomly selected within a given volume year. Cell values are raw numbers of articles selected within journal by year.

Year	Population Size ($N = 5521$)	Sample Size ($n = 552$)	Confidence Level %	Confidence Interval %
2008	964	96	95	9.5
2009	1053	105	95	9.1
2010	1070	107	95	9.0
2011	1186	119	95	8.5
2012	1248	125	95	8.3

Table 1.4. Intra- and inter-rater reliability (Kappa) for study characteristics ($n = 55$)		
	Intra-rater reliability	Inter-rater reliability
Discipline	0.97	0.85
Behavioral Epidemiology Framework	0.91	0.72
Methodology and Design	0.89	0.82
Theoretical Framework	0.82	0.93
Funding Source	1.00	1.00
Research Type	0.85	0.79

Table 1.5. Study characteristics of the authors from articles sampled from 2008-2012.	
Total, <i>n</i> (%)	
Number of Authors	
1	13 (2.4)
2	55 (10.0)
3	104 (18.8)
4	99 (17.9)
5	105 (19.0)
6	89 (16.1)
≤ 7	87 (15.8)
Region	
North America	153 (27.7)
Australia/New Zealand	65 (11.8)
Europe	197 (35.7)
Mediterranean/Middle East	5 (0.9)
Asia	28 (5.1)
Africa	3 (0.5)
South America	21 (3.8)
Multi	80 (15.5)
Corresponding Author	
Sex	
Male	351 (63.6)
Female	201 (36.4)
Field	
Kinesiology	317 (57.4)
Other	235 (42.6)

Table 1.6. Study characteristics of the articles sampled from 2008-2012.	
Total, <i>n</i> (%)	
Discipline	
Behavioral	108 (19.6)
Biophysical	371 (67.2)
Sociocultural	26 (4.7)
Behavioral/Biophysical	21 (3.8)
Behavioral/Sociocultural	24 (4.3)
Biophysical/Sociocultural	0 (0.0)
Behavioral/Biophysical/Sociocultural	2 (0.4)
Behavioral Epidemiology Framework	
Phase 1	78 (14.1)
Phase 2	51 (9.2)
Phase 3	349 (63.2)
Phase 4	62 (11.2)
Phase 5	6 (1.1)
Other	6 (1.1)
Methodology and Design	
Quantitative	
Measurement	51 (9.2)
Cross-sectional	142 (25.7)
Longitudinal	73 (13.2)
Quasi-experimental	183 (33.2)
Experimental	72 (13.0)
Qualitative	
Content analysis	11 (2.0)
Interview	12 (2.2)
Focus groups	5 (0.9)
Mixed-Methods	3 (0.5)

Table 1.6 cont. Study characteristics of the articles sampled from 2008-2012	
Total, <i>n</i> (%)	
Theoretical Framework	
Theory	177 (32.1)
Multi-theory	18 (3.3)
No theory explicitly stated	357 (64.7)
Funding Source	
Funded	291 (52.7)
No funding source stated	261 (47.3)
Research Type	
Informed Disciplinary	435 (78.8)
Synthetic Disciplinary	107 (19.4)
Transdisciplinary	10 (1.8)
Conceptual Disciplinary	0 (0.0)

Total, n (%)							
Journal	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Other	Total
<i>European Journal of Sport Science</i>	1 (4.3)	1 (4.3)	18 (78.3)	2 (8.7)	1 (4.3)	0 (0)	23 (100)
<i>International Journal of Behavioral Nutrition and Physical Activity</i>	3 (6.3)	5 (10.4)	21 (43.8)	13 (27.1)	1 (2.1)	5 (10.4)	48 (100)
<i>International Journal of Sports Medicine</i>	10 (13.3)	4 (5.3)	54 (72)	7 (9.3)	0 (0)	0 (0)	75 (100)
<i>Journal of Physical Activity and Health</i>	7 (14)	10 (20)	22 (44)	7 (14)	4 (8)	0 (0)	50 (100)
<i>Journal of Science and Medicine in Sport</i>	4 (8.7)	7 (15.2)	34 (73.9)	1 (2.2)	0 (0)	0 (0)	46 (100)
<i>Journal of Sports Sciences</i>	4 (4.7)	8 (9.4)	62 (72.9)	11 (12.9)	0 (0)	0 (0)	85 (100)
<i>Medicine and Science in Sports and Exercise</i>	37 (27.6)	6 (4.5)	77 (57.5)	14 (10.4)	0 (0)	0 (0)	134 (100)
<i>Research Quarterly for Exercise and Sport</i>	3 (8.1)	7 (18.9)	23 (62.2)	4 (10.8)	0 (0)	0 (0)	37 (100)
<i>Scandinavian Journal of Medicine & Science in Sports</i>	9 (20.5)	1 (2.3)	30 (68.2)	3 (6.8)	0 (0)	1 (2.3)	44 (100)
<i>The Physical Educator</i>	0 (0)	2 (20)	8 (80)	0 (0)	0 (0)	0 (0)	10 (100)
Total	78 (14.1)	51 (9.2)	349 (63.2)	62 (11.2)	6 (1.1)	6 (1.1)	552 (100)

Table 1.8. Number of articles in each research methodology and design type by journal.										
Total, n (%)										
Journal	Measurement	Cross-sectional	Longitudinal	Quasi-experimental	Experimental	Content analysis	Interview	Focus groups	Mixed-Methods	Total
<i>European Journal of Sport Science</i>	1 (4.3)	4 (17.4)	2 (8.7)	12 (52.2)	1 (4.3)	2 (8.7)	1 (4.3)	0 (0)	0 (0)	23 (100)
<i>International Journal of Behavioral Nutrition and Physical Activity</i>	8 (16.7)	16 (33.3)	5 (10.4)	3 (6.3)	11 (22.9)	1 (2.1)	1 (2.1)	2 (4.2)	1 (2.1)	48 (100)
<i>International Journal of Sports Medicine</i>	4 (5.3)	20 (26.7)	10 (13.3)	28 (37.3)	11 (14.7)	2 (2.7)	0 (0)	0 (0)	0 (0)	75 (100)
<i>Journal of Physical Activity and Health</i>	10 (20)	16 (32)	10 (20)	3 (6)	7 (14)	1 (2)	0 (0)	2 (4)	1 (2)	50 (100)
<i>Journal of Science and Medicine in Sport</i>	6 (13)	18 (39.1)	7 (15.2)	11 (23.9)	4 (8.7)	0 (0)	0 (0)	0 (0)	0 (0)	46 (100)
<i>Journal of Sports Sciences</i>	8 (9.4)	19 (22.4)	8 (9.4)	39 (45.9)	6 (7.1)	3 (3.5)	2 (2.4)	0 (0)	0 (0)	85 (100)
<i>Medicine and Science in Sports and Exercise</i>	5 (3.7)	25 (18.7)	20 (14.9)	63 (47)	21 (15.7)	0 (0)	0 (0)	0 (0)	0 (0)	134 (100)

