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Mobile Computer Application for Promoting Physical Activity

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Abstract

Despite evidence that physical activity reduces the risk of falls and other causes of disability and death, the majority of older adults do not engage in physical activity on a regular basis. Mobile technology applications have emerged as potential resources for promoting physical activity behavior. This article describes features of a new application, Ready~Steady, highlighting approaches used in its design and development, and implications for clinical practice. Iterative processes enabled the design, development, implementation, and evaluation of the application consistent with the wellness motivation theory, as well as established user-specific strategies and theoretical design principles. Implications in terms of potential benefits and constraints are discussed. Integrating technology that promotes health and wellness in the form of mobile computer applications is a promising adjunct to nursing practice.

Major causes of death and disability among older adults in the United States are linked to unhealthy behaviors, including physical inactivity (U.S. Department of Health and Human

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Services, 2013). Fewer than 60% of older adults report engaging in physical activity on a regular basis; 16% report engaging in strengthening activities, despite evidence that even light intensity activity and less sedentary activity have positive effects on health (Centers for Disease Control and Prevention, 2013; Marshall & Ramirez, 2011). Examples of significant consequences of physical inactivity include decreased leg strength, decreased balance, and the potentially devastating effects of falls. At least 30% of adults older than 60 fall each year, despite availability of interventions promoting balance, leg strengthening, and walking activities (Stevens & Sogolow, 2010). Mobile technology applications (apps) have emerged as potential resources for promoting physical activity behavior, yet few of these apps have been tested or integrated into health promotion interventions.

Conventional approaches to promoting physical activity typically involve education, advice on activities that improve stamina or muscle strength, and referral to exercise groups or physical therapists. Interprofessional providers, including nurses, as well as family members and friends, play a vital role in fostering motivation for increased physical activity among older adults (Brawley, Rejeski, & King, 2003). Theoretical and empirical evidence support that motivation for physical activity among older adults is influenced by interrelated biological, social, and environmental resources, as well as behavioral change processes such as self-knowledge, motivational appraisal, and self-regulation (Carstensen & Hartel, 2006). The wellness motivation theory (Fleury, 1996) serves as a guide for understanding the complex, dynamic problem of decreased motivation for physical activity among older adults and provides a basis for a wellness motivation intervention addressing this problem as a way to reduce fall risk among community-dwelling older adults.

The availability of mobile technology apps creates important opportunities to enhance interventions to promote motivation for physical activity among older adults. Modern mobile technology includes sensors (e.g., accelerometers) and programmable features that provide real-time and historical feedback to users (Fogg, 2003). Despite the proliferation of apps claiming to improve health, few published reports address older adult users and promoting physical activity based on theory and current research (Albaina, Visser, van der Mast, & Vastenburg, 2009; Consolvo, McDonald, & Landay, 2009; King et al., 2012). As no existing app reflected elements of the wellness motivation theory, a new app, Ready~Steady, was designed that addressed wellness motivation content for intervention, including social network support, empowering education, and motivational support (Perez & Fleury, 2009), with the goal of increasing motivation for physical activity among older adults.

The new app was designed, developed, implemented, and evaluated consistent with the wellness motivation theory, as well as established user-specific strategies and theoretical design principles. An initial evaluation of the app by older adults guided improvements to newer iterations. This work was accomplished through collaborative efforts of experts in biomedical informatics, theory testing and model generation, user-centered design and behavioral science, and gerontological advanced practice nursing. The purpose of this article is to describe the features of Ready~Steady, to highlight approaches used for design and development, and to discuss implications for clinical practice.

FEATURES

The app was developed on the iOS mobile platform because it offers movement sensors and a screen to display feedback, all within one device (e.g., iPod touch®, iPhone®). This platform eliminates the need for users to connect their wearable device to a computer for feedback. The app is programmed to capture, store, and evaluate accelerometer data sensed by the iPod touch. These data are used by the app to provide real-time and historically trended feedback to users via its display interface. Features of the app include content chosen for its main, informational, and historical screens (Figure 1).

Main Screen

Images selected for the main screen of the app include a positive metaphorical picture, a gauge, a minute counter, and positive motivational messages. All images draw from data about physical activity obtained from the sensor in the mobile computer and goals set by individual users regarding the number of minutes they would like to be active in a 24-hour period. The metaphorical picture is one of a blooming garden. At the beginning of the day, before a user has worn the iPod touch or smartphone, the garden simply displays a blue sky with a few cumulus clouds and green grass. With movement, five flowers bloom, one by one, from the green grass. When goals for minutes of activity in a day are met, a bird appears in the sky and the full garden remains. The image of the garden includes a sun that also acts as a gauge. At the beginning of the day, before a user has worn the iPod touch or smartphone, the sun is light yellow. With physical movement, the sun incrementally becomes darker gold. The rate at which the garden grows and the sun turns from light yellow to gold depends on progress toward meeting individual goals for minutes of activity per day.

