AN ABSTRACT OF THE DISSERTATION OF

Jafrā D. Thomas for the degree of Doctor of Philosophy in Kinesiology
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Title: Kinesiology's Knowledge Production, Mass Translation, and Utilization Problem: Critical Appraisal and Theoretical Analysis of Physical Activity Websites

Abstract approved by: _____
Bradley J. Cardinal

Background: The communication of kinesiology-based principles to lay adults through educational resources freely available online is suspect and understudied. The first purpose of this dissertation was to advance knowledge on the quality of physical activity educational resources that lay adults could locate online. The second was to determine if quality measures differed on the basis of production source.

Inclusion criteria: Samples must have been a web article freely available to the public, written in English, used text as the primary medium of communication, and produced by one of the following types of organizations: commercial, governmental, professional association, or voluntary health agency.

Methods: The Google search engine and lay adult search strategies were used to locate web articles for review. A sample of 139 web articles was obtained (commercial = 36, government = 35, professional association = 32, and voluntary health agency = 36). The *2008 Physical Activity Guidelines for Americans* 18 to 64 years of age were used to

evaluate message consistency to national physical activity health guidelines (PAGs). The Suitability Assessment of Materials (SAM) procedure was used to assess the suitability of web article content for health-related communication. The Content Analysis Approach to Theory Specified Persuasive Communication (CAATSPEC) method was used to analyze the extent recommended health behavior concepts were used in web article messages. The CAATSPEC message categories were knowledge-based information, outcome expectancy, self-regulation, self-efficacy, and other messages.

Descriptive results: Web article content that was published or updated between 2008 and 2018 (M = 2015.97, SD = 2.42), most of which (i.e., 94.23%) were based in the United States, was obtained from 52 unique organizations. Most web articles included as a focus the promotion of physically active lifestyles (i.e., 55.39%), followed by the provision of ideas or suggestions for physical activity or exercise (i.e., 54.68%).

Analytic results of study one: There were 123 web articles eligible for review, of which 72 presented PAG-related messages. Most to all of these web articles (n = 44 to 72; 61.1% to 100%) presented information that was inconsistent or lacked messages corresponding to one of the 17 PAGs considered, of which the degree of inconsistency or absence was significant for 15 guidelines ($p < .05$). Production source was associated with consistency for five guidelines, all related to aerobic (endurance) physical activity ($p \leq .05$), otherwise the rate of guideline absence or inconsistency did not change on the basis of production source. Most messages consistent with a PAG had to do with aerobic (endurance) physical activity. The lowest rate of consistent web articles had to do with guidelines for adults with sedentary lifestyles or who are modestly active (M ≈ 3%).

Analytic results of study two: The overall web article suitability level ranged from unsatisfactory (i.e., SAM score = 26.47%) to optimal (i.e., SAM score = 77.78%) for the aggregate sample. The mean overall level of suitability for the aggregate sample was satisfactory and greater than the minimum cut point, M = 56.20%, SD = 10.36, 95% CI [54.48, 57.92], t (138) = 18.431, $p < .001$, d = 2.21. There were seven subcategories which the majority of web articles having unsatisfactory suitability (all $p < .05$): 1) reading grade level [97.1% of web articles]; 2) use of graphics [96.8% of web articles]; 3) summary/reviews inadequate or absent [84.2% of web articles], 4) typography [68.3% of web articles], 5) context before new information [65.5% of web articles], 6) explanation of lists/tables/figures [58.4% of web articles], and 7) use of relevant illustrations [54.7% of web articles]. Most web articles had satisfactory to optimal levels for the remaining suitability subcategories assessed ($p < .05$). Production source was associated with suitability for two subcategories (i.e., evident purpose, layout $p \leq .05$). Even so, both positive and negative suitability attributes of the sample web articles did not meaningfully vary on the basis of production source.

Analytic results of study three: Descriptively, most messages presented on web articles were other (M = 29.49%, SD = 10.04%), followed by messages that targeted self-efficacy (M = 26.36%, SD = 14.52%), outcome expectancy (M = 17.14%, SD = 11.72%,), self-regulation (M = 13.55%, SD = 10.24%), then knowledge-based information (M = 13.45%, SD = 9.12%). One or more categories differed in magnitude, RM-ANOVA F (2.598, 135) = 48.737, $p < .001$, partial η^2 = .261. The other message and self-efficacy categories were similar in size (p = .877), and both were greater than all other categories (all $p < .001$). Web articles devoted a larger portion of messages to targeting outcome

expectancies than to presenting knowledge-based information (p = .029). The portion of messages devoted to self-regulation was similar in size to knowledge-based information (p = 1.00) and outcome expectancy (p = .285) categories. Most outcome expectancy messages were positive (M = 81.47%, SD = 11.07%) and targeted instrumental attitudes (M = 58.93%, SD = 29.24%, both $p < .001$) Sources of production differed along two theory-based categories, outcome expectancy and self-efficacy, one-way MANOVA Wilk's lambda = .855, F (3, 135) = 1.778, p = .05, partial η^2 = .051. Commercial and voluntary health agency produced more web articles devoted to messages targeting positive outcome expectancies than did governmental web articles (both $p \leq .05$). Compared to commercial sources, governmental web articles devoted more messages that targeted self-efficacy (p = .006, d = 0.81) and fewer that presented other messages (p = .013, d = 0.74).

Conclusion: Through the Internet, lay adults are likely to locate web articles that often present behavioral advice that is inconsistent with national physical activity health guidelines. While the overall suitability of the web article communication appears to be satisfactory, users' ability to comprehend and learn from the material presented is limited by seven correctable issues. Web article messages may target multiple evidence-based concepts from theories of health behavior, which enhances their potential to be effective. The degree to which web articles target the recommended concepts of health behavior theory vary based on production source. Presented in the Discussion section of this dissertation are strategies that developers of educational resources aimed at promoting physical activity behavior can use to improve the quality of their materials, as well as

recommendations for future research aimed at closing the “science gap” in knowledge translation.

Kinesiology's Knowledge Production, Mass Translation, and Utilization Problem: Critical Appraisal and Theoretical Analysis of Physical Activity Websites

By
Jafrā D. Thomas

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APPROVED:

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Dean of the Graduate School

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.

_____

Jafrā D. Thomas

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DEDICATION

The work of this dissertation is dedicated to my cousin and best friend, Nikkisha R. Robinson. In all this, I have never felt alone but only encouraged that I could persevere and grow as I would hope. This dissertation is dedicated to Bradley J. Cardinal, my doctoral program advisor and mentor. Truly, the work of this dissertation and the milestones that have led up to it would not have been possible were it not for us connecting. This dissertation is dedicated to Coach Eric Weir, who kindly offered to help me relocate from California to Oregon by giving me a ride. You made embarking on this journey possible and our time together made it all the more special. Finally, this dissertation is dedicated to the scholars whose research has taught me so much and whose work is the foundation of this dissertation.

Chapter 1 – Introduction

There are many actions that can constitute "physical activity promotion." Actions may include encouraging a friend to become an "exercise buddy" or displaying posters to inspire people to take the stairs instead of riding an elevator. People, organizations, and governments all can engage in physical activity promotion to one degree or another. Inspired by DiClemente, Salazar, and Crosby's (2013) definition of health promotion, physical activity promotion is any action intended to increase personal value towards physical activity throughout the day and to motivate the adoptions of behaviors that support adherence to scientific health guidelines. This definition captures the many aims of everyday adults interested in becoming more physically active and healthy. Also captured is the objectives of lay individuals and professionals working to improve the health of their communities or organizations, in part, by increasing the prevalence of regular physical activity among their peers and constituents.

One of kinesiology's aims is to help people achieve and/or maintain a healthy, active lifestyle (Cardinal, Kang, Farnsworth, & Welk, 2015). Toward this end, and particularly since the publication of Henry's (1964) seminal paper, the discipline of kinesiology has been amassing a large body of knowledge organized around various sub-disciplines (e.g., biomechanics, exercise physiology, motor behavior, sport sociology, sport and exercise psychology), which has no doubt resulted in greater depth of knowledge and understanding (Park, 2011). How that knowledge is or is not used is paramount to achieving the important aim of promoting healthy, active lifestyles for all. At this juncture, and consistent with Park's impassioned plea for those working in kinesiology to "put words into actions" (p. 383), it seems that sufficient knowledge has

been accumulated to offer practical guidelines for achieving holistic health via physical activity for a variety of populations across the lifespan (Dunn & Blair, 2002; Ennis, 2017). As but one example of this is the "2018 Physical Activity Guidelines Advisory Committee Scientific Report", from which the 2018 physical activity guidelines for the United States were based (Physical Activity Guidelines Advisory Committee, 2018). One popular means of disseminating and accessing such information is through the Internet.

The Internet provides unique opportunities for wide-scale dissemination of physical activity information and other potentially actionable content and/or interfacing. The Internet is a primary resource of self-directed health-information seeking behaviors by most adults, including those seeking information about physical activity. In this medium, health-related information is communicated primarily via the written word, which may be supplemented by audio, video, and/or visual materials. Written communication is an effective way to convey health information related to physical activity. Some of the benefits of written communication include the ability to review key information, provide concise step-by-step instructions, the ability to be easily archived for later retrieval and use, and to convey motivational messages that reinforce healthful physical activity behaviors. There are also genuine challenges to conveying written kinesiology information via the Internet, which result in barriers to knowledge translation for the discipline (Thomas & Cardinal, 2018).

The overarching aim of this dissertation is to identify some of the common quality issues associated with written health-related information about physical activity that is available on the Internet. On the basis of this critical appraisal and theoretical analysis, the case for future research and praxis aimed at improving the development and

dissemination of quality physical activity resources will be advanced. Through these efforts, this study seeks to narrow the "science gap" between kinesiology's knowledge production and its use in the lives of people (i.e., translating research and theory into practice; Brawley & Latimer, 2007).

Chapter 2 – Literature Review

Supporting Adherence to Physical Activity Guidelines: A Public Health Priority

Chronic diseases are a leading cause of social and economic burden in many parts of the world, and the leading cause of morbidity and premature mortality in most industrialized nations. For example, 86% of the 2.7 trillion dollars of direct and indirect healthcare costs accrued annually in the U.S. are due to ameliorable chronic physical and psychological health conditions (Gerteis et al., 2014). One cost-effective strategy for better managing this is through primary prevention. This is consistent with the third iteration of public health, which focuses on lifestyle behaviors (DeSalvo, O'Carroll, Koo, Auerbach, & Monroe, 2016). Among different lifestyle behaviors, one of the most important is physical activity (Lee, Shiroma, Lobelo, Puska, Blair, & Katzmarzyk, 2012; Wen et al., 2011)

Most national and international health agencies endorse guidelines that encourage the regular accumulation of moderate to vigorous aerobic activity on five or more days of the week, as well as two days of muscle-strengthening activities that target the large muscle groups of the body. Following these guidelines achieves similar physical and psychological health outcomes without the debilitative side effects or financial expenses that are often associated with many common pharmacological treatments (Martin,

Church, Thompson, Earnest, & Blair, 2009; Naci & Ioannidis, 2013; Warburton, Nicol, & Bredin, 2006). Further, adherence to physical activity guidelines may help to reduce the dosages of pharmaceutical agents that are otherwise medically necessary (Asano & Finlayson, 2014). Beyond its health benefits, physical activity can serve as a source of intrinsic pleasure, increased feelings of vitality, greater life satisfaction, healthy aging, and an overall better quality of life (Anokye, Trueman, Green, Pavey, & Taylor, 2012; Jurakić, Pedišić, & Greblo, 2010; Bize, Johnson, & Plotnikoff, 2007).

Despite its importance and contributions to a better quality of life, the majority of adults do not engage in physical activity regularly. For example, the U.S. Department of Health and Human Services (2017) reports that less than 5% of adults meet the guideline of accumulating 30 minutes of aerobic (endurance) physical activity a day. Only about 50% of U.S. adults meet the health guidelines for weekly amounts of aerobic (endurance) physical activity, and when the muscle-strengthening guideline is also considered, about 20% of U.S. adults meet the totality of the scientifically based guidelines (Harris, Watson, Carlson, Fulton, & Dorn, 2013). Further confounding this is that approximately half of the people who initiate a physical activity program will dropout (i.e., relapse) within the first six months (Marcus et al., 2000). The high rate of relapse within the physical activity domain has been a stable observation for decades (Fjeldose, Neuhaus, Winkler, & Eakin, 2011; Nigg, Borrelli, Maddock, & Dishman, 2008). Clearly, the vast majority of people in the United States never realize the potential benefits associated with living a physically active lifestyle.

Physical inactivity is also a global health issue with nearly 25% of the world's adult population classified as being insufficiently active (World Health Organization,

2018). Adults in many nations struggle to adopt and adhere to physical activity guidelines, especially those who reside in highly industrialized nations (World Health Organization, 2018). As such, the World Health Organization and many individual nations have made regular physical activity participation a priority (Khol et al., 2012). One means of supporting this is through the use of health communication and health technology (Bernhardt, 2004; Bickmore & Paasche-Orlow, 2012; *Healthy People 2020*).

Health Promotion via Internet Technology

The Internet has become a popular source of health information among adults. For example, in the early 2000s approximately 25% of U.S. adults regularly accessed the Internet, whereas by 2007 a nearly threefold increase was observed, with 72% regularly accessing the Internet (Chou, Hunt, Beckjord, Moser, & Hesse, 2009; Fox & Jones, 2009). As of 2015, ~80% of the U.S. adult population regularly access the Internet, of which 75% of users — up from 61% in 2009 — reported using the Internet to locate health-related information (Fox & Jones, 2009; Poushter, 2016; Prestin, Vieux, & Chou, 2015). The Internet is not only popular for obtaining health-related information, it is also a first source for many adults to plan or change their health behaviors, including physical activity (Berry, Spence, Plotnikoff, & Bauman, 2011; Hesse et al., 2005; Huberty, Dinkel, Beets, & Coleman, 2013; Prestin et al., 2015; Warner & Procaccino, 2004). Moreover, divergent social groups appear to use the Internet similarly, making it a rare medium that can be used to deliver health communications to the populace, including otherwise hard to reach audiences or population subgroups (Burke-Garcia & Scally, 2014).

Advances in Internet access and technology continue to expand not only the medium's reach but also its applications. For example, people have greater access to health information and technological tools that allow them to engage with health content, and even one-another, interactively and/or virtually (Kosma, Cardinal, & McCubbin, 2005). Consider, too, how managed care providers and healthcare organizations are encouraging their patients to use patient portal systems and Internet-based mobile device programs with the hope of facilitating preventive health behavior adoption and maintenance, higher quality patient-provider interactions, better use of healthcare services in general, and a reduction in healthcare costs for individuals, families, communities, and society (Forkner-Dunn, 2003; Kontos, Blacke, Chou, & Prestin, 2014; Neupert & Mundie, 2009, Wiecha & Pollard, 2004).

In the healthcare environment, in particular, text-based communication strategies have many potential uses including: 1) reminders of key information discussed during a healthcare visit, 2) providing instructions for referrals or prescriptions, 3) encouraging the use of preventive services, and 4) providing guidance and advice regarding healthy lifestyle behavior changes and/or supporting positive health behavior practices (Kim & Lee, 2016; Lee, Lee, Kim, & Kang, 2012; Pignone, DeWalt, Sheridan, Berkman, & Lohr, 2005; Sheridan et al., 2011). Such materials are used outside of the healthcare system, too. For example, people proactively and autonomously seeking out health information on the Internet (Hesse et al., 2005). The common denominator in many of these communications is that they are written; they rely on the written word.

Supporting Physical Activity Promotion via Health Literacy Promotion

While most U.S. adults recognize physical activity has health benefits and value it for that reason, many are unaware of the precise recommendations for weekly physical activity or for steps to become more physically active (Ballard, Mathis, & Wallace, 2002; Moore, Fulton, Kruger, & McDivitt, 2010; Morrow, Krzewinski-Malone, Jackson, Bungum, & Fitzgerald, 2004). The act of increasing awareness of the physical activity guidelines and sharing practical behavioral strategies to meet them is an example of health communication promoting physical activity via enhancing health literacy.

Health literacy refers to a person's knowledge, motivation, confidence, and skill in obtaining and/or using accurate health information to plan or carry out health-related behaviors (Osborn, Paasche-Orlow, Bailey, & Wolf, 2011; Sørensen et al., 2012). While low levels of health literacy contribute to health disparities and is a barrier to achieving health equity, high levels of health literacy are associated with participation in positive, health-promoting behaviors (i.e., prevention-oriented health behaviors such as health screenings and physical activity, among others) and decreased risk of preventable hospitalizations (Taggart et al., 2012). Health literacy is also positively associated with adhering to recommendations based on scientific consensus statements for using physical activity to manage chronic health conditions in clinical adult populations (Eckman et al., 2012; Fitzpatrick et al., 2016; Hill-Briggs et al., 2011). The mere act of seeking out health information is also associated with positive health outcomes, including a positive trend towards meeting physical activity guidelines (Aaby, Friis, Christensen, Rowlands, & Maindal, 2017; Dominick, Pekemezi, & Marcus, 2013; Shi, Nakamura, & Takano, 2004). More broadly, interventions and services that include health literacy promotion as a

primary objective observe greater program adherence, chronic disease management, and sustained health behavior change (Kim & Lee, 2016; Lee et al., 2012; Sheridan et al., 2011).

Because of its potential for rapid, wide-scale dissemination, the Internet appears to be a viable means of enhancing health literacy in addition to supporting general physical activity changes. Kim and Xie (2017) performed a systematic review and found nine studies demonstrating the potential for Internet disseminated health communications to promote health literacy. Six of the nine studies delivered Internet-based interventions designed specifically for adults with low literacy or who were elderly; the studies reported increases in health knowledge and confidence to locate and apply health information. Their findings are consistent with in-person patient education counseling interventions that aim to promote health literacy and improve self-management of chronic conditions among clinical populations that experience social marginalization (e.g., racial minority, people with disabilities). The findings by Kim and Xie expand knowledge concerning the utility of health literacy interventions delivered through the Internet. Prior research syntheses have also demonstrated that Internet interventions may be just as effective in changing physical activity behavior as in-person interventions (Davies, Spence, Vandelanotte, Caperchione, & Mummery, 2012; Wantland, Portillo, Holzemer, Slaughter & McGhee, 2004; Webb, Joseph, Yardley, & Michie, 2010). Increases in health literacy are fundamental to ensuring positive physical activity behavior changes are sustained.

Issues to address in web-based health literacy and PA promotion. While websites may increase health literacy promotion and play an effective role in physical

activity, the quality of website content is a limiting factor in achieving these outcomes. The potential of lay resources to promote physical activity via health literacy promotion is subverted because content is not consistent with physical activity guidelines and/or may not meet readability recommendations for mass health communication (Berstam et al., 2005; Eysenbach, Powell, Kuss, & Sa, 2002; Gagliardi & Jadad, 2002; Jadad & Gagliardi,1998, Zhang Sun, & Xie, 2015). Emerging literature suggests that websites may be further compromised via their scarce use of health behavior change theories and/or techniques (Evers et al., 2003; Gorczynski & Patel. 2014; Gorczynski, Patel, & Ganguli, 2013; Jetha, Faulkner, Gorczynski, Abour-Nicitopoulos, & Ginis, 2011; Shirazipour, Baillie, Galaviz, Jarvis, & Latimer-Cheung, 2015; Tristani, Basset-Gunter, & Tanna, 2017; Vandelanotte et al., 2014). Though widely accessed, there is also concern that health-related websites may actively reinforce health inequities due to the limited quality of their presentation (Berland et al., 2001; McGloin & Eslami. 2015; van der Vaart, Drossaert, Heus, Taal, & van de Laar, 2013). Low quality websites require users to draw upon their available social capital to obtain supplemental support to navigate, understand, and/or use the material (Alvarez, Kawachi, & Romani, 2017; Berland et al., 2001, Nijiland, van Gemert-Pijnen, Boer, Steenhouder, & Seydel, 2008; Schoo, Lawn, & Carson, 2016). Low-quality websites can further reinforce health inequities when users experience barriers or marginalization to access high-quality information in general due to built-environment factors, stigmatization concerns, time constraints, or other socioeconomic barriers (Burkell, Wolfe, Potter, & Jutai, 2006; Chesser, Burke, Reyes, & Rohrberg, 2016; Edwards, Krassioukov, & Fehlings, 2002; Lee, Giovenco, & Operario, 2017; Loprinzi & Beets; 2014; Hampton, 2018; Schrank, Sibitz, Unger, & Amerin, 2010;

Warner & Procaccino, 2004). Ensuring that physical activity resources meet quality standards and that they do not inadvertently privilege some over others is fundamental to advancing the goal of healthy, active living for all, regardless of social circumstances or societal position.

Adequate health literacy abilities are not a given. Adults of all ages and formal school years typically display inadequate health literacy levels (Diviani, Van Den Putte, Giani, & Van Weert, 2017). Kutner, Greenberg, Jin, and Paulsen (2006) reported that 90% of the participants in their nationally representative study of English speaking adults lacked adequate levels of health literacy. Health literacy conceptual models posit that age and educational attainment are associated with health literacy (negatively and positively, respectfully), but the empirical evidence in support of this is mixed (Osborn et al., 2011; Squiers, Peinado, Berkman, & Boudewyns, 2012). For example, research on college-attending adults frequently reports that members of this demographic group tend to poorly judge the reliability and quality of information (Stellefson et al., 2011). Ivanitskaya et al. (2010) found in their study of college-attending adults that participants whose only source of health information were via the Internet demonstrated a significantly lower ability to critical judge content for accuracy and reliability. The body of research on college-attending adults also suggests that members may typically grossly overestimate their ability to select resources that contain reliable and accurate health-related information (Escoffery, et al., 2005; Ivanitskaya, O'Boyle, & Casey, 2006; Redmond, 2008). The low ability to critically evaluate online resources for accuracy and reliability has been reported in studies of diverse population segments, including adults managing chronic conditions and those with low literacy levels (Diviani et al., 2017). A

best practice approach is to not assume the abilities of intended end-users, but strive to make sure that content is as accessible as possible by meeting precautionary recommendations for wide usability among diverse population segments (Coulter, 1998; Dewalt et al., 2011).

Quality resources for quality Health Literacy and PA promotion. Most adults have difficulty understanding or applying health information to their own lives, making it essential that the information disseminated is accurate, easy to understand, and actionable. As such, the *Healthy People 2020* goals specific to health communication and health technology include the following objectives: "(1) improve the health literacy of the population (HC/HIT-1), increase the proportion of quality, health-related websites (HC/HT-8.1), and increase the proportion of websites that meet established usability principles (HC/HT-8.2)" (*HealthyPeople2020*). Given their popularity and potential to enhance health equity, websites must be designed based on firm principles associated with both health literacy and physical activity promotion. Figure 1 presents a conceptual model developers and disseminators of written resources can use as a visual reminder of firm principles for quality educational materials.

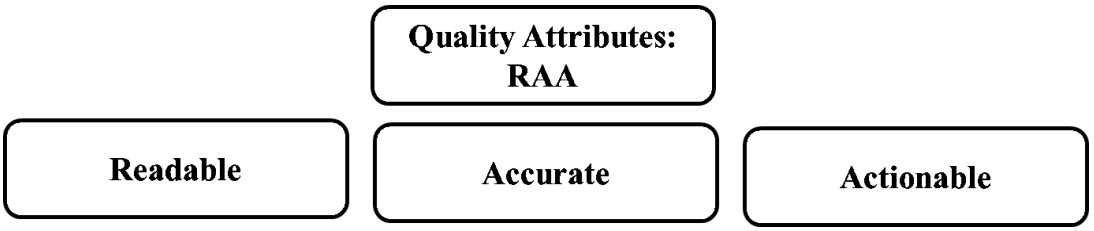


Figure 1. Visual model of three general principles for the quality development and/or selection of educational materials for dissemination to lay adult audiences.

Quality resources disseminated via the Internet are integral to meeting the principal aims of the *Healthy People 2020* goals specific to health communication and

health technology (Devine, Broderick, Harris, Wu, & Hilifiker, 2016; *HealthyPeople2020*). Indicators of quality resources include the following attributes: written content is easy to read and understand, physical activity guidelines are accurately communicated, and the resources provides research-supported behavior change techniques informed by health behavior theories (Cardinal, 1995; Cardinal & Seidler; 1995; Eckman et al., 2012; Fitzpatrick et al., 2016; Hill-Briggs et al., 2011; Hill-Briggs, Lazo, Renosky, & Ewing, 2008; Marshall et al., 2003; Vallance, Courneya, Plotnikoff, Yasui, & Mackey, 2007; Vallance, Lesniak, Belanger, & Courneya, 2010).

Credibility and Accuracy Issues to the Quality of Health Promotion Websites

Concerns for alarm. Prior to the widespread accessibility of Internet content being what it is today, leaders within the medical and allied health professions urged scholars and professional bodies to ensure that only quality information (i.e., accurate, credible, readable, and actionable) was being disseminated via the Internet (e.g., Cline & Hayes, 2001; Eysenbach et al., 2002; Lam, Roter, & Cohen, 2013; Post & Mainous, 2010; Sassenberg, 2017; Shoemaker, Wolf, & Brach, 2014; Silberg, Lundberg, & Muscacchio, 1997; Wyatt, 1997; Zun, Downey, & Brown, 2011). Nearing the close of the 20th century, for example, Silberg et al. (1997) published an article in *Journal of the American Medical Association* with the subtitle, "Caveant lector et viewor—Let the reader and viewer beware." Just over a decade later, Bonnar-Kidd and colleagues (2009) published an empirical article in *Health Communications* expressing little confidence that lay users will be able to easily find quality online physical activity information. Two decades after Silberg et al.'s (1997) study was published, Devine and colleagues (2016) urged academic and professional leaders to make quality online health-related websites a

national public health priority. The inspirations for these calls to action are based in part on a larger movement towards patient-centered care, where a key objective is to empower patients to take responsibility and exercise authority over their health management (Kontos et al., 2014; McKenzie, 2013). The calls to actions are also inspired by cultural shifts that encourage individuals to obtain health information and use it to manage their health risk via adoption of healthy lifestyles (Ayo, 2012; Kujipers, Groen, Aaronson, & Harten, 2013). Health literacy is critical to patient empowerment, and a fundamental approach to health literacy promotion is patient education using written resources (Kujipers et al., 2013; Moerenhout et al., 2013; Samoocha, Bruinvels, Elbers, Anema, & van der Beek, 2010).

Internet technology not only expanded access to information but also allowed anyone, including neophytes and charlatans, to publish content with little to no oversight or vetting by experts. While published content by non-experts (e.g., blogs, online reviews) could be appealing for relational reasons (Stephens, Gains, & Dailey, 2014; Zhang, 2014), there is an enhanced risk that inaccurate information is being disseminated to unsuspecting audiences. There are concerns too that the Internet could create new marketplaces for people and business to misinform or deceive lay audiences with inaccurate information or exaggerations in order to sell health-related goods or services with questionable efficacy (Berry, McCarville, & Rhodes, 2008; Ivanitskaya et al., 2010). Similar observations have been empirically documented in print resources disseminated through more traditional means (Cardinal, 2002).

Quality assessment efforts. Scholars and professional societies have spearheaded developing quality-rating tools that could be used to display that a website has met

quality standards. These displays may take the form of certifications, seals of approval, or quality awards (Zhang et al., 2015). The intention behind these tools is to provide a practical method of identifying quality, credible online content.

Silberg et al. (1997) developed a rating tool based on common quality criteria used to evaluate print media: authorship (authors, contributors, institutional affiliations, relevant credentials), attributions (references and sources for all content, copyright), disclosers (ownership, sponsorship, underwriting, commercial funding arrangements, potential conflicts of interest), and currency (publication or update date). These criteria have since been adopted by the *Journal of the American Medical Association* and have been used to study websites that disseminate health-related physical activity content to various lay adult audiences (Bonnar-Kidd et al., 2009; Gorczynski & Patel, 2014; Gorczynski, Patel, & Ganguli, 2013). Over the years a number of third-party vendors have been established to provide independent quality evaluations of online content and award certifications/awards/seals to organizations who meet their standards (O'Grady, 2006; Risk & Dzenowagis, 2001). The Health on the Net Foundation is an example of a third-party vendor; website operators can apply to receive an HONcode certification to demonstrate to users that their site meets quality and ethical standards similar to those outlined by Silberg et al. (1997). A new era of rating tools has emerged that focuses on replicating the manner that lay users follow to help developers anticipate the perceived usefulness of website content and to help guide resource development (Hölzel et al., 2015).

Summary and implications of the quality assessment literature. Beyond the examples mentioned above, there is an even larger body of research testing out tools to

evaluate domain-specific and general health-related content presented on websites. For example, Zhang et al. (2015) reported the existence of over 200 unique quality rating tools developed to study the quality of information presented on the Internet (Berstam et al., 2005; Gagliardi & Jadad, 2002; Jadad & Gagliardi,1998). For their study, Zhang et al. reviewed quality rating studies that were not included in prior systematic reviews (Berstam et al., 2005; Eysenbach et al., 2002; Gagliardi & Jadad, 2002; Jadad & Gagliardi, 1998). They found that over 50% (N = 163) of the studies included in their systematic review generated a negative conclusion concerning the sampled websites. The overall negative evaluation stemmed from four main issues: 1) the content contained multiple instances of inaccurate information, 2) the content was incomplete, 3) sites were difficult to navigate, and 4) the text had poor readability. Only 9% of the studies reviewed by Zhang and colleagues had an overall positive review. Their findings are consistent with prior systematic reviews that reviewed the quality of health-related websites.

A key implication of the quality assessment literature is that work must happen on the frontend to ensure that users can reliably locate quality health-related information on the Internet (Zhang et al., 2015). The instruments used to rate websites tend to be cumbersome to use resulting in diminished practicality (Eysenbach et al., 2002). Zhang and colleagues created a quality rating evaluation form based on criteria common to forms used in previous research; their synthesized form contained 11 domains, while the average number of criteria across forms used in previous research was 13. In addition to the tedious task of completing an evaluation form, many of the quality rating tools possess low inter-rater reliability and questionable validity due to a lack of consensus on

the definition of quality information and on how to operationalize quality indicators (Barnes et al., 2009; Hendrick et al., 2012; Khazaal et al., 2010; Wilson, 2002; Zang et al., 2015).

Credibility and Accuracy Issues to Quality Web-based PA Promotion

Websites with physical activity related content are also wrought with the same four types of quality problems that Zhang et al. (2015) reported. For example, Bonnar-Kidd et al. (2009) reported that only 22% of their sample of 41 websites intended for the general public had communicated physical activity-related information with high quality—none of the websites were highly accurate. Gorczynski, Patel and Ganguli (2013) reported that 59% of their sample of 17 of websites provided information that was not supported by physical activity guidelines. Two studies suggested that websites that target specific population segments or practitioners may also possess questionable information quality. Jetha et al. (2011) evaluated websites with physical activity related content specific to individuals with spinal cord injuries and found they lack satisfactory accuracy. Although the websites in their sample were of high technical quality, only 20% of their sample of 30 websites presented specific physical activity recommendations. Ahmed, Sullivan, Schneiders, and McCrory (2012) combined a systematic search process with a purposive sampling method to obtain 41 websites presenting prevention/management information on sports concussions to the general public. They assessed the websites for accuracy using a checklist that was developed using the most recent scientific consensus statement at the time of the study. Just over half of the statements observed in their sample of websites were consistent with their 22-item list. In

other words, the information presented was at best incomplete and at worst highly inaccurate.

The quality and accuracy of health-related websites appear to be suboptimal regardless of domain-type or intended audience segment. Bonnar-Kidd et al. (2009) compared information quality and accuracy by website domain type and found preliminary evidence that domain type is associated with quality and accuracy. In their sample, dot-gov and dot-net/edu were associated with quality and accuracy, while only dot-net/edu was associated with accuracy (Bonnar-Kidd et al., 2009). Notably, the content of websites within the significantly associated categories had a moderate level of accuracy (Bonnar-Kidd et al., 2009). In the physical activity domain, questionable validity of website quality certification has been documented. Ahmed et al. (2012) reported no significant difference in information accuracy between HONcode certified and noncertified lay educational sport concussion websites. Ahmed et al. (2012) also postulated that quality certified content may not be regularly updated by site webmasters or operators. Irrespective of source or topic areas, lay adults will be hard-pressed to locate credible or accurate content having to do with physical activity.

Dissertation hypotheses one and two. On the basis of this literature review on credibility and accuracy issues that broadly affect health-related communications and Internet-disseminated physical activity information, we advanced the first hypothesis listed below. Second, we observed across studies that website or web article messages mainly presented information consistent with aerobic (endurance) physical activity. The second hypothesis of this study is based on this observed trend in the literature. Both hypotheses are listed below.

> **Ha_1**: The majority of web articles will focus on physical activity promotion will present behavioral advice or recommendations that are inconsistent with the United States' *2008 Physical Activity Guidelines for Americans* (PAGs).
>
> **Ha_2**: If a web article provides information consistent with one or more 2008 PAG, most will correspond to guidelines for aerobic (endurance) physical activity rather than muscle-strengthening.