Table 1.8 cont. Number of articles in each research methodology and design type by journal.										
Total, n (%)										
Journal	Measurement	Cross-sectional	Longitudinal	Quasi-experimental	Experimental	Content analysis	Interview	Focus groups	Mixed-Methods	Total
<i>Research Quarterly for Exercise and Sport</i>	7 (18.9)	9 (24.3)	3 (8.1)	11 (29.7)	1 (2.7)	1 (2.7)	4 (10.8)	1 (2.7)	0 (0)	37 (100)
<i>Scandinavian Journal of Medicine & Science in Sports</i>	1 (2.3)	11 (25)	8 (18.2)	11 (25)	10 (22.7)	1 (2.3)	1 (2.3)	0 (0)	1 (2.3)	44 (100)
<i>The Physical Educator</i>	1 (10)	4 (40)	0 (0)	2 (20)	0 (0)	0 (0)	3 (30)	0 (0)	0 (0)	10 (100)
Total	51 (9.2)	142 (25.7)	73 (13.2)	183 (33.2)	72 (13)	11 (2)	12 (2.2)	5 (0.9)	3 (0.5)	552 (100)

Total, n (%)					
Journal	Informed Disciplinary	Interdisciplinary	Transdisciplinary	Conceptual Disciplinary	Total
<i>European Journal of Sport Science</i>	19 (82.6)	4 (17.4)	0 (0)	0 (0)	23 (100)
<i>International Journal of Behavioral Nutrition and Physical Activity</i>	22 (45.8)	23 (47.9)	3 (6.3)	0 (0)	48 (100)
<i>International Journal of Sports Medicine</i>	71 (94.7)	3 (4)	1 (1.3)	0 (0)	75 (100)
<i>Journal of Physical Activity and Health</i>	28 (56)	21 (42)	1 (2)	0 (0)	50 (100)
<i>Journal of Science and Medicine in Sport</i>	36 (78.3)	9 (19.6)	1 (2.2)	0 (0)	46 (100)
<i>Journal of Sports Sciences</i>	76 (89.4)	9 (10.6)	0 (0)	0 (0)	85 (100)
<i>Medicine and Science in Sports and Exercise</i>	115 (85.8)	17 (12.7)	2 (1.5)	0 (0)	134 (100)
<i>Research Quarterly for Exercise and Sport</i>	25 (67.6)	10 (27)	2 (5.4)	0 (0)	37 (100)
<i>Scandinavian Journal of Medicine & Science in Sports</i>	38 (86.4)	6 (13.6)	0 (0)	0 (0)	44 (100)
<i>The Physical Educator</i>	5 (50)	5 (50)	0 (0)	0 (0)	10 (100)
Total	435 (78.8)	107 (19.4)	10 (1.8)	0 (0)	552 (100)

Table 1.10. Study volume by content and methodological characteristics of the articles sampled from 2008 to 2012.						
	2008	2009	2010	2011	2012	p-value
Corresponding Author						$p = 0.61$
Men	55	67	73	75	80	
Women	41	39	34	41	46	
Discipline						$p = 0.36$
Behavioral	18	25	22	17	26	
Biophysical	63	72	74	82	80	
Sociocultural	9	3	6	4	4	
Behavioral/Biophysical	1	5	2	5	8	
Behavioral/Sociocultural	5	1	4	7	7	
Biophysical/Sociocultural	0	0	0	0	0	
Behavioral/Biophysical/Sociocultural	0	0	0	1	1	
Region						$p = 0.87$
North America	28	31	25	33	36	
Australia/New Zealand	15	14	12	13	11	
Europe	36	33	42	43	43	
Mediterranean/Middle East	0	1	1	1	2	
Asia	5	6	6	7	4	
Africa	1	0	1	0	1	
South America	1	3	3	4	10	
Multi	10	18	18	15	19	

Table 1.10 cont. Study volume by content and methodological characteristics of the articles sampled from 2008 to 2012.						
	2008	2009	2010	2011	2012	p-value
Methodology and Design						$p = 0.39$
Quantitative						
Measurement	8	10	11	12	9	
Cross-sectional	27	28	25	35	28	
Longitudinal	12	13	12	14	21	
Quasi-experimental	34	33	27	40	44	
Experimental	10	18	23	7	21	
Qualitative						
Content analysis	2	2	4	2	0	
Interview	2	1	4	5	0	
Focus groups	1	1	1	0	2	
Mixed-Methods	0	0	1	1	1	
Behavioral Epidemiology Framework						$p = 0.06$
Phase 1	14	12	18	21	20	
Phase 2	8	12	11	7	12	
Phase 3	65	65	62	78	75	
Phase 4	8	17	12	6	18	
Phase 5	0	0	4	1	0	
Other	1	0	1	3	1	
Theoretical Framework						$p = 0.15$
Theory	36	37	37	39	28	
Multi-theory	4	5	2	5	2	
No theory explicitly stated	56	64	69	72	96	

Table 1.10 cont. Study volume by content and methodological characteristics of the articles sampled from 2008 to 2012.						
	2008	2009	2010	2011	2012	p-value
Funding Source						$p = 0.03$
Funded	43	54	46	65	83	
No funding source stated	53	52	62	51	43	
Research Type						$p = 0.72$
Informed Disciplinary	72	81	81	98	99	
Synthetic Disciplinary	22	23	26	16	24	
Transdisciplinary	2	2	1	2	3	
Conceptual Disciplinary	-	-	-	-	-	

