

Invited Article

When Adults Don't Exercise: Behavioral Strategies to Increase Physical Activity in Sedentary Middle-Aged and Older Adults

Margie E. Lachman, PhD,^{1,*} Lewis Lipsitz, MD,² James Lubben, PhD,³ Carmen Castaneda-Sceppa, MD, PhD,⁴ and Alan M. Jette, PT, PhD, MPH, FAPTA⁵

¹Department of Psychology, Brandeis University, Waltham, Massachusetts. ²Institute for Aging Research, Hebrew SeniorLife, Harvard Medical School, Boston, Massachusetts. ³School of Social Work, Boston College, Chestnut Hill, Massachusetts. ⁴Department of Health Sciences, Bouve College of Health Sciences, Northeastern University, Boston, Massachusetts. ⁵Department of Health Sciences, Massachusetts General Hospital Institute of Health Professions, Boston.

*Address correspondence to: Margie E. Lachman, PhD, Department of Psychology, MS 062, Brandeis University, Waltham, MA 02453. E-mail: lachman@brandeis.edu

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Abstract

Physical activity is one of the most promising nonpharmacological, noninvasive, and cost-effective methods of health-promotion, yet statistics show that only a small percentage of middle-aged and older adults engage in the recommended amount of regular exercise. This state of affairs is less likely due to a lack of knowledge about the benefits of exercise than to failures of motivation and self-regulatory mechanisms. Many types of intervention programs target exercise in later life, but they typically do not achieve sustained behavior change, and there has been very little increase in the exercise rate in the population over the last decade. The goal of this paper is to consider the use of effective low-cost motivational and behavioral strategies for increasing physical activity, which could have far-reaching benefits at the individual and population levels. We present a multicomponent framework to guide development of behavior change interventions to increase and maintain physical activity among sedentary adults and others at risk for health problems. This involves a personalized approach to motivation and behavior change, which includes social support, goal setting, and positive affect coupled with cognitive restructuring of negative and self-defeating attitudes and misconceptions. These strategies can lead to increases in exercise self-efficacy and control beliefs as well as self-management skills such as self-regulation and action planning, which in turn are expected to lead to long-term increases in activity. These changes in activity frequency and intensity can ultimately lead to improvements in physical and psychological well-being among middle-aged and older adults, including those from underserved, vulnerable populations. Even a modest increase in physical activity can have a significant impact on health and quality of life. Recommendations for future interventions include a focus on ways to achieve personalized approaches, broad outreach, and maintenance of behavior changes.

Translational Significance: Physical activity is beneficial for psychological well-being, cognitive functioning, and physical health, yet the majority of older adults do not engage in regular exercise. A personalized approach using low-cost behavioral strategies to encourage an active lifestyle and to achieve long-lasting behavior change among those who are at risk for poor health outcomes is presented.

Keywords: Behavior change, Exercise/physical activity, Interventions, Motivation

It is hard to imagine there would be anyone who is unaware of the tremendous benefits of exercise for one's health and well-being. The messages are everywhere in the media and the culture at large. Indeed, a recent New York Times headline touted, "Closest thing to a wonder drug? Try exercise" (Carroll, 2016). For those who read the scientific literature, there is compelling evidence that an active lifestyle has broad benefits for cognitive, physical, and psychological health (Kohl et al., 2012; Powell, Paluch, & Blair, 2011). An active lifestyle can include participation in a wide range of activities—cognitively challenging tasks, social interactions, volunteer or paid work, hobbies, and physical exercise, all of which have some health benefits. The focus of this paper is on physical activity because it shows the strongest and most compelling effects for a wide range of health outcomes. Physical activity has been linked to numerous health benefits, including improved cardiovascular and respiratory health, enhanced insulin sensitivity, heightened bone and muscle strength, improved positive affect and cognitive function, and increased resistance to type 2 diabetes, cancers, and depression (e.g., Corder, Ogilvie, & van Sluijs, 2009; Kohl et al., 2012; Powell et al., 2011).