Readability Issues with Health Promotion Websites

Readability is another common indicator of information quality, and it is foundational to health literacy. Readability is a systematic method to help determine the degree to which a passage of text may be easily read and understood (Albright et al., 1996). A number of reliable and valid formulas have been developed that provide an estimate of the reading grade level necessary to comprehend a passage of text (Allensworth & Luther, 1986; Hanna, Brennan, Sambrook, & Armfield, 2015; Vaughan, 1976; Wang, Miller, Schmitt, & Wen, 2013).

Health promotion reading grade level recommendations. On the basis of two nationally representative studies, most U.S. adults comfortably read at the eighth-grade level (Kutner et al., 2006). Two widely endorsed general recommendations for producers of health-related educational resources have evolved from these two studies. First, resources should be developed so that they are written at or below the eighth-grade reading level. Second, the use of a standardized readability assessment protocol should be used to assure that the materials disseminated are written at or below the eighth-grade reading level prior to their wide-scale distribution (Mayer & Villaire, 2009; U.S. Department of Health and Human Services, 2012; U.S., National Cancer Institute, 1989). Together, these two recommendations represent universal precautions that minimize biases associated with a developer's or disseminator's subjective assessments of the ease

with which a text can be understood by its intended audience (Baur, 2010; Doak & Doak, 1980; Johnson & Stern, 2004; Thomas, 1999). The recommendations also help to guard against the possible overestimation of the abilities of the intended end-users with regard to understanding health-related information (Cardinal & Seidler, 1995; Wilson, Mood, & Nordstrom, 2010).

The recommendations that text does not exceed an eighth-grade reading level and to pretest resources using standard protocols are paramount to advancing health equity (Coulter & Ellins, 2007; DeWalt et al., 2011). Unfortunately, these widely endorsed recommendations appear to be rarely followed in everyday promotion activities (Gal & Prigat, 2005; Mercer, 1998; Shur, Lucado, & Feldman, 2011; Snyman & Penzhorn, 2007; Tagtow & Amos, 2000; Williams, Muir, & Rosdahl, 2016; Williamson & Martin, 2010; Winterbottom, Conner, Mooney, & Bekker, 2007). In contrast, the practical use of the recommendations for communicating health-related information specific to physical activity and other health-related topics has been documented for more than a quarter century (Cardinal, 2000; Cardinal & Sachs, 1992; Cardinal & Seidler, 1996; Hill-Briggs, Schumann, & Dike, 2012; Johnson & Stern, 2004; Reed-Pierce & Cardinal, 1996; Williams et al., 2016; Wilson, Mood, & Nordstrom, 2010). Documents that are easier to read and understand better promote health behavior, knowledge, and self-management, as well as self-regulation; importantly, these gains tend to be equivalent among those with low, basic, or high literacy levels (Clement, Ibrahim, Crichton, Wolf, & Rowlands, 2009; Coulter & Ellins, 2007; Eckman et al., 2012; DeWalt et al., 2006; Fitzpatrick et al., 2016; Hill-Briggs et al., 2011; Hill-Briggs, Lazo, Renosky, & Ewing, 2008; Kim & Lee, 2016; Kiser et al., 2011; Lee, Lee, Kim, & Kang, 2012; Pignone et al., 2005; Rosal et al., 2011;

Sheridan et al., 2011; Vallance et al., 2007; Weiss, 1998). Notably, adults also prefer health-related information presented in plain and simple language, irrespective of their years of formal schooling (Williams, 2005; Davis et al., 1998; Zhang, 2014). To advance and support population-wide physical activity promotion and health literacy, content intended for wide-scale dissemination must be easy to read and understand (i.e., $\leq 8^{th}$-grade reading grade level; Baur, 2010; Nielsen-Bohlman, Panzer, & Kindig, 2004; Rudd, Comings, & Hyde, 2003).

Trends in the readability of health resources. Readability is a general issue in communicating information about physical activity and other health topics. In a meta-analysis comprised of 819 estimates across 14 physical activity studies that assessed the reading level of widely disseminated materials, the materials were found to exceed the eighth-grade level by at least two full grade levels (Thomas, Flay, & Cardinal, 2018). Moreover, the readability of web materials in the Thomas et al. (2018) study did not differ significantly between print and web-based materials, and similar comparative observations have been reported in other content domains too (Simonds, Rudd, Sequist, & Colditz, 2011). Some evidence exists that website readability may differ across health topics and production sources (Cochrane, Gregory, & Wilson, 2012; McInnes & Haglund, 2011). In sum, regardless of health topic or organizational production source, websites tend to exceed the maximum reading level recommended for wide-scale dissemination of health-related information (i.e., $\leq 8^{th}$ grade) and by as much as two-full grade levels (Cochrane et al., 2012; McInnes & Haglund, 2011; Thomas et al., 2018). Further, a growing body of evidence suggests that reading grade levels may be largely equivalent among various categories of organizations that produce web content (Baur,

2010; Cochrane et al., 2012; McInnes & Haglund, 2011; Seitz et al., 2017; Walsh & Volsko, 2008), including when the content is related to physical activity (Thomas & Cardinal, 2018).

Notably, little to no readability research may exist regarding the physical activity information distributed via listservs (Thomas et al., 2018). Listserv content is viewed as a viable channel of health communication and includes advice columns, blog entries and ehealth newsletters (Ferguson, 1998; Fridsma, Ford, & Altman, 1994; Hassol et al., 2004; Locher, 2010). While organizational affiliation/familiarity and perceived credibility both predict greater trust in content and motivation to engage with difficult to understand information (Matingwina & Raju, 2017; Stephens et al., 2014; Zhang, 2014), these factors make it even more important to understand the degree lay listserv health-related communication meets usability standards for wide dissemination, including standards for readability (Gal & Prigat, 2005; Kontos et al., 2014; Kutner et al., 2006; Matingwina & Raju, 2017; Schur et al., 2011; Tagtow & Amos, 2000).

More than Readability, Suitability

To achieve their desired effects, written resources must be easily understood and valued by their end-users (Doak, Doak, & Root, 1996). That is, resources must be suitable for their intended audience(s). A common postulate of theories on adult learning is that adults value and prefer educational resources that are easy to understand and problem-focused (Merriam, Caffarella, & Baumgartner, 2007). Toward that end, a number of assessment tools have been developed to measure overall suitability of health-related resources, the most common of which is Doak et al.'s (1996) Suitability

Assessment of Materials (SAM; Murphy, Chesson, Berman, Arnold, & Galloway, 2001; Shieh & Hosei, 2008; Taylor-Clarke et al., 2012).

Suitability is the systematic assessment of health-related resources to determine the degree to which they are likely to be valued by adults, which is determined by assessing their ability to teach and support content application (Doak et al., 1996). SAM was developed to allow practitioners to assess the suitability of text-based print and digital media (Doak et al., 1996). It measures suitability by assessing multiple factors, including those related to readability (e.g., font-size, reading grade level, sentence length), information relevance (e.g., clear purpose, explained graphics), content organization, interactivity features, cultural appropriateness, and if self-efficacy to read and understand text is being promoted. Each assessment dimension subdomain is scored using a 3-point scale and the percentage of the sum total is used to generate an overall suitability classification of Not Suitable, Adequate, or Superior. This multidimensional rating system is intended to help guide the development or selection of appropriate health promotion media for wide-scale dissemination and to inform developers as to whom the resources might be disadvantaging (Doak et al., 1996). Recognizing that access to certain types of information has been historically unequal; Thomas and Cardinal (2018) framed this as a social justice issue.

The SAM has been used to assess the quality of print health promotion media that is used in everyday health communication practices and within health-related websites. This body of research reveals that resources tend to contain adequate overall suitability, with the most common areas in need of improvement being providing summaries or reviews of key informational points, including interactional features, and reducing

required reading levels to the recommended eighth-grade level (Ryan et al., 2014; Shieh & Hosei, 2008; Smith et al., 2014; Tian, Champlin, Mackert, Lazard, & Agrawal, 2014; Tran, Singh, Singhal, Rudd, & Lee, 2017; Vallance, Taylor, & Lavalle, 2008). However, knowledge about the suitability of written physical activity-related resources represents a notable gap in the extant literature. For example, only three (21.43%) of the 14 studies included in the Thomas et al. (2018) meta-analysis and obtained via a systematic search measured multiple suitability indicators; only one generated an overall suitability composite score. That said, the limited available literature specific to physical activity resources, which has only assessed print materials and not websites, is consistent with the larger body of suitability studies (Hill-Briggs & Smith, 2008; Vallance et al., 2008; Wallace, Bielak, & Linn 2010). This is certainly suggestive of the need to more carefully and thoroughly assess physical activity websites in terms of their suitability.

Dissertation hypotheses three to five. On the basis of research reviewed on the reading grade level and suitability of physical activity information intended for lay audiences, we tested the following hypotheses in this dissertation.

> **Ha_3**: Most web articles will have a satisfactory level of overall suitability, with the smallest number classified as optimal.
>
> **Ha_4**: Most web articles will have unsatisfactory suitability for the following three subcategories: information summary/review, interactional features, and reading grade level.
>
> **Ha_5**: The mean reading grade level of web articles will be similar across sources of production.

Health Behavior Theory: A Missing Ingredient

Another important consideration when evaluating the potential of lay resources to promote health literacy and physical activity behavior change is the degree that health

behavior theory is represented in the resources. Resources that incorporate behavior change theory are more likely to promote health literacy and may be more valued by end-users (Brawley & Latimer, 2007; Ehlers & Huberty, 2014). As Brawley and Latimer noted, the physical activity guidelines merely inform individuals about the necessary quantity of physical activity required to achieve health benefits; however, the missing ingredient is the how-to information and awareness of persuasive communication strategies based on contemporary theories of human motivation. Evidence-based approaches for incorporating such strategies into materials have been advanced (Brawley & Latimer, 2007; Latimer, Brawley, & Bassett, 2010; Rothman, Bartels, Wlaschin, & Salovey, 2006; Wardle, 2000).

Knowledge of health risks, though important, by itself is insufficient to lead to health behavior change or adherence (Abraham, Sheeran & Johnston, 1998; Abraham, Southby, Quandte, Krahé, & Sluijs, 2007). Unfortunately, the majority of information presented in educational resources tends to be irrelevant, inaccurate, or may only present aspects of the physical activity guidelines. So, in addition to quality concerns regarding content accuracy and poor readability, health promotion resources tend to be missing theoretically derived and empirically tested behavior change strategies as well.

Recommended theory-based constructs. Three psychological constructs have been recommended for inclusion in physical activity promotion materials. These constructs are self-regulation, self-efficacy, and outcome expectancy. Several systematic reviews and quantitative syntheses of physical activity behavior change interventions delivered using a variety of mediums suggest that these constructs are effective across various adult populations (Brawley, Gierc, & Locke, 2013; Conn, Hafdahl, Brown, &

Brown, 2008; McCauley & Blissmer, 2000; Michie, Abraham, Whittington, & McAteer, 2009; Rhodes & Pfaeffli, 2010; Stacey, James, Chapman, Courneya, & Lubans, 2015; Williams & French, 2011), including for interventions delivered primarily through the Internet (Webb et al., 2010) and to audiences who have been historically disadvantaged (Kosma et al., 2005; Ma & Ginis, 2018). On the basis of their systematic review, Latimer et al. (2010) concluded that when theory-based behavior change strategies are carefully designed to target self-efficacy, better adherence to the physical activity guidelines results. That said, self-regulation appears to have the greatest overall evidentiary support, while self-efficacy and outcome expectancy remain somewhat mixed (Brawley et al., 2013; Conn et al., 2008; McCauley & Blissmer, 2000; Michie et al., 2009; Rhodes & Pfaeffli, 2010; Williams & French, 2011; Webb et al., 2010). Targeting self-regulation, self-efficacy, and outcome expectancies seem to be a potentially powerful way of reliably promoting population-wide health literacy and physical activity behavior change.

Content analysis studies have assessed the extent to which websites with physical activity content target recommended psychological constructs using theory-based behavior change techniques shown to be effective in the literature. For example, Vandelanotte et al. (2014) screened 750 websites, 204 of which were initially identified as physical activity promotion websites. After the removal of duplicate, fee-based, or non-operational websites, their final sample included 46 physical activity websites that were free to use by the general public. Over 50% of the content in their final sample focused on the presentation of factual knowledge, and approximately 46% promoted self-regulation by promoting self-monitoring, goal setting, or providing feedback. Vandelanotte et al.'s (2014) findings were similar to those of Doshi et al. (2003) who had

conducted a similar study more than a decade earlier, which implies that either the web content had not been updated and/or that very little real progress had occurred in this area over time. Others, too, have reported that physical activity websites most often share factual knowledge, but rarely integrate empirically supported and theoretically derived behavioral strategies (Evers et al., 2003; Gorczynski, Patel, & Ganguli, 2013; Gorczynski & Patel. 2014; Jetha et al., 2011; Shirazipour et al., 2015; Tristani et al., 2017). This observation has been reported with physical activity print materials as well (Gainforth et al., 2011; Kilman & Rhodes, 2008; Vallance et al., 2008).

Research Implications for PA Promotion Practices

Given the importance of ensuring that online resources foster health literacy, greater solution-oriented attention is warranted with regards to their quality. Toward this end, research efforts are underway. First reliable and valid readability formulas allow researchers to empirically demonstrate how a text can be simplified. A number of web tools have been created to expedite this process. Second, tally systems based on physical activity guidelines have been used to determine the accuracy and completeness of health messages and to identify which guidelines tend to be excluded. In contrast, published protocols aimed at assessing the extent that theory is represented in media are often incomplete and difficult to reliably employ. Additionally, while many researchers report acceptable inter-rater reliability in their studies, many of the protocol require post-hoc deliberations to resolve disagreements, further minimizing their translation into daily practices. Further confounding this is that lay audiences and non-experts may not have the expertise, interest, or time necessary to reliably assess educational materials for their suitability and accuracy. They may reject the materials as a result (e.g., they are not

relevant, they require too much effort). Or, they may accept the materials as presented with little understanding of the limitations noted in regard to the use of behavior theory or material suitability. In either scenario, the material's potential for promoting health literacy and supporting behavior change is mitigated. As such, the task of producing appropriate materials lies squarely on the shoulders of the material's developers. Discerning and ethical distributors should mandate that developers of print and web materials adhere to quality standards that are fundamental to the general effectiveness of materials before their widespread dissemination to an otherwise unsuspecting audience.

To support quality development of health educational resources based on their integration of theory and theory-based behavior change techniques, attention has been given to developing reliable and valid content analysis methods. Abraham et al. (2007) developed the Content Analysis Approach to Theory-specified Persuasive Educational Communication (CAATSPEC). Researchers can use the CAATSPEC to reliably develop coding manuals with line-by-line assessments of text-based media messages. Abraham et al. (2007) reported acceptable line-by-line inter-rater reliability for their final coding manual ($r \geq .95$). The CAATSPEC is a reliable method to precisely assess the frequency and variety of psychological constructs targeted in a written text. From this, Abraham et al. (2007) suggested that missing information could be identified and then relatively easily incorporated into a revised written document.

The CAATSPEC has been reliably applied to assess the extent that recommended psychological constructs are targeted in physical activity-focused materials, but its applications have been limited (Elliot et al., 2016; Gainforth et al., 2011, Tristani et al., 2017). The primary focus of this body of literature has been to print materials. One study

used the CAATSPEC method to analyze brochures advertising recreational walking paths (Elliott et al., 2016), and another used it to analyze physical activity promotion brochures primary intended for circulation in medical and health care offices targeting nonclinical adult populations (Gainforth et al., 2011). A more recent study applied the CAATSPEC to analyze educational websites intended for parents of children with disabilities and that contained content-related to physical activity promotion (Tristani et al., 2017). Current applications of the CAATSPEC to the physical activity domain have enhanced understanding as to the precise integration of theory-based behavioral change techniques, and future studies can expand this understanding by applying the method to websites intended to promote physical activity among the general public. Research addressing these noted gaps will not only advance knowledge on the integration of theory into the content of physical activity promotion resources, but the findings could also provide a precise indication for how content may be revised to better target theoretical constructs such as self-regulation and outcome expectancy (Abraham et al., 2007; Gainforth et al., 2011).

Dissertation hypotheses six and seven. If the focus of future research is to use the CAATSPEC method to study lay websites focused on physical activity promotion among adults, then Gainforth et al.'s (2011) findings can be used to test hypotheses. They were the first to adapt the CAATSPEC method to study the extent that physical activity messages targeted self-regulation, self-efficacy, and outcome expectancy, and their sample of materials was intended as resources to support health-related behaviors of adults. CAATSPEC-method based studies published after their work focused on adult

care providers or tourist advertisements. On the basis of Gainforth et al.'s results, we tested the following hypotheses.

> **Ha6**: Messages would fall into the following hierarchical order from high to low: other messages, self-efficacy messages, knowledge-based information messages, outcome expectancy messages, and self-regulation messages.
>
> **Ha7**: Most outcome expectancy messages would promote instrumental attitudes about physical activity.

In Need of Knowledge Translation Assessments

At their core, integrated disciplines such as kinesiology have as part of their mission the translation of research into practices for the common good (Cardinal, 2016a; Gill, 2007; Ulrich, 2011). Ainsworth (2009) argued for the process of knowledge translation in kinesiology to be viewed as a continuum that basic and applied research contributes to. On the basis of previous reports, the movement of knowledge along this continuum is quite slow. Over a decade can go by before research is translated into everyday health practices (Balas, 2001; McGlynn et al., 2003). As Ainsworth (2009) and others have argued, decade-long delays to using kinesiology research to benefit the general public need not be the case; concerted research attention is required to help ensure it is not (Brawley et al., 2013; Cardinal, 2013, 2014, 2016a,b, 2017a,b; Cardinal et al., 2017; Coocky, 2017; Dunn & Blair, 2002; Gill, 2007; Khol et al., 2012; Martens, 1990; Schary & Cardinal, 2015; Thomas & Cardinal, 2018; Thomas et al., 2018; Ulrich, 2011).

Awareness of where research tends to cluster along the knowledge translation continuum is key to minimizing prolonged delays in its application in everyday public health practices. Sallis, Owen, and Fotheringham (2000) proposed the behavioral

epidemiology framework as a means of classifying health behavior research that can help promote such awareness. There are five phases in their framework: first to establish the link between behaviors and health; second to develop methods to measure behavior; third to identify factors that influence behavior; fourth to evaluate interventions to change behavior; fifth to translate research into practice. On the basis of a stratified random sample of 552 journal articles that were published in kinesiology journals between 2008-2012, Schary and Cardinal (2016) reported that the largest majority were focused on phase three (62.2%) of the behavioral epidemiology framework, followed by phase one (14.1%), phase four (11.2%), phase two (9.2%), and phase five (1.1%). An overarching aim of the behavioral epidemiology framework is to move research results into everyday practice (Sallis et al., 2000). If research activities do not address the latter phases, progress can be stalled or perhaps even halted altogether (Dunn & Blair, 2002; Sallis et al., 2000).

Several researchers have reported results that support the conclusions of Schary and Cardinal (2016). For example, Dixon-Ibarra, Vanderbom, Anisia, and Driver (2014) reported that 49% of empirical studies about physical activity and multiple sclerosis (K = 139) published between 2000 and 2014 focused on establishing the links between behavior and health (Phase 1), 18% developed methods to measure physical activity behavior among individuals with multiple sclerosis (Phase 2), 24% identified factors that influenced physical activity behavior (Phase 3), 9% evaluated physical activity behavior change interventions (Phase 4), and 0% translated research into practice (Phase 5). Cleveland, Driver, Swank, and Macklin (2015) reviewed 202 empirical studies about physical activity and stroke rehabilitation published between 2000 and 2014. They found

that 70% focused on establishing the link between physical activity and health (Phase 1), 11% developed methods to measure physical activity behavior (Phase 2), 10% identified factors that influence behavior (Phase 3), 8% evaluated behavior change interventions (Phase 4), and 1% translated research into practice (Phase 5). Several other systematic audits of physical activity peer-reviewed empirical research (K = 190) published between 1979 and 2012 have reported similar findings using the behavioral epidemiology framework classification scheme (Nery, Driver, & Vanderbom, 2013; Vanderbom, Driver, & Nery-Huwit, 2014). In contrast, several reviews were published in the same time periods like that of the audited studies that concluded with health promotion guidelines using physical activity (e.g., Eldar & Marincek, 2000; Ginis & Hicks, 2007; Morriss, Dodd, & Morris, 2004; Taylor, Dodd, Shields, & Bruder, 2007).

Literature reviews and research synthesis studies, such as meta-analysis, represent the degree to which scientific knowledge advancement has occurred within a given area of inquiry (Ogilvie, Hamilton, Egan, & Petticrew, 2005; Petticrew & Roberts, 2006). On the basis of multiple literature reviews and synthesis studies, Brawley et al. (2013) suggested that sufficient knowledge has been accumulated to permit the provision of conservative guidelines for translating kinesiology academic knowledge into wide-scale physical activity health promotion practices. Despite this, little research attention has been devoted to knowledge translation overall.

For example, at the dawn of the 21st century, Eakin, Glasgow, and Riley (2000) reviewed print mediated physical activity interventions in primary care settings in order to discern their potential practical implications on the basis of Glasgow, Vogt, and Boles (1999) RE-AIM (i.e., reach, effectiveness, adoption, implementation, and maintenance)

framework. They concluded that print-mediated interventions during primary care visits were effective in promoting physical activity behavior, irrespective of intervention intensity. Of course, those were materials being used in conjunction with experimental interventions versus freestanding, patient education materials. Freestanding, patient education materials of the same era were found to be too complex and difficult for the typical American adult to read and understand (Reed-Pierce & Cardinal, 1996). This is much the same conclusion that Rudd, Moeykens, and Colton (1999) reached in their review; substantial evidence existed suggesting that lay health communication materials were not using plain, simple language and that they were routinely written at levels that were too difficult for adults to comfortably read. These finding have been further substantiated across a variety of population segments and settings (Eltorai, Sharma, Wang, & Daniels, 2015; Lattimore et al., 2010; McInnes & Haglund 2011; Morony, Flynn, McCaffery, Jansen, & Webster, 2015; Neuhauser et al., 2013; Ramanadhan et al., 2012; Thomas et al., 2018; Williamson & Martin, 2010; Williams et al., 2016; Winterbottom et al., 2007).

What Remains to Be Learned

While research does support the potential utility of print and Internet-based physical activity resources, the effectiveness of these resources appears to be diminished because of poor readability, poor suitability, and a general shortage of evidence- and theory-based behavioral techniques embedded within the materials. Some of the textual features that are most likely to persuasively communicate physical activity information to people are known. It is unclear just how well these features are incorporated into Internet-

based physical activity promotion resources, or if the use of recommended theory-based concepts varies on the basis of production source.

Study aims. This dissertation studied physical activity information that was intended for lay adult audiences and disseminated via freely accessible websites. There were three aims of this dissertation. First, document the extent information intended to guide physical activity behaviors were consistent with national physical activity health guidelines. Second, document the overall suitability of information for communication to lay adult audiences. Third, document the extent theory-based messages are used in Internet-disseminated physical activity information. Fourth, for each of the previously presented aims, determine if results vary on this basis of production source. These specific aims were addressed in this dissertation by testing the seven hypotheses presented in the Literature Review section. Except for reading grade level, hypotheses were not advanced on how results would vary based on production source—primarily because previous research had not performed such direct comparisons, or because methodologies used were too dissimilar to base hypotheses upon results aggregated from prior studies. The findings of this dissertation provide direction to efforts aimed at improving the potential of physical activity lay resources to promote health literacy and active lifestyles, as well as guide future research aimed at closing the "science gap" in knowledge translation.

Chapter 3 – Materials and Methods

Sample

For this cross-sectional study of freely available physical activity promotion websites, we adapted the inclusion criteria used by Thomas and Cardinal (2018). Discussed here are specific adaptations made. The focus of this study was on promotional messages disseminated through unique web articles include as part of unique websites. A web article was defined as containing the following characteristics: a document primarily formatted for viewing as a webpage through an Internet web browser; the primary purpose of which was to provide information, discuss ideas or provide suggestions pertaining to a specific topic indicated by the document title; the document content was complete in that it had an appreciable beginning, middle, and end; the document was not part of a series of articles that required reference to a previous or proceeding publication; finally communication must have been primarily through text, which is the number one form of health communication and a preferred medium by adults when their goal is to learn (Birru et al., 2004; Huberty et al., 2005; Warner & Procaccino, 2004). Periodically, the term webpage is used in this write-up. Webpage is a generic term that represents a document containing content and hosted on a website (e.g., audio file, link repository, video file, web article; Mozilla.org, 2019).

For inclusion in this study, the primary focus of the web articles had to have been physical activity promotion, which we defined as any effort or action to increase personal value towards physical activity and to motivate physical activity behaviors. Second, the communication objective of the web article had to have been educational where the explicit goal was to teach, guide or persuade the reader in planning or completing some

sort of behavior related to physical activity. Web articles whose primary function was to list ideas (e.g., “top 20 cardio exercises”) were ineligible for inclusion. To ensure the results could be generalized to organizations for which content was produced, entities whose primary function was to disseminate information produced by others were ineligible for inclusion (e.g., news articles, personal blogs, press-releases).

As the aim of this study was to analyze web articles that typical lay adult users would locate via the Internet, plain-language search terms were used exclusively. A list of plain language search terms was generated between the dissertation author and the Dissertation Committee Chair (BJC), then arranged into a logic grid format (Aromataris & Riitano, 2014). Originally, the logic grid had ten rows, each representing an independent search. The terms were partitioned into two columns: query subject (e.g., “cardio AND exercise*”) and query goal/aim (e.g., ideas OR recommendations OR routines OR suggestions OR tips OR “workout plan*”). In addition to the search term logic grid, a list of sites to search directly was generated because they were known to produce physical activity promotion content (Thomas & Cardinal, 2018).

The search strategy document underwent four independent and critical reviews by three professionals with expertise on information seeking behaviors by lay adult information. The experts were a web strategist and digital communication specialist (Oregon State University), an associate professor and science librarian (Oregon State University), and a public librarian responsible for selecting materials related to physical activity and exercise (Corvallis-Benton County Public Library, Oregon). The purpose of their critical reviews was to ensure that the search terms were ecologically valid and appropriate search operators were used (e.g., AND). The finalized logic grid contained 19

rows and a list of 30 organizations. Appendix 1 presents the finalized search strategy logic grid.

The Google search engine was used to search the Internet, which is the preferred Internet search engine of 83% of U.S. adults (Purcell, Brenner, & Rainie, 2012). Internet searches were carried out with the web browser set to private to avoid browser history and other customizations from potentially biasing search engine results (McInnes & Haglund, 2011). Only the first four pages generated from initial search results were assessed, which is consistent with previous research and the general searching behavior of adults (Gorczynski, Patel, & Ganguli, 2013; Harland & Bath, 2007; Kim, 2009; Lorigo, Pan, Hembrooke, Joachims, Granka, & Gay, 2006; Pan, Hembrooke, Joachims, Lorigo, Gay, & Granka, 2007). In addition to a general Internet search, a direct search of websites was undertaken using the Google search engine and the established list of search terms (Karch, 2018). Directly searching websites using the Google search engine was similar to performing a general search of the Internet with the engine. The search began on the Google search engine home page. First, the website top domain URL was entered into the search bar with a colon following it (e.g., “acsm.org:”). Second, the search terms generated for this dissertation were entered after the top domain, and page results that listed webpage URL links that belonged to the website of inquiry were generated, just as would be observed with a general Internet search. At no time during the search processes were webpage hyperlinks activated to locate more potential samples. The hyperlinked webpages themselves were the potential webpages to be considered for potential inclusion on the basis of the inclusion and exclusion criteria advanced for this dissertation.

Web articles from four sources of productions were sought in this study: commercial, government, professional associations, and voluntary health agencies. Cardinal and Sachs (1992) first proposed this classification scheme, and the definitions advanced by Thomas and Cardinal (2018) were used to sort web articles into one of the four categories. The Google search engine was used to search the Internet and specific sites between July 23-28, 2018. A total of 436 web articles were located using the general Internet search. As the predominant result of the general Internet search was commercial sources, the direct site search focused only on the government, professional, and voluntary health agency categories. There were 197 web articles obtained from the direct search of websites.

The universal resource locator (URL) for each webpage result of the Google search procedures were copied into a spreadsheet document, Microsoft Office® Excel® 2016 (a.k.a., "Excel;" Version 1803). Once there, each URL hyperlink was activated to be taken to its specific webpage to document webpage characteristics and determine if its content met the dissertation inclusion criteria. Webpages having not met the dissertation inclusion criteria were tagged, and so too were duplicates of web articles that were eligible for inclusion. Duplicates and excludable webpages were located and removed using the search and find procedures of the Excel program (Support.Office.com, 2018).

Based on the study inclusion/exclusion criteria, the search procedures generated a large and diverse set of web articles eligible for study inclusion (n = 285). This set of web articles were defined as the population of web articles that lay users would locate using plain language search terms. A stratified random sample was drawn and representative to 95% of their respective subpopulations (Krejcie & Morgan, 1970). To preserve the

internal validity of the study sample, iterative bootstrapping procedures were used to systematically counter-balance the sample sizes across the production source subgroups (Cardinal, 1995; Krejcie & Morgan, 1970; Zhu, 1994, 1997). All random generalization procedures used in this study were performed using the free services of the random.org webtool, which has documented acceptable reliability and validity (Random.org, 2019; Foley, 2001; Kenny, 2005; URL Address: <https://www.random.org/>). Using the extraction and processing procedures by Thomas and Cardinal (2018), the content of each web article selected for study inclusion was extracted into a unique Microsoft Office® Word® (a.k.a. Word; Version 16.0) word-processor document. Figure 1 illustrates the sample acquisition process for this study. and Table 1 depicts the bootstrapping process in detail. The representativeness of the study subgroup samples to their respective subpopulations ranged between 60 percent and 100 percent (*Med* = 85%, *M* = 82.5%, *SD* = 12.84%, 95% CI = [69.9%, 95.1%]). A study sample of 139 randomly selected web articles were obtained and distributed into the following subgroups: commercial (*n* = 36), government (*n* = 35), professional association (*n* = 32), and voluntary health agency (*n* = 36).

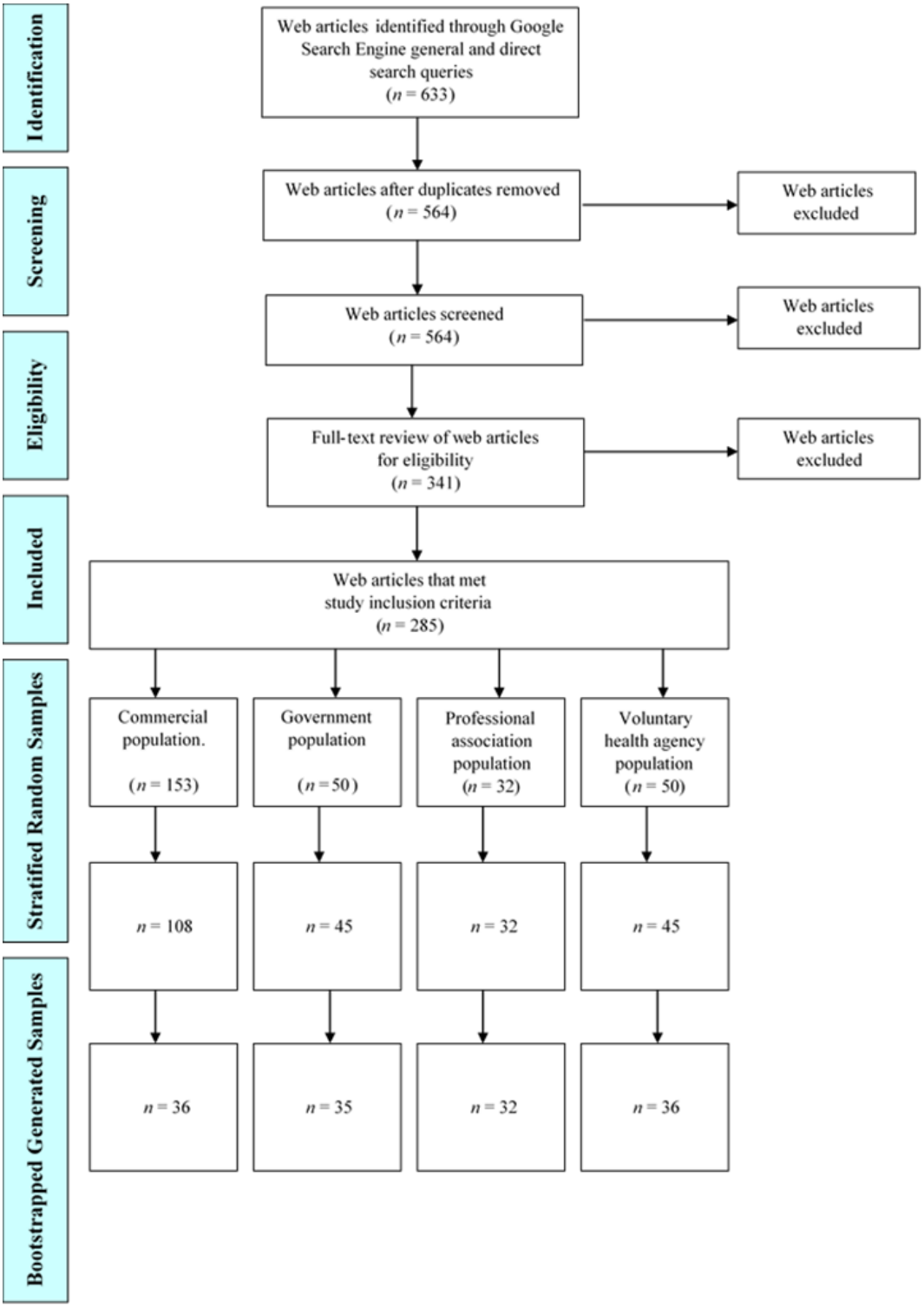


Figure 2. A flowchart based on the *2009 PRISMA Flow Diagram*. It depicts the sample acquisition process for this study of freely accessible physical activity promotion web articles intended for lay adult audiences.