Table 1.11. Step-wise regression analysis predicting interdisciplinary research.		
Variable	β	95% CI
Discipline		
Behavioral		reference
Biophysical*	-0.19	(-0.29, -0.10)
Sociocultural*	0.26	(0.06, 0.39)
Behavioral/Biophysical*	0.83	(0.65, 1.01)
Behavioral/Sociocultural*	0.74	(0.56, 0.92)
Behavioral/Biophysical/Sociocultural*	0.71	(0.24, 1.18)
Behavioral Epidemiology Framework		
Phase 1		reference
Phase 2	-0.12	(-0.26, 0.17)
Phase 3	-0.04	(-0.14, 0.05)
Phase 4	0.04	(-0.10, 0.17)
Phase 5*	0.70	(0.39, 1.02)
Other	0.01	(-0.31, 0.33)
Theoretical Framework		
Theory		reference
Multi-theory*	0.45	(0.24, 0.65)
No theory explicitly stated	-0.05	(-0.12, 0.02)
<i>Note:</i> Adjusted $R^2 = 0.52$ ($p < 0.001$)		
*statistically significant ($p < 0.001$)		

Chapter 4. Manuscript 2

Uncovering the Mystery of Interdisciplinary Research in Kinesiology

Abstract

Purpose: Kinesiology's multidisciplinary nature would seem an ideal configuration for conducting interdisciplinary research (IDR). Unfortunately, increased specialization has caused fragmentation among kinesiology's sub-disciplines. IDR has been proposed as a potential solution to overcome the disintegration that has been described, yet much remains unknown about the role of IDR in kinesiology. **Method:** This qualitative study explored kinesiologists' perception of IDR, including perceived benefits and limitations. The sample was comprised of kinesiologists ($n = 45$) from higher education, the majority from North America and Europe (76.2%). Only a minority of the participants self-identified as disciplinary researchers ($n = 23.2\%$). Each participant answered a primarily open-ended, seven question internet survey. Themes were uncovered using an open-coding protocol. **Results:** The overarching themes were Benefits (i.e., the positive aspects to conducting IDR) and Limitations (i.e., the challenges to conducting IDR), each with eight sub-themes. The most prominent sub-themes for Benefits were New Perspectives, Better Results, and Collaboration Potential. The most prominent sub-themes for Limitations were Collaboration Problems, Challenging Methodology, and Limiting Results and Analysis. Overall, all participants felt IDR was valuable to the field, but each had legitimate reservations, creating a somewhat contradictory environment that causes tension between the perceived benefits and limitations. **Conclusion:** Until the tension can be resolved, IDR may continue to remain on the fringes of kinesiology research.

Interdisciplinary research (IDR) is becoming an important and much discussed topic in higher education circles and throughout the research enterprise more broadly (Basken, 2012b; Jacobs, 2009; Ruse, 2010). IDR is more than just scholastic rhetoric, it is being adopted and operationalized by funding agencies. For example, the National Science Foundation (Basken, 2012a) and the National Institutes of Health (Freedson, 2009; Giacobbi, Buman, Romney, Klatt, & Stoddard, 2012) strongly encourage IDR in grant proposals.

Despite its growing importance, the application of IDR often remains cryptic to academics and administrators; the term is ambiguous and misunderstood. The confusion may stem from the numerous and often competing definitions that abound (Klein, 1990). Amidst the ambiguity, however, several scholars have suggested operationalized, “working definitions” of IDR by combining characteristics of several theoretical definitions (Aboelela et al., 2007; Committee on Science, 2005; Lattuca, 2001). Although even the “working definitions” vary, there are common characteristics, such as: (1) a project that groups together two or more distinct scientific disciplines; (2) integrating knowledge that is not limited to any one field; (3) and using the perspective and skills of all involved disciplines throughout the entire research process. In addition, IDR can be conceptualized as a continuum with different levels spanning from disciplinary to transdisciplinary (Lattuca, 2001).

Perhaps a more imminent concern for faculty members are the barriers deterring them from pursuing interdisciplinary projects. Carayol and Thi (2005) stated that

traditional academic career incentives do not encourage IDR. For example, there is a tension between professional advancement (e.g., tenure, promotion, establishing oneself as an authority in field) and IDR, which may discourage un-established junior faculty and graduate students from conducting IDR projects (Rhoten & Parker, 2004). Likewise, IDR projects often take longer to complete than do traditional disciplinary-based research projects (Campbell, 2006; Rhoten & Parker, 2004), which can complicate logistics, strain funding, and make such work unattractive to those facing the ever-present and clicking tenure-clock.

Despite its potential barriers, there may be advantages to IDR too. Klein (1990) argued that IDR can produce results that are not possible in a disciplinary framework. Echoing her sentiment, Rhoten and Parker (2004) showed that young academics thought IDR could help science address large societal issues (e.g., obesity, poverty, quality education) more effectively than could disciplinary approaches alone. The idea that IDR may help to solve large and complex problems is reflected in academia's growing support of IDR, as previously discussed. In fact, many universities have started IDR centers through "cluster hiring", or the simultaneous hiring of multiple faculty members from different disciplines or disciplinary areas, with a goal of collaboratively exploring complex problems (Severin, 2013).

On the surface, kinesiology has the appearance of or the potential for a natural IDR "cluster" because of the multidisciplinary nature of the discipline (Bories & Swanson, 2005). Since Henry's (1964) urgent call for kinesiology (then physical education) to become more "academic", the field has evolved into numerous sub-

disciplinary areas representing the physical sciences (e.g., biomechanics, physiology), social sciences (psychology, sociology), and humanities (e.g., history, philosophy). With so many different academic areas studying physical activity, IDR appears to be a natural fit for kinesiology.

Unfortunately, and in spite of warnings from Henry (1964, 1978) and others (Bressan, 1979; Siedentop, 1972), it became clear in the ensuing decades that with specialization came fragmentation and disunity (Corbin, 1993; Hoffman, 1985; Newell, 1990; Park, 1998; Thomas, 1987). That is, many kinesiologists today seem to work in relative subdisciplinary isolation, perhaps even affiliating most closely with the parent discipline from which their subdisciplinary area arises (e.g., pedagogy, physiology, psychology) rather than working with others across and within the subdisciplinary domains that comprise kinesiology (Gill, 2007; Newell 2007). In an interesting twist of fate, then, instead of being exclusively a means of advancing science and solving the complex problems associated with the work of the field, IDR is increasingly being seen as a possible strategy for unifying and strengthening kinesiology's multidisciplinary structure (Gill, 2007; Kretchmar, 2013; Newell, 2007).