Physical activity is arguably the most promising non-pharmacological, noninvasive, and cost-effective method of health-promotion, that is, to the extent that people do it. Yet, statistics show that only a small percentage of adults engage in regular physical activity (Ashe, Miller, Eng, & Noreau, 2009) and the numbers are lower for middle-aged and older adults (Thorpe, Owen, Neuhaus, & Dunstan, 2011). The percentage of adults getting adequate amounts of exercise remains quite low. A recent report from the National Center for Health Statistics and the CDC reports that only about 20% of adults meet the federal recommended guidelines for aerobic and strength-training activity (Clarke, Norris, & Schiller, 2017). Additionally, this percentage decreases with age, with only 12.7% of those 65 years or age and older getting the recommended amounts of exercise (Clarke et al., 2017). Maintaining physical activity throughout life is an important public health objective (Corder et al., 2009) that is within reach with the right kind of interventions. In fact, physical inactivity has been called a global pandemic and is cited as one of the leading causes of death (Kohl et al., 2012).

Why are adults in the United States so inactive? Most adults are likely aware of the benefits of activity, so these statistics suggest either very low levels of motivation and/or failures of self-regulation and control (Nielsen & Reiss, 2012). There are many barriers to doing regular physical exercise, including limited free time, fear of falling, cost, transportation, pain, and lack of enjoyment (Bock et al., 2014). Even when adults do adopt exercise regimens, their participation is typically not maintained over time. Just a modest increase in physical activity and reduction in sedentary behavior can have an impact on health and quality of life. The goal of this paper is to consider a personalized approach that uses effective low-cost motivational and

behavioral strategies for increasing physical activity, which could have far-reaching benefits for individual and population-level health of middle-aged and older adults (Powell et al., 2011).

Physical Activity, Health, and Vulnerable Populations

Active aging is a means to postponing functional declines and compressing morbidity into a shorter period later in life (Fries, 2012; Paúl, Ribeiro, & Teixeira, 2012; World Health Organization, 2002). There is widespread evidence that those who are more physically active enjoy better physical, psychological, and cognitive health, and are more productive, able to work longer, more socially engaged, and have an overall better quality of life (Corder et al., 2009; Kohl et al., 2012; Powell et al., 2011). Thus a focus on strategies for increasing activity has great potential for a broad-based impact.

Promoting an active lifestyle can have important consequences for morbidity and mortality in the United States, rates of which have worsened when compared to those of other countries (Crimmins & Beltrán Sánchez, 2011; Freedman et al., 2013; Institute of Medicine, 2013). One apparent reason for the alarming health trends in the United States is the increase in chronic illnesses that are exacerbated by obesity, functional limitations, and disabilities that are often tied to inactivity, resulting in increased health care costs and reductions in productivity (Antonucci et al., 2012). In the United States, built environments are typically designed around automobiles more so than other developed peer nations (Institute of Medicine/National Research Council, 2013). In countries that enjoy better health than the United States, physical activity (e.g., walking, hiking, or riding bicycles to work or the store) is typically more prominent in daily routines. Another key factor contributing to the poor health outcomes in the United States is the large degree of economic inequality, which accounts in large part for health disparities and premature or accelerated aging (Adler & Stewart, 2010). Thus, another important goal is to target those who are most vulnerable to poor health outcomes, namely those with low socioeconomic status and/or minority groups, who typically are less active and have more chronic conditions than the general population (Chen, 2012). Psychosocial and behavioral factors can attenuate aging-related declines and promote resilience especially among those at greatest risk for decline (NIA, 2012; Ryff et al., 2012) with the promise of improving quality of life and productive engagement.

Behavior Change and Physical Activity

The focus of this paper is on promoting a positive health behavior, that is, physical activity, rather than reducing a negative one such as sedentary behavior. Research has suggested that focusing on the benefits of physical activity is

more effective for behavior change than presenting the risks of a sedentary lifestyle (Notthoff & Carstensen, 2014).