Table 1. Step-wise sample reduction process using an iterative bootstrapping method to generate similar subgroup sample sizes

	Commercial	Government	Professional Association	Voluntary Health Agency
Identified study population	*n* = 153	*n* = 50	*n* = 32	*n* = 50
Stratified random sample	*n* = 108 95% representative	*n* = 45 95% representative	*n* = 32 100% representative	*n* = 44 95% representative
Bootstrapped sample 1	*n* = 86 90% representative	*n* = 40 90% representative		*n* = 40 90% representative
Bootstrapped sample 2	*n* = 70 85% representative	*n* = 35 85% representative		*n* = 36 85% representative
Bootstrapped sample 3	*n* = 59 80% representative			
Bootstrapped sample 4	*n* = 52 75% representative			
Bootstrapped sample 5	*n* = 45 70% representative			
Bootstrapped sample 6	*n* = 40 65% representative			
Bootstrapped sample 7	*n* = 36 60% representative			
Study subgroup samples	*n* = 36	*n* = 35	*n* = 32	*n* = 36

Representative to study population	60%	85%	100%	85%

Note. The estimated level of representativeness ascribed to the stratified random sample and each bootstrap iteration stage is based on the table to determine sample size from a known population developed by Krejcie and Morgan (1970). The set sample size for each bootstrap iteration was determined using Krejcie and Morgan's (1970) table.

Instrument Pilot Work

All forms and codebooks used to extract information from the sample web articles were created by the dissertation author, then reviewed for clarity and consistency by the Dissertation Committee Chair (BJC). The two raters discussed each form until a preliminary consensus was established for all concepts and data extraction procedures. Revisions were made to reflect this established consensus. Pilot work consisting of two practice tests using different material samples (n = 4 to 5, respectively) and containing all four production source types of interest was done. Intra- and interrater reliability was assessed as part of each pilot test phase, and the sample materials were selected from a subsample of web articles Thomas and Cardinal (2018) randomly selected to measure the reliability and validity of their procedures. Following each round of independent coding, the two raters met and discussed any discrepancies that emerged, reached consensus on each, and then the dissertation author revised the coding forms and procedures. After the two pilot test phases, both raters felt the forms were ready to be tested with a subsample from the present study.

Reliability and validity assessment plan. Achieving absolute agreement was not the objective of the reliability and validity assessment. The purpose of these assessments

was to document the magnitude that raters *consistently* agreed in their coding, then use that information to improve the coding procedures prior to the sample being fully coded. Following Riffe, Lacy, and Fico's (2014) recommendation to establish a general sense of reliability and validity, multiple methods were used. To determine the reliability of measurement procedures and coding forms for all categorical measures, Cohen's (1960) kappa (*k*; agreement controlling for chance) and Krippendorff's (1980, 2011) alpha (a_k; disagreement controlling for chance) were used to measure rater reliability. Krippendorff's (1980, 2011) alpha was used to measure rater reliability for the form used to quantify the use of behavior change techniques within web articles as it may be also computed for interval, ordinal, and ratio levels of measurement. The following cut-points advanced by Landis and Koch (1977, p. 165) were used to interpret the kappa and $alpha_k$ coefficient results: less than .00 indicates "poor" reliability, .00-.20 "slight" reliability, .21-.40 "fair" reliability, .41-.60 "moderate" reliability, .61-.80, "substantial" reliability, and .81-1.00 "almost perfect" reliability.

Given Cohen's kappa and Krippendorff's alpha at times may overly penalize minor discrepancies between raters (Gwet, 2008, 2014), multiple measures of reliability should help to also pragmatically interpret their estimates (Riffe, et al., 2014). The additional reliability measures used were the paired-sample *t*-test for the mean reading grade level estimates and Pearson's correlation, with an $r \geq .70$ representing good reliability. The Statistical Program for the Social Sciences (SPSS; Version 25) was used to perform the correlation and paired-sample *t*-test analyses. Kappa and $alpha_k$ were calculated using the free online rater reliability calculator developed Freelon (2010, 2013), ReCal OIR (ordinal, interval, ratio; URL address:

<http://dfreelon.org/utils/recalfront/>). Convergent validity was assessed for the electronic tool used to estimate web article reading grade level; hand calculations and comparison with another formula computed by the same online program were used.

About 17% of web articles from each production source subgroup was randomly selected to assess the reliability and validity of the study instruments for the study sample. Note that the two raters met to discuss any new interrater discrepancies that emerged after the pilot phase concluded for each measure discussed in the proceeding sections. One-hundred percent consensus was reached on all construct interpretations and data extraction procedures, then revisions were made to all forms and codebooks prior to the coding of the full sample by the dissertation author.

Measures

Adherence to physical activity guidelines. The sample web articles were assessed for the presence of endorsed public health physical activity health guidelines for adults. The guidelines chosen were the *2008 Physical Activity Guidelines for Americans* (PAGs) for adults 18 to 64 years of age. These PAGs were chosen for three reasons. First, the 2008 PAGs were the "primary source of information for policymakers, physical educators, health providers, and the public on the amount, types, and intensity of PA [physical activity] needed to achieve many health benefits [for] adults, adolescents, and children" for web articles sampled for this dissertation (Cooper et al., 2016, p. 134, Table 1). Second, the second edition PAGs (2018) did not become available until after the sample collection period concluded. Third, even if the 2018 PAGs were published before the sample collection period concluded, it would have been unreasonable to expect there would have been sufficient time for the guidelines to have been incorporated into web

articles eligible for inclusion in this dissertation. Of note, the guidelines of the 2008 PAGs for adults 18 to 64 years of age remain largely unchanged in the second edition; the one exception being the retraction of the recommendation to accumulate physical activity in 10-minute intervals to obtain health benefits (U.S. Department of Health and Human Services, 2018).

Web articles that targeted older adults or pregnant (expecting) women were excluded from this analysis. Web articles were coded "Yes" or "No" for the presence of messages related to the physical activity guidelines. Web articles coded "Yes," were reinspected using a line-by-line analysis for the presence of at least one fully consistent message to 17 unique guidelines. These 17 guidelines were distributed into the following four categories: aerobic physical activity (n = 7), for additional health benefits via aerobic physical activity (n = 3); muscle-strengthening physical activity (n = 2), and physical activity guidelines for inactive (sedentary) adults (n = 5). For each guideline item, web articles were coded consistent or inconsistent, with inconsistent representing no guideline-related messages being present or observed messages being inconsistent. The PAG form demonstrated modest interrater reliability (k = .46, a_k = .46). Intrarater reliability over a 12-day grace period was substantial (k = .70, a_k = .70). Notably, the raw agreement was high for both the intra- and interrater reliability assessments (97.2% and 92.3%, respectively), suggesting that minor rater discrepancies were overly penalized in the coefficient calculations (Gwet, 2008, 2014). Appendix 2 presents a copy of the finalized coding form for physical activity guidelines.

Multidimensional assessment of suitability. Suitability was assessed using Doak et al.'s (1996) Suitability Assessment of Materials (SAM), which is the most

widely used suitability measure in research of health-related communication (Murphy et al., 2001; Shieh & Hosei, 2008; Taylor-Clarke et al., 2012). SAM is comprised of a 22-item rating scale that evaluates the suitability of written educational resources for health communication along six dimensions: 1) content, 2) cultural appropriateness, 3) graphics, 4) layout and typography, 5) learning and motivational stimulation, and 6) literacy demand. Under each dimension, suitability is assessed on a 3-point scale (0 = Not Suitable, 1 = Adequate, and 2 = Superior). The total score observed is then divided by the maximum number of points possible, resulting in a percentage value. Overall suitability for the document is assigned on the basis of the following percent cut-points: 0-39% ("Not Suitable Material"), 40-69% ("Adequate Material"), and 70-100% ("Superior Material"). Within this study, the suitability nomenclature proposed by Coulter (1998) was used to emphasize that optimal suitability should be the goal when developing or selecting written resources for wide-scale dissemination (i.e., "Unsatisfactory" = 0-39%; "Satisfactory" = 40-69%; and "Optimal" = 70-100%). The cultural appropriateness subcategory was excluded from the assessment within this study because the precise cultural characteristics of end-users would have been indeterminable with the design of this study (Vallance et al., 2008). Appendix 3 presents a copy of the SAM coding form adapted for use to complete this dissertation.

Good internal validity (i.e., $a \geq .70$; Clayton, 2009) with fair to good interrater agreement not due to chance has been reported for the SAM subcategories (i.e., $.30 > k < .81$; Kang, Fields, Henry, Cornett, & Beck, 2005; Vallance et al, 2008). The SAM independent interrater reliability ranged between poor and substantial for the present study: content ($r = .76$, $p < .001$; $a_k = .69$), literacy demand (excluding SMOG

calculation; r = .08, p = .476; a_k = .08), graphics (r = .35, p < .001; a_k = .26), layout & typography (r = -.21, p < .079; a_k = -12), and learning stimulation/motivation (r = .63, p < .001; a_k = .59). Inter-rater discrepancies were primarily due to systematic bias, where one coder would consistently rate one category lower by one unit. Nonsystematic discrepancies were observed, with few ratings being extreme opposites. Categories with less than moderate agreement experienced systematic discrepancies with a few nonsystematic but extremely opposite ratings. Reliability suffered mainly due to the systematic nature of the discrepancies, rather than their magnitude. The observed paradox between raw percent agreement and the agreement coefficients substantiates this conclusion. The graphics category had the lowest raw agreement (i.e., 47.8%) but the highest reliability, and the layout and typography the highest raw agreement (i.e., 56.5%) and the lowest reliability. Both raters were able to come to consensus quickly on all discrepancies. Intrarater reliability following a five-day grace period ranged between moderate and almost perfect: content (r = .87, p < .001; a_k = .86), literacy demand (r = .67, p < .001; a_k = .60), graphics (r = .86, p < .001; a_k = .90), layout and typography (r = .87, p < .001; a_k = .85), and learning stimulation/motivation (r = .78, p < .001; a_k = .77).

Reading grade level measure. The Simple Measure of Gobbledygook (SMOG; McLaughlin, 1969) formula was used estimate the reading grade level of resources as part of the literacy demand assessment for the SAM protocol (Vallance et al., 2008). SMOG estimates are correlated with 100% comprehension for a body of text 30 words or more and 90% with text less than 30 words using a modified formula (Allensworth & Luther, 1986; Vaughan, 1976). Other readability formulas have much lower comprehension correlations, typically 50% or lower (Powers, 1988; Wang et al., 2013).

The SMOG can be performed by hand within 10 minutes while providing accurate, conservative results with good inter- and intrarater reliability (i.e., $r \geq .90$), as well as good convergent validity with other commonly used reading grade level measures, such as the Fry Graph and the Flesch-Kinkaid Readability formula (i.e., $r \geq .80$; Cardinal & Sachs, 1992; Meade & Smith, 1991; Thomas & Cardinal, 2018; Vaughan, 1976; Wang et al., 2013). In this study, SMOG calculations were performed with the free webtool provided by online-utility.org (URL address: <https://www.online-utility.org/english/readability_test_and_improve.jsp>). The SMOG webtool demonstrated good interrater reliability with the manual SMOG results ($r = .81$, $p < .001$; t_{paired} [22] = 2.124, $p = .045$, $d = 0.29$). All intrarater reliability assessments followed a three-day grace period. The SMOG webtool also demonstrated good intrarater reliability ($r = .99$, $p < .001$; t_{paired} [22] =1.769, $p = .091$, $d = 0.00$), as well as good convergent validity when compared to the FOG index results calculated by the same website ($r = .97$, $p < .001$; t_{paired} [22] = .649, $p = .523$, $d = 0.01$). Good intrarater reliability was observed for the SMOG manual results ($r = .88$, $p < .001$; t_{paired} [22] = .214, $p = .833$, $d = 0.03$), and the FOG webtool results ($r = .99$, $p < .001$; t_{paired} [22] = 1.524, $p = .142$, $d = 0.02$).

Use of behavior change techniques. The degree that web article messages presented behavioral change techniques that targeted theory-based psychological antecedents to physical activity was assessed with the Content Analysis Approach to Theory-Specified Persuasive Educational Communication (CAATSPEC; Abraham et al., 2007). Good intercoder reliability is reported for this method ($r > .85$; Abraham et al., 2007). Acceptable intercoder reliability has been reported for use of the CAATSPEC method to measure the degree that print brochures and web articles physical activity

resources employed evidence- and theoretically-based behavior change techniques (i.e., *k* > .60, *rs* > .75; Gainforth et al., 2011; Tristani et al., 2017). The CAATSPEC codebook of this study adopted the classification scheme developed by Gainforth et al. (2011) since it was developed to assess the extent messages targeted recommended theoretical constructs. The categories were: 1) knowledge-based information, 2) outcome expectancy, 3) self-regulation, 4) self-efficacy messages, and 5) other messages. Using a comparative table, Gainforth et al. (2011) demonstrated good construct validity for their operational definitions with those used in the taxonomy of behavior change techniques developed by Abraham and Michie (2008), which has been used to systematically and quantitatively synthesize the results of physical activity intervention studies (e.g., Michie et al., 2009; Webb et al., 2010). A follow-up analysis was done to categorize outcome expectancy messages as targeting one of three attitude types: affective, instrumental, or both affective and instrumental (Gainforth et al., 2011).

The format of the codebook used in the present study was guided by the codebook developed by Elliott et al. (2016), and it contained example messages and prompts to redirect users to correct categories to help avoid mis-categorizations (e.g., informs about the existence of physical activity recommendation *versus* prompts reader to work towards a specific behavioral goal). As Gainforth et al. (2011) did not present operational definitions for theoretical self-efficacy predictors (e.g., mastery experiences, verbal persuasion, vicarious experiences), Mead, Cohen, Kennedy, Gallo, and Latkin's (2016) operational definitions were used. Interrater reliability for the CAATSPEC method ranged between fair to substantial across the main categories in the present study: knowledge-based information (r = .52, p < .001, a_k = .51), outcome expectancy (r = .75, p

< .001, a_k = .71), self-regulation (r = .48, p < .001, a_k = .40), self-efficacy (r = .52, p < .001, a_k = .52), other messages (r = .80, p < .001, a_k = .79), and outcome expectancy follow-up (r = .55, p < .001, a_k = .53). Intrarater reliability following a six-day grace period ranged between moderate and almost perfect: knowledge-based information (r = .86, p < .001, a_k = .84), outcome expectancy (r = .85, p < .001, a_k = .85), self-regulation (r = .50, p < .001, a_k = .50), self-efficacy (r = .79, p < .001, a_k = .74), other messages (r = .83, p < .001, a_k = .81), and outcome expectancy follow-up (r = .69, p < .001, a_k = .69). Appendix 4 presents the CAATSPEC coding form used to complete this dissertation, and Appendix 5 presents the CAATSPEC codebook.

Analysis

Unless otherwise indicated, all statistical analyses were performed in the Statistical Program for the Social Sciences (Version 25). Statistical significance was set at the probability value of $p \leq .05$.

Descriptive

Descriptive statistics were used to summarize attributes of the sample of web articles as a whole and on the basis of production source. The tally counts used to measure the frequency of messages corresponding to the behavior change technique subcategories were converted to percentage points, with the denominator being the total number of tallies for a web article. To estimate the portion of messages that targeted a main behavior change technique category (e.g., outcome expectancy), the given subcategories were first summed, divided by the total tallies for a web article, then converted into a percentage point. As substantial differences in message frequency to a given behavior change technique subcategory could occur across web articles, medians

estimates (*Med*) were computed to measure central tendency along with mean values (*M*). Ninety-five-percent confidence interval estimates were computed for mean estimates of the suitability overall score and reading grade level. Beyond the attributes assessed to address the specific research aims of this dissertation, the following resource characteristics were documented: the publication or update (revision) date, topic areas covered, intended adult audience (e.g., men, older adults, women), total word count, and use of polysyllabic words.

Main Analysis

Three studies comprised the main analysis of this dissertation. These studies addressed the set of hypotheses set forth in the literature review section. Study one was to test hypotheses about adherence to the physical activity guidelines. Study two focused on the evaluation of web article suitability for communicating health-related information. Study three examined the degree that evidence-based health behavior concepts and techniques were used on web articles.

Dissertation study one. A Chi-square Goodness-of-Fit test was used to determine if the consistent-inconsistent categorizations were unequal for the sample of web articles for each of the 17 *2008 PAGs* assessed. Likelihood Chi-square tests (i.e., $L\chi^2$) were performed to determine if production source was associated with the degree that web articles were observed to present consistent *PAG* messages. Cramer's *V* was used to measure the magnitude of association estimated by the $L\chi^2$ statistic using the following interpretive guidelines: .10 "minimal," .30 "typical," and .50 "substantial" (Vaske, Gliner, & Morgan, 2002).

Dissertation study two. A one-sample *t*-test was used to determine if the aggregate sample mean suitability score differed from the lower-end cut-point indicative of satisfactory suitability (i.e., 40%). The one-sample *t*-test was also used to determine if the aggregate sample mean reading grade level differed from the recommended eighth-grade reading level. To determine the magnitude of the observed difference, Cohen's *d* (1988) was used to compute a standardized difference in effect. The magnitude of the observed differences was interpreted with the following guidelines: 0.20 "minimal," 0.50 "typical," and 0.80 "substantial" (Vaske et al., 2002).

A one-way analysis of variance (ANOVA) was used to determine if production sources differed on the basis of mean suitability score and mean reading grade level. The magnitude of the difference detected by the omnibus ANOVA test was interpreted using the following guidelines for Partial-eta square (i.e., "partial η^2"): .0099 "minimal," .0588 "typical," and .1379 "substantial" (Richardson, 2011; Vaske et al., 2002). Cohen's (1988) *d* was used to compute the magnitude of pair-wise differences and was calculated using the free webtool provided by SocialStatistics.com (2019).

Dissertation study three. A repeated-measures analysis of variance (RM-ANOVA) was performed to determine if behavior change technique main categories differed in message frequency (Gainsforth et al., 2011). Though rarely used in this way, RM-ANOVA is an appropriate analytic method to test for categorical differences when multiple measures of continuous variables are performed on the same set of web articles (Pallant, 2016; Pituch & Stevens, 2016). The assumption that categorical variables are uncorrelated and have equal variance was tested using Mauchly's (1940) test of sphericity (Pallant, 2016; Thomas, Nelson, & Silverman, 2011). The Geisser/Greenhouse

conservative correction to the *F*-statistic was used if the assumption of sphericity was violated (Stamm & Safrit, 1975; Thomas et al., 2011). The partial η^2 statistic was used to determine the magnitude of effect detected by the RM-ANOVA. Main effects were tested for significant difference using the *Bonferroni* confidence interval adjustment.

Repeated-measures analysis of variance (RM-ANOVA) was also used to determine if within-categorical differences in frequency occurred across the behavior change technique main categories. As the behavior change technique for each main category mean value is based on the summation of its subcategory means, the percentage of each subcategory mean to that of the main category mean is reported for this comparative analysis. For example, if the subcategory self-regulatory messages that prompted readers to set goals had a mean value of 12.5% for the study sample, this subcategory would represent the most common type of self-regulatory subcategory message for the sample (i.e., 62.5%) if 20% of messages in the sample promoted self-regulation.

Production source comparisons. A one-way multivariate analysis of variance (MANOVA) was used to determine if production sources differed in message frequency along the five-main behavior change concept/technique categories (i.e., knowledge-based information, outcome expectancy, self-regulation, self-efficacy, and other messages). A separate one-way MANOVA was used to determine if sources of production differed in the frequency which outcome expectancy messages targeted two attitude types (i.e., affective, instrumental, or both affective and instrumental attitudes). For both MANOVA tests presented above, the category mean values will approximately sum to 100, allowing for one category value to be inferred if values for all other categories are known,

violating the assumption of variable independence. To ensure variable independence was not violated, one dependent variable category was excluded from the planned MANOVA's presented above. The alternate hypothesis is still testable with one dependent variable excluded.

The assumptions for univariate and multivariate analysis of variance were checked using the guidelines presented by Mertler and Vannatta (2013). Pillai's Trace was conducted as the method to determine if the MANOVA's were significant in the event that one or more assumptions were violated, otherwise Wilk's lambda was used (Mertler & Vannatta).

As a study aim was to determine if web article messages differed in the frequency which messages targeted behavior change concepts/techniques on the basis of production source, a univariate ANOVA post-hoc test was performed as the follow-up to a significant MANOVA (Mertler & Vannatta; Pituch & Stevens, 2016; Tabachnick & Fidell, 2019). Post-hoc power estimates, represented by the beta-coefficient (i.e., β), were inspected and reported following each MANOVA and ANOVA. *Tukey's Honest Significant Difference* pairwise comparison tests were performed following significant ANOVA omnibus tests.

Chapter 4 – Results

Sample Description

The study sample was comprised of 139 web articles obtained from 52 organizations (i.e., 28 commercial, 11 governmental, 3 professional association, and 10 voluntary health agency). The majority of organizations were based in the United States (n = 49, 94.23%), and the web article publication/update year ranged between 2008 and

2018 (*M* = 2015.97, *SD* = 2.42), though 21.58 percent (*n* = 30) did not include any such information (i.e., 13 from commercial sources, 6 from government sources, and 11 from voluntary health agency sources). Most web articles included at least one graphic (*n* = 113, 81.29%), and most targeted both men and women or was neutral (*n* = 118, 84.89%); 16 web articles targeted women (11.5%) and four targeted men (2.87%).

The message content of most web articles included a focus on promoting physically active lifestyles (*n* = 77), followed by a focus on providing ideas/suggestions for physical activity or exercise (*n* = 76), then the management of a specific health condition (*n* = 28), then technical instruction for exercise (*n* = 22), then strategies to overcome exercise barriers (*n* = 20), then providing an overview of exercise training principles (*n* = 5), and finally exercise nutrition education and strategies (*n* = 1); four web articles included a focus area that did not fit any of the categories previously listed. The above values will not sum to the sample size because a given web article could have had multiple focus areas. Most web articles had a general subject area other than aerobic/muscle fitness promotion (*n* = 70, 50.4%; e.g., tips to get active, stay active, or get ‘in shape’), followed by muscle fitness (*n* = 36, 25.9%), aerobic fitness (*n* = 30, 21.6%), then aerobic and muscle fitness (*n* = 3, 2.2%).

Main Analysis: Study One Results

Whole-sample physical activity guideline consistency. After excluding web articles that targeted older adults and pregnant (expecting) women, 123 web articles remained with just over half (*n* = 72, 58.5%) presenting PAG-related messages. For the 17 guideline categories, the vast majority of these web articles (i.e., *n* = 44 to 72; 61.1% to 100%) did not present a single guideline-consistent message. Chi-square Goodness-of-

Fit tests empirically confirmed this trend was significant ($p < .001$) for all but one of the *2008 PAG*s assessed: engage in aerobic activity for at least 10 minutes ($p = .059$). Not a single message was consistent with 14 of the 17 guidelines for over 75 percent of the subsample web articles. Table 3 presents the full descriptive and goodness-of-fit results for all 17 guidelines organized by guideline category (e.g., aerobic vs. muscle strengthening).

Physical activity guideline consistency by production source. There were two guidelines where the majority of web articles presented at least one consistent message. They were the guidelines to accumulate 150 minutes of moderately intensity physical activity a week (PAG 1; government sources only) and the guidelines to perform aerobic (endurance) activity in at least 10-minute bouts (PAG 4; government and professional association sources only). The remaining 15 guidelines had over 50 percent of web articles presenting messages inconsistent with the 2008 PAGs irrespective of production source. For 12 of the 17 guidelines considered, the source of production was not associated with the degree of message consistency (all $p \geq .05$). Variations between sources of production were minimal for these 12 guidelines ($V = .11$-$.26$) except one guideline, which advised people to do 300 minutes of moderately-intense weekly aerobic (endurance) physical activity to obtain additional health benefits through aerobic (endurance) activity. The magnitude of variation between production sources was typical ($V = .32$).

Table 2. Chi-square goodness-of-fit test: Percent of web articles that presented at least one message consistent with physical activity guidelines for adults age 18-64

General category	Guideline	% No (*n*)	% Yes (*n*)	Median %		df	X^2	*p*-value
				No	Yes			
For health benefits from aerobic (endurance) physical activity	PAG 1	66.7 (48)	33.3 (24)	84.7	15.3	1	8.000	.005
	PAG 2	79.2 (57)	20.8 (15)			1	24.500	< .001
	PAG 3	84.7 (61)	15.3 (11)			1	34.722	< .001
	PAG 4	61.1 (44)	38.9 (28)			1	3.556	.059
	PAG 5	90.3 (65)	9.7 (7)			1	46.722	< .001
	PAG 6	91.7 (66)	8.3 (6)			1	50.000	< .001
	PAG 7	98.6 (71)	1.4 (1)			1	68.056	< .001
For additional benefits from aerobic (endurance) physical activity	PAG 8	93.1 (67)	6.9 (5)	95.8	4.2	1	53.389	< .001
	PAG 9	95.8 (69)	4.2 (3)			1	60.500	< .001
	PAG 10	97.2 (70)	2.8 (2)			1	64.222	< .001
For health benefits from muscle strengthening physical activity	PAG 11	90.3 (65)	9.7 (7)	90.3	9.7	1	46.722	< .001
	PAG 12	90.3 (65)	9.7 (7)			1	46.722	< .001
	PAG 13	97.2 (70)	2.8 (2)	97.2	2.8	1	64.222	< .001

Guidelines for adults with inactive/sedentary lifestyles	PAG 14	73.6 (53)	26.4 (19)	1	16.056	< .001
	PAG 15	97.2 (70)	2.8 (2)	1	64.222	< .001
	PAG 16	100 (72)	0 (0)	--	--	--
	PAG 17	90.3 (65)	9.7 (7)	1	46.722	< .001

Note. The guidelines references are the *2008 Physical Activity Guidelines for Americans* for adults age 18-64. The number of eligible samples was $n = 72$. The null-hypothesis of each goodness-of-fit test was equal distribution (i.e., $72 \div 2 = 36$). A separate statistic was calculated for each guideline comparison. For summary purposes, the cumulative median percent for the no-yes dichotomy is presented for each general guideline category. Listed here are the definitions for the PAG codes: PAG 1 = *attain 150 minutes (or 2 hours and 30 minutes) a week of moderate-intensity aerobic physical activity*; PAG 2 = *attain 75 minutes (or 1 hour and 15 minutes) a week of vigorous-intensity aerobic physical activity*; PAG 3 = *attain 75 minutes (or 1 hour and 15 minutes) a week of equivalent combination of moderate- and vigorous-intensity aerobic physical activity*; PAG 4 = *Perform aerobic activity in episodes of at least 10 minutes*; PAG 5 = *Preferably, aerobic activity should be spread throughout the week*; PAG 6 = *aerobic activity should be on at least 3 days a week*; PAG 7 = *people gain health benefits from 60 minutes of moderate-intensity aerobic activity*; PAG 8 = *increase aerobic activity to 300 minutes (or 5 hours) a week of moderate-intensity physical activity for additional health benefits*; PAG 9 = *increase aerobic activity to 150 minutes (or 2 hours and 30 minutes) a week of vigorous-intensity physical activity for additional health benefits*; PAG 10 = *increase aerobic activity to 150 minutes (or 2 hours and 30 minutes) of an equivalent combination of moderate- and vigorous-intensity physical activity for additional health benefits*; PAG 11 = *do moderate or high intensity activity that involves all major muscle groups on two or more days of the week*; PAG 12 = *do at least one set of 8-12 repetitions of each exercise for muscle strengthening*; PAG 13 = *gradually work up to 150 minutes of physical activity*; PAG 14 = *avoid inactivity and/or any amount of activity is better than none*; PAG 15 = *initial intensity should be light or moderate, for short periods of time, spread throughout the week*; PAG 16 = *start with one day a week of light or moderate effort for muscle-strengthening activity*; and PAG 17 = *could slightly increase effort until it becomes moderate to high*.

A significant association between production source and message consistency was observed for give guidelines, all having to do with aerobic (endurance) physical activity (all $p \leq .050$). Four of these guidelines were weekly recommendations for obtaining the most health benefits through aerobic (endurance) physical activity. The fifth was the advice to accumulate daily physical activity through bouts of at least 10-minutes in duration. Across the five guidelines, the government source subgroup contained the greatest portion of web articles with at least one consistent message (range: 19.0% to 57.1%), followed by voluntary health agency (range: 4.8% to 38.1%), commercial (range: 0% to 15.8%), and last professional association (range: 0% to 54.5%). The strength of association between production source and web article consistency was typical across the five guidelines (i.e., $V = .32$-$.39$).

The full results of the comparative analysis between production and message guidelines is partitioned into categories that correspond to the following tables: Table 3 (PAG: aerobic), Table 4 (PAG: additional aerobic benefits), Table 5 (PAG: muscle-strengthening), and Table 6 (PAG: inactive/sedentary adults).

Main Analysis: Study Two Results

Suitability level of the aggregate sample. The overall suitability level of the aggregate sample ranged between unsatisfactory (i.e., 26.47%) and optimal (i.e.,77.78%). This range in suitability level was observed across all SAM main categories. There were 9 (i.e., 6.5%) web articles classified as being overall unsatisfactory, 120 (i.e., 86.3%) satisfactory, and 10 (i.e., 7.2%) optimal. The SAM categories from highest to lowest suitability score were as follows: content ($M = 66.92\%$, $SD = 12.81\%$), layout and typography ($M = 62.95\%$, $SD = 19.64\%$), learning stimulation, motivation ($M = 61.99\%$,

SD = 23.68%), literacy demand (*M* = 50.81%, *SD* = 14.89%), and last graphics (*M* = 39.54%, *SD* = 20.02%). The aggregate sample suitability level across all subcategories was satisfactory, except for the graphics which approached satisfactory. The mean overall suitability level for the sample of web articles was satisfactory and substantially greater than the 40% minimum cut-point, *M* = 56.20%, *SD* = 10.36, 95% CI [54.48, 57.92], *t* (138) = 18.431, $p < .001$, *d* = 2.21).

Suitability level by SAM subcategories. The majority of web articles had satisfactory or optimal suitability for 12 of the 19 subcategories. These were 1) evident purpose, 2) content about behavior, 3) limited scope, 4) writing style and active voice, 5) common vocabulary used, 6) use of road signs, 7) cover graphics shows purpose, 8) layout factors, 9) use of subheadings, 10) interactions, 11) behaviors modeled and specific, and 12) promoted self-efficacy to read and understand text. The majority of web articles were unsatisfactory for the following seven subcategories: 1) reading grade level (97.1%); 2) types of graphics used (96.8%); 3) summary/review included (84.2%); 4) typography (68.3%); 5) context before new information (65.5%); 6) lists/tables/etc., explained (58.4%); and 7) use of relevant illustrations (54.7%). Table 7 presents the distribution of web articles by suitability level for each SAM subcategory.

Table 3. Comparison by production source: Percent of web articles that presented at least one message consistent with aerobic physical activity guidelines for adults age 18-64

Guideline	Match	Commercial	Government	Professional Association	Voluntary Health Agency	Median	df	$L\chi^2$	*p*-value	(*V*)
PAG 1	No	84.2	42.9	90.9	61.9	69.96	3	11.790	.008	.39
	Yes	15.8	57.1	9.1	38.1	30.02				
PAG 2	No	94.7	66.7	100	66.7	82.03	3	12.388	.006	.37
	Yes	5.3	33.3	0	33.3	17.98				
PAG 3	No	100	66.7	100	81.0	86.93	3	14.376	.002	.39
	Yes	0	33.3	0	19.0	13.08				
PAG 4	No	89.5	42.9	45.5	61.9	59.95	3	11.690	.009	.38
	Yes	10.5	57.1	54.5	38.1	40.05				
PAG 5	No	94.7	90.5	90.9	85.7	90.50	3	.956	.812	.11
	Yes	5.3	9.5	9.1	14.3	9.50				
PAG 6	No	89.5	90.5	100	90.5	90.50	3	2.100	.552	.13
	Yes	10.5	9.5	0	9.5	9.50				
PAG 7	No	100	95.2	100	100	100	3	2.499	.476	.19
	Yes	0	4.8	0	0	0				

Note. The guidelines references are the *2008 Physical Activity Guidelines for Americans* for adults age 18-64. The number of eligible samples was $n = 72$. Listed here are definitions for the PAG codes: PAG 1 = *attain 150 minutes (or 2 hours and 30 minutes) a week of moderate-intensity aerobic physical activity*; PAG 2 = *attain 75 minutes (or 1 hour and 15 minutes) a week of vigorous-intensity aerobic activity*; PAG 3 = *attain 75 minutes (or 1 hour and 15 minutes) a week of equivalent combination of moderate- and vigorous-intensity aerobic activity*; PAG 4 = *perform aerobic activity in episodes of at least 10 minutes*; PAG 5 =

preferably, aerobic activity should be spread throughout the week; PAG 6 = *aerobic activity should be done at least 3 days a week;* and PAG 7 = *people gain health benefits even from 60 minutes a week of moderate-intensity aerobic activity*. For summary purposes, the median value is presented for each guideline comparison between production sources. The test statistic reported is the likelihood ratio Chi-square statistic. A separate statistic was calculated for each guideline comparison. The measure of effect reported is Cramer's *V*.