Yet, there are concerns surrounding IDR in kinesiology. The actual benefits of IDR in kinesiology are still unknown, perhaps due to the dearth of research surrounding IDR in kinesiology. Before IDR's potential to unify kinesiology can be determined, one must understand kinesiologists' perceptions of IDR, including its perceived importance, barriers, and incentives. Therefore, the purpose of this descriptive study was to explore

kinesiologists' perceived barrier and incentives to conducting IDR with no *a priori* hypotheses.

Methods

Sample. The sampling frame ($N = 315$) was restricted to corresponding authors of research articles randomly selected from 10 kinesiology-focused, peer-reviewed journals published from 2008-2012 (see Appendix A). To be included in the sampling frame, the corresponding authors had to be at least 18 years old; able to read and write in English; published at least one article in a kinesiology-focused, peer-reviewed journal; and be in a kinesiology-related academic department or organization.

Every author included in the sampling frame was invited via email to take an online survey. The selected participants received up to three emails over two weeks. In total, 315 initial emails were sent, 30 emails were returned as undeliverable, 240 opted out of participation, 45 provided at least one useable answer, and 34 answered all of the questions. The final response rate was 14.29% for at least one useable answer and 10.79% for all questions answered. All information used for selecting and contacting the sample were publically available in the journal or on the internet.

Survey. Participants were given a seven-question internet survey, employing five open-ended, qualitative questions, one quantitative question, and one quantitative and qualitative question (See Appendix D). The survey was developed using both Berg and Lune's (2012) recommendations for creating qualitative research questions and Dillman, Smyth, and Christian's (2009) recommendations for internet surveys. The questions asked the authors about their research experience and opinion of interdisciplinary research in

kinesiology. Following the seven questions, participants were asked demographic information (i.e., highest degree earned, field of highest degree, year highest was awarded, academic rank, length of time at current institution, interdisciplinary training, and gender).

The survey was designed and distributed using the Qualtrics Research Suite (<http://www.qualtrics.com>). Since participation was completed entirely online, the directions and inclusion criteria was given before the survey. By completing the survey, each participant agreed to the stated terms. The institutional review board of the authors' university approved the study.

Data Analysis. Following the data collection, themes were uncovered from each open-ended question using an open-coding protocol. The protocol followed Glaser and Strauss' (1967) guidelines: (1) ask the data a specific and consistent set of questions, (2) analyze the data minutely, (3) frequently interrupt the coding to write a theoretical note, and (4) never assume the analytic relevance of any traditional variable. The lead author then thematically coded the data. To help minimize bias, a second independent researcher reviewed the coding and suggested revisions. A consensual agreement between the researchers produced the final thematic coding.

Following the analyses, all 45 participants were asked to member-check the initial results. Seventeen participants (37.77% response rate) reviewed the results with the understanding that they may include more information than any one individual submitted. There were no reported discrepancies or concerns regarding the results. Of the study

participants who member-checked the data, a representative comment was, “the results reflect clearly the ideas wrote in the survey.”

Results

Sample Demographics. The sample demographics are shown in Table 2.1.

Although every participant did not answer every question, there was enough information to get an adequate description of the sample. Men composed approximately two-thirds of the sample. All participants held a doctoral degree and came from an academic environment. Because the titles associated with academic rank vary by country of employment, the academic titles shown should be interpreted with caution. The majority of participants were from North America and Europe (76.2%). Only a minority of participants self-identified themselves as being a disciplinary-focused researcher (23.2%). Finally, all of the responding participants ($n = 42$) felt that IDR is important to the field of kinesiology.

Themes. As seen in Table 2.2, eight sub-themes emerged from the participants' responses and these were organized under the larger thematic areas of benefits and limitations. Benefits refer to the perceived positive aspects of IDR, whereas Limitations refers to the difficulties surrounding IDR. Although every participant thought IDR was both beneficial and limiting, the responses were slightly skewed towards beneficial. Furthermore, several participants justified a negative statement by stating the limitation was not “major” or “I really don't see any [problems]. Unless...” Similar rationalizations were not attached to the beneficial comments.

Benefits

New perspectives. Thirty-two participants indicated that incorporating different ideas, theories, and frameworks, allows a research team to, “study a research question from different angles.” This was seen as beneficial to kinesiology research because, “each discipline provides only one perspective about human movement and multiple perspectives are likely to provide a better understanding of what is being observed.” In addition, as kinesiologists try to understand increasingly complex phenomena, “it is critical to integrate the knowledge of other fields into kinesiology.” Thus, IDR provides, “increased insight and knowledge generation.”

Better results. Twenty-seven participants thought that IDR produced better results than disciplinary research, especially when studying complex phenomena like human movement. One participant’s comments captured this nicely: “interdisciplinary research offers both broader and more in-depth outcomes in addressing questions related to human experience.” In addition, IDR was seen to create, “more insightful answers to research hypotheses” and thought of as being, “less reductionist”.

Collaboration. Sixteen participants felt that collaborating with other (sub-) disciplines enhanced their research. Seen as an extension of new perspectives, collaborations provided, “opportunities to network”, allowing one to, “work with people who are experts in related fields.” These IDR teams create new ideas, deepening the overall understanding of human movement. Furthermore, several participants indicated that partnering with practitioners and clinicians would be beneficial because they have different viewpoints than academics.

Funding potential. The ability to secure funding was reported as a benefit of IDR by 14 participants. This was exemplified by the following participant's comment:

“I do feel that interdisciplinary involvement makes it easier to get funding from different sources than would be possible with just our own discipline. Some research grants are only available for people who are working with teams of three or more researchers, for example.”

Another participant noted, “...I find that one of the benefits of IDR is the access to funding sources that I would not have had [had I been] working solely with kinesiologists in a university setting.”

Better methodology. Eleven participants mentioned that IDR improves research design by allowing kinesiologists to use different techniques, measures, and technology. For example:

Having suggestions from many disciplines before I start a research project can make my research design a lot stronger, and also prepare me for the kinds of criticisms that I may receive from people outside my discipline. By taking these into account from the beginning, I can make sure my research and my reports on the research are harder to criticize when they are finished.

Increased publication and application. Ten participants felt that IDR was an effective strategy for publication. Just as IDR helps with funding opportunities, it also increases, “the number of publication and presentation” opportunities, especially for, “journals that target a broad audience (JSS, RQES).” In addition, there was a mutual feeling that there is a, “preference for interdisciplinary research in high standard

journals.” Finally, research should have application, as there is a, “need to apply results to wider interests.” One participant expanded, saying that, “applying the new findings usually needs interdisciplinary-focused research.”