Better evidence of the determinants of behavior change would contribute greatly to understanding when and how to intervene to create and sustain lifelong healthy behavior patterns in those who have the most to gain from adopting them (Antonucci et al., 2012). Many types of intervention programs target exercise in later life, but they typically do not achieve sustained behavior change, and there has been little increase in the exercise rate in the population over the last decade (Antonucci et al., 2012; Clarke, Norris, & Schiller, 2017; Kohl et al., 2012). Most intervention studies are based on formal exercise programs and regimens. These programs typically require setting aside a chunk of time to go to a gym or lab setting and may require purchasing equipment or memberships. An alternative approach is to integrate physical activity into daily life routines in the context of work, social contacts, and other desirable everyday activities based on personalized goals and interests, as suggested by the National Institute on Aging Go4Life Program (NIA, 2018). This type of daily life integration can involve such strategies as scheduling a time slot for a daily walk in one's calendar, riding a bicycle to the store, walking to a colleague's office rather than emailing, parking in a distant parking lot at work or the mall, or walking while socializing with friends or meeting with coworkers.

Motivational Approaches for Increasing Physical Activity

Many exercise programs have been developed and these programs typically focus on skills training and provide equipment and teach routines for exercise. By contrast, a motivation-focused approach (West et al., 2011) empowers participants to develop meaningful and personalized programs integrated into daily life routines and buttressed with enhanced social supports in the community settings where adults live, work, and receive services. This approach addresses participants' mindsets about activity and their motivation for doing it with the goal of long-term maintenance (Fleig, Pomp, Schwarzer, & Lippke, 2013). Activity can be promoted and adopted as a lifestyle, a possible self (e.g., I will be physically fit), or an identity (e.g., I am an active person). Such a motivational approach recognizes the multiple influences on human behavior that interact in complex ways to employ a unique multicomponent model of behavior change. It is also compatible with a personalized approach adapting the proposed intervention according to each individual's values, beliefs, emotional states, goals, socioeconomic circumstances, and environmental context. Rather than promote a common exercise program for everyone with common goals, a personalized multicomponent approach acknowledges the importance of incorporating activity into one's particular everyday lifestyle. Behavior change is more successful and long-lasting when it combines action plans with motivational factors, beliefs,

and expectancies that are critical to everyday decisions about exercise (Lachman, 2006). A personalized approach recognizes the importance of taking into account obstacles and barriers while encouraging realistic goals that enable gradual attainment. The notion that everyone should walk 10,000 steps a day, promoted by the activity tracker industry, is not feasible or evidence-based (Sullivan & Lachman, 2017).

A Multicomponent Approach to Behavior Change

In longitudinal work, a combination of social support, control beliefs and physical activity showed long-term protective effects for functional declines; the more of these components at baseline, the less physical decline over a 10-year period, as shown in the Midlife in the United States (MIDUS) study of middle-aged and older adults (Lachman & Agrigoroaei, 2010). Such findings from observational studies can be translated into intervention research to test combinations of strategies for reducing disability and improving health. There are some multicomponent intervention studies that combine physical exercise and cognitive training (e.g., Barnes et al., 2013; Eggenberger, Schumacher, Angst, Theill, & de Bruin, 2015), although these studies typically are interested in the effects on cognition rather than on physical activity. Others consider attitudes and beliefs about exercise in the context of increasing physical activity (e.g., French, Olander, Chisholm, & McSharry, 2014), with varying degrees of effectiveness for older adults. Research also shows that providing social support in the context of an exercise program can increase self-efficacy, which in turn has beneficial effects for physical activity (e.g., Rackow, Scholz, & Hornung, 2015). Conclusions from a meta-analysis of physical exercise programs for older adults found that programs with a theoretically-derived intervention and those that combined cognitive and behavioral components were the most effective in increasing physical activity (Chase, 2015). A multicomponent approach can teach exercise skills, address self-defeating attitudes and obstacles, assist in goal-setting, and provide social support and incentives, yet few exercise intervention programs include more than one or two such components.