A fraction of numbers is displayed just beneath the garden image on the main screen. The numerator of the fraction represents minutes during which the user has been physically active during the current day. The denominator represents the self-defined goal of number of minutes of physical activity in a given day. The numerator increases one digit at a time with each minute the user is physically active (real time), and continues to count even when exceeding the self-defined goal. When the goal is met, a statement appears under the image of the blooming garden that reads, “Goal completed, you have been active for xx minutes today. Well done.”

Motivational messages are visible when the user taps the screen. The affect of the messages changes as users make progress toward achieving their goal for physical activity. For example, one visible message at the beginning of the day states, “Where there is a will, there is a way.” When users have been physically active enough minutes to meet 50% and then 100% of their goal, messages appear such as, “Bloom where you are,” and “Slow and steady wins the race.” Figure 2 illustrates examples of the incremental motivational messages that appear when the screen is tapped.

The rationale for providing positive, not negative, feedback, and metaphorical, aesthetically pleasing images, not avatars or isolated simple gauges, was based on theory, previous research, and feedback from potential users (Albaina et al., 2009; Consolvo et al., 2009; McMahon, Vankipuram, Hekler, & Fleury, 2013). Participants in an initial evaluation

preferred the blooming garden in combination with a minute counter and a gauge. They stated that the blooming garden elicited positive emotion such as pleasant and happy feelings (McMahon et al., 2013). They also chose to have a gauge embedded in the picture and a number; both helped them to quantify their progress quickly. This is consistent with principles used to guide the design process and research identifying that metaphorical images and numerical feedback are appealing to older adults (Albaina et al., 2009).

Information Screen

The information screen directs users to “watch the flowers bloom as you get more active.” It contains three overlapping frames of the garden with increasing levels of bloom and is available on all three screens of the app by tapping the icon illustrating a universal symbol for information (Figure 1).

Activity History Screen

The activity history screen illustrates a graph trending total minutes of physical activity each day, over the course of a week. The *y* axis of the graph ranges from 0 to 150 minutes and the *x* axis indicates the day of the week. Total minutes of activity per day are plotted every 24 hours. The graph also displays a red line indicating the self-defined goal of activity minutes per day. The icon directs users to view the historical graph and illustrates a common image similar to those seen depicting stock market trends. The *x* and *y* axes are labeled, and arrows enable users to scroll through weekly results. The rationale for this element was that research and theory indicate historical information about health behavior trends contributes to self-evaluation and self-regulation of positive health behaviors. For example, a person may see his or her activity trends increasing over time, decreasing over time, or changing drastically on certain days. Any case may improve understanding of health behavior patterns and inform critical thinking about what types of situations might be associated with certain behavior (e.g., wearing or not wearing the monitor, changes in life situations) and how they might maintain or increase activity.

APPROACHES TO DESIGN AND DEVELOPMENT

All three screen displays incorporate: (a) established user-specific and theory-guided approaches for technology design; (b) the theory upon which the wellness motivation intervention was based; and (c) an initial evaluation by older adults. Although older adults are diverse, certain characteristics may influence their use of mobile technology. Older adults tend to use smartphones and mobile technology less often compared with younger adults (Smith, 2011), as well as experience changes in dexterity and sensory function that influence the use of mobile technology (Federal Interagency Forum on Aging-Related Statistics, 2010). Therefore, the app has just three display screens that are easily accessible through corresponding icons in the lower third of each screen. Display images were made to be clear and readable by using sans serif typology, large fonts for letters and numbers, and high contrast in images and writing. Minimalist displays were used; care was taken to reduce clutter and the complexity of text and illustrations. To prevent error, instructions for opening the app were embedded on the wallpaper of the iPod touch devices tested (Figure 1).

Established theoretical design principles systematically applied in approaches to design Ready~Steady include the following characteristics (Consolvo et al., 2009):

- An abstract metaphorical representation of physical activity via the image of a blooming garden.
- Unobtrusive interface displays that do not interrupt routines but are easily accessible when preferred.
- Public acceptability of mobile computers housing the app (e.g., iPod touch, iPhone).
- Aesthetic qualities such as flowers on the main screen interface display and maintaining physical comfort while wearing the mobile computer using a small elastic personal belt (SPIbelt™, Overton Enterprises, Austin, TX) (Photo).
- Positive images and feedback.
- Controllable elements in the app such as ability to individualize goals and adjust thresholds and algorithms for sensing.
- Trending historical physical activity data.
- Comprehensive measurement of physical activity intensity, duration, and frequency.