Movement is multidimensional. Five participants agreed that human movement is, “a function of many inter-related elements including physiological, social, cultural, psychological and other processes.” Such a complex phenomenon is best understood through IDR because it, “opens avenues to adopt technologies, strategies and knowledge from various fields to sustain positive behavior change.”

Benefits the field. Five participants also thought IDR was beneficial to the field, both externally and internally. Within the broader realm of academia, IDR was described as a way to bring, “positive attention to kinesiology”. One participant’s comment provided a representative explanation, “I think it [IDR] is a way to promote the type of research we lead...being able to conduct interdisciplinary research would help the field of kinesiology build a stronger identity.” In addition, “utilizing an interdisciplinary approach helps answer questions in ways that unify the field”, strengthening the bonds between sub-disciplines.

Limitations

Collaboration problems. Rarely is IDR done independently, IDR is usually conducted by a team of researchers from different disciplines. Fifteen participants expressed, “such people may not exist within a department or university or these people may not be interested in collaboration. One would most likely have to seek our comrades from other universities.” Having to build virtual research teams can pose a problem

because it takes time to build healthy, working relationships. In addition, one participant mentioned that there are “territorialism or turf wars” between supposed collaborators, with certain kinesiosologists worried that other disciplines will get the credit for *their* research. Perhaps more seriously, some participants did not feel respected by potential collaborators: “The natural science subdisciplines (e.g., physiology, biomechanics) sometimes view the behavioural science subdisciplines (e.g., psychology, sociology) as “softer” and therefore less scientific. That assumption can make it difficult for the behavioural science groups to participate on equal footing.”

Challenging methodology. Thirteen participants mentioned that IDR can have an adverse effect on methodology, especially when partnering with other disciplines. Interdisciplinary research, “can make quantifying metrics quite challenging, and there will likely be dispute (between disciplines) of varying severity in how best to measure or analyze a given task in the context of a problem of interest.”

Limiting results and analysis. Eleven participants expressed concern that IDR was too broad, hindering the depth required for adequate insight. For example:

I think a limitation may be due to the breadth of research involved and exposing the research to potentially a lot more confusing variables in order to address the research problem. I think it may be difficult to analyze a problem with the proper amount of detail in order to address this breadth.

In addition, different disciplines may have, “conflicting primary aims” and, “different research directions” that dilute the results and weaken the analyses.

Logistical barriers. According to 11 participants, conducting IDR is logistically demanding, requiring a greater time investment than disciplinary research. It takes longer to collect data, analyze results, and set-up research team meetings. These hurdles were made more difficult because many participants felt that their institution did not support IDR. One researcher's comments nicely summarized the general sentiment, "the added time and complexity of these types of studies is too great relative to the time and resources available." Thus, the time extra investment deters researchers who are already overcommitted. Finally, two participants specifically mentioned the lack of formal IDR training, turning IDR into a process of trial-and-error.

Increased financial cost. Due to the complex nature of some IDR studies, nine participants said financial costs were a significant barrier. For example:

Because human development moderates or mediates relationships in all kinesiology research questions, longitudinal studies accounting for growth and maturation are required for establishing cause and effect relationships. This is costly, time consuming and subject to attrition.

In addition, there can be ambiguity regarding the distribution of grant monies among IDR team members. One participant even posed the questions, "Who gets the indirect funding from grants? How are those roles managed?"

Disciplinary Jargon. Five participants thought a particular IDR "challenge is to build a common language and a common object so that it becomes possible and useful to work with colleagues of other disciplines." Each discipline has its own vocabulary, making collaborations challenging. Trying to speak, "the same language is difficult at

times between interdisciplinary researchers” because many researchers are reluctant to learn another discipline’s jargon.

Hinders career advancement. Five participants worried that pursuing IDR would negatively affect their career advancement (i.e., tenure and promotion). It was seen as more difficult to get promoted, “from research that doesn’t fit obvious disciplinary categories.” One participant expressed that, “interdisciplinary research has hurt me in job-hunting.”

Publishing difficulties. Only three participants considered IDR a publishing liability, making it more difficult to publish a journal article. A “non-interdisciplinary journal may be less interested in a paper that is comprised of an interdisciplinary team of researchers.” Worries extended beyond the scope of the journal, it was expressed as, “often difficult to publish [IDR] as most reviewers are not interdisciplinary.”

Discussion

The primary purpose of this study was to explore kinesiologists’ views of IDR. The results revealed an interesting relationship between the perceived benefits and limitations of IDR. Prior to exploring that relationship, however, one needs to understand the subtle bias in the results. The participants unanimously agreed that IDR was beneficial to kinesiology, a surprising outcome since 23% self-identified as disciplinary-focused researchers. The unanimous result may be due to academia’s embrace of IDR (Basken, 2012b; Jacobs, 2009; Ruse, 2010), with participants feeling obliged to agree because it is the “right” answer. Regardless of the reason, the results should be interpreted with an understanding of this positive bias.

The results exposed a complex relationship between the participants and IDR. As previously mentioned, each participant thought IDR had positive and negative attributes, organized within two dichotomous themes: Benefits and Limitations. Much like the two-headed “Pushmi-pullyu” mythical animal from *The Story of Doctor Dolittle* children’s book (Lofting, 1920), these two themes simultaneously push and pull researchers in both directions. For example, while IDR is generally seen as beneficial, participants still had reservations that dampened their enthusiasm. The sub-themes further illustrate this tension. Both themes had five similar sub-themes: results, collaboration, funding, methodology, and publishing. Exploring these five sub-themes will help shed light on this paradoxical situation. Yet, it should be noted that all the sub-themes are inter-related, with any one sub-theme being influenced by the others.

It was not surprising that “Results” was a controversial topic because significant and meaningful results are the lifeblood of research. Over twice as many participants thought IDR produced better, more robust results. Participants thought that IDR more fully captured the complexities of human movement because human movement does not occur in a vacuum rather it is simultaneously influenced by (and is influencing) physiological, psychological, social, and environmental factors. Yet, trying to study too many factors can produce shallow results that lack the depth of knowledge needed to adequately understand anything. Ultimately, the relationship should not be as binary as it appears in this study. The participants shared the extreme views that permeate throughout academia. Instead of viewing results from IDR as either too limited or too broad, researchers should view IDR on a continuum and try to seek a balance. The *Pushmi-*

Pullyu analogy illustrates this balance. If both heads are actively “feeding” (i.e., acquiring knowledge), then the animal’s shared torso (i.e., the discipline of kinesiology) will grow in size and influence as the new knowledge is “metabolized” (i.e., processed for daily use; used to positively grow the structure of the overall organism). The underlying assumption being that the knowledge is known and understood within the broader scientific discipline and professions affected by it, akin to Ziegler’s (2011) long-standing call for organizational principles for the field.