Table 4. Comparison by production source: Percent of web articles that presented at least one message consistent with guidelines for additional health benefits via aerobic physical activity for adults age 18-64

Guideline Match		Commercial	Government	Professional Association	Voluntary Health Agency	Median	df	$L\chi^2$	*p*-value	(*V*)
PAG 8	No	100	81.0	100	95.2	97.6	3	7.826	.050	.32
	Yes	0	19.0	0	4.8	2.4				
PAG 9	No	100	90.5	100	95.2	97.6	3	3.692	.297	.19
	Yes	0	9.5	0	4.8	2.4				
PAG 10	No	100	90.5	100	100	100	3	5.069	.564	.26
	Yes	0	9.5	0	0	0				

Note. The guidelines references are the *2008 Physical Activity Guidelines for Americans* for adults age 18-64. The number of eligible samples was *n* = 72. Listed here are definitions for the PAG codes: PAG 8 = *increase aerobic activity to 300 minutes (or 5 hours) a week of moderate-intensity physical activity*; PAG 9 = *increase aerobic activity to 150 minutes (or 2 hours and 30 minutes) a week of vigorous-intensity physical activity*; and PAG 10 = *increase aerobic activity to 150 minutes (or 2 hours and 30 minutes) of an equivalent combination of moderate- and vigorous-intensity physical activity*. For summary purposes, the median value is presented for each guideline comparison between production sources. The test statistic reported is the likelihood ratio Chi-square statistic. A separate statistic was calculated for each guideline comparison. The measure of effect reported is Cramer's *V*.

Table 5. Comparison by production source: Percent of web articles that presented at least one message consistent with the physical activity guidelines for muscle-strengthening for adults age 18-64

Guideline Match		Commercial	Government	Professional Association	Voluntary Health Agency	Median	df	$L\chi^2$	*p*-value	(*V*)
PAG 11	No	89.5	81.0	90.9	100	90.2	3	5.988	.112	.25
	Yes	10.5	19.0	9.1	0	9.8				
PAG 12	No	84.2	90.5	90.9	95.2	90.7	3	1.401	.705	.14
	Yes	15.8	9.5	9.1	4.8	9.3				

Note. The guidelines references are the *2008 Physical Activity Guidelines for Americans* for adults age 18-64. The number of eligible samples was *n* = 72. Listed here are definitions for the PAG codes: PAG 11 = *do moderate or high intensity activity that involves all major muscle groups on two or more days of the week*; PAG 12 = *do at least one set of 8-12 repetitions of each exercise for muscle strengthening*. For summary purposes, the median value is presented for each guideline comparison between production sources. The test statistic reported is the likelihood ratio Chi-square statistic. A separate statistic was calculated for each guideline comparison. The measure of effect reported is Cramer's *V*.

Table 6. Comparison by production source: Percent of web articles that presented at least one message consistent with the physical activity guidelines adults age 18-64 with inactive (sedentary) lifestyles

Guideline Match		Commercial	Government	Professional Association	Voluntary Health Agency	Median	df	$L\chi^2$	*p*-value	(*V*)
PAG 13	No	100	90.5	100	100	100	3	5.069	.167	.26

	Yes	0	9.5	0	0	0				
PAG 14	No	84.2	61.9	72.7	76.2	74.45	3	2.672	.445	.19
	Yes	15.8	38.1	27.3	23.8	25.55				
PAG 15	No	94.7	100	100	95.2	97.6	3	2.402	.493	.15
	Yes	5.3	0	0	2.8	1.4				
PAG 16	No	100	100	100	100	100	--	--	--	--
	Yes	0	0	0	0	0				
PAG 17	No	84.2	85.7	90.9	100	88.3	3	5.426	.143	.22
	Yes	15.8	14.3	9.1	0	11.7				

Note. The guidelines references are the *2008 Physical Activity Guidelines for Americans* for adults age 18-64. The number of eligible samples was *n* = 72. Listed here are definitions for the PAG codes: PAG 13 = *gradually work up to 150 minutes of physical activity*; PAG 14 = *avoid inactivity and/or any amount of activity is better than none*; PAG 15 = *initial intensity should be light or moderate, for short periods of time, spread throughout the week*; PAG 16 = *start with one day a week of light or moderate effort for muscle-strengthening activity*; and PAG 17 = *could slightly increase effort until it becomes moderate to high*. For summary purposes, the median value is presented for each guideline comparison between production sources. The test statistic reported is the likelihood ratio Chi-square statistic. A separate statistic was calculated for each guideline comparison, except for PAG 16 due to no variation between production sources. The measure of effect reported is Cramer's *V*.

Table 7. Frequency count and Chi-square goodness-of-fit analysis of web article distribution across suitability categories by suitability level for the study sample

Suitability categories	**Un-satisfactory** *n* (%)	**Satisfactory** *n* (%)	**Optimal** *n* (%)	**df**	X^2	***p*-value**
Content						
Evident purpose	7 (5.0%)	47 (33.8%)	85 (61.2%)	2	65.669	< .001
Content about behavior	1 (.7%)	16 (11.5%)	122 (87.8%)	2	187.784	< .001
Limited scope	4 (2.9%)	35 (25.2%)	100 (71.9%)	2	103.612	< .001
Summary/re-view included	117 (84.2%)	10 (7.2%)	12 (8.6%)	2	161.712	< .001
Literacy demand						
Reading grade level	135 (97.1%)	4 (2.9%)	0 (0.0%)	1	123.460	< .001
Writing style, active voice	8 (5.8%)	64 (46.0%)	67 (48.2%)	2	47.669	< .001
Vocabulary: common word use	7 (5.0%)	76 (54.7%)	56 (40.3%)	2	54.403	< .001
Context before new info.	91 (65.5%)	28 (20.1%)	20 (14.4%)	2	65.281	< .001
“Road signs” used	12 (8.6%)	13 (9.4%)	114 (82.0%)	2	148.245	< .001
Graphics						
Cover graphic shows purpose	6 (8.0%)	15 (20.0%)	54 (72.0%)	2	52.080	< .001
Type of graphics	60 (96.8%)	2 (3.2%)	0 (0.0%)	1	54.258	< .001

Illustration relevance	75 (54.7%)	27 (19.7%)	35 (25.5%)	2	28.964	< .001
Lists, tables, etc., explained	59 (58.4%)	21 (20.8%)	21 (20.8%)	2	28.594	< .001
Graphics: captions used	51 (77.3%)	5 (7.6%)	10 (15.2%)	2	57.909	< .001
Layout and typography						
Layout factors	1 (.7%)	97 (70.8%)	39 (28.5%)	2	102.365	< .001
Typography	95 (68.3%)	44 (31.7%)	0 (0.0%)	1	18.712	< .001
Subheading ("chunking") used	33 (30.8%)	24 (22.4%)	50 (46.7%)	2	9.776	.008
Learning stimulation and motivation						
Interactions used	56 (40.3%)	53 (38.1%)	30 (21.6%)	2	8.734	.013
Behaviors modeled and specific	21 (15.1%)	20 (14.4%)	98 (70.5%)	2	86.432	< .001
Self-efficacy to read and understand text	22 (15.8%)	44 (31.9%)	72 (52.2%)	2	27.304	< .001
Mean sample distributions	43.1 (37.1%)	32.5 (24.5%)	49.3 (38.4%)			

Note. The study sample size was 139 web articles. The number of samples will not always total to 139 for each row. Discrepancies in total are due to exclusion of samples with "not applicable" subcategory categorization(s) (e.g., did not contain a cover graphic, did not present tables/figures/illustrations/lists). The alternate hypothesis of the Chi-square Goodness-of-Fit test was that distribution of the sample web articles across the suitability levels was not equal between the three levels (i.e., "unsatisfactory," "satisfactory," "optimal").

Suitability by production source. The mean suitability level was satisfactory across the production source subgroups. Production sources did not differ in their overall suitability score according to the one-way ANOVA omnibus test, F (3, 135) = .802, p = .495, partial η^2 = .018, β = .220. On the basis of Levene's test, the error variance was homogenous for the total SAM suitability score. Although the magnitude of any difference for the total suitability score was minimal between the sources of production, the aggregate subcategory suitability scores suggested it would be informative to determine if production sources differed along one or more SAM subcategories. A one-way MANOVA was performed. The null-hypothesis of equal covariance was retained, Box's M = 50.754, F (45, 43796) = 1.052, p = .378. Significant difference along one or more subcategories was detected by the omnibus test, Wilk's lambda = .745, F (3, 135) = 2.696, p = .001, partial η^2 = .093, β = .988. The error variance was homogenous for all subcategory suitability scores (i.e., Levene's test). Follow-up ANOVA's found significant difference(s) along two subcategories: content (F [3, 134] = 2.949, p = .035, partial η^2 = .062, β = .689); and layout and typography (F [3, 134] = 4.07, p = .005, partial η^2 = .092, β = .874. Commercial sources had a greater content suitability score than government sources (p = .039) and a greater score for layout and typography compared to professional association samples (p = .002).

As the SAM suitability score is computed from an ordinal classification scheme, follow-up Chi-square tests were performed to determine on which subcategories commercial sources might have differed compared to government and professional associations. Commercial and government sources differed along only one content subcategory, evident purpose ($L\chi^2$ = 7.081, df = 2, p = .029). Differences between the two

groups appeared present for all three suitability levels. Government sources had more samples classified as unsatisfactory (i.e., 8.6% vs. 0.0%) and satisfactory (i.e., 37.1% vs. 22.2%), while fewer were classified as optimal (i.e., 54.3% vs. 77.8%). The magnitude of the observed associations between commercial and government sources approached typical (V = .29). Commercial and professional association sources differed along one of three layout and typography subcategories, layout factors ($L\chi^2$ = 23.880, df = 2, p < .001). Commercial sources had a greater number of samples classified as optimal (i.e., 41.7% vs. 0.0%) and professional association a greater number classified as satisfactory (i.e., 58.3% vs 96.9%). The magnitude of these associations was substantial (V = .51).

Reading grade level. The reading grade level of the web articles ranged between seventh grade (i.e., 6.87) and a Bachelor's level of education (i.e., 16.13). The sample aggregate reading grade level exceeded the recommended eighth-grade level and the magnitude of this difference was substantial, M = 11.26, SD = 1.92, 95% CI [10.94, 11.58], t (138) = 19.832, p < .001, d = 1.35. A one-way ANOVA test did not detect a significant difference between sources of production on the basis of reading grade level, F (3, 135) = 2.389, p < .072, partial η^2 = .050, β = .587 (it is worth mentioning the post-hoc statistical power was less than satisfactory for this analysis; Thomas et al., 2011). The magnitude of observed differences approached typical. The mean reading grade level was above the eighth-grade level for all sources of production source. Table 8 presents the descriptive statistics for the reading grade level, textual characteristics, and update/publication year by production source and for the sample as a whole.

Table 8. Mean and value ranges for reading grade level, text statistics, and publication/update year by production source

	Commercial	Government	Professional Association	Voluntary Health Agency	Whole Sample
	n = 36	*n* = 35	*n* = 32	*n* = 36	*N* = 139
Reading grade level	10.74 (± 1.67)	11.44 (± 1.94)	10.98 (± 2.10)	11.84 (± 1.86)	11.26 (±1.92)
Minimum	7.47	8.69	6.87	8.24	6.87
Maximum	14.13	15.78	15.01	16.13	16.13
Number of words	1263.97 (±1083.83)	843.89 (±703.88)	860.28 (±345.87)	646.97 (±464.83)	905.46 (±744.35)
Minimum	367	127	349	101	101
Maximum	5409	3022	1813	2423	5409
Number of sentences	67.89 (±59.42)	52.71 (±43.61)	57.28 (±29.72)	37 (±24.19)	53.63 (±42.89)
Minimum	18	8	12	3	3
Maximum	296	198	137	111	296
Number of polysyllable words	161.50 (±202.91)	121.29 (±119.72)	110.97 (±69.03)	93.92 (±83.78)	122.24 (±132.16)
Minimum	15	20	35	22	15
Maximum	1187	596	416	446	1187
Year updated/published	2016 (±2)	2016 (±1)	2014 (±2)	2015 (±2)	2016 (±2)
Minimum	2009	2013	2009	2008	2008
Maximum	2018	2018	2018	2018	2018

Note. Thirty samples did not include an update or publication year: 13 commercial sources, 6 government sources, and 11 voluntary health agency sources. The plus-minus symbol (±) represents one standard deviation from the mean value. Year updated/published data reported are based on rounded values.

Main Analysis: Study Three Results

Use of behavior change techniques. From the greatest to the least amount of messages, the analysis of web articles on the use of behavior change techniques resulted

in the following categorical order: other messages (*M* = 29.49%, *SD* = 10.04, *SE* [mean] = .852, *Med* = 29.11%), self-efficacy (*M* = 26.36%, *SD* = 14.52, *SE* [mean] = 1.23, *Med* = 26.79), outcome expectancy (*M* = 17.14%, SD = 11.72%, *SE* [mean] .994, *Med* = 14.29%), self-regulation (*M* = 13.55%, *SD* = 10.24%, *SE* [mean] = .868, *Med* = 12.5%), and knowledge-based information (*M* = 13.45%, *SD* = 9.12%, *SE* [mean] = .744, *Med* = 11.54%). The assumption of sphericity was not met, and the conservative *F*-statistic was used to test for significant difference between categories, Mauchly's $W = .413$, $p < .001$ (Thomas et al., 2011). A significant difference was detected between one or more categories by the RM-ANOVA, F (2.598, 135) = 48.737, $p < .001$, partial $\eta^2 = .261$, $\beta = 1.00$. The magnitude of effect was substantial. In the follow-up comparisons, the other message and self-efficacy categories did not differ ($p = .877$); however, both differed from the knowledge-based information, outcome expectancy, and self-regulatory categories (all $p < .001$). The outcome expectancy category contained more messages than the knowledge-based information category ($p = .029$). The self-regulatory category did not differ from the knowledge-based information category ($p = 1.00$) or the outcome expectancy category ($p = .285$).

Replicating the follow-up classification to the outcome expectancy message category by Gainsforth et al. (2011) produced the following rank order: instrumental outcome expectancy (*M* = 58.93%, *SD* = 29.24%, *SE* [mean] = 2.54%, *Med* = 62.50%), affective outcome expectancy (*M* = 24.57%, *SD* = 27.13%, *SE* [mean] = 2.35, *Med* = 20.00%), then affective and instrumental outcome expectancy (*M* = 16.49%, *SD* = 23.04%, *SE* [mean] = 1.99%, *Med* = 8.33%). As Mauchly's test of sphericity was significant ($p = .008$), the conservative *F*-statistic was used, and significant difference

with an effect size substantial in magnitude was detected, F (1.866, 130) = 63.652, p < .001, partial η^2 = .325, β = 1.00. In the follow-up comparisons, the instrumental outcome expectancy category had a greater number of messages than the other two (both, p < .001). No other differences were significant.

Within-category comparison of behavior change technique subcategories

Knowledge-based information. Messages that informed about physical activity recommendations or suggestions were the most frequent type of knowledge-based information (M = 35.89%, SD = 5.53%), followed by advise to see or work with an allied health/fitness/medical professional (M = 22.67%, SD = 4.97%), information about barriers to physical activity/exercise without solutions (M = 17.91%, SD = 3.82%), physical activity behavioral definitions (M = 13.37%, SD = 3.34%), and then statistics (M = 10.15%, SD = 3.49%). Mauchly's test of sphericity was significant (p < .001), the conservative F-statistic was used and a significant difference of a typical magnitude and approaching substantial was detected, F (3.529, 134) = 13.294, p < .001, partial η^2 = .088, β = 1.00. The portion of messages devoted to presenting information about recommendations/suggestions for physical activity was larger than all other knowledge-based information subcategories (all p < .05). Compared to information to see or work with an allied health/fitness/medical professional this difference was small and approaching moderate (d = 0.34); to information about barriers, typical (d = 0.51); to behavioral definitions, typical and approaching substantial (d = 0.66); and to statistics, typical and approaching substantial (d = 0.75). The portion of messages to see or work with a professional was greater than messages that presented statistics, and the magnitude

of this difference was small and approaching typical (p = .025, d = 0.39). No other differences were observed.

Outcome expectancy. Messages that presented a positive outcome expectancy to physical activity/exercise were the predominant type used in the sample of web articles (M = 81.47%, SD = 11.07%). Messages that presented health risks due to physical activity/exercise accounted for approximately 7% of outcome expectancies promoted in the sample (M = 6.76%, SD = 4.94%), and messages that presented negative consequences to a sedentary lifestyle accounted for approximately 12% (M = 11.77%, SD = 2.93%). These category means significantly differed according the conservative F-statistic with the magnitude in difference being substantial, Mauchly's test $p < .001$, F (1.307, 136) = 129.874, $p < .001$, partial η^2 = .485, β = 1.00. The positive outcome expectancy category differed from the other two subcategories and the magnitude of this difference was substantial (both, $p < .001$, $d > 1.00$). No other differences were detected (p = .251, d = 0.21).

Self-regulation. Messages that encouraged/prompted readers to do or think about strategies to manage/overcome barriers to physical activity/exercise accounted for just over half of self-regulatory messages (M = 56.13%, SD = 7.17%). Messages that encouraged/prompted the reader to set/work towards an physical activity/exercise goal were the second most common type (M = 22.14%, SD = 4.26%), followed by messages that encouraged/prompted to make a plan for physical activity/exercise (M = 14.24%, SD = 3.24%), with the least common being messages that encouraged/prompted the reader to self-monitor their physical activity/exercise behavior (M = 7.48%, SD = 2.23%). The self-regulation subcategories differed according to the conservative F-statistic with the

magnitude in difference being substantial, Mauchly's test $p < .001$, F (1.981, 135) = 60.792, $p < .001$, partial $\eta^2 = .306$, $\beta = 1.00$. Messages that encouraged/prompted managing/overcoming barriers was larger than all other subcategories (all, $p < .001$); the magnitude of this difference was typical and approaching substantial compared to those that encouraged/prompted to set/strive toward a goal ($d = 0.78$) and substantial compared to the remaining subcategories (both, $d > 1.00$). The frequency of messages prompting readers to set/strive towards goals ($p < .001$, $d = 0.58$) and to make a plan ($p = .020$, $d = 0.33$) were more common than messages encouraging/prompting self-monitoring behaviors, with the magnitude in difference being typical and minimal, respectively. No other differences were detected.

Self-efficacy. The most common self-efficacy message were those providing textual models of behaviors or cognitions ($M = 19.00\%$, $SD = 5.66\%$), followed by messages that informed how to increase the level of physical activity/exercise ($M = 17.14\%$, $SD = 7.00\%$), messages that encouraged/prompted mastery attempts ($M = 15.14\%$, $SD = 5.96\%$), instructions on how to perform a physical activity/exercise behavior ($M = 13.52\%$, $SD = 6.13\%$), instructions for how to avoid negative consequences to physical activity/exercise ($M = 13.31\%$, $SD = 6.15\%$), messages that used verbal (social) persuasion ($M = 9.60\%$, $SD = 3.60\%$), messages that informed how to obtain social support ($M = 6.08\%$, $SD = 3.34\%$), use of visual models ($M = 4.52\%$, $SD = 3.92\%$), with the least common message type being those that prompted vicarious experiences ($M = 1.68\%$, $SD = 2.27\%$). A difference between one or more self-efficacy subcategories was detected using the conservative F-statistic, the size being typical in

magnitude and approaching substantial, Mauchly's test $p < .001$, F (5.833, 131) = 12.899, $p < .001$, partial $\eta^2 = .085$, $\beta = 1.00$.

Text-based models occurred more often than visual models ($p < .001$, $d = 0.78$), messages employing verbal persuasion ($p = .002$, $d = 0.52$), messages presenting vicarious experiences ($p < .001$, $d = 1.06$), and messages that informed how to obtain social support ($p < .001$, $d = 0.73$); the magnitude of these differences ranging between typical and substantial. Visual models were used to the same degree as messages that used verbal persuasion ($p = .149$), promoted vicarious experiences ($p = 1.00$), and informed about ways to get social support ($p = 1.00$); with messages from all other categories used more often (all $p < .05$). The majority of these differences were typical in magnitude ($d = 0.55$ to 0.78), while the difference with instructions on how to avoid negative consequences approached typical ($d = 0.45$). Except compared to the use of visual models ($p = 1.00$), messages from all categories were used more often than those that presented vicarious experiences (all $p < .05$). Compared to the frequency of messages on obtaining social support, the magnitude was approaching typical ($d = 0.41$) and typical, approaching substantial, for the remaining comparisons ($d = .66$ to $.78$) except with text-based models ($d = 1.06$). In addition to visual models and messages that provided vicarious experience, messages that encouraged/prompted mastery experience were used more often than those that informed about how to get social support ($p < .001$, $d = 0.49$). No other differences were detected.

Use of behavior change techniques by production source.

Dependent variable covariance was homogenous between production source groups, Box's M = 37.796, F (30, 49207.450) = 1.192, $p = .216$. Sources of production

differed along one category or more, Wilk's lambda = .855, F (3, 135) = 1.778, p = .05, partial η^2 = .051, β = .824. Error variance across all dependent variable categories was equal except for knowledge-based information (p = .028). The sources of production were similar in the number of messages devoted to knowledge-based information (F [3, 135] = .426, p = .735, partial η^2 = .009, β = .133); and self-regulation (F [3, 135] = 1.368, p = .255, partial η^2 = .030, β = .358). Power for these follow-up ANOVA's was low in both cases, the magnitude of difference between sources small for knowledge-based information and approached moderate for self-regulation. Difference between production sources was detected for outcome expectancy (F [3, 135] = 3.348, p = .021, partial η^2 = .069, β = .750); self-efficacy (F [3, 135] = 3.977, p = .009, partial η^2 = .081, β = .826); and other messages (F [3, 135] = 3.614, p = .015, partial η^2 = .074, β = .785).

A difference in the use of outcome expectancy messages was observed for two comparisons: commercial relative to government (p = .025, d = 0.75); and government relative to voluntary health agency (p = .054, d = 0.77). In both cases, government sources contained fewer outcome expectancy messages on average. The magnitude of difference was typical and approaching substantial. For self-efficacy messages, the only sources of production to differ were commercial and government, and the magnitude of this difference was substantial (p = .006, d = 0.81). Commercial and government sources were also the only two sources to differ on the number of other messages, with commercial presenting a greater number relative to governmental sources (p = .013, d = 0.74). The magnitude of this difference was typical and approaching substantial.

To determine which subcategories differences occurred in, a follow-up MANOVA/ANOVA was conducted for each pairwise comparison. The MANOVA was

significant for commercial sources relative to government sources, Pillai's Trace = .119, F (1, 69) = 3.025, p =.036, partial η^2 = .119, β = .687. The assumption of equal multivariate variance was not met (Box's M = 17.025, F [6, 34417] = 2.703, p = .013), though the assumption of equal univariate variance was met for all subcategory variables. Commercial sources devoted a greater percentage of messages towards promoting positive outcome expectancies for physical activity and exercise (M = 16.98%, SD = 12.27%, SE [mean] = 2.05%, Med = 13.19%) than did government sources (M = 10.29%, SD = 10.12%, SE [mean] = 1.71%, Med = 7.69%), F (1, 69) = 6.252, p =.015, partial η^2 = .083, β = .687. The magnitude of effect was typical and approaching substantial. No other statistical differences were detected by the post-hoc ANOVA's, though these tests were substantially under powered (i.e., β < .20). The measure of effect indicated the magnitude of the descriptive differences were minimal (i.e., partial η^2 < .02).

With respect to government compared to voluntary health agency sources, the MANOVA statistic approached significance, Pillai's Trace = .094, F (1, 69) = 2.326, p = .083, partial η^2 = .094, β = .561. The assumption of equal multivariate covariance was met, Box's M = 8.089, F (6, 34417.292) = 1.284, p = .260. Given the magnitude of the observed differences was typical and approaching substantial, and that the observed power was considerably low, the subcategory descriptive and distribution properties were reexamined. Meaningful differences appeared to occur for only one subcategory, positive outcome expectancies (d = 0.56). The measures of effect revealed minimal differences (i.e., d < 0.25) in the context of severe skewness (i.e., > 3) and kurtosis (i.e., > 10) for the other two subcategories. Given the evidence to suggest meaningful and real difference occurred along one category, a follow-up Independent Samples t-test was performed. The

results confirmed government and voluntary health agency sources differed, with web articles produced by voluntary health agencies devoting more messages to promoting a positive outcome expectancy towards physical activity/exercise, t (69) = 2.354, p = .021, equal variance assumed. The magnitude of difference was typical (d = 0.56).

Though the assumption of equal multivariate covariance was not met, Box's M = 185.938, F (45, 15614) = 3.557, p < .001), significant difference between commercial and government sources was detected for one or more self-efficacy subcategory by the follow-up one-way MONOVA (Pillai's Trace = .440, F (1, 69) = 5.327, p < .001, partial η^2 = .440, β = .999). Except for vicarious experiences and verbal persuasion, the error variance was heterogenous for the self-efficacy subcategories. Government sources contained more self-efficacy messages than commercial for the following subcategories: text-based behavioral models (F [1, 69] = 28.081, p < .001, partial η^2 = .289, β = .999; GOV: M = 8.14%, SD = 6.37%, SE [mean] = 1.08%, Med = 7.69%; COM: M = 2.09%, SD = 2.48%, SE [mean] = .413%, Med = .81%); encourages/prompts of mastery experiences (F [1, 69] = 5.718, p =.02, partial η^2 = .077, β = .655; GOV: M = 6.68%, SD = 8.76%, SE [mean] = 1.48%, Med = 4.44%; COM: M = 2.99%, SD = 2.94%, SE [mean] = .491%, Med = 2.94%), how to get social support (F [1, 69] = 5.176, p < .026, partial η^2 = .070, β = .612; GOV: M = 2.33%, SD = 3.29%, SE [mean] = .556%, Med = 0.00%; COM: M = .85%, SD = 2.09%, SE [mean] = .348%, Med = 0.00%), and how to increase one's level of physical activity or exercise (F [1, 69] = 5.041, p = .028, partial η^2 = .068, β = .600; GOV: M = 4.73%, SD = 5.90%, SE [mean] = .998%, Med = 3.57%; COM: M = 2.21%, SD = 3.21%, SE [mean] = .535%, Med = 0.00%). The magnitude of these differences was substantial for the first comparison, and typical and approaching

substantial for the remaining three. Commercial messages contained a larger number of messages that instructed how to perform an exercise or physical activity (F [1, 69] = 5.042, p =.028, partial η^2 = .068, β = .600; COM: M = 5.24%, SD = 7.18%, SE [mean] = 1.19%, Med = 2.54%; GOV: M = 2.07%, SD = 4.30%, SE [mean] = .728%, Med = 0.00%). The magnitude of this difference was typical and approaching substantial. Commercial and government sources were similar in their use of messages that provided visual behavioral models, verbal persuasion, promotion of vicarious experiences, and instructions/advise on how to avoid negative consequences due to physical activity or exercise.

Attitudes targeted by outcome expectancy messages by production source. Six web articles lacked data for the outcome expectancy attitudinal categories (i.e., zero outcome expectancy messages were observed) resulting in the following number of web articles used for this analysis: commercial (n = 36), government (n = 30), professional association (n = 31), voluntary health agency (n = 36). Univariate error variance was heterogeneous for messages that simultaneously targeted instrumental and affective attitudes, only. Multivariate covariance was heterogeneous, Box's M = 29.218, F (9, 170711.631) = 3.155, p = .001. Web articles were similar in the percentage of outcome expectancy messages that targeted instrumental, affective, and both affective and instrumental attitudes, irrespective of production source with differences between sources minimal and approaching typical, Pillai's Trace = .090, F (3, 129) = 2.020, p = .063, partial η^2 = .045, β = .731.

Chapter 5 – Discussion

The Presence of Physical Activity Guidelines

Web articles have become a popular source of health-related information among adults, and the Internet may commonly be a first source of physical activity information among North Americans. Of concern, though, is that Internet-based messages may promulgate advice that is inconsistent with the established physical activity guidelines issued by national public health agencies. To advance documentation on the extent Internet-based communication presents messages inconsistent with established physical activity guidelines by an authoritative body, we tested two hypotheses. The first hypothesis was that most web articles sampled would contain messages that were inconsistent with the *2008 Physical Activity Guidelines for Americans* 18 to 64 years of age (PAGs), and second was that web articles would more often contain message consistent with aerobic (endurance) activity PAGs relative to muscle-strengthening PAGs.

The results of this dissertation supported our first hypothesis and partially supported our second. Most of the web articles that presented advice on topics addressed by the PAGs were inconsistent with the 17 guidelines considered. Depending on the guideline considered, the portion of web articles *lacking* at least one consistent message ranged between nearly two-thirds to all web articles which met the inclusion criteria for review. The subsample portion that lacked at least one consistent message was significant for all but two guidelines considered; one was the recommendations to perform aerobic activity in at least 10-minute intervals (i.e., $p > .05$) and now retracted in the 2018 edition; the second was the guideline to start with light to moderate intensity muscle-

strengthening activity once per week. No web article was observed to present messages consistent with this guideline, and no *p*-value was able to be computed but *visibly* a practically significant finding nonetheless. Aerobic (endurance) activity guidelines were observed to often contain a greater portion of web articles with at least one consistent message, but this was not the case for *all* aerobic (endurance) activity guidelines. The portion of web articles with messages consistent to muscle-strengthening guidelines was larger than six of the 11 aerobic (endurance) activity guidelines considered. The aerobic (endurance) activity guidelines that typically contained a larger portion of web articles were those focused on accumulating a weekly amount of physical activity. By comparison to the two muscle-strengthening guidelines for substantial health benefits, 1.5 to 3.4 times as many web articles presented at least one consistent message to an aerobic (endurance) activity guideline for substantial health benefits.

We also tested if the rate of web article consistency with the PAGs varied on the basis of production source, the second apparent study to perform this type of comparative analysis. The first study to do so appears to have been Bonnar-Kidd et al. (2009) ten years ago. Our results provide evidence that the type of web article organization which content is produced may influence the extent that advice adheres to established guidelines, but this may only be true for certain aerobic (endurance) activity recommendations. Significant associations of typical magnitude were observed only for aerobic (endurance) activity recommendations having to do with weekly amounts of physical activity, and the advice to accumulate activity in 10-minute intervals at a minimum (now retracted in the 2018 guidelines). Where significant association was observed, government sources of production often produced a larger portion of the web

articles observed with messages consistent to the PAGs followed by voluntary health agencies in most cases; professional associations and commercial sources had the fewest number of web articles with consistent messages. These findings are similar to the ones reported by Bonnar-Kidd et al. (2009) 10 years ago. On the basis of their reported values of explained variance derived from their analyses of variance (i.e., ANOVAs), Bonnar-Kidd et al. observed a magnitude of association approaching that of typical between source producer and message consistency; also similar to our own findings (Pituch, & Stevens, 2016; Vaske et al., 2002). Their methods allowed only for a summative analysis of association (Bonnar-Kidd et al., 2009), and our analysis advances knowledge as to which guidelines might consistency be dependent upon source of production. The study-level patterns of consistency that we observed for our aggregate sample held true across the four production source categories that we studied. Our results add further evidence that web articles often may contain advice that is inconsistent with the established physical activity health guidelines, irrespective of production source (Ahmed et al., 2012; Bonnar-Kidd et al, 2009; Gorczynski, & Patel, 2014 Gorczynski et al., 2013; Jetha et al., 2011).

The findings of this dissertation denote several unique implications about the utility of physical activity advice that is disseminated through the Internet.

Frist in addition to the evidence that web articles in circulation may often contain inconsistent messages to established physical activity health guidelines, our results suggest that adults who are sedentary or modestly active are *least* likely to locate web articles with valid advice for achieving health and fitness benefits through physical activity. Short-term and maintenance of physical activity behavior changes among

members of these two groups may offer the greatest health and economic benefits to individuals, organizations, and communities (Carlson, Adams, Yang, & Fulton, 2018; Hadgraft & Owen, 2017; Owen, Sparling, Healy, Dunstan, & Matthews, 2010; Pratt, Norris, Lobelo, Roux, & Wang, 2014; U.S. Department of Health and Human Services, 2002). Physical activity guidelines to support adoption and eventual maintenance of higher activity levels among adults with predominantly sedentary lifestyles had the fewest portion of web articles with consistent messages for most guidelines and less than 3% for most. Guidelines that prompted the modest weekly goal of 60 minutes of moderate-intensity aerobic (endurance) activity had less than 2% of web articles accurately convey this guideline.