The wellness motivation theory guided the inclusion of features in the Ready~Steady app to allow users to easily and comprehensively evaluate their pattern of physical activity behavior and progress, while providing positive messages.

Details of the design and initial evaluation of the Ready~Steady app are described in other publications (McMahon et al., 2013; Vankipuram, McMahon, & Fleury, 2012). In the initial evaluation of the app, older adult participants noted that with certain improvements, the app may be usable and acceptable among older adults, and that most of the motivational messages included were valid (McMahon et al., 2013). They advised the design team to make instructions for using the app and the mobile computer (iPod touch) more explicit and to include illustrations. They also suggested adjusting one of the motivational messages, adding another, and evaluated two messages as *not relevant*, which were removed from the app. These evaluations, including suggestions to expand the range of numbers visible in the activity history graph, were integrated into the current iteration of the app (Figure 1 and Figure 2). The app was used to enhance a wellness motivation intervention recently tested for feasibility among rural, community-dwelling older adults, including a re-evaluation of the app for usability and acceptability. The main results of the study support that the Ready~Steady app was usable and acceptable by intervention participants (mean age = 85) (McMahon, 2012).

DISCUSSION AND IMPLICATIONS

This article, highlighting features of a new app, as well as design and development approaches, has clinical implications for nurses working with older adults. Features of the app include ease of use, clear visualization, and positive messages and illustrations

promoting self-assessment, problem solving, setting realistic goals, receiving rewards, and self-regulating activities (McMahon et al., 2013). Approaches used to design and develop Ready~Steady provided a foundation for interprofessional, user-centered, iterative processes whereby app usability and relevance were optimized. Implications are described as potential benefits and constraints to using this and other health apps.

This article's presentation of a mobile computer app, consistent with previous research, implies that technology has potential benefits of increasing health and wellness enhancing behaviors. Researchers have identified that despite having lower rates of smartphone and computer use compared with younger populations, many older adults are interested in technologies that provide information that is personally meaningful (Alicea-Planas, Neafsey, & Anderson, 2011) and that helps them remain healthy and independent (Heinz et al., 2013). Apps implemented to promote physical activity among older adults need to be interesting, personally relevant, and usable by individuals who do not have experience with smartphones, the iPod touch, or apps; who may have changes in dexterity and vision; and who may not participate in recommended physical activities on a regular basis. Error prevention efforts should be evident not only through app features, but through protocols addressing instruction and troubleshooting. In an era when patient engagement for optimizing health and wellness is a priority, adding usable and meaningful technology to clinical tool repertoires might enhance interventions that promote healthy lifestyles and support independence.

A perceived constraint to using technology is that it will replace certain forms of social support and potentially contribute to social isolation (Heinz et al., 2013). Therefore, care should be taken in the design and implementation of health-related apps to emphasize potential for increasing social interaction. In the case of Ready~Steady, one-on-one interaction is required to first introduce the purpose of the app and basics about its operation and how a client might use it. Information from the app that clients share with nurses may be used to: (a) explore health behavior patterns, progress, and barriers; (b) provide positive feedback; and (c) facilitate problem solving, identification of potential personal and community resources, and the development or revision of realistic and valued goals. Future iterations of the Ready~Steady app and others could include data sharing and virtual social networking features. The effects of technology use on social engagement and social support as well as the access to technologies across different communities are topics that warrant better understanding (Carstensen & Hartel, 2006).

CONCLUSION

Integrating technology that promotes health and wellness in the form of mobile computer apps is a promising adjunct to nursing practice. However, to ensure usability, acceptability, and effect, care must be taken to design, recommend, and support apps that reflect user preferences and their capabilities. Apps must also be based on empirical and theoretical evidence. Such motivational mobile technology appears to be applicable for older adults with wide-ranging functionality; be they marathon runners or those living with chronic conditions. Nurses can lead wellness promotion efforts and enhance patient engagement by participating in the design, evaluation, and implementation of such technology.

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Figure 1. Screen displays illustrating (from left to right), wallpaper, main app, information, and activity history screens.

Figure 2.
Main screen with images of blooming garden as minutes of activity increase and incremental motivational statements.

Photo.

Woman viewing her activity graph and wearing the iPod touch® within the small personal elastic belt.