Finding the proper balance is more of an art form than a science, because it takes many factors into consideration, such as: type of research, research goals, variable(s) of interest, and desired degree of sensitivity and specificity. In addition, the results are dependent on available resources (e.g., equipment, facilities, funding). Thus, due to the countless number of possible considerations and resources, universal recommendations are beyond the scope of this study.

Collaboration is almost always necessary when conducting IDR; and similar to results, collaboration is controversial. Collaborating with people in different disciplines can widen perspective and deepen understanding on a particular topic because it is impossible to know everything about a topic. This expansion of knowledge could mitigate previously held biases and assumptions, helping to improve a study’s quality. In addition, working with non-academics (e.g., community leaders, industry partners, practitioners) can help make the research more applicable and/or contextually relevant.

Ironically, the biggest challenge to reaping the benefits of collaboration is collaboration itself. From the participants’ descriptions, egos and elitism often hinder

productive communication. Not respecting all disciplines'/subdisciplines' ability to add value to a project undermines IDR and reinforcing biases and assumptions about other disciplines/subdisciplines.

Even if everyone's opinions are equally valued, it still takes time to build collaborations. Stemming from the sub-theme, "Logistical Barriers", the increased complexities of IDR require more time and effort, which is supported by the literature (Campbell, 2006; Rhoten & Parker, 2004). As discussed in greater detail below, young faculty members, under the pressure for production to obtain tenure (i.e., the "publish or perish" paradigm), do not always have such luxuries. Additionally, finding a common scientific language amid the jungle of disciplinary jargon can be another hurdle often too high to overcome. In order to successfully collaborate, researchers, and the universities that support them, must first believe that the potential benefits outweigh the barriers. But belief is not enough, researchers, and the universities that support them, must also invest in resources (e.g., equipment, facilities, funding, time) to overcome the barriers. Belief without proper investment may result in chaos, confusion, frustration, and/or inaction.

Similar to results and collaboration, more participants felt IDR expanded funding opportunities. Participants overwhelmingly noted that obtaining grants alleviated many of the IDR challenges by supplying resources. Grants, however, do not magically solve all problems. Instead, problems shift to the fair appropriation of the monies. With pressure to bring in external funding to departments, large sums of money can cause rifts in research teams because dispersion can be complex and political. In addition, funding may not be sufficient to a research team's needs or department expectations, which could also cause

tension among research members. Thus, the emphasis on funding might hinder rather than facilitate IDR. Future research should examine the role of funding on IDR in greater detail.

Valid and reliable measurements are critical to the success of any research endeavor. Due to the importance of methodology, it was not surprising to see conflicting opinions about the role of methodology in IDR. Out of the five sub-themes with reciprocal relationships, methodology was the only sub-theme that had more negative than positive comments. The primary challenge was agreeing on the best way to measure and analyze the variables of interest. Other participants, however, felt that working with different disciplines strengthened the methodology because researchers in other disciplines were able to see limitations in any one technique and offer suggestions. Initially these two viewpoints appear to be opposite, but they are actually related. Researchers often disagree about the best methodology because they each see the strengths of their design and the limitations of the others, as described in the negative connotation. The research teams that can productively collaborate (without egos or elitist attitudes) can find the best methodology (or combination thereof) based off their collective expertise, moving to the situation described in the positive connotation. The inter-related relationship of these sub-themes becomes increasingly important because finding the best methodology through productive collaboration will produce the best results.

Publishing is one of the primary currencies academics collect and are evaluated on for career advancement, especially among young academics seeking tenure and

promotion. Participants saw IDR as both an effective strategy to increase publication and as a barrier towards publication. Although more participants felt it increased opportunities to publish, the type of publication outlet may be the key to understanding this contradiction. The content of an academic journal is determined by its editor-in-chief, editorial board, and reviewers, all of whom are guided by the journal's mission statement and/or purpose. The content of academic conferences is often premised in a similar manner. However, journals and conferences differ in their level of interdisciplinary focus. In addition, certain sub-disciplines and regions (e.g., Asia, Europe, North America) may encourage IDR more than others. Thus, the participant's sub-discipline and location may determine the publishing opportunities. Future research should examine IDR publishing in kinesiology.

Not all of the Benefits sub-themes are reciprocal in nature, specifically: "New Perspectives", "Movement is Multidimensional", and "Benefits the Field". All three of these sub-themes focus on more universal aspects and/or benefits of IDR in kinesiology, illustrating that IDR is beneficial for the field in general. Additionally, having no Limitations sub-theme counter-part emerge supports the positive bias of the responses. Since there were no negative sub-themes like "Movement is Disciplinary" or "Harms the Field", participants felt that at least the idea of IDR is more beneficial than limiting.

Perhaps most enlightening is the comparison of the Benefits sub-theme "Benefits the Field" with the Limitations sub-theme "Hinders Career Advancement". As previously described "Benefits the Field" is more universal and idealistic, whereas "Hinders Career Advancement" is more individualized and realistic. This enigmatic pairing shows the

inconsistent expectations of higher education, reflective, again, of the *Pushmi-Pullyu* metaphor described previously, or, perhaps even the dynamic tension one might experience in a game of tug-of-war. At the same time universities and departments tout their support of IDR, they are very often rewarding disciplinary research. Until the mix-messaging stops, researchers will continue to feel the tension between helping the field versus helping their career.

What Does This Paper Add?

Despite the rhetoric, IDR in kinesiology is a controversial topic. There is an obvious tension between IDR's perceived benefits and limitations. While there is a general consensus that IDR is beneficial, many kinesiologists have legitimate hesitations. These hesitations stem from an apparent double standard, whereby academics and administrators praise the potential of IDR, but primarily reward those following a more disciplinary/sub-disciplinary-oriented research paradigm. Until there is a shift in academic thinking that elevates IDR to the same level of importance and support as disciplinary research, researchers will have to continue to overcome unnecessary barriers. Kinesiologists seem to perceive that IDR holds great promise, but we must work together to lower the hurdles to make it a reality. IDR must also be evaluated over time to see if assumptions about unifying the field really follow, or if something else unexpected occurs (e.g., Kinesiology gets morphed into something altogether different from what it was in yesteryear and what it is today).