A second implication is that web articles may unintentionally prompt individuals to set unrealistic physical activity goals. About 25% of the U.S. adult population is physically inactive during leisure periods of their day, and the percentage of U.S. adults who meet the recommendation of accumulating 150 minutes of moderate-intensity aerobic (endurance) activity or its equivalent is near 50%; both of these statistics have persisted for over two decades to date and with modest variation (An, Xiang, Yang, & Yan, 2016; Moore, Harris, Carlson, Kruger, & Fulton, 2012; U.S. Department of Health and Human Services, 2002). In our sample, there were two guidelines with which a large number of web articles presented consistent messages: engage in at least 10-minute bouts of activity (now retracted in the 2018 PAGs); and avoid inactivity/any amount of activity is beneficial. While the popularity of these messages suggests that content producers include appropriate advice for the least active, contextually these messages could also be delivered in messages to motivate moderately/highly active readers to stay active or

increase their activity level. The gestalt of our findings—both at the study- and production source level—suggests this latter scenario may often be the case concerning Internet-disseminated physical activity information intended for lay adult audiences.

A third implication of our results is that information seekers may be more likely to encounter messages inconsistent with public health guidelines for muscle-strengthening activity than for aerobic (endurance) activity. While muscle fitness was the second most popular focus of web articles (aerobic fitness was third), approximately 10% of web articles with PAG-related messages presented at least one consist message with basic muscle-strengthening PAGs. There were between ~15% to 38% of web articles which presented at least one consistent message with basic aerobic (endurance) activity guidelines — a one-and-one-half to four-fold difference in magnitude for the aggregate sample. Though for a few cases a greater portion of web articles presented messages consistent to muscle-strengthening PAGs at the production source level, the trend was for the portion of web articles to be greater for aerobic (endurance) activity PAGs.

Study limitations. There are several limitations to the present study which should be kept in mind. First, it is possible that edits to web article content could result in a decrease or an increase in consistency with a given guideline. These potential changes are not captured using a cross-sectional study design. This limitation was partially addressed by documenting the mean and range of dates that sample web articles were published or last updated. Second, the population of web articles from which our study sample was drawn does not represent the entire population of web articles that were eligible for inclusion in our study.

Second, although the Google search engine is the predominant choice among U.S. adults, web article results obtain through it could modestly vary with results obtained through other search engines. Web articles were also sampled in a small window of time, and newly created web articles that potentially would have met our inclusion criteria were omitted. This limitation was addressed using established search methodology to replicate lay user information seeking behaviors, a process that was evaluated and adjusted using independent input from three professional experts with relevant training in information science and search and retrieval strategies. Still, search methods used to mimic lay searches likely will not produce search results which 100% match what an individual may obtain for two reasons. First, user Internet browser cookie settings or browser history could affect search engine results. Second the number and combination of search terms used at a given time may produce different search engine results.

Finally, although dichotomous classification systems similar to the one that we used are a popular method by researchers (Bonnar-Kidd et al., 2009; El-Haddad, Spooner, Faruqi, Denny-Wilson, & Harris, 2016; Gorczynski & Patel, 2014; Gorczynski et al., 2013; Jetha et al., 2011; Vallance et al., 2008), such approaches do limit the conclusions that could be drawn of *how* consistent messages tend to be. It has been reported that websites may produce PAG consistent messages on one web article and an inconsistent message to the same PAG on another (Bonnar-Kidd et al., 2009), but the magnitude of these occurrences has yet to be quantified. It is possible that at-odd messages could occur on the same web article, too. Quantitatively documenting the degree that messages are consistent with PAGs and how often inconsistencies occur (if at all) for a given guideline would help to fill a knowledge gap in the literature. We took a

modest step towards this more nuanced methodology by first documenting if PAG-related messages were present, than quantifying the rate which web articles presented at least one consistent message for a set of PAGs.

Future research recommendations. On the basis of the findings and limitations of our study, there are several specific ways that future research can increase knowledge about to the quality of physical activity advice intended for lay adult audiences presented via the Internet.

First, individuals are most likely to find advice appropriate for moderately to highly active adults. Future research could test this hypothesis by comparing websites based on their apparent population activity group and the extent appropriate guidelines are communicated, with intended audience potentially determined from information extract from titles and/or opening paragraphs. A precursor study could be to limit the web articles to those intended for adults with predominantly sedentary lifestyles and assess the extent advice is consistent with guidelines for this demographic group.

Second, future research could test the hypothesis that lay adult web articles that promote physical activity are more likely to contain messages inconsistent with physical activity guidelines for muscle-strengthening activity than for aerobic (endurance) activity.

Third, although the guidelines used in this study encompassed a broad range of individuals, future research could advance knowledge of the quality of advice generally communicated by assessing web articles intended for subpopulations whom adapted physical activity guidelines/consensus statements exist (e.g., women who are expecting to become pregnant/pregnant/postpartum; individuals with spinal cord injuries; older adults, individuals with certain chronic conditions such as osteoarthritis). Research in this area

may be especially pertinent if an ample period has occurred between two sets of physical activity guidelines for a given subpopulation (e.g., 5 years).

Fourth, established physical activity guidelines are communicated in multiple languages. It would be informative to know the extent which non-English web articles may present advice consistent with physical activity guidelines, especially if the intended audience belongs to a group which adapted guidelines exist.

Sixth, a typically referenced limitation of cross-sectional study designs is web articles are sampled at one time point, but researchers typically extract publication or update date information for their samples. Ganta, Hussein, and Frank (2012) provide one potential analytic method that could be used to understand the generalizability of cross-sectional research results using typically extracted date information. It appears this analytic method has yet to be adapted to study consistency with national physical activity health guidelines.

Seventh, research that contributes to theoretical knowledge about the process and context in which physical activity promotional messages are produced is needed. Such lines of inquiry would help to identify viable ways to improve the quality of advice presented via print and Internet-based media. The process and context which physical activity behavioral resources are produced has been studied within kinesiology (Lattimore et al., 2010), but kinesiology research focused on the process or context (e.g., organizational factors) is scant (Thomas & Cardinal, 2018).

Finally, the communication of inaccurate advice for achieving health and fitness through media is a persistent trend because the communicators of that information also lack adequate knowledge. The results of content analytical studies support this

hypothesis. So, too, do studies that assess knowledge of exercise prescription guidelines (the basis of many physical activity health guidelines) among kinesiology college students and certified exercise professionals (Ekkekakis, Albee, & Zenko, 2016; Zenko & Ekkekakis, 2015). However, professionals formally trained in exercise science are not the only individuals tasked with communicating health-related physical activity information. Consider the wide availability of media communications that are on health and fitness topics and produced by commercial, government, professional, and voluntary health agency organizations. Future research that tests educational strategies or modules designed for a broad audience and intended to promote adequate skill in communicating basic, valid, health-related physical activity advice would fill an overlooked knowledge translation gap within kinesiology (Cardinal, 2013; Cardinal et al., 2015; Thomas et al., 2018).

The Suitability of Physical Activity Promotion Web articles

Adults often use the Internet—largely irrespective of age or socioeconomic status—to locate information on physical activity to promote personal health or fitness. The intention behind these searches is practical (e.g., to enhance personal knowledge, to guide goal-directed behaviors). However, most web articles available may contain preventable limitations that undermine their ability to support users in achieving their objectives. One well-documented barrier that limits the suitability of behavioral resources for practical use is an unsatisfactory reading level (i.e., too high). There are other limitations that may affect behavioral resources beyond reading grade level, but these are understudied concerning physical activity resources (digital or print mediums; Thomas et al., 2018). Using the Suitability of Materials (SAM) protocol, we addressed this gap in

the research literature through a study of freely accessible lay web articles which focused on physical activity promotion among adults. On the basis of previous research reports, we generated three hypotheses. First, most web articles would have a satisfactory level of overall suitability, with the smallest number classified as optimal. Second, the majority of web articles would have unsatisfactory suitability for the following three subcategories: information summary/review, interactional features, and reading grade level. Third, we hypothesized that mean reading grade levels would be similar across sources of production.

Our first hypothesis was partially supported by our findings. Most web articles in our sample had an overall satisfactory level of suitability. Technically, the optimal category was the second most populated category, but the sample number appeared to be equivalent to that of the unsatisfactory category. The sample distribution across the suitability levels is a distinctive finding of this study compared to previous reports of print and web article resources. The satisfactory category sample size was 12 to 13 times larger than the optimal and unsatisfactory categories, respectively. The apparent only other study to evaluate physical activity resources observed the satisfactory category to be 3.7 to 1.8 times larger than the optimal and unsatisfactory categories, respectively (Vallance et al., 2008). The other irregularity to previous findings is the portion of our sample with an overall unsatisfactory level of suitability. It appeared to be significantly smaller than previous reports of print and web article resources across a variety of health topics, including compared to Vallance et al.'s (2008) study of print physical activity educational resources (i.e., 6.5% vs. 30%). The size of our optimal category appeared to differ from those reported in the peer-reviewed research literature. The size of our

optimal category was also markedly smaller than that reported by Vallance et al. (2008; i.e., 7.2% vs. 15%). Our results support the prediction that most behavioral resources will have an overall satisfactory suitability level, but not the prediction that the fewest number of resources will have an overall suitability that is optimal.

Our second hypothesis was partially supported as well. Two of the three predictions were consistent with our findings. Most web articles in our sample had unsatisfactory suitability for reading grade level (i.e., > 8th grade) and information summaries/reviews (i.e., not included). Most web articles contained satisfactory or optimal interactional features which prompted the user to engage with content information (contrary to our second hypothesis). Beyond the findings supporting two predictions of our second hypothesis, there were five other suitability criteria on which most of the web articles were unsatisfactory: 1) context before new information; 2) explanation of graphics; 3) graphics, 4) illustration relevance, and 5) typography. We did not expect these categories to emerge as predominant suitability issues. Vallance et al.'s (2008) study was the only one to suggest graphical information presented in physical activity resources may be unsatisfactory (i.e., lack explanation) for most materials. Otherwise, our results appear to differ from previous reports for the four categories, and there are two potential reasons why. First, the suitability studies we reviewed did not evaluate web articles focused on physical activity promotion. Second, different rating tools in addition to the SAM were used across the studies we reviewed. The quality measures may differ from the SAM for assessing graphics and the presentation of the information, or because suitability cut points may vary between instruments, both of which could lead to potentially contradictory conclusions. Our results supported our

prediction that most resources would have unsatisfactory reading grade levels and omit summaries/reviews, while they did not support our prediction that most resources would lack interaction features.

The predictions of our third hypothesis was supported by the results of this study. The mean reading grade level of web article resources was greater than the eighth-grade level, the maximum recommended for health-related educational resources intended for lay adult audiences. The mean reading grade level of our sample of materials was about three full reading grade levels higher than the eighth-grade level, representing a substantial difference. The findings of the present study corroborate the results of a recent meta-analysis that suggested physical activity resources exceed the eighth-grade reading level by at least 2.5 grades on average, irrespective of whether the medium is print or web article (Thomas et al., 2018). Astonishingly, the mean reading level of our sample of web articles was the same value reported 27 years ago by Cardinal and Sachs' (1992) for their sample of print-based educational physical activity resources. This parallelism further underscores readability as a persistent issue of physical activity resources intended for lay audiences.

Consistent with the second prediction of our third hypothesis, mean reading levels did not differ between sources of production. All sources of production were, on average, above the maximum eighth-grade level. These mean values appeared equivalent to the mean reading level for the total sample. This is the second primary study of web article educational resources on physical activity that suggests variations in reading grade level are minimal between sources of production (Thomas & Cardinal, 2018). Power to detect significant differences was low in both reports, though power was twice as large in the

present study (i.e., β = .59 versus .27). As the previous study had a 14.7% larger sample size, a likely reason for why power was higher in the present study is because the observed effect between one or more groups was larger (Thomas et al., 2011). This difference in observed effects may be due to the sampling procedures used in the present study to generate counter-balance group sizes. For small to moderate effects, it may be difficult to obtain sufficient power to detect true differences in the reading grade level of physical activity promotion web articles, if they should exist between sources of production. That said, the results of this study support the hypothesis that the reading grade level of physical activity lay educational resources is unsatisfactory irrespective of production source. Reading grade level was predominantly unsuitable across all production source categories in this study and in previous research (Thomas & Cardinal, 2018); the association between production source and reading level suitability was minimal in both reports.

Beyond specifying the limitations to the suitability of physical activity educational web articles, the results of this study clarify qualities that support their general use among lay adults. There were 12 of 19 suitability subcategories for which most web articles were satisfactory or optimal. The 12 subcategories corresponded to all five general suitability areas assessed: content, literacy demand, graphics, layout and typography, and learning stimulation and motivation. Web articles did especially well conveying a specific purpose, keeping the focus narrow and about behaviors (rather than information that is abstract, etiological, or mechanistic). Many web articles also modeled suggestions or instructions using examples or visual media (e.g., video, figure). Another pertinent observation was that most web articles contained two qualities that would ease

the literacy demands on users: first, most authors used a conversational and direct style of communication; second technical terms or jargon was limited, omitted, or often explained with plain language when used. Most web articles contained features that would make it easier for readers to focus on textual messages. This was accomplished using sufficient white space, limiting bulleted messages to no more than seven points, and organizing content into multiple subsections demarcated with informative subtitles. Finally, most web articles were organized in ways that would stimulate motivation to learn. This was often done by breaking the text up into short paragraphs and including prompts/activities that promoted engagement or reflection. Layout design and learning stimulations may indirectly ease literacy demands on users. Production source was unassociated with the trends summarized in this paragraph, except for two subcategories, but even then, suitability for most web articles was satisfactory or optimal. Our results suggest that most physical activity web articles may contain relevant information and messages that prompt readers to learn the information and potentially apply the behavioral advice that is presented.

The results of this study illustrate a potential tension within physical activity educational web articles that is made possible by assessing suitability factors. A tension may represent implicit forms of constraint that limits the ability of resources to be educational for users and support the long-term content application. For example, the content of web articles were suitable in multiple ways but rarely did the authors reinforce key ideas using a summary or review. Though features were often employed to stimulate interaction and learning, these interactional features mainly prompted *passive* learning (e.g., question-answer versus fill-in-the-blank; i.e., satisfactory suitability rather than

optimal). While literacy demands were eased using a conversational style of writing and common vocabulary, the sentences were often constructed in such a way that the messages would not be easily read nor understood by most adults (i.e., unsatisfactory reading grade level). Creating inviting prose is an important first step, but ensuring messages are readable for *satisfactory* comprehension is equally important. In fact, Doak et al. (1996) warns that an unsatisfactory reading grade level represents a sign a resource is a no-go for dissemination. It is important to keep in mind that suitability tensions may exist within lay educational materials, where suitability is at least satisfactory in one aspect and unsatisfactory in another for a given quality domain. That said, tensions in suitability are preventable (Doak et al., 1996). The results of this study highlight which suitability tensions may exist on web articles focused on physical activity promotion unbeknownst to users.

Study limitations. There are several limitations to the present study that are important to keep in mind. First, this study employed a cross-sectional analysis of web articles focused on physical activity promotion. Changes to content and web article layout that could potentially decrease or increase suitability were not captured. Second, web articles a typical user may obtain could vary from those sampled in this study due to variations in browser settings and the set of search terms used. Third, while web articles were located using systematic and validated search processes, the number of organizations omitted from our search is unknown. The results represent a potential suitability trend, but they may not represent web article profiles disseminated by a specific organization. Suitability could be higher or lower in a given area. Finally, the cultural appropriateness of web articles could not be assessed in the current study as

determining suitability for a given audience segment was not an objective. Cultural appropriateness represents the second of two no-go suitability signs for dissemination; not assessing it limits our understanding of which audience segments for whom the results may be extrapolated (Doak et al., 1996).

Future research recommendations. On the basis of the results and limitations of the present study, we offer several recommendations for future research.

First, there were multiple suitability issues that affected most of our sample of web articles that differed from previous reports. To determine the extent that our results represent general suitability qualities of web articles focused on physical activity promotion, we recommend independent replication studies be conducted. As the bulk of studies that attempt to replicate published research results may do so with varying methodological fidelity or rigor; established guidelines for replication research should be followed (e.g., Asendorpf et al., 2009; Halperin, Vigotsky, Foster, & Pyne, 2018).

Second, content analysis research of the quality of physical activity educational resources intended for lay audiences may predominantly employ cross-sectional study designs. Only one study located through systematic search and included in a meta-analysis of related research supplemented their cross-sectional design with a quasi-longitudinal analysis (Ganta et al., 2012; Thomas et al., 2018). Given the potential variability of web article content, longitudinal analysis is a practically significant but underused approach to studying the quality of Internet-disseminated lay educational resources with content-related to physical activity promotion. Longitudinal studies would help to fill knowledge gaps pertaining to the stability of information disseminated via the Internet, such as how long does a given article remain published but unedited/updated

versus the rate which articles are replaced with topically similar articles. What association these and other potential changes might have with the quality of physical activity-related information is largely unknown. Given the potential of sampling articles that are topically similar but which represent a different focus from the same URL, it may be best to designate the unit of analysis at the level of production source in pre-post longitudinal designs (e.g., repeated-measures analysis; Pallant, 2016; Pituch & Stevens, 2016).

Third, it is recommended that future researchers include as an analytical objective the direct comparison of production sources along quality measures. Thomas et al. (2018) reported the presence of only two studies that had made direct comparisons between sources of production, one study sampled print media and the other sampled web media predominantly. While multiple studies of print-based lay educational physical activity resources intended for adult audiences have been carried out, the last to directly compare sources of production was 27 years ago (Cardinal & Sachs, 1992). Future research that also compares print-based resources along multiple measures of suitability would help extend the seminal work of Cardinal and Sachs, which focused on the reading grade level of resources (Vallance et al., 2008). While the Internet is a popular primary source of physical activity information, print-based media are also highly valued educational resources among adults (Longo et al., 2010; Shi et al., 2004; Warner & Procaccino, 2004), and at times they may be more effective in physical activity promotion (Marks et al., 2006; Marshall, Leslie, Bauman, Marcus, & Owen, 2003). Given that the missions of noncommercial organizations typically include as an objective reducing health-related disparities or inequities, it is important to continuously document the extent to which

resources produced may vary along quality and utility measures on the basis of production source (Thomas et al., 2018).

Fourth, future research that investigates intrapersonal, interpersonal, or organizational level factors that may influence resource quality and potential to translate kinesiology knowledge would help to build theoretical knowledge that guides future capacity building interventions (Gal & Prigat, 2005; Thomas et al., 2018). Such lines of inquiry could generate insight into factors that support or constrain the production of suitable physical activity educational resources intended for lay adult audiences (Brown et al., 2004; Lattimore et al., 2010; Macabasco-O'Connell & Fry-Bowers, 2011; Tagtow & Amos, 2000; Thomas & Cardinal, 2018).

Finally, work focused on testing or advancing psychometrically sound measures of readability and suitability for the study of resources which communicate in diverse languages would represent a promising line of future research.

Presence of Theory-based Messages on Physical Activity Promotion Web articles.

The Internet is used by adults as a primary source for physical activity-related information and advice, but the ability of resource messages to motivate users to act on what is presented is questionable. The majority of message space may often be devoted to factual or irrelevant information instead of targeting reliable motivational determinants of physical activity behaviors. This represents a gap in knowledge translation between academic research and the educational resources that are disseminated to lay audiences. We used a methodology designed to improve the standardization and replication of research results to determine the general ways that lay physical activity promotion web articles target motivation. On the basis of Gainforth et al.'s (2011) descriptive mean

frequency results of print media, we tested the hypothesis that messages would fall into the following hierarchical order from high to low: other messages, self-efficacy messages, knowledge-based information messages, outcome expectancy messages, and self-regulation messages. A second hypothesis we tested was that most outcome expectancy messages would promote instrumental attitudes about physical activity.

The results of our study partially supported our first hypothesis and fully supported our second. Most messages were of the other message category on average, and messages that attempted to promote self-efficacy were the second most common type. The self-regulation category was technically not the smallest, which is contrary to our hypothesis. The self-regulation categorical mean frequency, however, was equivalent to that of the knowledge-based information category, which was the smallest. The outcome expectancy category was the third largest category rather than the fourth as we hypothesized. Finally, instrumental attitudes were the most frequent target of outcome expectancy messages, consistent with our second hypothesis.

The results of this study suggest that progress has been made on the availability of lay educational resources capable of motivating physical activity behavior. For example, messages that presented knowledge-based information was the smallest message category. Though results vary between reports of Internet research, knowledge-based information has constituted between a near majority to a majority of text-based messages in past studies. Most knowledge-based informational messages in our sample presented advice or recommendation about physical activity, followed by the recommendation to seek advice or work with a health-related professional (e.g., physician, fitness professional), with information about potential barriers as the third largest subcategory.

Taken together, these results suggest that many web articles may be viewed as informative and encourage users to seek expert advice to plan changes to their physical activity. Another positive quality of our sample was that although other-related messages were one of the largest categories, messages that targeted self-efficacy, self-regulation, and outcome expectancies constituted collectively the majority of messages on average (i.e., $M = 57.09\%$). How messages were used to target the three evidence-based determinants of motivation appear to be consistent with research-based recommendations. First, constructs were targeted in diverse ways. Self-efficacy was tied as the largest message category and contained five subcategories that were similar in size, one being prompts of mastery experiences, one use of verbal encouragement, and the reaming three being how-to information (e.g., how to perform a behavior, how to increase activity level). The similarity in size between these five subcategories suggests these message-types may be used in tandem often on physical activity promotion web articles. Text-based models were the largest self-efficacy message used, and our results suggest behavioral example were regular additions to physical activity advice or recommendations. Second, the majority of outcome expectancy messages used gained-framed messaging, which is when positive consequences to advice, recommendations, or instructions are emphasized. Gain-framed messaging has been shown to be more persuasive and educational than neutral or negative-framed messages for physical activity promotion (Li, Cheng, & Fung, 2014). While most outcome expectancy messages targeted instrumental attitudes, about 41% of messages in our sample targeted affective attitudes, many of which may have focused on positive affective consequences. Evidence suggests the inclusion of positive affective appeals will enhance the persuasiveness of

physical activity promotional messages. Taken together, our results suggest that physical activity web articles' messages may effectively enhance user confidence and interest to engage in physical activity behavior.

The evidence is limited and mixed as to what constitutes an optimal mixture and number of theory-based messages, or even if more is better. However, research evidence is consistent that presenting theory-supported behavioral change techniques will often enhance the motivational effectiveness of resources. An important perspective to keep in mind is that adults who search for physical activity information are motivated to understand resource messages and have intention to adopt behavioral changes. A realistic role of media is that they help maintain a motivational level sufficient for action by providing users with normative messages, encouragement, and advice that is adaptable to the current context of the user's lives (Cardinal et al., 2017; Sallis et al., 2006). Media such as web articles can also have an educative role, whereby messages support users in developing attitudes, skills, experiences, and self-efficacies that help sustain routines over time, rather they are recently adopted or not (Thomas, VanNess, & Cardinal, 2016). To that end, a critical eye is needed—by content developers and disseminators—for how the educative and motivational potential of web articles can be improved using recommended theory-based concepts.

The results of this study reveal general ways which the ability of web articles to motivate short-term and sustained physical activity behaviors may be improved. A basic approach would be to increase the number of messages that encourage readers to apply self-regulatory behavioral techniques. Messages that prompt or encourage self-regulatory techniques have the potential to enhance user's self-efficacy, motivation, and ability to

sustain physical activity routines or changes, but these messages appear to be the least type employed in freely accessible lay web articles that are focused on physical activity promotion. On average, about 30 percent of messages were other-related in our sample. Reducing the portion of other-related messages—that is, messages that do not present knowledge-based information, target self-efficacy, or outcome expectancies—is one avenue by which to increase self-regulatory messages without increasing the volume of text. Further, most messages (i.e., $M \approx 48.32\%$) prompted, advised, encouraged, or otherwise sought to persuade users to act (e.g., text-based models), but few (i.e., $M \approx 1.01\%$) encouraged or prompted users to self-monitor their physical activity behavior(s) or behavioral outcomes. Compared to outcome expectancies and self-efficacy, the behavioral effects of interventions on self-regulation are more consistent, and at times of greater magnitude, all of which has resulted in multiple recommendations that self-regulation be emphasized in physical activity educational resources and strategies (Brawley et al., 2013). By making self-regulation a central focus of physical activity promotion web articles, producers would increase alignment between web article content and what is recommended based on theory and evidence.

On the basis of our results, there are two other general ways to improve the motivational and educational value of freely accessible physical activity promotion web articles. The first is to increase the number of messages that provide vicarious experience; second is to use more visual models. Vicarious experiences are kin to anecdotes. They allow users to see or learn how a relatable other has persevered or succeed in doing a physical activity behavior. Preliminary research demonstrates that anecdotes may be more effective in increasing comprehension despite when text modestly exceeds the

recommended eighth-grade reading level (Michielutte, Bahnson, Dignan, & Schroeder, 1992). Findings from focus-group research suggest that anecdotes are not only welcomed by adult users, but also desired; anecdotes add intrigue to messages that present physical activity guidelines or recommendations (Berry, Witcher, Holt, & Plotnikoff, 2009). Beyond helping increase message attention and comprehension, Ashford, Edmunds, and French (2010) showed in their meta-analysis of intervention studies that use of vicarious experience was one of the strongest ways to increase physical activity self-efficacy (d = 0.33, $p < .001$). On average, less than 1% of web article messages promoted a vicarious experience in our study sample. Adding messages that prompt vicarious experiences is one immediate way to improve the potential of web articles to motivate physical activity behavior.

Second, the careful selection of visual media represents another feasible way to improve web articles. About 82% of our sample included at least one graphic, but an average of 1.19% of messages was of visual models that depicted a behavior related to physical activity. While graphics can enhance the visual appeal of web articles, reinforce key messages, and appear to be commonly used in Internet-disseminated physical activity information (Thomas & Cardinal, 2018), their potential to motivate and educate readers may be curbed by inadequate design (dissertation study 2). Before settling on a graphic, content producers of web articles should ensure the graphic is relevant, illustrates a message presented in text, and contains text beneath it which helps the reader to easily understand the purpose of the graphic (Doak et al., 1996).

Our results suggest that the frequency which theory-based concepts or techniques are used in web article messages does vary between production source, but which sources

differ from one another depends on the concept or technique measured. Descriptively, commercial sources used the least number of messages to promote user confidence to engage in physical activity or follow a recommendation. Two potential reasons might explain this descriptive trend. First, authors of commercial sources prioritize other message objectives over behavioral confidence. Second, authors of commercial sources may use messages to narrowly target self-efficacy. Compared to governmental web articles, commercial web articles had a significantly larger number of messages that targeted one self-efficacy subcategory; governmental had a significantly larger number of messages along four self-efficacy subcategories. We also observed that web articles produced by commercial and voluntary health agency (VHA) organizations used a significantly larger number of messages to promote positive outcome expectancies compared to governmental. This finding suggests that authors of commercial and VHA web articles may devote greater text-space to persuading users to accept their messages than do authors of governmental web articles. This may be an effective strategy if these outcome expectancy messages were paired with behavioral or self-regulatory prompts (Sweet, Brawley, Hatchell, Gainforth & Latimer-Cheung, 2014), but it remains to be determined since we did not track message pairings with outcome expectancy messages.

Bonnar-Kidd et al. (2009) performed a similar analysis comparing websites by production source and observed similar findings as are reported for the present study. They speculated that content producers for noncommercial websites may have greater exposure to health communications about population-based physical activity promotion strategies (Bonnar-Kidd et al., 2009). Our results substantiate their speculation. Although web articles by voluntary health agencies also had a significantly larger proportion of

positive outcome expectancy messages than did governmental, both production sources had similar mean percentages for total self-efficacy messages. While commercial web articles devoted a greater amount of text to other-related messages than that of governmental, other-related messages was the largest category across all production source categories studied. Further, the sources of production were also statistically similar across multiple message categories studied. Altogether, our results suggest that the potential of web articles to promote physical activity could be enhanced if content producers responded to our recommendations for general improvement, largely irrespective of production source.

When attempting to improve the potential of web articles to motivate user behavior, content producers have an ethical obligation to also review content for common issues to suitability and correct them prior to (re)dissemination. In this same sample of web articles discussed here, we observed that nearly all contained reading grade levels that were unsatisfactory for wide dissemination, though the text was composed in ways that made content inviting to read (dissertation study 2). Reading grade level represents a precise measure of adults' ability to easily comprehend text, not just read it. It is one of two criteria that if unsatisfactory should signify that educational material is a no-go for dissemination (Doak et al., 1996), but it has remained a persistent issue to mitigate despite awareness by producers that readability is important for communication (Thomas et al., 2018). A second issue common to physical activity educational resources is the omission of physical activity health guidelines from content messages. At the same time, print and Internet text-based resources commonly present users with information about how much activity to do, and many instances are of writers' attempt to present actual

guideline information—the information unfortunately is incomplete or inaccurate. The present sample of web articles also had issues having to do with physical activity health guidelines (dissertation study 1). Small changes to text result in large improvements to reading grade level suitability, and the same is true concerning consistency with physical activity health guidelines. To aid in their critical review, content producers can use free online toolkits published by national public health government agencies (e.g., the United States' Department of Health and Human Services).

Study limitations. The results of this study should be interpreted with the following limitations in mind. First, this study used a cross-section design, which does not capture potential changes over time of the prevalence of recommended theoretical concepts or behavioral techniques within web article content. Second, web articles that made up the present sample were not based on an exhaustive search of the Internet and were obtained within a narrow time window, both conditions mean that web articles potentially eligible for inclusion may have been excluded from consideration. The potential effects of this limitation were mitigated using Internet search strategies that mimicked those used by lay adults, though results obtained with these strategies may vary from a given user for two reasons: one, browser settings and two, the idiosyncratic selection of terms to search the Internet. Third, only web articles written in English were considered for inclusion in this study. Finally, although some web articles were sampled from the same top domain in the present study and several noncommercial websites were directly searched, this study did not search free websites whose chief function was to be a physical activity intervention. Beyond audio-video media, such websites might also sequentially introduce readers to educational text-based web articles as users work their

way through online programs (Doshi et al., 2003; Evers et al., 2003; Vandelanotte et al., 2014). The limits listed in this paragraph may affect the degree that results of this study generalize to specific websites.

Future research recommendations. On the basis of the results and limitations of this study, we offer several recommendations for future research.

First, we recommend the replication of our work to document the degree our findings are reproducible. This study represents the first to assess the use of theory in freely accessible physical activity promotion web articles, located using lay adult search behaviors, and using the CAATSPEC method to directly compare sources of production in addition to performing sample-level analyses. Replication studies would also advance understanding of how message used by sources of production may compare across recommended theoretical concepts. Our results were similar to Bonnar-Kidd et al.'s (2009) in how commercial sources compared to governmental, but it was impossible to determine if their observations were also related to self-efficacy as points of difference were unspecified in their article.

Second, our results suggested that commercial and voluntary health organizations use a greater volume of gained-framed messages than do governmental sources. The potential effectiveness of this pattern was indeterminable as we did not track how positive outcome expectancy messages were paired with other message types. Work that tracks such pairings would fill this gap in knowledge concerning freely accessible physical activity promotion web articles.

Third, our study focused on individual web articles. Future research could advance knowledge by sampling web articles of entire websites, basing inclusion criteria

on website popularity or end-user subpopulation. Studies of websites using sentence-level analyses would also clarify the generalizability of trends reports in the literature. The heterogeneity of results appears large when studies are compared to one another across recommended theoretical concepts. The results of studies using dichotomous coding schemes may overestimate the prevalence of theory-based messages. For example, while knowledge-based information is commonly reported as one of the largest categories of messages, the results of our study suggest it may be one of the smaller categories and not occupy as much text-space as previous reports suggest.

Fourth, this study only considered web articles written in English for inclusion. Future research that develops CAATSPEC-based codebooks for analyzing content in different languages would fill gaps in the extant literature. Few studies appear to assess the use of theory-based messages on web articles in languages other than English, and it appears the CAATSPEC method as yet to be adapted to the study of physical activity promotion materials beyond those in English.

Finally, our results and that of previous reports suggest that content producers incorporate theoretical concepts into the messages of physical activity promotion web articles. Why is unknown, though. Mixed method studies that include qualitative analysis of interviews with produces could provide insight into the motives behind message selection. Such research could reveal why similarities and differences in the use of theory on web articles may exist between sources of production.

Chapter 6 – Conclusion

Through this dissertation, the quality of freely available physical activity educational resources that lay adults would likely locate online was appraised. Three broad categories were considered. They were 1) message consistency with national health guidelines for physical activity; 2) suitability for health-related communication; and 3) use of evidence-based concepts from theories of health behavior. The results of this dissertation indicate that physical activity promotion web articles that communicate primarily through text have multiple qualities that enhance their message appeal and potential to be effective, largely irrespective of production source but not always the case. The results also suggest the educational value of web articles are undermined by correctable suitability issues and the use of messages inconsistent with national health guidelines for physical activity. These issues which mitigated web article quality were general to web articles irrespective of production source.