Figure 1 shows a personalized and multicomponent conceptual model designed to guide interventions to increase health-promoting behaviors, specifically physical activity, while recognizing individual differences in needs, context, and goals. The model can be applied to guide behavior change efforts at the individual and group level. It is designed to provide a framework for addressing obstacles and incorporating physical activity into daily routines. This is in contrast to more regimented exercise programs. This heuristic model is based on theories and research showing that personal and contextual background factors and vulnerabilities will influence the nature of personal

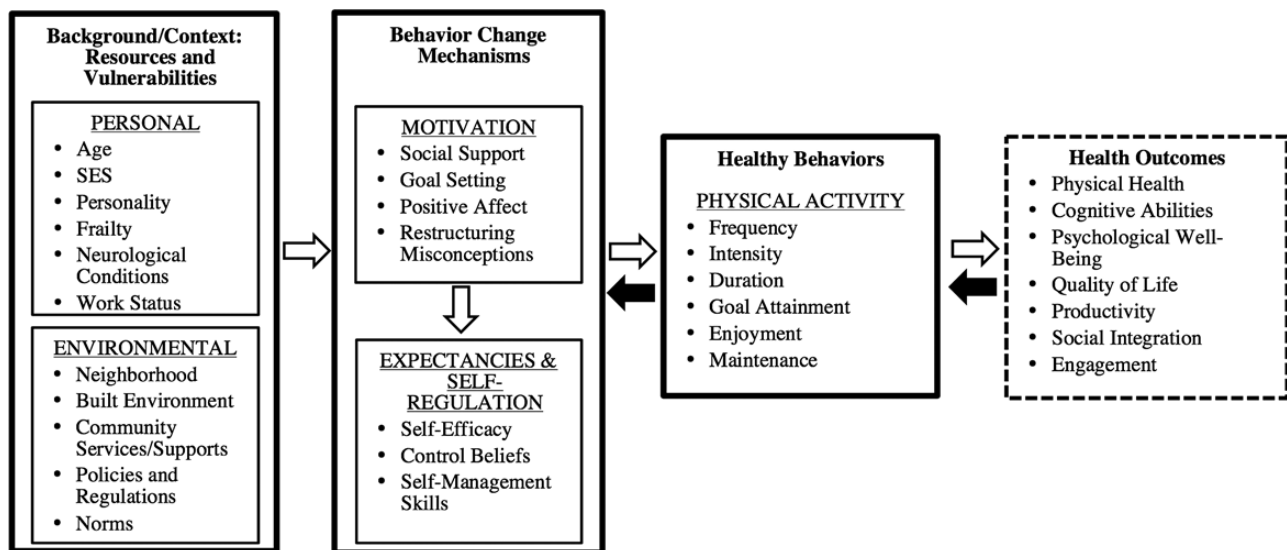


Figure 1. A personalized and multicomponent approach to behavior change: a conceptual model developed by the Boston Roybal Center for Active Lifestyle Interventions (RALI Boston).

goals and appropriate motivational strategies (Sullivan & Lachman, 2017).

The effectiveness of behavior change can be enhanced by considering personal attributes such as age, personality, cognitive status, health, and socioeconomic status as well as their environmental context. Interventions can be tailored to fit different needs and characteristics of the person and the environmental context (see Figure 1). For example, there is mixed evidence as to whether those with cognitive or neurological impairments can benefit from physical activity or exercise interventions. Some studies have found similar benefits of endurance and strength training for cognitive functioning among those who are cognitively impaired and those who are cognitively intact (Heyn, Johnsons, & Kramer, 2008). A meta-analysis found that walking benefited executive functioning in healthy adults, but this was not the case for those with cognitive impairment (Scherder et al., 2014). Indeed, more research is needed to identify ways to tailor interventions to be effective for those who have constraints such as cognitive impairments, chronic conditions, or mental health issues. The neighborhood in which individuals live and places they work vary in terms of their walkability, safety from crime, open green space, age friendliness, and policies that support physical activity (Barnett, Barnett, Nathan, Van Cauwenberg & Cerin, 2017). These factors can be taken into account when designing and tailoring personalized interventions to encourage more physical activity.