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Table 2.1. Demographic information of sample	
<i>n</i> (%)	
Gender (<i>n</i> = 42)	
Men	27 (64.3)
Women	15 (35.7)
Highest Degree (<i>n</i> = 39)	
Doctor of Philosophy (PhD)	38 (97.4)
Doctor of Physical Therapy (DPT)	1 (2.6)
Academic Rank (<i>n</i> = 35)	
Graduate Student	7 (20.0)
Post Doctoral Fellow	2 (5.7)
Lecturer/Senior Lecturer	7 (20.0)
Assistant Professor	8 (22.9)
Associate Professor	9 (25.7)
Professor	2 (5.7)
Region (<i>n</i> = 42)	
North America	19 (45.2)
South America	1 (2.4)
Europe	13 (31.0)
Australia/New Zealand	9 (21.4)
Self-Identified Research Focus (<i>n</i> = 43)	
Disciplinary	3 (6.9)
Mostly Disciplinary	7 (16.3)
Neutral	12 (27.9)
Mostly Interdisciplinary	14 (32.6)
Interdisciplinary	7 (16.3)

Table 2.2. Themes and sub-themes from faculty perceptions of interdisciplinary research in kinesiology

<p>Benefits</p> <ul style="list-style-type: none">New Perspectives ($n = 32$)Better Results ($n = 27$)Collaboration Potential ($n = 16$)Funding Potential ($n = 14$)Better Methodology ($n = 11$)Increased Publications and Application ($n = 10$)Movement is Multidimensional ($n = 5$)Benefits the Field ($n = 5$) <p>Limitations</p> <ul style="list-style-type: none">Collaboration Problems ($n = 15$)Challenging Methodology ($n = 13$)Limiting Results and Analysis ($n = 11$)Logistical Barriers ($n = 11$)Increased Financial Cost ($n = 9$)Disciplinary Jargon ($n = 5$)Hinders Career Advancement ($n = 5$)Publishing Difficulties ($n = 3$)

Chapter 5. General Conclusion

General Conclusion

While academics continue to talk about the benefits of interdisciplinary research (IDR), within kinesiology, IDR is still understudied and often misunderstood. Uncovering the breadth and depth of IDR in kinesiology is beyond the scope of any one study, but this dissertation took the initial steps towards clarity by completing a descriptive review of IDR, proposing an initial model of IDR, and describing kinesiology's perceived benefits and limitations. Interestingly and importantly, while disciplinary research far exceeded IDR in the quantitative study, all surveyed kinesiology in the qualitative study still perceived IDR as beneficial to the field and for solving complex human movement problems (e.g., physical inactivity, sedentary living). Future research should explore this perplexing result. Prospective projects could include examining disciplinary-focused journals, researching the role of translational research within IDR, interviewing kinesiology with IDR experience, studying IDR training in graduate programs (including research methods courses and books used in the field), or determining IDR best practices.

Regardless of the research avenue, in order to maximize IDR's effectiveness, there needs to be as much emphasis placed on understanding IDR as there is placed on implementing IDR. Without continued reflection and examination, conducting IDR may not yield the results needed to solve internal struggles (e.g., fragmentation) or external problems (e.g., physical inactivity, sedentary living). Without the unconditional support from administrators, faculty, and funding agencies, we may never truly know IDR's potential.

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Appendices

Appendix A: Journal Mission Statements

Chapter 3

European Journal of Sport Science

“The editorial policy of the Journal pursues the multi-disciplinary aims of the College: to promote the highest standards of scientific study and scholarship in respect of the following fields: (a) Applied Sport Sciences; (b) Biomechanics and Motor Control; c) Physiology and Nutrition; (d) Psychology, Social Sciences and Humanities and (e) Sports and Exercise Medicine and Health. The Journal also aims to facilitate and enhance communication across all sub-disciplines of the sport sciences.”

(<http://www.tandfonline.com/action/aboutThisJournal?show=aimsScope&journalCode=ejs20#.UZp-a3CRD0A>)

International Journal of Behavioral Nutrition and Physical Activity

“IJBNPA is unique in its focus on the behavioral aspects of diet and physical activity; its inclusion of multiple levels of analysis, including populations, groups and individuals; and its inclusion of epidemiology, and behavioral, theoretical and measurement research areas.” (<http://www.ijbnpa.org/about>)

International Journal of Sports Medicine

“The following sections define the scope of the journal: Training & Testing; Orthopedics & Biomechanics; Clinical Sciences; Nutrition; Behavioural Sciences; Physiology & Biochemistry; Immunology; Genetics & Molecular Biology.”

(<http://www.thieme.com/index.php>)

Journal of Physical Activity and Health

“Of interest is work studying the role of physical activity as it relates to health as well as reports of efforts to increase physical activity on individual and community levels. JPAH is an interdisciplinary journal published for researchers and practitioners in fields of disease and injury prevention and control where physical activity may play a vital role.”

(<http://journals.humankinetics.com/jpah-mission>)

Journal of Science and Medicine in Sports

“The Journal considers for publication...sub-disciplines relating generally to the broad sports medicine and sports science fields: sports medicine, sports injury (including injury epidemiology and injury prevention), physiotherapy, podiatry, physical activity and health, sports science, biomechanics, exercise physiology, motor control and learning, sport and exercise psychology, sports nutrition, public health (as relevant to sport and exercise), and rehabilitation and injury management...an interdisciplinary perspective with specific applications to sport and exercise and its interaction with health will also be considered.” (<http://www.elsevier.com/journals/journal-of-science-and-medicine-in-sport/1440-2440#>)

Journal of Sport Sciences

“The Journal of Sports Sciences publishes articles of a high standard on various aspects of the sports sciences covering a number of disciplinary bases, including anatomy, biochemistry, biomechanics, psychology, sociology, as well as ergonomics, kinanthropometry and other interdisciplinary perspectives. The Journal presents research findings in the growing area of exercise and sports sciences to an international audience.” (<http://www.tandfonline.com/action/aboutThisJournal?show=aimsScope&journalCode=rjsp20#.UZqAnHCRD0A>)