Though slow, knowledge translation of kinesiology is happening and the rate may vary depending on the quality indicator. Be that as it may, the findings of this dissertation substantiate there are unnecessary delays in knowledge translations that are also persistent barriers. These are the low rate of advice consistent with national physical activity health guidelines and unsatisfactory reading grade levels of materials. The social significance is that web articles inadvertently reinforce inequities in health literacy and potentially physical activity behaviors across populations. While a key role of health-related media is to promote environments that motivate healthful behavior—in this case the frequently circulating media messages about physical activity—Internet information environments likely serve to motivate the sufficiently active and those with means to

supplement online resources they may locate (e.g., with health care access, membership to fitness or health clinics, subscriptions to nutrition and physical activity products). Individuals hoping to reach recommended weekly amounts of physical activity may be prompted to set unrealistic goals and less likely to find appropriate advice for behavior change. Individuals primarily dependent on Internet-based media for health information with limited access to quality, credible sources of information are least likely to encounter web articles that are easily understandable or contain content summaries that reinforce learning. Web articles may contain other correctable quality issues pertaining to suitability that further reduce their appropriateness for health-related communication.

Given that there was a large portion of our sample in which the author(s) attempted to communicate a physical activity guideline and make their content easy to understand or inviting to read, the collective findings of this dissertation support the hypothesis that content producers have limited knowledge of health literacy issues commonly experienced by adults, or they may be overconfident in their ability to communicate information accurately and clearly. Our findings also suggest that producers of physical activity-related web articles have limited understanding about factors which produce dependency on the Internet for health information and why it matters their articles are resourceful for a wide and diverse audience.

Collaborations between scholars and organizations that produce freely available physical activity resources are needed. From them, safety nets can emerge that work towards two key aims. First is to sensitize producers and developers to basic knowledge in kinesiology for achieving health and physical fitness. Second is to sensitize producers and developers to issues that detract from the educational quality of physical activity

resources—then build capacity to address them. Towards these two aims, strategies for helping to ensure the quality dissemination of physical activity resources was advanced within the Discussion section, as well as direction for future research aimed at closing the "science gap" in knowledge translation.

Bibliography

Aaby, A., Friis, K., Christensen, B., Rowlands, G., & Maindal, H. T. (2017). Health literacy is associated with health behaviour and self-reported health: A large population-based study in individuals with cardiovascular disease. *European Journal of Preventive Cardiology*, *24*, 1880-1888. https://doi.org/10.1177/2047487317729538

Abraham, C., Sheeran, P., & Johnston, M. (1998). From health beliefs to self-regulation: Theoretical advances in the psychology of action control. *Psychology and Health*, *13*, 569-591.

Abraham, C., Southby, L., Quandte, S., Krahé, B., & Sluijs, W. (2007). What's in a leaflet? Identifying research-based persuasive messages in European alcohol-education leaflets. *Psychology and Health*, *22*, 31-60. https://doi.org/10.1080/14768320600774405

Ahmed, O. H., Sullivan, S. J., Schneiders, A., G., & McCrory, P. R. (2012). Concussion information online: Evaluation of information quality, content and readability of concussion-related websites. *British Journal Sports of Medicine*, *46*, 675-683. doi:10.1136/bjsm.2010.081620

Ainsworth, B. E. (2009). The translation of health research in kinesiology. *Quest*, *61*, 84-92. http://dx.doi.org/10.1080/00336297.2009.10483603

Albright, J., de Guzman, C., Acebo, P., Paiva, D., Faulkner, M., & Swanson, J. (1996). Readability of patient education resources: Implications for clinical practice. *Applied Nursing Research*, *9*, 139–143. http://dx.doi.org/10.1016/S0897-1897(96)80254-0

Allensworth, D. D., & Luther, C. R. (1986). Evaluating printed resources. *Nurse Educator*, *11*, 18–22.

Alvarez, E. C., Kawachi, I., & Romani, J. R. (2017). Family social capital and health – a systematic review and redirection. *Sociology of Health & Illness*, *39*, 5–29. https://doi.org/10.1111/1467-9566.12506

An, R., Xiang, X., Yang, Y., & Yan, H. (2016). Mapping the prevalence of physical inactivity in the U.S. States, 1984-2015. *PLoS ONE*, *11*. doi: 10.1371/journal.pone.0168175

Anokye, N. K., Trueman, P., Green, C., Pavey, T. G., & Taylor, R. S. (2012). Physical activity and health related quality of life. *BMC Public Health*, *12*. https://doi.org/10.1186/1471-2458-12-624

Aromataris, E., & Riitano, D. (2014). Constructing a search strategy and searching for evidence: A guide to the literature search for a systematic review. *American Journal of Nursing*, *114*, 49-56. doi: 10.1097/01.NAJ.0000446779.99522.f6

Asano, M., & Finlayson, M. L. (2014). Meta-analysis of three different types of fatigue management interventions for people with multiple sclerosis: Exercise, education and medication. *Multiple Sclerosis International*, *2014*. http://dx.doi.org/10.1155/2014/798285

Asendorpf, J. B., Conner, M., De Fruyt, F., De Houwer, J., Denissen, J. J. A., Fiedler, K., … Wicherts, J. M. (2009). Recommendations for increasing replicability in psychology. *European Journal of Personality*, *27*, 108-119. doi: 10.1002/per.1919

Ayo, N. (2012). Understanding health promotion in a neoliberal climate and the making of health conscious citizens. *Critical Public Health, 22*, 99-105. doi: 10.1080/09581596.2010.520692

Balas, E. A. (2001). Information systems can prevent errors and improve quality. *Journal of the American Medical Informatics Association, 8*, 398-399. https://doi.org/10.1136/jamia.2001.0080398

Ballard, J. E., Mathis, S., & Wallace, L. S. (2002). Correlates of lifetime physical activity in young women. *Medicine & Science in Sports & Exercise*, *34*, S65. Retrieved from http://journals.lww.com/acsm-msse/Fulltext/2002/05001/CORRELATES_OF_LIFETIME_PHYSICAL_ACTIVITY_IN_YOUNG.354.aspx

Barnes, C., Harvey, R., Wilde, A., Hadzi-Pavlovic, D., Wilhelm, K, & Mitchell, P. B. (2009). Review of the quality of information on bipolar disorder on the Internet. *Australian & New Zealand Journal of Psychiatry*, *43*, 934-945.

Baur, C. (2010). *The national action plan to improve health literacy*. Washington, DC: U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. Retrieved from http://www.nationaloralhealthconference.com/docs/presentations/2010/Cynthia%20Bauer%20-%20National%20Plans%20to%20Improve%20Health%20Literacy.pdf

Berland, G. K., Elliott, M. N., Morales, L. S., Algazy, J. I., Kravitz, R. L., Broder, M. S., ... & Watkins, K. E. (2001). Health information on the Internet: accessibility, quality, and readability in English and Spanish. *Journal of the American Medical Association, 285*, 2612-2621. doi:10.1001/jama.285.20.2612

Bernhardt, J. M. (2004). Communication at the core of effective public health. *American Journal of Public Health, 94*, 2051-2053. doi: 10.2105/AJPH.94.12.2051

Berry, T. R., McCarville, R. E., & Rhodes, R. E. (2008). Getting to know the competition: A content analysis of publicly and corporate funded physical activity advertisements. *Journal of Health Communication, 13*, 169-180. https://doi.org/10.1080/10810730701854086

Berry, T. R., Spence, J. C., Plotnikoff, R. C., & Bauman, A. (2011). Physical activity information seeking and advertising recall. *Health Communication, 26*, 246-254. doi:10.1080/10410236.2010.549810

Berry, T. R., Witcher, C., Holt, N. L., & Plotnikoff, R. C. (2010). A qualitative examination of perceptions of physical activity guidelines and preferences for format. *Health Promotion Practice, 11*, 908–916. https://doi.org/10.1177/1524839908325066

Berstam, E. V., Sagaram, S., Walji, M., Johnson, C. W., & Meric-Bernstam, F. (2005). Usability of quality measures for online health information: Can commonly used technical quality criteria be reliably assess? *International Journal of Medical Informatics, 74*, 675-683.

Bickmore, T. W., & Paasche-Orlow, M. K. (2012). The role of information technology in health literacy research. *Journal of Health Communication, 17*(Suppl. 3), 23–29. https://doi.org/10.1080/10810730.2012.712626

Birru, M. S., Monaco, V. M., Charles, L., Drew, H., Njie, V., Bierria, T., ... & Steinman, R. A. (2004). Internet usage by low-literacy adults seeking health information: An observational analysis. *Journal of Medical Internet Research, 6*. doi: 10.2196/jmir.6.3.e25

Bize, R., Johnson, J. A., & Plotnikoff, R. C. (2007). Physical activity level and health-related quality of life in the general adult population: A systematic review. *Preventive Medicine, 45*, 401-415. https://doi.org/10.1016/j.ypmed.2007.07.017

Bonnar-Kidd, K. K., Black, D. R., Mattson, M., Coster, D. (2009). Online physical activity information: Will typical users find quality information? *Health Communication, 24*, 165-175. doi: 10.1080/10410230802676763

Brawley, L. R., Gierc, M. S. H., & Locke, S. R. (2013). Powering adherence to physical activity by changing self-regulatory skills and beliefs: Are kinesiologists ready to counsel? *Kinesiology Review, 2*, 4-16. https://doi.org/10.1123/krj.2.1.4

Brawley, L. R., & Latimer, A. E. (2007). Physical activity guides for Canadians: Messaging strategies, realistic expectations for change, and evaluation. *Applied Physiology, Nutrition, and Metabolism*, *32*(S2E), S170-S184.

Brown D. R., Ludwig R., Buck G.A., Durham M. D., Shumard, T., & Graham, S. S. (2004). Health literacy: Universal precautions needed. *Journal of Allied Health*, *33*, 150–155. Retrieved from http://www.ingentaconnect.com/content/asahp/jah/2004/00000033/00000002/art00011

Burke-Garcia, A., & Scally, G. (2014). Trending now: Future directions in digital media for the public health sector. *Journal of Public Health*, *36*, 527-534. https://doi.org/10.1093/pubmed/fdt125

Burkell, J. A., Wolfe, D. L., Potter, P. J., & Jutai, J. W. (2006). Information needs and information sources of individuals living with spinal cord injury. *Health Information & Libraries Journal, 23*, 257-265. https://doi.org/10.1111/j.1471-1842.2006.00686.x

Cardinal, B. J. (1995). Development and evaluation of stage-matched written resources about lifestyle and structured physical activity. *Perceptual and Motor Skills, 80,* 543–546. doi: doi.org/10.2466/pms.1995.80.2.543

Cardinal, B. J. (2000). (Un)informed consent in exercise and sport science research? A comparison of forms written for two reading levels. *Research Quarterly for Exercise and Sport, 71,* 295-301.

Cardinal, B. J. (2002). Advertising content in physical activity print materials. *American Journal of Health Promotion, 15,* 255-258. doi: https://doi.org/10.4278/0890-1171-16.5.255

Cardinal, B. J. (2013). Service vs. serve-us: What will your legacy be? *Journal of Physical Education, Recreation & Dance*, *84*, 4-6. https://doi.org/10.1080/07303084.2013.781855

Cardinal B. J. (2014). Physical activity psychology research: Where have we been? Where are we going? *Kinesiology Review*, *3*, 44-52. http://dx.doi.org/10.1123/kr.2014-0036

Cardinal, B. J. (2016a). Physical activity education's contributions to public health and interdisciplinary studies: Documenting more than individual health benefits.

Journal of Physical Education, Recreation & Dance, *87*, 3-5. http://dx.doi.org/10.1080/07303084.2016.1142182

Cardinal, B. J. (2016b). Toward a greater understanding of the syndemic nature of hypokinetic diseases. *Journal of Exercise Science & Fitness*, *14*(2), 54-59.

Cardinal, B. J**.** (2017a). Quality college and university instructional physical activity programs contribute to *mens sana in corpore sano*, "the good life," and healthy societies. *Quest, 69*, 531-541. doi: 10.1080/00336297.2017.1320295

Cardinal, B. J. (2017b). Beyond the gym: There is more to physical education than meets the eye. *Journal of Physical Education, Recreation & Dance*, *88,* 3-5. https://doi.org/10.1080/07303084.2017.1260917

Cardinal, B. J., Austin, S. C., Cluster, M. A., Rasquinha, A. M., Rodenberg, S. A., & Thomas, J. D. (2017). Exercise and sport attire marketing: Message framing, orientation, and worldview. *Research Quarterly for Exercise and Sport*, *88*(Suppl. 1), A34-A35. doi: 10.1080/02701367.2017.1295756

Cardinal, B. J., Kang, M., Farnsworth, J. L., II, & Welk, G. J. (2015). Historical context and current status of the intersection of physical activity and public health: Results of the 2015 American Kinesiology Association's opportunities for kinesiology survey. *Kinesiology Review*, *4*, 329-345. doi: http://dx.doi.org/10.1123/kr.2015-0033

Cardinal, B. J., & Sachs, M. (1992). An analysis of the readability of exercise promoting literature with implications and suggestions for practice. *Research Quarterly for Exercise and Sport*, *63*, 186–190. http://dx.doi.org/10.1080/02701367.1992.10607579

Cardinal, B. J., & Seidler, T. L. (1995). Readability and comprehensibility of the "Exercise Lite" brochure. *Perceptual and Motor Skills*, *80*, 399-402. https://doi.org/10.2466/pms.1995.80.2.399

Carlson, S. A., Adams, K., Yang, Z., Fulton, J. E. (2018). Percentage of deaths associated with inadequate physical activity in the United States. *Preventing Chronic Disease, 15*. http://dx.doi.org/10.5888/pcd18.170354

Chesser, A., Burke, A., Reyes, J., & Rohrberg, T. (2016). Navigating the digital divide: A systematic review of eHealth literacy in underserved populations in the United States. *Informatics for Health and Social Care*, *41*, 1-19. doi: 10.3109/17538157.2014.948171

Chou, W. Y. S., Hunt, Y. M., Beckjord, E. B., Moser, R. P., & Hesse, B. W. (2009). Social media use in the United States: Implications for health communication. *Journal of Medical Internet research*, *11*. doi: 10.2196/jmir.1249

Clayton, L. H. (2009). TEMPtEd: Development and psychometric properties of a tool to evaluate material used in patient education. *Journal of Advanced Nursing*, *65*, 2229-2238. doi: 10.1111/j.1365-2648.2009.05049.x

Clemente, S., Ibrahim, S., Crichton, N., Wolf, M., & Rowlands, G. (2009). Complex interventions to improve the health of people with limited literacy: A systematic review. *Patient Education and Counseling*, *75*, 340-351. doi: 10.1016/j.pec.2009.01.008

Cleveland, S., Driver, S., Swank, C., & Macklin, S. (2015). Classifying physical activity research following stroke using the behavioral epidemiologic framework. *Topics in*

Stroke Rehabilitation, *22*, 289–298. https://doi.org/10.1179/1074935714Z.0000000043

Cline, R. J. W., & Haynes, K., M. (2001). Consumer health information seeking on the Internet: The state of the art. *Health Education Research*, *16*, 671-692.

Cochrane, Z. R., Gregory, P., & Wilson, A. (2012). Readability of consumer health information on the internet: A comparison of US government–funded and commercially funded websites. *Journal of Health Communication*, *17*, 1003-1010.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement, 20*, 37–46. https://doi.org/10.1177/001316446002000104

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences* (2nd ed). Hillside. NJ: Lawrence Earlbaum Associates.

Conn, V. S., Hafdahl, A., R., Brown, S. A., & Brown, L. M. (2008). Meta-analysis of patient education interventions to increase physical activity among chronically ill adults. *Patient Education Counseling*, *70*, 157-172. https://doi.org/10.1016/j.pec.2007.10.004

Cooper, K. H., Greenberg, J. D., Castelli, D. M., Barton, M., Martin, S. B., & Morrow, J. R. (2016). Implementing policies to enhance physical education and physical activity in school. *Research Quarterly for Exercise Science*, *87*, 133-140. doi: 10.1080/02701367.2016.1164009

Coulter, A. (1998). Evidence based patient information is important, so there needs to be a national strategy to ensure it. *British Medical Journal*, *317*, 225–227. Retrieved from http://pubmedcentralcanada.ca/pmcc/articles/PMC1113581/pdf/225.pdf

Coulter, A., & Ellins, J. (2007). Effectiveness of strategies for informing, educating, and involving patients. *British Medical Journal*, *335*, 24-27. doi: 10.1136/bmj.39246.581169.80

DiClemente, R., J., Salazar, L. F., & Crosby, R. A. (2013). *Health behavior theory for public health: Principles, foundations, and applications*. Burlington, MA: Jones & Bartlett Learning.

Davies, C. A., Spence, J. C., Vandelanotte, C., Caperchione, C. M., & Mummery, W. K. (2012). Meta-analysis of internet-delivered interventions to increase physical activity levels. *International Journal of Behavioral Nutrition and Physical Activity, 9*. http://www.ijbnpa.org/content/9/1/52

Davis, T. C., Fredrickson, D. D., Arnold, C., Murphy, P. W., Herbst, M., & Bocchini, J. A. (1998). A polio immunization pamphlet with increased appeal and simplified language does not improve comprehension to an acceptable level. *Patient Education and Counseling*, *33*(1), 25-37.

DeSalvo, K. B., O'Carroll, P. W., Koo, D., Auerbach, J. M., & Monroe, J. A. (2016). Public health 3.0: Time for an upgrade. *American Journal of Public Health, 106*, 621-622. doi: 10.2015/AJPH.2016.303063

Devine, T., Broderick, J., Harris, L. M., Wu, H., & Hilfiker, S. W. (2016). Making quality health websites a national public health priority: Toward quality standards. *Journal of Medical Internet Research, 18*. https://doi.org/10.2196/jmir.5999

DeWalt, D. A., Broucksou, K. A., Hawk, V., Brach, C., Hink, A., Rudd, R., & Callahan, L. (2011). Developing and testing the health literacy universal precautions toolkit. *Nursing Outlook*, *59*, 85-94. https://doi.org/10.1016/j.outlook.2010.12.002

DeWalt, D. A., Malone, R. M., Bryant, M. E., Kosnar, M. C., Corr, K. E., Rothman, R. L., … Pignone, M. P. (2006). A heart failure self-management program for patients of all literacy levels: A randomized, controlled trial [ISRCTN11535170]. *BMC Health Services Research, 6*. https://doi.org/10.1186/1472-6963-6-30

Diviani, N., van den Putte, B., Giani, S., & van Weert, J. C. (2015). Low health literacy and evaluation of online health information: A systematic review of the literature. *Journal of Medical Internet research, 17*. doi: 10.2196/jmir.4018

Dixon-Ibarra, A., Vanderbom, K., Dugala, A., & Driver, S. (2014). Systematic framework to evaluate the status of physical activity research for persons with multiple sclerosis. *Disability and Health Journal*, *7*, 151–156. https://doi.org/10.1016/j.dhjo.2013.10.004

Doak, L. G., & Doak, C. C. (1980). Patient comprehension profiles: Recent findings and strategies. *Patient Counselling and Health Education, 2*, 101-106. doi:10.1016/S0738-3991(80)80049-8

Doak, C. C., Doak, L. G., & Root, J. H. (1996). *Teaching patients with low literacy skills* (2nd ed.). Philadelphia, PA: J.B. Lippincott.

Dominick, G. M., Dunsiger, S. I., Pekmezi, D. W., & Marcus, B. H. (2013). Health literacy predicts change in physical activity self-efficacy among sedentary Latinas. *Journal of Immigrant and Minority Health, 15*, 533-539. https://doi.org/10.1007/s10903-012-9666-7

Doshi, A., Patrick, K., Sallis, J. F., Calfas, K. (2003). Evaluation of physical activity web sites for use of behavior change theories. *Annals of Behavioral Medicine*, *25*, 105-111. PMID: 12704012

Dunn, A., & Blair, S. (2002). Translating evidenced-based physical activity interventions into practice. The 2010 challenge. *American Journal of Preventive Medicine*, *22*, 8–9. https://doi.org/10.1016/S0749-3797(02)00432-4

Eakin, E. G., Glasgow, R. E., Riley, K. M. (2000). Review of primary care-based physical activity intervention studies: Effectiveness and implications for practice and future research. *Journal of Family Practice*, *49*(2), 158-168.

Eckman, M. H., Wise, R., Leonard, A. C., Dixon, E., Burrows, C., Khan, F., & Warm, E. (2012). Impact of health literacy on outcome and effectiveness of an educational intervention in patients with chronic disease. *Patient Education and Counseling*, *87*, 143-151. doi: 10.1016/j.pec.2011.07.020

Edwards, L., Krassioukov, A., & Fehlings, M. G. (2002). Importance of access to research information among individuals with spinal cord injury: Results of an evidenced-based questionnaire. *Spinal Cord*, *40*, 529-535. doi:10.1038/sj.sc.3101364

Ehlers, D. K., & Huberty, J. L. (2014). Middle-aged women's preferred theory-based features in mobile physical activity applications. *Journal of Physical Activity & Health, 11*, 1379–1385. https://doi.org/10.1123/jpah.2012-0435

Ekkekakis, P., Albee, M. J., & Zenko, Z. (2016). Knowledge of exercise prescription guidelines across one 4-year kinesiology curriculum. *Research Quarterly for Exercise and Sport, 87*, 124-130. https://doi.org/10.1080/02701367.2015.1083524

Eldar, R., & Marincek, C. (2000). Physical activity for elderly persons with neurological impairment: A review. *Scandinavian Journal of Rehabilitation Medicine, 32*, 99–103. https://doi.org/10.1080/003655000750045433

El-Haddad, N., Spooner, C., Faruqi, N., Denney-Wilson, E., & Harris, M. (2016). Readability and content analysis of lifestyle education resources for weight management in Australian general practice. *BMC Obesity*, *3*. doi: 10.1186/s40608-016-0097-1

Elliott, L. R., White, M. P., Taylor, A. H., & Abraham, C. (2016). How do brochures encourage walking in natural environments in the UK? A content analysis. *Health Promotion International*, *33*, 299-310. https://doi.org/10.1093/heapro/daw083

Eltorai, A. E., Sharma, P., Wang, J., & Daniels, A. H. (2015). Most American Academy of Orthopaedic Surgeons' online patient educational materials exceed average patient reading level. *Clinical Orthopaedics and Related Research, 4*, 1181-1186. doi: 10.1007/s11999-014-4071-2

Ennis, C. D. (2017). Educating students for a lifetime of physical activity: Enhancing mindfulness, motivation, and meaning. *Research Quarterly for Exercise and Sport*, 1–10. https://doi.org/10.1080/02701367.2017.1342495

Escoffery, C., Miner, K.R., Adame, D.D., Butler, S., McCormick, L., & Mendell, E. (2005). Internet use for health information among college students. *Journal of American College Health*, *53*, 183–188. doi: 10.3200/JACH.53.4.183-188.

Evers, K. E., Prochaska, J. M., Prochaska, J. O., Driskell, M. M., Cummins, C. O., & Velicer, W. F. (2003). Strengths and weaknesses of health behavior change programs on the Internet. *Journal of Health Psychology, 8*, 63-70. https://doi.org/10.1177/1359105303008001435

Eysenbach, G., Powell, J., Kuss, O., & Sa, E. R. (2002). Empirical studies assessing the quality of health information for consumers on the world wide web: a systematic review. *Journal of the American Medical Association, 287*(20), 2691-2700. doi: 10.1001/jama.287.20.2691

Ferguson, T. (1998). Digital doctoring—opportunities and challenges in electronic patient-physician communication. *Journal of the American Medical Association, 280*, 1361-1362. doi:10.1001/jama.280.15.1361

Fitzpatrick, S. L., Golden, S. H., Stewart, K., Sutherland, J., DeGross, S., Brown, T…Hill-Briggs, F. (2016). Effect of DECIDE (Decision-making Education for Choices In Diabetes Everyday) program delivery modalities on clinical and behavioral outcomes in urban African Americans with type 2 diabetes: A randomized trial. *Diabetes Care*, *39*, 2149-2157. doi: 10.2337/dc16-0941

Fjeldsoe, B., Neuhaus, M., Winkler, E., & Eakin, E. (2011). Systematic review of maintenance of behavior change following physical activity and dietary interventions. *Health Psychology*, *30*(1), 99-109. http://dx.doi.org/10.1037/a0021974.supp

Foley, L. (2001). *Analysis of an on-line random number generator* (Bachelor's degree final project, Trinity College Dublin, Ireland). Retrieved from https://www.random.org/analysis/Analysis2001.pdf

Forkner-Dunn, J. (2003). Internet-based patient self-care: The next generation of health care delivery. *Journal of Medical Internet Research, 5*. doi:10.2196/jmir.5.2.e8

Fox, S., & Jones, S. (2009). *The social life of Internet users*. Washington, DC: Pew Internet & American Life Project. Retrieved from http://www.pewinternet.org/2009/06/11/the-social-life-of-health-information/

Freelon, D. G. (2010). ReCal: Intercoder reliability calculation as a web service. *International Journal of Internet Science, 5,* 20-33. Retrieved from http://www.ijis.net/ijis5_1/ijis5_1_index.html

Freelon, D. G. (2013). ReCal OIR: Ordinal, interval, and ratio intercoder reliability as a web service. *International Journal of Internet Science, 8,* 10-16. Retrieved from http://www.ijis.net/ijis8_1/ijis8_1_index.html

Fridsma, D. B., Ford, P., & Altman, R. (1994). A survey of patient access to electronic mail: attitudes, barriers, and opportunities. In *Proceedings of the annual symposium on computer application in medical care* (p. 15). American Medical Informatics Association. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2247793/

Gainforth, H., Barg, C. J., Latimer, A. E., Schmid, K. L., O'Malley, D., & Salovey, P. (2011). An investigation of the theoretical content of physical activity brochures. *Psychology of Sport and Exercise, 12,* 615-620. doi: 10.1016/j.psychsport.2011.06.002

Gagliardi, A., & Jadad, A. R. (2002). Examination of instruments used to rate quality of health information on the Internet: Chronicle of a voyage with an unclear destination. *British Medical Journal, 324,* 569-573.

Gal, I., & Prigat, A. (2005). Why organizations continue to create patient information leaflets with readability and usability problems: An exploratory study. *Health Education Research, 20,* 485–493. https://doi.org/10.1093/her/cyh009

Ganta, A., Yi, P. H., Hussein, K., & Frank, R. M. (2014). Readability of sports medicine-related patient educational materials from the American Academy of Orthopaedic Surgeons and the American Orthopaedic Society for Sports Medicine. *The American Journal of Orthopedics, 43,* E65-E68. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/24730006

Gerteis, J., Izrael, D., Deitz, D., LeRoy, L., Ricciardi, R., Miller, T., & Basu, J. (2014). *Multiple chronic conditions chartbook: 2010 medical expenditure panel survey data* (Contract No. 290-2010-00004i-2). Agency for Healthcare Research and Quality, U.S. Department of Health and Human Services. Retrieved from https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/prevention-chronic-care/decision/mcc/mccchartbook.pdf

Gill, D. L. (2007). Integration: The key to sustaining kinesiology in higher education. *Quest, 59,* 269-286. http://dx.doi.org/10.1080/00336297.2007.10483552

Ginis, K. A. M., & Hicks, A. L. (2007). Considerations for the development of a physical activity guide for Canadians with physical disabilities. *Applied Physiology Nutrition*

and Metabolism-Physiologie Appliquee Nutrition Et Metabolisme, *32*, S135–S147. https://doi.org/10.1139/H07-108

Glasgow, R. E., Vogt, T. M., & Boles, S. M. (1999). Evaluating the public health impact of health promotion interventions: The RE-AIM framework. *American Journal of Public Health*, *89*(9), 1322–1327.

Gorczynski, P., & Patel, H. (2014). Quality of online physical activity information for long-haul truck drivers. *International Journal of Workplace Health Management*, *7*, 40–53. http://dx.doi.org/10.1108/IJWHM-06-2013-0021

Gorczynski, P., Patel, H., & Ganguli, R. (2013). Evaluating the accuracy, quality, and readability of online physical activity, exercise, and sport information for people with schizophrenia. *Mental Health and Physical Activity*, *6*, 95–99. https://doi.org/10.1016/j.mhpa.2013.06.001

Gwet, K. L. (2008). Computing inter-rater reliability and its variance in the presence of high agreement. *British Journal of Mathematical and Statistical Psychology*, *61*, 29-48. https://doi.org/10.1348/000711006X126600

Gwet, K. L. (2014). Agreement coefficients for nominal ratings: A review. In *Handbook of inter-rater reliability: The definitive guide to measuring the extent of agreement among raters* (4 ed, pp. 27-72).

Hadgraft, N., & Own, N. (2017). Sedentary behavior and health: Broadening the knowledge base and strengthening the science. *Research Quarterly for Exercise and Sport*, *88*, 123-129. http://dx.doi.org/10.1080/02701367.2017.1305257

Halperin, I., Vigotsky, A. D., Foster, C., & Pyne, D. B. (2018). Strengthening the practice of exercise and sport-science research. *International Journal of Sports Physiology and Performance*, *13*, 127-134. https://doi.org/10.1123/ijspp.2017-0322

Hampton, K. N. (2018). *Device Divides, Mobile vs Wired Broadband: The Social Implications for Urban and Rural Communities* (SSRN Scholarly Paper No. ID 3139753). Rochester, NY: Social Science Research Network. Retrieved from http://papers.ssrn.com/abstract=3139753

Hanna, K., Brennan, D., Sambrook, P., & Armfield, J. (2015). Third molars on the Internet: A guide for assessing information quality and readability. *Journal of Medical Internet Research*, *4*. doi:10.2196/ijmr.4712

Harland, J., & Bath, P. (2007). Assessing the quality of websites providing information on multiple sclerosis: evaluating tools and comparing sites. *Health Informatics Journal*, *13*, 207-221. https://doi.org/10.1177/1460458207079837

Harris, C. D., Watson, K. B., Carlson, S. A., Fulton, J. E., & Dorn, J. A. (2013). Adult population in aerobic and muscle-strengthening physical activities—United States, 2011. *MMWR: Morbidity and Mortality Reports*, *62*, 326-330. Retrieved from https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6217a2.htm

Hassol, A., Walker, J. M., Kidder, D., Rokita, K., Young, D., Pierdon, S., … Ortiz, E. (2004). Patient experiences and attitudes about access to a patient electronic health care record and linked web messaging. *Journal of the American Medical Informatics Association*, *11*, 505–513. https://doi.org/10.1197/jamia.M1593

HealthyPeople2020 (2018, April 9). Health communications and health information technology. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/health-communication-and-health-information-technology

Hendrick, P. A., Ahmed, O. H., Bankier, S. S., Chan, T. J., Crawford, S. A., Ryder, C. R., ... & Schneiders, A. G. (2012). Acute low back pain information online: An evaluation of quality, content accuracy and readability of related websites. *Manual Therapy, 17*, 318-324. Retrieved from https://www.sciencedirect.com/science/article/pii/S1356689X12000495

Henry, F. (1964). Physical education: An academic discipline. *Journal of Health, Physical Education & Recreation, 35*(7), 32–35, 69. Retrieved from https://shapeamerica.tandfonline.com/doi/abs/10.1080/00221473.1964.10621849?journalCode=ujrd18#.WtE6f4jwbIU

Hesse, B. W., Nelson, D. E., Kreps, G. L., Croyle, R. T., Arora, N. K. …Viswanath, K. (2005). Trust and sources of health information. *Archives of Internal Medicine, 165*, 2618–2624. doi: 10.1001/archinte.165.22.2618

Hill-Briggs, F., Lazo, M., Peyrot, M., Doswell, A., Chang, Y-T., Hill, M. N…Bancati, F. L. (2011). Effect of problem-solving-based diabetes self-management training on diabetes control in a low income patient sample. *Journal of General Internal Medicine, 26*, 972-980. doi:10.1007/s11606-011-1689-6

Hill-Briggs, F., Lazo, M., Renosky, R., & Ewing, C. (2008). Usability of a diabetes and cardiovascular disease education module in an African American, diabetic sample with physical, visual, and cognitive impairments. *Rehabilitation Psychology, 53*, 1-8. doi: 10.1037/0090-5550.53.1.1

Hill-Briggs, F., Schumann, K. P., & Dike, O. (2012). 5-step methodology for evaluation and adaptation of print patient health information to meet the $<5^{th}$ grade readability criterion. *Medical Care, 50*, 294-301. doi: 10.1097/MLR.0b013e318249d6c8

Hill-Briggs, F., & Smith, A. S. (2008). Evaluation of diabetes and cardiovascular disease print patient education resources for use with low health literate populations. *Diabetes Care, 31*, 667-671. https://doi.org/10.2337/dc07-1365

Hölzel, L. P., Ries, Z., Dirmaier, J., Zill, J. M., Kriston, L., Klesse, C., … Bermejo, I. (2015). Usefulness scale for patient information material (USE) - Development and psychometric properties. *BMC Medical Informatics and Decision Making, 15*. https://doi.org/10.1186/s12911-015-0153-7

Huberty, J., Dinkel, D., Beets, M. W., & Coleman, J. (2013). Describing the use of the Internet for health, physical activity, and nutrition information in pregnant women. *Maternal and Child Health Journal, 17*, 1363–1372. doi:10.1007/s10995-012-1160-2

Ivanitskaya, L., Brookins-Fisher, J., O'Boyle, I., Vibbert, D., Erofeev, D., & Fulton, L. (2010). Dirt cheap and without prescription: How susceptible are young US consumers to purchasing drugs from rogue Internet pharmacies? *Journal of Medical Internet Research, 12*. doi: 10.2196/jmir.1520.