The specific strategies and mechanisms used, the varieties of activity targeted, and the types of vulnerable populations may vary, with possibilities for focusing on the individual and/or on changing the environmental features that can support physical activity. This view is consistent with the World Health Organization (Paúl et al., 2012; WHO, 2002) recommendations, which focus on both

“beliefs and behaviors that support healthy aging using a personalized approach and emphasizing the importance of the perceived ability to control, cope with, and make personal decisions about how one lives on a day-to-day basis.”

There is evidence from experimental intervention studies that motivation, expectancies (e.g., beliefs about one’s abilities to achieve desired outcomes), and self-regulatory factors (e.g. self-control, goal setting) are essential mechanisms to evoke sustained, health-promoting behavior changes (Lachman, Jette, Tennstedt, Harris, & Peterson, 1997; Lachman, Neupert, & Agrigoroaei, 2011; McAuley et al., 2011). Increasing activity in middle-aged and older adults calls for a novel combination of behavior change strategies as represented in the empirically-derived conceptual model in Figure 1, which can serve as a heuristic for translation to intervention research. It includes a combination of motivational strategies including social support, goal setting, and positive affect coupled with cognitive restructuring of negative and self-defeating attitudes and misconceptions. These components are expected to increase motivation to exercise by increasing expectancies for exercise self-efficacy (i.e., perceived abilities to reach a specific exercise goal), sense of control (i.e., beliefs about the extent to which one can overcome obstacles and constraints), and self-regulatory and self-management skills (e.g., action planning, emotion regulation, self-control), which in turn should lead to physical activity goal attainment and enjoyment of a more active lifestyle. These changes in activity frequency and intensity can ultimately lead to improvements in health and well-being among middle-aged and older adults, including those who are at risk for poor health outcomes. Intervention programs often target one behavior or health outcomes in one domain. Yet interventions such as those to increase physical activity, which can affect multiple aspects of health, including physical functioning, psychological well-being,

cognitive abilities, and productivity, are desirable and may be more economical in the long run (Kremen, Lachman, Pruessner, Sliwinski, & Wilson, 2012).

As illustrated in Figure 1, behavior change mechanisms include motivational factors, expectancies, and self-regulatory factors. Realistic goals and regular feedback about progress can provide incentives and rewards for sustained activity. Many sedentary adults hold erroneous, negative, and self-defeating views about their ability to exercise. They may assume they are too old to exercise, that it won't do them any good, or that exertion would be harmful and could lead to falls or pain. Identifying barriers and reframing negative misconceptions about exercise are important for motivating behavior change. Providing social support in various forms can facilitate goal formation. Moreover, social support and other rewarding experiences in the context of activity can enhance positive affect, thereby making the activities desirable and more likely to be repeated.

Cognitive behavioral strategies and cognitive restructuring (e.g., reframing, emotion regulation) are effective for increasing self-efficacy and sense of control and positive emotions (Lachman et al., 2011). Strategies such as (a) setting and committing to realistic goals, (b) action plans for how to implement goals, (c) positive and gain-focused message framing with clear communication of program benefits, (d) social support and encouragement, (e) feedback and recognition of progress, (f) incentives for sustained participation, and (g) rewards for compliance and excellent performance are recommended to increase motivation and change behavior.

The dark arrows in Figure 1 illustrate the bidirectional or reciprocal nature of the relationships between health, physical activity, and motivational factors. Improvements in health and well-being can lead to increases in physical activity. In turn, increases in the frequency and intensity of physical activity can lead to increases in control beliefs and self-efficacy as well as positive emotions and additional social contacts and support (Lachman, 2006).