Medicine and Science in Sport and Exercise

“Medicine & Science in Sports & Exercise features original investigations, clinical studies, and comprehensive reviews on current topics in sports medicine and exercise science. With this leading multidisciplinary journal, exercise physiologists, physiatrists, physical therapists, team physicians, and athletic trainers get a vital exchange of information from basic and applied science, medicine, education, and allied health fields.” (<http://journals.lww.com/acsm-msse/pages/aboutthejournal.aspx>)

Research Quarterly for Exercise and Sport

“This comprehensive professional journal features articles and research notes encompassing such topic areas as biomechanics, epidemiology, motor behavior, measurement and evaluation, physiology, pedagogy, psychology and history/philosophy/sociocultural foundations.” (<http://www.aahperd.org/rc/publications/rqes/>)

Scandinavian Journal of Medicine and Science in Sports

“The journal publishes original articles on the traumatologic (orthopedic), physiologic, biomechanic, medical (including rehabilitation), sociologic, psychologic, pedagogic, historic and philosophic aspects of sport. Scandinavian Journal of Medicine & Science in Sports is thus multidisciplinary and encompasses all elements of research in sport.” ([http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1600-0838/homepage/ProductInformation.html](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1600-0838/homepage/ProductInformation.html))

The Physical Educator

The Physical Educator is one of the longest standing journals providing research-based articles relating to physical education, health, recreation, and related areas. (<http://js.sagamorepub.com/pe>)

Appendix B: Panel of Experts

Chapter 3

Earle Ziegler is Dean and Professor Emeritus from the University of Western Ontario, Canada. He has over 70 years of experience in the professorial ranks. His areas include the Sport Humanities (History and Philosophy of Sport) and Sports Administration and Management. He earned his Ph.D. at Yale University.

Scott Melville is a Professor Emeritus from Eastern Washington University. He has 40 years of experience in the professorial ranks. His areas include Motor Learning and Physical Education Pedagogy, with teaching experience in Adapted Physical Education and Biomechanics. He earned his Ph.D. at the University of Iowa.

Duane Knudson is a Professor and Department Chair at Texas State University. He has 25 years of experience in the professorial ranks. His area is Biomechanics. He earned his Ph.D. at the University of Wisconsin, Madison.

Marita Cardinal is a Professor at Western Oregon University. She has 20 years of experience in the professorial ranks. Her areas include Dance (Science and Education), Movement Education, and Fitness. She has an interdisciplinary masters degree, as well as an interdisciplinary teaching assignment. She earned her Ed.D. at Temple University.

Paul Loprinzi is an Assistant Professor at Bellarmine University. He has two years of experience in the professorial ranks. His areas are Physical Activity and Health, Sport and Exercise Psychology, and Exercise Physiology. He earned his Ph.D. at Oregon State University.

The panel has 157 total years of experience ($M = 31.4$ years of experience) from across a range of disciplinary areas, academic ranks, and administrative levels of experience. They represent different regions of the United States of America (USA) and two different countries (Canada and USA), as well as different levels of institutions (i.e., private liberal arts, regional comprehensive, and major research university). Both men and women were included on the panel. They also each have some degree of interdisciplinary in their academic preparation, teaching, and/or scholarship.

Appendix C: Coding Protocol for Journal Articles
Chapter 3

Journal:
 Year:
 Article
 Title:
 # of
 Authors:

Corresponding Author

Code	Variable
	Name:
	Sex:
0	Male
1	Female
	Institution:
	Department:
	Email:
0	Kinesiology affiliated
1	Not Kinesiology affiliated
0	Domestic
1	International
2	Multi-national

Article

Code	Variable
	dis: Discipline(s) Represented (select all that apply)
0	Behavioral
1	Biophysical
2	Sociocultural
3	Behavioral/Biophysical
4	Behavioral/Sociocultural
5	Biophysical/Sociocultural
6	Behavioral/Biophysical/Sociocultural
7	Other (specify):

bef: Behavioral Epidemiology Framework (select highest phase)

- 0 Phase 1: establish links between physical activity and outcome(s),
- 1 Phase 2: develop and apply measurements
- 2 Phase 3: identify factors that influence physical activity
- 3 Phase 4: evaluate interventions that promote physical activity
- 4 Phase 5: translate research into practice

meth: Methodology and Design

Quantitative

- 0 Measurement
- 1 Cross-sectional
- 2 Longitudinal
- 3 Quasi-experimental
- 4 Experimental

Qualitative

- 5 Content analysis
- 6 Interview
- 7 Focus groups
- 8 Mixed-Methods
- 9 Other (specify)

theof: Theoretical Framework

- 0 Theoretical (specify)
- 1 Multi-theory (specify):
- 2 No theory explicitly stated

fund: Funding Source

- 0 Yes (specify)
- 1 No funding source stated

idt: Interdisciplinary Typology

- 0 Informed Disciplinarity
- 1 Synthetic Interdisciplinarity
- 2 Transdisciplinarity
- 3 Conceptual Disciplinarity

Appendix D: Sample Questionnaire
Chapter 4

Questionnaire

Thank you for your interest in our research. You have been selected to participate in “Uncovering the Mystery of Interdisciplinary Research in Kinesiology” because you were identified as the corresponding author of a kinesiology-focused research article published in 2008 to 2012 in one of ten kinesiology journals that are the focus of our investigation. This research project is designed to understand the role of interdisciplinary research in the field of kinesiology. The survey will take you about 15 minutes. Please answer all questions openly and honestly. Your answers will remain confidential and will be reported anonymously.

For the purpose of this study, interdisciplinary research is broadly defined as any study that undertaken:

...from two or more distinct scientific disciplines. The research is based upon a conceptual model that links or integrates theoretical frameworks from those disciplines, uses study design and methodology that is not limited to any one field, and require the use of perspective and skills of the involved disciplines throughout phases of the research process (Aboelela, et al., 2007, p. 364)

1. How do you view yourself as a researcher?

1	2	3	4	5
Disciplinary				Interdisciplinary
Focused				Focused

2. Do you think interdisciplinary research is important for the field of kinesiology?

Yes	No
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Please explain your answer:

3. In your own opinion, please explain any potential benefits of interdisciplinary research in the field of kinesiology?

4. In your own opinion, please explain any potential limitations of interdisciplinary research in the field of kinesiology?

5. In your own opinion, please explain any barriers to conducting interdisciplinary research in the field of kinesiology?

6. In your own opinion, please explain any incentives to conducting interdisciplinary research in the field of kinesiology?

7. Please write any other comments you have about interdisciplinary research

8. What is the size of your institution?