Ivanitskaya, L., O'Boyle, I., Casey, A. M. (2006). Health information literacy and competencies of information age students: results from the interactive online Research Readiness Self-Assessment (RRSA). *Journal of Medical Internet Research, 8*. doi: 10.2196/jmir.8.2.e6

Jadad, A. R., & Gagliardi, A. (1998). Rating health information on the Internet: Navigating to knowledge or to Babel? *Journal of the American Medical Association, 279*, 611-614. doi: 10.1001/jama.279.8.611

Jetha, A., Faulkner, G., Gorczynski, P., Arbour-Nicitopoulos, K., & Ginis, K. A. M. (2011). Physical activity and individuals with spinal cord injury: Accuracy and quality of information on the Internet. *Disability and Health Journal, 4*, 112-120. https://doi.org/10.1016/j.dhjo.2010.07.001

Johnson, J. L., & Stern, E. B. (2004). Readability of patient education materials: A comparison of rural and urban cardiac rehabilitation sites in Minnesota. *Journal of Cardiopulmonary Rehabilitation, 24*, 121-127. Retrieved from http://journals.lww.com/jcrjournal/pages/articleviewer.aspx?year=2004&issue=03000&article=00010&type=abstract

Jurakić, D., Pedišić, Ž., & Greblo, Z. (2010). Physical activity in different domains and health-related quality of life: A population-based study. *Quality of Life Research, 19*, 1303-1309. https://doi.org/10.1007/s11136-010-9705-6

Kang, E., Fields, H.W., Cornett, S., & Beck, F. M. (2005). An evaluation of pediatric dental patient education materials using contemporary health literacy measures. *Pediatric Dentistry*, *27*, 409-413. Retrieved from http://www.ingentaconnect.com/content/aapd/pd/2005/00000027/00000005/art00012

Karch, M. (2018 October 9). Use Google to search within a single website: Narrow your search to a single website with this tip. *Lifewire.com* Retrieved from https://www.lifewire.com/Google-search-one-website-1616499

Kenny, C. (2005). *Random number generators: An evaluation and comparison of Random.org and some commonly used generators* (Bachelor's degree final project, Trinity College, Dublin, Ireland). Retrieved from https://www.random.org/analysis/Analysis2005.pdf

Khazaal, Y., Chatton, A., Cochand, S., Coquard, O., Fernandez, S., Khan, R., & Zullino, D. (2010). Quality of web-based information on alcohol dependence. *Drugs: Education, Prevention and Policy*, *17*, 248-260. https://doi.org/10.3109/09687630802530696

Kim, J. (2009). Describing and predicting information-seeking behavior on the web. *Journal of the American Society for Information Science and Technology*, *60*. doi: 10.1002/asi.21035

Kim, S. H., & Lee, A. (2016). Health-literacy-sensitive diabetes self-management interventions: A systematic review and meta-analysis. *Worldviews on Evidence-Based Nursing*, *13*, 324–333. https://doi.org/10.1111/wvn.12157

Kim, H., & Xie, B. (2017). Health literacy in the eHealth era: A systematic review of the literature. *Patient Education and Counseling*, *100*, 1073-1082. https://doi.org/10.1016/j.pec.2017.01.015

Kiser, K. Jonas, D. Warner, Z., Scanlon, K., Shilliday, B. B., & DeWalt, D. A. (2011). A randomized control trial of a literacy-sensitive self-management intervention for chronic obstructive pulmonary disease patients. *Journal of General Internal Medicine*, *27*, 190-195. doi: 10.1007/s11606-011-1867-6

Kohl, H. W., Craig, C. L., Lambert, E. V., Inoue, S., Alkandari, J. R., Leetongin, G., ... & Lancet Physical Activity Series Working Group. (2012). The pandemic of physical inactivity: Global action for public health. *The Lancet*, *380*, 294-305. https://doi.org/10.1016/S0140-6736(12)60898-8

Kontos, E., Blake, K. D., Chou, W.-Y. S., & Prestin, A. (2014). Predictors of eHealth usage: Insights on the digital divide from the Health Information National Trends Survey 2012. *Journal of Medical Internet Research*, *16*. https://doi.org/10.2196/jmir.3117

Kosma, M., Cardinal, B. J., & McCubbin, J. A. (2005). A pilot study of a web-based physical activity motivational program for adults with physical disabilities. *Disability and Rehabilitation: An International, Multidisciplinary Journal, 27*, 1435-1442. doi: https://doi.org/10.1080/09638280500242713

Krippendorff, K. (1980). *Content analysis: An introduction to its methodology*. Thousand Oaks, CA: Sage.

Krippendorff, K. (2011). Computing Krippendorff's alpha-reliability. Retrieved from http://repository.upenn.edu/asc_papers/43

Kuijpers, W., Groen, W. G., Aaronson, N. K., & van Harten, W. H. (2013). A systematic review of web-based interventions for patient empowerment and physical activity in chronic diseases: Relevance for cancer survivors. *Journal of Medical Internet Research*, *15*. doi: 10.2196/jmir.2281

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*, 607–610. https://doi.org/10.1177/001316447003000308

Kutner, M., Greenburg, E., Jin, Y., & Paulsen, C. (2006). *The Health Literacy of America's Adults: Results from the 2003 National Assessment of Adult Literacy* (NCES 2006-483). National Center for Education Statistics. Retrieved from http://files.eric.ed.gov/fulltext/ED493284.pdf

Lam, C. G., Roter, D. L., & Cohen, K. J. (2013). Survey of quality, readability, and social reach of websites on osteosarcoma in adolescents. *Patient Education and Counseling*, 90, 82-87. https://doi.org/10.1016/j.pec.2012.08.006

Landis, J., & Koch, G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33*, 159–174.

Latimer, A. E., Brawley, L. R., & Bassett, R. L. (2010). A systematic review of three approaches for constructing physical activity messages: What messages work and what improvements are needed? *International Journal of Behavioral Nutrition and Physical Activity*, *7*. https://doi.org/10.1186/1479-5868-7-36

Lattimore, D., Griffin, S. F., Wilcox, S., Rheaume, C., Dowdy, D. M., Leviton, L. C., & Ory, M. G. (2010). Understanding the challenges encountered and adaptations made by community organizations in translation of evidence-based behavior change physical activity interventions: A qualitative study. *American Journal of Health Promotion*, *24*, 427–434. http://doi.org/10.4278/ajhp.081024-QUAL-252

Lee, J. H., Giovenco, D., & Operario, D. (2017). Patterns of health information technology use according to sexual orientation among us adults aged 50 and older: Findings from a national representative sample-national health interview survey

2013-2014. *Journal of Health Communication*, *22*, 666–671. https://doi.org/10.1080/10810730.2017.1341566

Lee, T. W., Lee, S. H., Kim, H. H., & Kang, S. J. (2012). Effective intervention strategies to improve health outcomes for cardiovascular disease patients with low health literacy skills: A systematic review. *Asian Nursing Research*, *6*, 128–136. https://doi.org/10.1016/j.anr.2012.09.001

Lee, I-M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., & Katzmarzyk, P. T. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *Lancet, 380*, 219-229. doi:10.1016/S0140-6736(12)61031-9

Li, K.-K. , Cheng, S.-T. & Fung, H. H. (2014). Effects of message framing on self-report and accelerometer-assessed physical activity across age and gender groups. *Journal of Sport & Exercise Psychology*, *36*, 40-51. doi:10.1123/jsep.2012-0278

Locher, M. A. (2010). Health Internet sites: A linguistic perspective on health advice columns. *Social Semiotics*, *20*, 43–59. https://doi.org/10.1080/10350330903438402

Longo, D. R., Schubert, S. L., Wright, B. A., LeMaster, J., Williams, C. D., & Clore, J. N. (2010). Health information seeking, receipt, and use in diabetes self-management. *Annals of Family Medicine*, *8*, 334-340. doi: 10.1370/afm.1115

Loprinzi, P. D., & Beets, M. W. (2014). Need for increased promotion of physical activity by health care professionals. *Preventive Medicine*, *69*, 75-79. https://doi.org/10.1016/j.ypmed.2014.09.002

Lorigo, L., Pan, B., Hembrooke, H., Joachims, T., Granka, L., & Gay, G. (2006). The influence of task and gender on search and evaluation behaviors using Google. *Information Processing and Management*, *42*, 1123-1131. doi:10.1016/j.ipm.2005.10.001

Ma, J. K., & Ginis, K. A. M. (2018). A meta-analysis of physical activity interventions in people with physical disabilities: Content, characteristics, and effects on behaviour. *Psychology of Sport and Exercise*, *37*, 262-273. https://doi.org/10.1016/j.psychsport.2018.01.006

Macabasco-O'Connell, A., & Fry-Bowers, E. K. (2011). Knowledge and perceptions of health literacy among nursing professionals. *Journal of Health Communication*, *16*, 295-307. doi: 10.1080/10810730.2011.604389

Marcus, B. H., Forsyth, L. H., Stone, E. J., Dubbert, P. M., McKenzie, T. L., Dunn, A. L., & Blair, S. N. (2000). Physical activity behavior change: Issues in adoption and maintenance. *Health Psychology*, *19*, 32-41. doi:10.1037/0278-6133.19.Suppl1.32

Marks, J. T., Campbell, M. K., Ward, D. S., Ribisil, K. M., Wildermuth, B., & Symons, M. J. (2006). A comparison of web and print media for physical activity promotion among adolescent girls. *Journal of Adolescent Health*, *39*, 96-104. doi: 10.1016/j.jadohealth.2005.11.002

Marshall, A. L., Bauman, A. E., Owen, N., Booth, M. L., Crawford, D., Marcus, B. H. (2003). Population-based randomized controlled trial of a stage-targeted physical activity intervention. *Annals of Behavioral Medicine, 25*, 194-202. doi: 10.1207/S15324796ABM2503_05

Marshall, A., L., Leslie, E. R., Bauman, A. E., Marcus, B., H., & Owen, N. (2003). Print versus website physical activity programs. *American Journal of Preventive Medicine, 25*, 88-94. doi: https://doi.org/10.1016/S0749-3797(03)00111-9

Martens, R. (1990). Knowledge problems in physical education. In the American Academy of Physical Education Papers No. 24, *New possibilities, new paradigms?* (pp. 93-99). Champaign, IL: Human Kinetics. Retrieved from http://www.worldcat.org/title/new-possibilities-new-paradigms-sixty-second-annual-meeting-new-orleans-louisiana-march-27-28-1990/oclc/22733597&referer=brief_results

Martin, C. K., Church, T. S., Thompson, A. M., Earnest, C. P., & Blair, S. N. (2009). Exercise does and quality of life: A randomized controlled trial. *Archives of Internal Medicine, 169*, 269-278. doi: 10.1001/archinternmed.2008.545

Matingwina, T., & Raju, J. (2017). An integrated framework for disseminating health information to students in Zimbabwe. *Libri, 67*, 35-50. https://doi.org/10.1515/libri-2016-0054

Mauchly, J. W. (1940). Significance test for sphericity of a normal n-variate distribution. *The Annals of Mathematical Statistics*, *11*(2), 204-209. https://www.jstor.org/stable/2235878

Mayer, G., & Villaire, M. (2009). Enhancing written communications to address health literacy. *OJIN: The Online Journal of Issues in Nursing, 14*. doi: 10.3912/OJIN.Vol14No03Man03

McCauley, E., & Blissmer, B. (2000). Self-efficacy determinants and consequences of physical activity. *Exercise and Sport Sciences Reviews*, *28*, 85-88.

McGlynn, E. A., Asch, S. M., Adams, J., Keesey, J., Hicks, J., DeCristofaro, A., & Kerr, E. A. (2003). The quality of health care delivered to adults in the United States. *New England Journal of Medicine, 348*, 2635-2645. doi:10.1056/NEJMsa022615

McGloin, A. F., & Eslami, S. (2015). Digital and social media opportunities for dietary behaviour change. *Proceedings of the Nutrition Society*, *74*, 139–148. https://doi.org/10.1017/S0029665114001505

McInnes, N., & Haglund, B. J. (2011). Readability of online health information: Implications for health literacy. *Informatics for Health and Social Care*, *36*, 173–189. http://dx.doi.org/10.3109/17538157.2010.542529

McKenzie, S. (2013). *Getting physical: The rise of fitness culture in America*. Lawrence, KS: University Press of Kansas.

McLaughlin, G. H. (1969). SMOG grading—A new readability formula. *Journal of Reading*, *12*, 639-646. http://www.jstor.org/stable/40011226

Mead, E. L., Cohen, J. E., Kennedy, C. E., Gallo, J., & Latkin, C. A. (2016). The influence of graphic warning labels on efficacy beliefs and risk perceptions: A qualitative study with low-income, urban smokers. *Tobacco Induced Diseases, 14*, 25. https://doi.org/10.1186/s12971-016-0088-5

Meade, C. D., Smith, C. R. (1991). Readability formulas: Cautions and criteria. *Patient Education and Counseling, 17*, 153-158. https://doi.org/10.1016/0738-3991(91)90017-Y

Mercer, K.H.C. (1998). *An examination of three perspectives on nutrition education materials: The curriculum expert, the dietitian, and the patient* (Doctoral dissertation). Retrieved from http://elibrary.ru/item.asp?id=5463446

Merriam, S. B., Caffarella, R. S., & Baumgartner, L. M. (2007). *Learning in adulthood: A comprehensive guide* (3rd ed.). San Francisco, CA: Jossey-Bass.

Mertler, C. A., & Vannatta, R. A. (2013). *Advanced and multivariate statistical methods: Practical application and interpretation* (5 ed). Glendale, CA: Pyrczak Publishing.

Michie, S., Abraham, C., Whittington, C., & McAteer, J. (2009). Effective techniques in healthy eating and physical activity interventions: A meta-regression. *Health Psychology, 28*, 690-701.

Michielutte, R., Bahnson, J., Dignan, M. B., & Schroeder, E. M. (1992). The use of illustrations and narrative text style to improve readability of a health education brochure. *Journal of Cancer Education, 7*, 251-260. doi: 10.1080/08858199209528176

Moerenhout, T., Borgermans, L., Schol, S., Vansintejan, J., Van De Vijver, E., & Devroey, D. (2013). Patient health information materials in waiting rooms of family physicians: Do patients care? *Patient preference and adherence, 7*.

Moore, L.V., Harris, C. D., Carlson, S. A., Kruger, J., & Fulton, J. E. (2012). Trends in no leisure-time physical activity—United States, 1988-2010. *Research Quarterly for Exercise and Sport, 83*, 587-591. doi: 10.1080/02701367.2012.10599884

Moore, L. V., Fulton, J., Kruger, J. E., & McDivitt, J. (2010). Knowledge of physical activity guidelines among adults in the United States, HealthStyles 2003- 2005. *Journal of Physical Activity and Health, 7*, 141–149. http://journals.humankinetics.com/doi/abs/10.1123/jpah.7.2.141

Morris, S. L., Dodd, K. J., & Morris, M. E. (2004). Outcomes of progressive resistance strength training following stroke: A systematic review. *Clinical Rehabilitation, 18*, 27–39. https://doi.org/10.1191/0269215504cr699oa

Morony, S., Flynn, M., McCaffery, K. J., Jansen, J., & Webster, A. C. (2015). Readability of written materials for CKD patients: A systematic review. *American Journal of Kidney Disease, 65*, 842-850. doi: 10.1053/j.ajkd.2014.11.025

Morrow, J. R., Krzewinski-Malone, J. A., Jackson, A. W., Bungum, T. J., & Fitzgerald, S. J. (2004). American adults' knowledge of exercise recommendations. *Research Quarterly for Exercise and Sport, 75*, 231–237. https://doi.org/10.1080/02701367.2004.10609156

Murphy, P. W., Chesson, A. L., Berman, S. A., Arnold, C. L., & Galloway, G. (2001). Neurology patient education materials: Do our educational aids fit our patient's needs? *Journal of Neuroscience Nursing, 33*, 99-104. Retrieved from https://journals.lww.com/jnnonline/Abstract/2001/04000/Neurology_Patient_Education_Materials__Do_Our.6.aspx

Mozilla.org. (2019, March 18). What is the difference between webpage, website, web server, and search engine? Retrieved from https://developer.mozilla.org/en-US/docs/Learn/Common_questions/Pages_sites_servers_and_search_engines

Naci, H., & Ioannidis, J. P. A. (2013). Comparative effectiveness and drug interventions on mortality outcomes: Metaepidemiological study. *British Medical Journal, 347*. https://doi.org/10.1136/bmj.f5577

Nery, M. B., Driver, S., & Vanderbom, K. A. (2013). Systematic framework to classify the status of research on spinal cord injury and physical activity. *Archives of Physical Medicine and Rehabilitation, 94,* 2027–2031. https://doi.org/10.1016/j.apmr.2013.04.016

Neuhauser, L., Ivey, S. L., Huang, D., Engelman, A., Tseng, W., Dahrouge, D., … Kealey, M. (2013). Availability and readability of emergency preparedness materials for deaf and hard-of-hearing and older adult populations: Issues and assessments. *PLOS ONE, 8*. https://doi.org/10.1371/journal.pone.0055614

Neupert, P., & Mundie, C. (2009). Personal health management systems: Applying the full power of software to improve the quality and efficiency of care. *Health Affairs, 28*, 390-392. doi:10.1377/hlthaff.28.2.390

Nielsen-Bohlman, L., Panzer, A., & Kindig, D. (2004). *Health literacy: A prescription to end confusion*. Washington, D.C.: Institute of Medicine, National Academies Press. Retrieved from https://www.nap.edu/read/10883/chapter/1

Nigg, C. R., Borrelli, B., Maddock, J., & Dishman, R. K. (2008). A theory of physical activity maintenance. *Applied Psychology, 57,* 544-560. https://doi.org/10.1111/j.1464-0597.2008.00343.x

Nijland, N., van Gemert-Pijnen, J., Boer, H., Steehouder, M. F., & Seydel, E. R. (2008). Evaluation of internet-based technology for supporting self-care: Problems encountered by patients and caregivers when using self-care applications. *Journal of Medical Internet Research, 10*. https://doi.org/10.2196/jmir.957

Ogilvie, D., Hamilton, V., Egan, M., & Petticrew, M. (2005). Systematic reviews of health effects of social interventions: 1. Finding the evidence: how far should you go? *Journal of Epidemiology and Community Health, 59,* 804-808. doi: 10.1136/jech.2005.034181

O'Grady, L. (2006). Future directions for depicting credibility in health care web sites. *International Journal of Medical Informatics, 75,* 58-65. doi: 10.1016/j.ijmedinf.2005.07.035

Osborn, C. Y., Paasche-Orlow, M. K., Bailey, S. C., & Wolf, M. S. (2011). The mechanisms linking health literacy to behavior and health status. *American Journal of Health Behavior, 35,* 118–128. https://doi.org/10.5993/AJHB.35.1.11

Owen, N., Sparling, P. B., Healy, G. N., Dunstan, D. W., & Matthews, C. E. (2010). Sedentary behavior: Emerging evidence for a new health risk. *Mayo Clinic Proceedings, 85,* 1138-1141. doi:10.4065/mcp.2010.0444

Pan, B., Hembrooke, H., Joachims, T., Lorigo, L., Gay, G., & Granka, L. (2007). In Google we trust: User's decisions on rank, position, and relevance. *Journal of Computer-Mediated Communication, 12,* 801-823. doi:10.1111/j.1083-6101.2007.00351.x

Pallant, J. (2016). One-way analysis of variance. In *SPSS survival manual: A step by step guide to data analysis using IBM SPSS* (6 ed, pp. 255-270). New York, NY: McGraw-Hill Education.

Park, R.J. (2011). Historical reflections on diet, exercise, and obesity: The recurring need to "put words into action." *Canadian Bulletin of Medical Humanities, 28*, 383–401.

Petticrew, M., & Roberts, H. (2006). Why do we need systematic reviews? In *Systematic reviews in the social sciences: A practical guide* (pp.1-26) Malden, MA: Blackwell Publishing. Retrieved from https://www.Google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=7&ved=0ahUKEwilpd3T_rHaAhUl6YMKHQ_wDHgQFghPMAY&url=http%3A%2F%2Fxa.yimg.com%2Fkq%2Fgroups%2F18751725%2F462617161%2Fname%2Fmanalysis.pdf&usg=AOvVaw2lOwG--FN9HPCE5jqfEPyF

Physical Activity Guidelines Advisory Committee. (2018). *2018 Physical Activity Guidelines Advisory Committee Scientific Report*. Washington, DC: U.S. Department of Health and Human Services. Retrieved from https://health.gov/paguidelines/second-edition/report.aspx

Pignone, M., DeWalt, D. A., Sheridan, S., Berkman, N., Lohr, K. N. (2005). Interventions to improve health outcomes for patients with low literacy: A systematic review. *Journal of General Internal Medicine, 20*, 185-192. doi: 10.1111/j.1525-1497.2005.40208.x

Pituch, K. A., & Stevens, J. P. (2016). *Applied multivariate statistics for the social sciences: Analyses with SAS and IMB's SPSS* (6 ed). New York, NY: Routledge.

Post, R. E., & Mainous, A. G. (2010). The accuracy of nutrition information on the Internet for type 2 diabetes. *Archives of Internal Medicine, 170*, 1504-1506. doi: 10.1001/archinternmed.2010.289

Poushter, J. (2015). *Smartphone ownership and Internet usage continues to climb in emerging economies: But advanced economies still have higher rates of technology use*. Washington, DC: Pew Research Center. http://www.pewglobal.org/2016/02/22/smartphone-ownership-and-internet-usage-continues-to-climb-in-emerging-economies/

Powers, R. D. (1988). Emergency department patient literacy and the readability of patient-directed materials. *Annals of Emergency Medicine, 17*(2), 124-126. https://doi.org/10.1016/S0196-0644(88)80295-6

Pratt, M., Norris, J., Lobelo, F., Roux, L., & Wang, G. (2014). The cost of physical inactivity: Moving into the 21st century. *British Journal of Sports Medicine, 48*, 171-173. doi: 10.1136/bjsports-2012-091810

Prestin, A., Vieux, S. N., & Chou, W-Y. S. (2015). Is online health activity alive and well or flatlining? Findings from 10 years of the Health Information National Trends Survey. *Journal of Health Communication, 20*, 790-798. https://doi.org/10.1080/10810730.2015.1018590

Public Health Agency of Canada. (2010). *Presentation: Results from the PHAC consolations*.

Purcell, K., Brenner, J., & Rainie, L. (2012). *Search engine use 2012*. Washington, DC: Pew Internet & American Life Project. Retrieved from http://www.pewinternet.org/files/old-media/Files/Reports/2012/PIP_Search_Engine_Use_2012.pdf

Ramanadhan, S., Crisostomo, J., Alexander-Molloy, J., Gandelman, E., Grullon, M., Lora, V., … Viswanath, K. (2012). Perceptions of evidence-based programs among community-based organizations tackling health disparities: A qualitative study. *Health Education Research*, 27, 717–728. http://doi.org/10.1093/her/cyr088

Random.org. (2019). *Analysis*. Retrieved from https://www.random.org/analysis/

Redmond, T. L. (2008). *Electronic (digital) health information competency*: *A comparative analysis of knowledge and skills of rural and non-rural freshman college students* (Doctoral dissertation). Retrieved from *ProQuest*. Retrieved from https://search.proquest.com/docview/304838234

Reed-Pierce, R., & Cardinal, B. J. (1996). Readability of patient education resources. *JNMS: Journal of the Neuromusculoskeletal System, 4*, 8–11.

Rhodes, R., & Pfaeffli, L. (2010). Mediators of physical activity behavior change among adult non-clinical populations: A review update. *International Journal of Behavioral Nutrition and Physical Activity, 7*, 37-48.

Richardson, J. T. E. (2011). Eta squared and partial eta squared as measures of effect size in educational research. *Educational Research Review, 6*, 135-147. doi:10.1016/j.edurev.2010.12.001

Riffe, D., Lacy, S., & Fico, F. (2014). Reliability. In *Analyzing media messages: Using quantitative content analysis in research* (3 ed, pp 94-122). New York, NY: Routledge.

Risk, A., & Dzenowagis, J. (2001). Review of Internet health information quality initiatives. *Journal of Medical Internet Research, 3*. http://www.jmir.org/2001/4/e28

Rosal, M. C., Ockene, I. S., Restrepo, A., White, M. J., Borg, A., Olendzki, B…Reed, G. (2011). Randomized trial of a literacy-sensitive, culturally tailored diabetes self-management intervention for low-income Latinos. *Diabetes Care, 34*, 838-844. doi: 10.2337/dc10-1981

Rothman, A. J., Bartels, R. D., Wlaschin, J., & Salovey, P. (2006). The strategic use of gain-and loss-framed messages to promote healthy behavior: How theory can inform practice. *Journal of Communication, 56*(suppl_1), S202-S220. doi: 10.1111/j.1460-2466.2006.00290.x

Rudd, R. E., Comings, J. P., & Hyde, J. N. (2003). Leave no one behind: Improving health and risk communication through attention to literacy. *Journal of Health Communication, 8*(Suppl.), 104–115. https://doi.org/10.1080/713851983

Rudd, R. E., Moeykens, B. A., Colton, T. C. (1999). Health literacy: A review of medical and public health literature. *Review of Adult Learning and Literacy, 1*. http://www.ncsall.net/?id=522

Ryan, L., Logsdon, M. C., McGill, S., Stikes, R., Senior, B., Helinger, B., … Davis, D. W. (2014). Evaluation of printed health education materials for use by low-education families: Suitability and readability of materials. *Journal of Nursing Scholarship, 46*, 218–228. https://doi.org/10.1111/jnu.12076

Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annual*

Review of Public Health, *27*, 297-322. doi: 10.1146/annurev.publhealth.27.021405.102100

Sallis, J. F., Owen, N., & Fotheringham, M. J. (2000). Behavioral epidemiology: A systematic framework to classify phases of research on health promotion and disease prevention. *Annals of Behavioral Medicine*, *22*, 294–298. https://doi.org/10.1007/BF02895665

Samoocha, D., Bruinvels, D. J., Elbers, N. A., Anema, J. R., & van der Beek, A. J. (2010). Effectiveness of web-based interventions on patient empowerment: A systematic review and meta-analysis. *Journal of Medical Internet Research, 1*2. doi: 10.2196/jmir.1286

Sassenberg, K. (2017). Digital media as laypeople's source of information about the environment and health. *Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz*, *60*, 649–655. https://doi.org/10.1007/s00103-017-2549-2

Schary, D. P., & Cardinal, B. J. (2015). Interdisciplinary and intradisciplinary research and teaching in kinesiology: Continuing the conversation. *Quest, 67,* 173-184. doi: 10.1080/00336297.2015.1017586

Schary, D. P., & Cardinal, B. J. (2016). Interdisciplinary publication patterns in select kinesiology journals. *Journal of Contemporary Athletics, 10*(2), 103-117.

Seitz, C. M., Shiplo, S., Filippini, T., Kabir, Z., Lennon, J. L., & Fowler, D. (2017). The reading level of government and voluntary health organization smoking cessation websites: A descriptive analysis. *American Journal of Health Education, 48,* 392-399. doi: 10.1080/19325037.2017.1358122

Shirazipour, C. H., Baillie, C. P., Galaviz, K., Jarvis, J. W., & Latimer-Cheung, A. E. (2015). Evaluating the theoretical content of online physical activity information for people with multiple sclerosis. *International Journal of MS Care, 17*, 91-100. https://doi.org/10.7224/1537-2073.2013-048

Schoo, A., Lawn, S., & Carson, D. (2016). Towards equity and sustainability of rural and remote health services access: supporting social capital and integrated organisational and professional development. *BMC Health Services Research*, *16*. https://doi.org/10.1186/s12913-016-1359-9

Schrank, B., Sibitz, I., Unger, A., & Amerin, M. (2010). How patients with schizophrenia use the Internet: qualitative study. *Journal of Medical Internet Research*, *12*. http://dx.doi.org/10.2196/jmir.1550

Schur, C. L., Lucado, J. L., & Feldman, J. (2011). Local public health capacities to address the needs of culturally and linguistically diverse populations. *Journal of Public Health Management and Practice*, *17*, 177-186. doi:10.1097/PHH.0b013e3181fb0037

Sheridan, S. L., Halpern, D. J., Viera, A. J., Berkman, N. D., Donahue, K. E., & Crotty, K. (2011). Interventions for individuals with low health literacy: A systematic review. *Journal of Health Communication*, *16*(Suppl. 3), 30–54. https://doi.org/10.1080/10810730.2011.604391

Shieh, C., & Hosei, B. (2008). Printed health information materials: Evaluation of readability and suitability. *Journal of Community Health Nursing, 25*, 73-90. doi: 10.1080/07370010802017083

Shi, H-J., Nakamura, K., & Takano, T. (2004). Health values and health-information seeking in relation to positive change of health practice among middle-aged urban men. *Preventive Medicine, 39,* 1164-1171. doi:10.1016/j.ypmed.2004.04.030

Shoemaker, S. J., Wolf, M. S., & Brach, C. (2014). Development of the patient education materials assessment tool (PEMAT): A new measure of understandability and actionability for print and audiovisual patient information. *Patient Education and Counseling, 96,* 395-403. https://doi.org/10.1016/j.pec.2014.05.027

Silberg, W. M., Lundberg, G. D., & Musacchio, R. A. (1997). Assessing, controlling, and assuring the quality of medical information on the Internet: Caveant lector et viewor—Let the reader and viewer beware. *Journal of the American Medical Association, 277,* 1244-1245. doi:10.1001/jama.1997.03540390074039

Simonds, V. W., Rudd, R. E., Sequist, T. D., & Colditz, G. (2011). An assessment of printed diabetes-prevention materials available to a Northern Plains tribe. *Journal of Health Communication, 16,* 431-447. https://doi.org/10.1080/10810730.2010.546482

Smith, M., Morita, H., Mateo, K. F., Nye, A., Hutchinson, C., & Cohall, A. T. (2014). Development of a culturally relevant consumer health information website for Harlem, New York. *Health Promotion Practice, 15,* 664-674. doi: 10.1177/1524839914530401Snyman, M., & Penzhorn, C. (2007). An investigation into the processes used in the production of printed health messages in South Africa. *Communicare: Journal for Communication Sciences in Southern Africa, 26,* 59-73. http://hdl.handle.net/10520/EJC27701

Sørensen, K., Van den Broucke, S., Fullam, J., Doyle, G., Pelikan, J., Slonska, Z.…for (HLS-EU) Consortium Health Literacy Project European. (2012). Health literacy and public health: A systematic review and integrations of definitions and models. *BMJ Public Health, 12*. https://doi.org/10.1186/1471-2458-12-80

SocialStatistics.com (2019). *"Effect size calculator for t-test."* Retrieved from https://www.socscistatistics.com/effectsize/Default3.aspx

Squiers, L., Peinado, S., Berkman, N., Boudewyns, V., & McCormack, L. (2012). The health literacy skills framework. *Journal of Health Communication, 17*(sup3), 30–54. https://doi.org/10.1080/10810730.2012.713442

Stacey, F. G., James, E. L., Chapman, K., Courneya, K. S., & Lubans, D. R. (2015). A systematic review and meta-analysis of social cognitive theory-based physical activity and/or nutrition behavior change interventions for cancer survivors. *Journal of Cancer Survivorship, 9,* 305–338. https://doi.org/10.1007/s11764-014-0413-z

Stamm, C. L., & Safrit, M. J. (1975). Comparison of significance tests for repeated measures ANOVA design. *Research Quarterly, 46,* 403-409. https://doi.org/10.1080/10671315.1975.10616696

Stellefson, M., Hanik, B., Chaney, B., Chaney, D., Tennant, B., & Chavarria, E. A. (2011). eHealth literacy among college students: A systematic review with implications for eHealth education. *Journal of Medical Internet Research, 13.* http://doi.org/10.2196/jmir.1703

Stephens, K. K., Goins, E. S., & Dailey, S. L. (2014). Organizations disseminating health messages: The roles of organizational identification and HITs. *Health Communication, 29,* 398–409. https://doi.org/10.1080/10410236.2012.759896

Support.Office.com. (2018, n.d.). Find and remove duplicates. Retrieved from https://support.office.com/en-us/article/find-and-remove-duplicates-00e35bea-b46a-4d5d-b28e-66a552dc138d

Sweet, S. N., Brawley, L. R., Hatchell, A., Gainforth, H. L., & Latimer-Cheung, A. E. (2014). Can persuasive messages encourage individuals to create action plans for physical activity? *Journal of Sport & Exercise Psychology*, *36*, 413-423. http://dx.doi.org/10.1123/jsep.2013-0218

Tabachnick, B. G., & Fidell, L. S. (2019). *Using multivariate statistics* (7 ed). New York, NY: Pearson.

Taggart, J., Williams, A., Dennis, S., Newall, A., Shortus, T., Zwar, N., … Harris, M. F. (2012). A systematic review of interventions in primary care to improve health literacy for chronic disease behavioral risk factors. *BMC Family Practice*, *13*, https://doi.org/10.1186/1471-2296-13-49

Tagtow, A. M., & Amos, R. J. (2000). Extent to which dietitians evaluate nutrition education materials. *Journal of Nutrition Education*, *32*, 161-168. https://doi.org/10.1016/S0022-3182(00)70544-9

Taylor, N. F., Dodd, K. J., Shields, N., & Bruder, A. (2007). Therapeutic exercise in physiotherapy practice is beneficial: A summary of systematic reviews 2002-2005. *Australian Journal of Physiotherapy*, *53*, 7–16. https://doi.org/10.1016/S0004-9514(07)70057-0

Taylor-Clarke, K., Henry-Okafor, Q., Murphy, C., Keyes, M., Rothman, R., Churchwell, A…Sampson, U. K. A. (2012). Assessment of commonly available educational materials in heart failure clinics. *Journal of Cardiovascular Nursing*, *27*, 485-494. doi: 10.1097/JCN.0b013e318220720c

Thomas, J. J. (1999). Enhancing patient education: Addressing the issue of literacy. *Physical Disabilities Special Interest Section Quarterly*, *22*, 3-4.

Thomas, J. D., & Cardinal, B. J. (2018). Gibberish in communicating written physical activity information: Making strides at derailing a perpetual problem. *Sociology of Sport Journal*, *35*, 108-118. https://doi.org/10.1123/ssj.2017-0181

Thomas, J. D., Flay, B. R., & Cardinal, B. J. (2018). Are physical activity resources understandable as disseminated? A meta-analysis of readability studies. *Quest*, *70*, 492-518. https://doi.org/10.1080/00336297.2018.1463269

Thomas, J. D., VanNess, J. M, & Cardinal, B. J. (2016). Physical fitness and self-image: An evaluation of the exercise self-schema questionnaire using direct measures of physical fitness. *International Journal of Exercise Science*, *9*, 445-459. http://digitalcommons.wku.edu/ijes/vol9/iss4/7/

Thomas, J. R., Nelson, J. K., & Sliverman, S. J. (2011). *Research methods in physical activity* (6 ed). Champaign, IL: Human Kinetics.

Tian, C., Champlin, S., Mackert, M., Lazard, A., & Agrawal, D. (2014). Readability, suitability, and health content assessment of web-based patient education materials on colorectal cancer screening. *Gastrointestinal Endoscopy*, *80*. 284-290. doi: 10.1016/j.gie.2014.01.034

Tran, B. N. N., Singh, M., Singhal, D., Rudd, R., Lee, B. T. (2017). Readability, complexity, and suitability of online resources for mastectomy and lumpectomy.

Journal of Surgical Research, 212, 214-221. http://dx.doi.org/10.1016/j.jss.2017.01.012

Tristani, L. K., Bassett-Gunter, R., & Tanna, S. (2017). Evaluating Internet-based information on physical activity for children and youth with physical disabilities. *Adapted Physical Activity Quarterly, 34*, 55-71. doi: 10.1123/APAQ.2016-0012

Ulrich, B. D. (2011). Bridging kinesiology and society: Introduction. *Quest, 63*, 1-4. https://doi.org/10.1080/00336297.2011.10483658

U.S. Department of Health and Human Services. Centers for Medicare & Medicaid Services. (2012, March 16). *Toolkit for making written materials clear and effective*. Retrieved from https://www.cms.gov/Outreach-and-Education/Outreach/WrittenMaterialsToolkit/index.html

U.S. Department of Health and Human Services. (2017, January 26). *Facts & statistics: Physical activity*. Retrieved from https://www.hhs.gov/fitness/resource-center/facts-and-statistics/index.html

U.S. Department of Health and Human Services. (2002). *Physical activity fundamental to preventing disease*. Washington, D.C. Office of the Assistant Secretary for Planning and Evaluation. Retrieved from https://aspe.hhs.gov/system/files/pdf/72836/physicalactivity.pdf

U.S. Department of Health and Human Services. (2018). Physical activity guidelines for all Americans (2nd ed). Washington, D.C. Retrieved from https://health.gov/paguidelines/second-edition/

U.S. National Cancer Institute. Office of Cancer Communications. (1989). *Making health communication programs work: A planner's guide*. Darby, PA: Diane Publishing.

Vallance, J. K., Courneya, K. S., Plotnikoff, R. C., Yasui, Y., & Mackey, J. R. (2007). Randomized controlled trial of the effects of print resources and step pedometers on physical activity and quality of life in breast cancer survivors. *Journal of Clinical Oncology, 25*, 2352–2359. doi: 10.1200/JCO.2006.07.9988

Vallance, J., Lesniak, S. L., Belanger, L. J., & Courneya, K. S. (2010). Development and assessment of a physical activity guidebook for the Colon Health and Life-Long Exercise Change (CHALLENGE) trial (NCIC CO.21). *Journal of Physical Activity and Health, 7*, 794-801. doi: 10.1123/jpah.7.6.794

Vallance, J. K., Taylor, L. M., & Lavallee, C. (2008). Suitability and readability assessment of educational print resources related to physical activity: Implications and recommendations for practice. *Patient Education and Counseling, 72*, 342–349. https://doi.org/10.1016/j.pec.2008.03.010

Vandelanotte, C., Kirwan, M., Rebar, A., Alley, S., Short, C., Fallon, L…Duncan, M. J. (2014). Examining the use of evidence-based and social media supported tools in freely accessible physical activity intervention websites. *International Journal of Behavioral Nutrition and Physical Activity, 11*. https://doi.org/10.1186/s12966-014-0105-0

Vanderbom, K. A., Driver, S., & Nery-Hurwit, M. (2014). A systematic framework to classify physical activity research for individuals with spina bifida. *Disability and Health Journal, 7*, 36–41. https://doi.org/10.1016/j.dhjo.2013.09.002

van der Vaart, R., Drossaert, C. H., de Heus, M., Taal, E., & van de Laar, M. A. (2013). Measuring actual eHealth literacy among patients with rheumatic diseases: A

qualitative analysis of problems encountered using Health 1.0 and Health 2.0 applications. *Journal of Medical Internet Research, 15*. https://doi.org/10.2196/jmir.2428

Vaske, J. J., Gliner, J. A., & Morgan, G. A. (2002). Communicating judgments about practical significance: Effect size, confidence intervals and odds ratios. *Human Dimensions of Wildlife, 7*, 287–300. https://doi.org/10.1080/10871200214752

Vaughan, J. L. (1976). Interpreting readability assessments. *Journal of Reading, 19*, 635–639.

Wallace, L. S., Bielak, K., & Linn, B. (2010). Are English-language pedometer instructions readable? *Journal of Physical Activity and Health, 7*, 375–380. doi:10.1123/jpah.7.3.375

Walsh, T. M., & Volsko, T. A. (2008). Readability assessment of internet-based consumer health information. *Respiratory Care*, *53*(10), 1310-1315.

Wang, L. W., Miller, M. J., Schmitt, M. R., & Wen, F. K. (2013). Assessing readability formula differences with written health information resources: Application, results, and recommendations. *Research in Social and Administrative Pharmacy*, *9*, 503–516. https://doi.org/10.1016/j.sapharm.2012.05.009

Wantland, D. J., Portillo, C. J., Holzemer, W. L., Slaughter, R., & McGhee, E. M. (2004). The effectiveness of Web-based vs. non-Web-based interventions: A meta-analysis of behavioral change outcomes. *Journal of Medical Internet Research*, *6*. doi: 10.2196/jmir.6.4.e40

Warburton, D. E. R., Nicol, C. W., & Bredin, S. S. D. (2006). Health benefits of physical activity: The evidence. *Canadian Medical Association Journal*, *174*, 801-809. https://doi.org/10.1503/cmaj.051351

Wardle, J. (2000). Public health psychology: Expanding the horizons of health psychology. *British Journal of Health Psychology*, *5*, 329-336.

Warner, D., & Procaccino, J. D. (2004). Toward wellness: Women seeking health information. *Journal of the Association for Information Science and Technology*, *55*, 709-730. doi:10.1002/asi.20016

Webb, T., Joseph, J., Yardley, L., & Michie, S. (2010). Using the internet to promote health behavior change: A systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy. *Journal of Medical Internet Research, 12*. doi: 10.2196/jmir.1376

Weiss, B. D. (1998). Communicating with patients who have limited literacy skills: Report of the national work group on literacy and health. *Journal of Family Practice*, *46*(2), 168-176. PMID:9487325

Wen, C. P., Wai, J. P. M., Tsai, M. K., Yang, Y. C., Cheng, T. Y. D., Lee, M. C., ... & Wu, X. (2011). Minimum amount of physical activity for reduced mortality and extended life expectancy: A prospective cohort study. *The Lancet*, *378*, 1244-1253. https://doi.org/10.1016/S0140-6736(11)60749-6

Wiecha, J., & Pollard, T. (2004). The Interdisciplinary eHealth Team: Chronic Care for the Future. *Journal of Medical Internet Research, 6*. doi:10.2196/jmir.6.3.e22

Williams, P. (2005). Consumer understanding and use of health claims for foods. *Nutrition reviews, 63*, 256-264. doi:10.1111/j.1753-4887.2005.tb00382.x

Williams, S. L., & French, D. P. (2011). What are the most effective interventions techniques for changing physical activity self-efficacy and physical activity behavior – and are they the same? *Health Education Research, 26*, 308-322.

Williams, A. M., Muir, K. W., & Rosdahl, J. A. (2016). Readability of patient education materials in ophthalmology: A single-institution study and systematic review. *BMC Ophthalmology*, *16*. doi: 10.1186/s12886-016-0315-0

Williamson, J. M. L., & Martin, A. G. (2010). Analysis of patient information leaflets provided by a district general hospital by the Flesch and Flesch–Kincaid method. *International Journal of Clinical Practice*, *64*, 1824–1831. doi: 10.1111/j.1742-1241.2010.02408.x

Wilson, F. L., Mood, D., & Nordstrom, C. K. (2010). The influence of easy-to-read pamphlets about self-care management of radiation side effects on patients' knowledge. *Oncology Nursing Forum*, *37*, 774–781. doi: 10.1188/10.ONF.774-781

Wilson, P. (2002). How to find the good and avoid the bad or ugly: A short guide to tools for rating quality of health information on the Internet. *British Medical Journal*, *324*, 598-602.

Winterbottom, A., Conner, M., Mooney, A., & Bekker, H. L. (2007). Evaluating the quality of patient leaflets about renal replacement therapy across UK renal units. *Nephrology Dialysis Transplantation*, *22*, 2291-2296. doi: 10.1093/ndt/gfm095

World Health Organization (2018, February). Physical activity: Fact sheet. Retrieved from http://www.who.int/mediacentre/factsheets/fs385/en/

Wyatt, J. C. (1997). Commentary: Measuring quality and impact of the world wide web. *British Medical Journal*, *314*, 1879-1879. https://doi.org/10.1136/bmj.314.7098.1879

Zenko, Z., & Ekkekakis, P. (2015). Knowledge of exercise prescription guidelines among certified exercise professionals. *The Journal of Strength & Conditioning Research*, *29*, 1422-1432. doi: 10.1519/JSC.0000000000000771

Zhang, Y. (2014). Beyond quality and accessibility: Source selection in consumer health information searching. *Journal of the Association for Information Science and Technology*, *65*, 911–927. https://doi.org/10.1002/asi.23023

Zhang, Y., Sun, Y., & Xie, B. (2015). Quality of health information for consumers on the web: A systematic review of indicators, criteria tools and evaluation results. *Journal of the Association for Information Science and Technology*, *66*, 2071-2084. https://doi.org/10.1002/asi.23311

Zhu, W. (1994). Bootstrap estimation of a population's physical fitness status using small samples. *Medicine and Science in Sports and Exercise*, *26*(Suppl. 5), S217. (Abstract No. 1225). Retrieved from https://journals.lww.com/acsm-msse/Citation/1994/05001/1225_BOOTSTRAP_ESTIMATION_OF_A_POPULATION_S.1227.aspx

Zhu, W. (1997). Making bootstrap statistical inferences: A tutorial. *Research Quarterly for Exercise and Sport*, *68*, 44-55. https://doi.org/10.1080/02701367.1997.10608865

Zun, L. S., Downey, L., & Brown, S. (2011). Completeness and accuracy of emergency medical information on the web: Update 2008. *Western Journal of Emergency Medicine*, *12*, 448–454. https://doi.org/10.5811/westjem.2010.10.1607

APPENDICES

Appendix 1. List of terms and organizations used to locate potential study samples

	Search Term Combinations for the Google Search Engine	
Query	**Query Subject**	**Query Goal or Aim**
1.	active	(ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")
2.	exercise* OR (good AND exercise*)	(ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")
3.	(cardio AND exercise*) OR (good AND cardio AND exercise*)	(benefits OR ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")
4.	(core AND exercise*) OR (good AND core AND exercise*)	(benefits OR ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")
5.	(core AND training) OR (good AND core AND training AND exercise*)	(benefits OR ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")
6.	exercise* OR (good AND exercise*)	(benefits OR ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")
7.	fitness	(benefits OR ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")
8.	(fitness AND exercise*) OR (good AND fitness AND exercise*)	(ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")
9.	(gym AND exercise*) OR (good AND gym AND exercise*)	(benefits OR ideas OR recommendations OR routines OR suggestions OR tips OR "workout plan*")
10.	(home AND exercise*) OR (good AND home AND exercise*)	(benefits OR ideas OR recommendations OR routines OR suggestions OR tips OR "workout plan*")
11.	exercise* AND (running OR jogging)	(benefits OR ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")
12.	(good AND running AND exercise*) OR (good AND jogging AND exercise*)	(benefits OR ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")
13.	(strength AND training) OR ("strength training" AND exercises)	(benefits OR ideas OR routines OR suggestions OR tips OR "workout plan*")
14.	walking OR (good AND walking)	(benefits OR ideas OR recommendations OR routines OR suggestions OR tips OR "workout plan*")

15.	weightlifting OR (good AND weightlifting)	(benefits OR ideas OR routines OR suggestions OR tips OR "workout plan*")
16.	("weight training") OR (good AND "weight training")	(benefit* OR ideas OR routines OR suggestions OR tips OR "workout plan*")
17.	(good AND exercises) (weightlifting OR "weight training")	(ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")
18.	("weight loss" And exercise*) OR (good AND "weight loss" AND exercise*)	(ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")
19.	(good AND yoga) OR (good AND yoga AND exercise*)	(ideas OR recommendation OR routines OR suggestions OR tips OR "workout plan*")

Type	Organization Name	No.
Commercial	Active.com	
	e-How	
	Fitness Magazine	
	LiveStrong.Com	
	Prevention.com	
	Men's Health Magazine	
	Self Magazine	
	Women's Health Magazine	
	WebMD	
Federal Government		
	https://healthfinder.gov/	
	Centers for Disease Control and Prevention	
	National Heart, Lung and Blood Institute	
	National Aging Institute	
	National Cancer Institute	
	Office of Disease Prevention and Health Promotion	
	Department of Health and Human Services	
	National Institute of Diabetes and Digestive and Kidney Diseases	
Voluntary Health Agency	Mayo Clinic	
	The Arthritis Foundation	
	Helpguide.Org	

	American Association of Retired Persons	
	EatRight.Org	
	Kaiser Permanente	
	American Cancer Society	
	American Diabetes Association	
	American Heart Association	
Professional Associations	American College of Rheumatology	
	American Association of Family Physicians	
	American College of Sports Medicine	
	American Council on Exercise	

Appendix 2. Coding Form for Physical Activity Guidelines

Code Sheet: 2008 Adult (18-64 years of age) PA Guidelines Consistency

Date:_____ Sample #: _____
Targets: Older Adult or Pregnant (Expecting) Women? □ NO □ YES.
Coder Initials: _____

Directions
Notice: If targets older adults or women who are pregnant or expecting to become pregnant, **Do NOT code**. Mark "Yes" in identifier section above, then move to next sample.

For the entire document, see if at least **one** message **consistent** with each of the 17 items. Read carefully.
After you read the entire document, fill in blank rows with zeros.

Reminders

- A "**Yes**" means the message **explicitly** and **fully** matches the item. It does not have to be verbatim. It must **NOT** add different information.
- **Partially Consistent Example:** "Do at least 5 to 10-minute exercise." This is **NOT** fully consistent with item 4. Do **NOT** code as a "yes."
- **Inconsistent Example**, "Do at least 300 minutes/week of moderate exercise to lose weight." This does **NOT** match items 8-9. Weight-loss is **NOT** stated to be as an "additional benefit." Do **NOT** code as a "yes."

The below items **apply** to: advice, encouragements, instructions, prompts, recommendations, suggestions.

	Items	**0** No	**1** Yes
	Aerobic (endurance) PA Guidelines		
1.	Attain 150 minutes (or 2 hours and 30 minutes) a week of moderate-intensity aerobic physical activity.		
2.	Attain 75 minutes (or 1 hour and 15 minutes) a week of vigorous-intensity aerobic activity.		
3.	Attain 75 minutes (or 1 hour and 15 minutes) a week of equivalent combination of moderate- and vigorous-intensity aerobic activity.		
4.	Perform aerobic activity in episodes of **at least** 10-minutes.		

5.	Preferably, aerobic activity should be spread throughout the week.	
6.	States aerobic activity should be done at least 3 days a week.	
7.	People gain health benefits even from 60 minutes a week of moderate-intensity aerobic activity.	

The below items **apply** to: advice, encouragements, instructions, prompts, recommendations, suggestions.

	Items	**0** No	**1** Yes
	States for Additional and More Extensive Health Benefits…		
8.	**Increase aerobic activity** to /**do** 300 minutes (or 5 hours) a week of moderate-intensity physical activity.		
9.	**Increase aerobic activity** to /**do** 150 minutes a week of vigorous-intensity physical activity? No = 0. Yes = 1.		
10.	**Increase aerobic activity** to /**do** 150 minutes a week of an equivalent combination of moderate- and vigorous-intensity physical activity? No = 0. Yes = 1.		
	Muscle-Strengthening PA Guidelines		
11.	Do moderate **OR** high intensity activity that involves **ALL** major muscle groups **ON** 2 or more days the week		
12.	Do at least **ONE** set of 8-12 repetitions of each exercise for muscle strengthening.		
	Inactive Adults PA Guidelines**		
	[Must be directed at Inactive Adults]****		
13.	Gradually work up to 150 minutes of physical activity.		
14.	Avoid inactivity [**AND**/**OR**] Any amount of physical activity is better than none.		
15.	**Initial** intensity should be light or moderate, for short periods of time, spread throughout the week.		
16.	Start with **1 day** a week of **light or moderate** level effort for **muscle-strengthening** activity.		
17.	Could slightly increase effort (intensity) until it becomes moderate to high.		

Appendix 3. Suitability Assessment of Materials Rating Form

Adapted Suitability Assessment of Materials Rating Form
Instructions to Ensure High Rater Reliability

1. Review categorical definitions presented in chapter 4 of *Suitability Assessment of Materials*.
2. When in doubt on the most appropriate category, default to a strict interpretation. That is, grade one level down.
    a. **Example.** 1d: "In Sentence Construction, Context is Given Before Information." If you feel context is given more than 50% of time but less than 95% of the time, select Adequate.

3. Categories that require $\geq$ x items for Superior.
    a. **First** place the items in Yes or No categories by number. **Example**. 4a "Layout." Y:1,4,5 N: 2,3,6,7,8.
    b. **Second** count the total items under Y and N. In the example, there are 3 items under Y and 6 under N.
    c. **Note** some items may not apply because medium is a computer screen (e.g., Nongloss paper used). Place NA items in the N-category.
    d. If the number of items meets the amount required for Superior, assign 2.

Reminders

1. Do NOT rate base on the quality of a message. If the message meets a requirement, categorize appropriately.
2. "Chunking" refers to information or instructions presented in bulleted format. If none are present, use N/A.
3. "Road signs" refers to subtitles that explicitly state a topic or purpose for a subsection. Subtitles that do not present information that explicitly relates to the focus of the subtext is not sign posting.

Date: _____. Sample #. _____. Coder Initials: _____.

Rating Categories: 2 = superior. 1 = adequate. 0 = not suitable. N/A_3 = does not apply (adjust total score).
Percent of Score: Mark to two significant figures. That is, 25.XX%
Note: Review Instruction on first page if you become unsure of how to code a category.

FACTORS TO BE RATED	**SCORE**	**COMMENTS**
1. CONTENT		
(a) Purpose is evident		

(b) Content is about behaviors	
(c) Scope is limited	
(d) Summary or review included	

Subtotal: _____/Subtotal possible /Percent: _____%

2. LITERACY DEMAND

(a) Reading grade level. SMOG =	
(b) Writing style, active voice	
(c) Vocabulary uses common words	
(d) In sentence construction, the context is given before new information	
(e) Learning aids via "road signs"	

Subtotal: /Subtotal possible: /Percent: _____%

3. GRAPHICS

(a) Cover graphics shows purpose	
(b) Type of graphics	
(c) Relevance of illustrations	
(d) List, tablets, etc. explained	
(e) Captions used graphics	

Subtotal: _____/Subtotal possible: /Percent: _____%

4. LAYOUT AND TYPOGRAPHY

(a) Layout factors Y: N	
(b) Typography Y: N	
(c) Subheading ("chunking") used	

Subtotal: _____/Subtotal possible: /Percent: _____%

5. LEARNING STIMULATIONS, MOTIVATION

(a) Interaction used	
(b) Behaviors are modeled and specific	
(c) Motivation—self-efficacy **to read and understand the text**	

Subtotal: _____/Subtotal possible: /Percent: _____% Document Suitability is _____

Total SAM score: Percent	
Total possible score:	_____

Appendix 4. CAATSPEC Coding Form

Tally of Recommended Psychological Constructs

Date:_____ Sample #: _____ Coder Initials: _____

Reminder: Categorize based on strict interpretations per code book indicators.

Categories	Talley	Totals
1. KNOWLEDGE-BASED INFORMATION		
(a) PA behavioral definitions		
(b) Presents specific statistics		
(c) **Informs** about a PA **recommendation** OR **suggestions** Does NOT Prompt. Does NOT present consequence. ****Make sure not a category 3 or 4 item****.		
(d) Presents **barrier** to PA/exercise: **no solution given** in message.		
(e) Presents advice to see **or** work with medical professional		
2. OUTCOME EXPECTATIONS		
(a) **Negative explicit outcome** for not doing exercise/PA **OR** due to very little activity per week (e.g., 30 minutes/week; inactive lifestyle).		
(b) **Positive explicit outcome** of doing PA/exercise		
(c) **Explicit health risks** of negative consequence **because of** PA/exercise: e.g., injury, death, pain, physical irritation. **No solution given** (see 4h).		

3. SELF-REGULATION		
(a) Encourage/prompt **to set <u>OR</u> strive toward** an exercise/PA **goal**		
(b) Encourage/prompt **to make a plan** to exercise OR do a physical activity		
(c) Encourage/prompt to **self-monitor** exercise/PA behavior		
(d) Encourage/prompt to **do OR think about other strategies to manage/overcome exercise/PA barrier** [**<u>Target barrier must be explicit</u>**]		
4. SELF-EFFICACY		
(a) **Text model** performing behavior **OR** cognitions via text: **an example OR a list of examples**		
(b) **Visual model** performing behavior **OR** cognitions: image OR video		
(c) Presents verbal (social) **persuasion**: e.g., "**you can do it**;" **don't worry**"		
(d) Presents a **vicarious experience**: similar other <u>persevering</u> OR <u>succeeding</u>.		
(e) Encourages/prompts **mastery experience**: graded, achievable task OR attempt		
(f) How to **get social support**: advice, suggestion, OR instructions		
(g) How to **perform an exercise/PA**: advice, suggestion, OR instructions		

(h) How to **avoid negative consequences <u>DUE</u>** to physical activity/exercise: That is, <u>advice, suggestion, OR instructions</u> **Examples**: injury, dehydration, fatigue, pain, physical irritation.		
(i) How to **increase exercise/PA** levels: **frequency**, **duration**, OR **intensity**		
Categories	**Talley**	**Totals**
5. **OTHER MESSAGES** (additional lines, popular category)		
Examples: titles; headings; site-use instructions; sentences that do not correspond with any of the non-other messages subcategories.		

Phase 2 Coding: Outcome Expectations

Categories	**Talley**		**Totals**
6. OUTCOME EXPECTATIONS			
(a) **Affective** outcome expectation (e.g., enjoyment, fear or pain)			
(b) **Instrumental** outcome expectation (e.g., weight loss/management, fitness, chronic disease (risk) management)			
(c) Both **affective and instrumental** outcome expectations			

Appendix 5. CAATSPEC Codebook

CAATSPEC-Based Code book

Draft v1.6

August 25, 2018

In Partial Fulfillment of Jafra D. Thomas' PhD Dissertation

Kinesiology Program, Oregon State University

Instructions to Ensure High Reliability

The **unit of analysis** is the sentence. Code line-by-line. **NOTE**: PA = exercise = sport in Codebook.

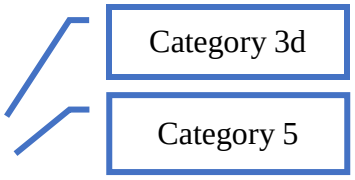
Excluded from the Content Analysis

- Text as part of pop-up banners.
- Text that appear in left and right task panes.
- Table of content information.

Lists and Bullet Points

- **Treat** listed information as **one** sentence, **except** when an apparently different message is introduced. See example below. New message = new sentence.
- *You can also work in walking when you:*

- Take the dog for a stroll through the neighborhood.
- Spend quality time with the family at the park.
- Park farther from your work place and use the stairs instead of the elevator.
- There's lots of ways to engage in it, Pate said.



Note: Remaining bullets may equal 1 sentence if points fall under one general idea or message.

Always **cross-reference** your decision with subcategory indicators**.** Especially if you come across a message that makes you question coding you did earlier in the article.

General Rules of Thumb

1. Titles and headings will be vague.
2. Vague statements will fall under the Other Messages category.
3. Two **different** categories could appear in the same sentence, **Except** for Other Messages.
4. **Comparative statements** will contain Positive and Negative outcome expectations simultaneously.

- **Example**: People who are physically active for about 7 hours a week have a lower risk of dying prematurely than those active less than 30 minutes a week. **Highlight** = negative outcome expectation.

Assigning to Non-other Categories (e.g., outcome expectations).

- Message must **explicitly** match categorical indicators.
- **Use strict interpretations**. If borderline, mark as other.
- Do NOT assign a subcategory to the same sentence more than once.

Counting Tallies

- Do NOT count tallies of the **same** subcategory back to back, **Except** for Category 6 (see below).
- **After** you mark a sentence for a category, **make a tally for that category.**

Category 6 is a follow-up analysis for Outcome Expectations.

- Perform this analysis after the entire document has been coded.

Category Indicators and Examples.

Knowledge-based Information

	Subcategory	Indicator	Example
1a	**PA definition(s)**	Definition of a physical activity **OR** of the term, "physical activity" **OR** about physical activity (e.g., moderate physical activity). **Count** examples following the introduction of a term.	*After term, MPA, an example is provided.* "…the good news is that **moderate-intensity aerobic activity**, like brisk walking, is generally **safe for most people**." *Definition following use of term, MPA.* "At this level, you should be able to talk, but not sing."
1b	**Statistics**	Presents statistics **using numerical values**. **Must be explicit**. **Double check the below conditions** **Code 2a** if sentence = chance of negative	*The below example presents statistical info (1b), a positive outcome to PA (2b) and a negative outcome to low PA (2c)* "People who are physically active for about 7 hours a week have a 40 percent [1b] lower risk of dying early [2b] than

		outcome + **<u>low</u>** PA behavior. **Code 2b** if **positive** outcome + PA in sentence **Code 2c** if **negative** outcome + PA in sentence **Code 1b + 2__** if numerical values presented and one of the above conditions are met for 2a b OR c.	those who are active for less than 30 minutes a week [2c]."
1c	**PA recommendations**	Iinforms about a <u>recommendation</u> or <u>suggestion</u> for physical activity behavior. **Does NOT explicitly** prompt or encourage reader to strive to meet a recommendation or suggestion (e.g., set a goal). **That would be 3a.** **Does NOT** advice or instruct… -how to do PA/exercise [that's 4g] -when to do PA/exercise [that's 3b] -How to change PA level [that's 4i]	"Even 60 minutes a week of moderate-intensity aerobic activity is good for you." ***Note**: This is also an example of what **NOT** to mark for 2b. Good = vague term.* *<u>Others are</u> Quality of life, Healthy, Fit* } *Vague* *To be marked as 2a/b/c, must **include <u>specific</u** outcome, emotion, or feeling (e.g., get stronger).*

1d	**PA barriers**	Informs about barrier(s) to physical activity **OR** a specific physical activity. Does **Not** provide suggestion/instruction to overcome/minimize barrier(s) **That would be 4h**.	Many adults find it difficult to make time for physical activity.
1e	**See/work with a medical professional**	Encourages reader to seek medical advice before performing a behavior change. Encourages reader to work medical professional to plan physical activity.	"Then, work with your doctor to come up with a physical activity plan that matches your abilities." *Messages like this do **NOT** meet criteria for goal setting [3a] or PA planning [3b]. Absent is explicit messages to try a PA. Or try or consider establishing a PA routine.*

Outcome Expectations

	Subcategory	Indicator	Example
2a	Negative consequences	Presents negative consequences to not engaging in a physical activity (e.g., exercise) **OR** physical activity in general (e.g., not meeting an authoritative recommendation) **OR** due to very little activity per week (e.g., 30 minutes/week).	
2b	Positive consequences	Presents positive consequences to engaging in a physical activity (e.g., exercise) **OR** physical activity in general (e.g., meeting a recommendation/suggestion).	"Strong scientific evidence shows that physical activity can help you maintain your weight over time."
2c	Risks associated with exercise/PA explicit	Presents or discusses risk(s) **as a consequence** of physical activity **OR** changing PA behavior. Example: Injury, health incident, death.	"Cardiac events, such as a heart attack, are rare during physical activity."

		Does NOT present solutions to manage or reduce risk….**That would be 4h**.	"They worry that physical activity may increase their risk of miscarriage."

Self-regulation

	Subcategory	Indicator	Example
3a	Goal setting	Encourages or prompts to set a PA outcome behavioral goal.	"Aim for 150 minutes of moderate-intensity aerobic activity, 75 minutes of vigorous-intensity aerobic activity, or an equivalent mix of the two each week"
3b	Planning	Encourages or prompts to plan action steps to work towards goal: When, where, how, **AND/OR** how often.	"Just find an approach that you find enjoyable"
3c	Self-monitor	Encourages or prompts to use an instrument to track behavior.	"Consider keeping a journal to monitor how your body reacts to meals and snacks so that you can tweak your diet for optimal performance."
3d	Overcome barrier	Presents a strategy or solution to a barrier to help overcome it.	And if you're busy—like most of us—you can split up your walks into 10-15 minutes each.

Self-efficacy

	Subcategory	Indicator	Example
4a	Model behavior with text	Presents examples for how a behavior may be performed. That is, physical activity or behavior that supports physical activity (e.g., meal planning)	"Here are some examples of warm-up activities: …For a brisk walk, walk slowly for five to 10 minutes."
4b	Model behavior with illustrative media (video, picture, table, figure)	Visual media showcases how a task may be performed (e.g. example exercise calendar). …presents person performing a relevant activity.	A table presenting an exercise schedule. Video of person performing PA/exercise.

			Picture of person performing PA/exercise or supportive behavior.

4c	Social Persuasion	Tells the reader they have skill or ability to perform behavior, even when faced with barriers. **Must be explicit**.	"It's easy." *This **explicitly** states the reader has the ability to do the activity.* ↓***does not meet criteria.*** "All you have to do is lace up with a good pair of sneakers—and walk" *Above implies walking is not difficult. **That's category 5**.*
4d	Vicarious experience	Describes a similar other **succeeding** or **persevering** with a task.	
4e	Mastery experience	Encourages or prompts reader try or do a **graded** or a small/achievable PA behavior. **Include** behaviors supportive of PA behavior. That is, behaviors **done** to **enhance** PA **behavior consistency**, **effort**, or **proficiency**.	"You can also try modified yoga or pilates" *This works. Prompts the reader to try a way they could achieve at.* ***Message quality is low**. No examples of what modified looks like or link to reference provided.*
4f	How to get social support	Provides **instructions** or **advice** for getting social support.	
4g	How to do a PA	Provides **instructions** or **advice** on how to **perform** a physical activity or exercise. Emphasis should be on performance.	"Warm-ups and cool downs generally involve doing your activity at a slower pace and reduced intensity" *This advices on what intensity to perform a warm up.*

4h	How to avoid negative consequences ***due*** to PA (e.g., injury, dehydration, fatigue).	Provides **instructions** or **advice** on **how to avoid** a negative consequence to physical activity (e.g., injury, fatigue, dehydration).	"You need adequate fluids before, during, and after exercise to help prevent dehydration."
4i	How to increase PA levels	Provides **instructions** or **advice** on how to **increase** physical activity.	