Motivational and Self-regulatory Mechanisms

In developing the guiding conceptual model, we integrate a number of well-known behavior change theories such as the Health Beliefs Model (Rosenstock, Strecher, & Becker, 1988), the Theory of Planned Behavior (Ajzen, 2011), the Transtheoretical Model and Stages of Change (Nigg et al., 2011; Prochaska & Prochaska, 2011; Prochaska & Velicer, 1997; Ravesloot et al., 2011), and Implementation Intentions (Gollwitzer, 1999; Gollwitzer & Oettingen, 2016). All of these models are based in social-cognitive behavioral theory and focus on self-regulatory strategies that can lead to better goal attainment. These approaches all provide potential frameworks for the conceptualization and measurement of behavior change, and there is substantial overlap in concepts and practice across these different

models (Abraham & Michie, 2008). The most common behavior techniques include self-regulatory skills such as goal setting, self-monitoring of progress, encouragement, and feedback (Cadmus-Bertram, Marcus, Patterson, Parker, & Morey, 2015).

A social-cognitive behavioral approach (Bandura, 1997) has been effective in previous intervention work with older adults (Jette et al., 1999; McAuley et al., 2011; Tennstedt et al., 1998). For example, implementation intentions (Gollwitzer & Oettingen, 2016) focus on forming an "if-then plan" in advance that can lead to effective behavior change by increasing self-efficacy (confidence in one's ability to exercise) and control (beliefs about self-control). The beliefs that one can regulate behavior and that efforts will make a difference for outcomes are key to behavior change (Arbour & Ginis, 2008). Such beliefs are critical factors for adoption and retention of physical activity (Anderson, Winnett, Wojcik, & Williams, 2012; Marcus, Selby, Niaura, & Rossi, 1992; Neupert, Lachman, & Whitbourne, 2009; Strecher, DeVellis, Becker, & Rosenstock, 1986). Indeed, evidence from observational studies shows that expectancies and self-regulatory processes involving self-efficacy and self-control play a major role in behavior and contribute to health outcomes (Infurna, Gerstorf, & Zarit, 2011; Infurna, Ram, & Gerstorf, 2013). Beliefs that aging-related declines are inevitable and irreversible or that barriers are insurmountable are prevalent among middle-aged and older adults, especially those from low socioeconomic or low educational backgrounds (Lachman & Weaver, 1998). Such negative attitudes can foster helplessness and promote a sense there is little one can do to take control over their own aging process. As illustrated in observational studies, those who have little confidence in their abilities or believe they have little control over outcomes use less effort and less effective problem-solving strategies, are more anxious, ruminate more, are less task focused, and adopt fewer health promoting behaviors such as exercise, in part because they assume their efforts will not make a difference (Cotter & Lachman, 2010; Lachman & Agrigoroaei, 2010). Such results provide an empirical basis for translation to evidence-based interventions to improve health.

It is possible to modify self-efficacy and enhance the sense of control and doing so has positive implications for motivation and behavior change (Bandura, 1997; Lachman et al., 2011). These attitudinal changes may be especially valuable for those vulnerable to poor health outcomes (Lachman & Weaver, 1998). Cognitive restructuring of misconceptions and negative expectancies has been successful with older adults in the context of reducing fear of falling and increasing confidence for becoming more active (Tennstedt et al., 1998), and improving strength and overall fitness among those with osteoarthritis (Hughes et al., 2004).

Positive affect is a key factor involved in promoting behavior change and health (see Kok et al., 2013; Notthoff & Carstensen, 2014). If an activity is enjoyable it is more likely to be repeated and sustained. There is evidence that

positive, gain-framed messages are more successful in encouraging behaviors for skin cancer prevention, smoking cessation, and physical activity (Gallagher & Updegraff, 2012; Notthoff & Carstensen, 2014) than negative loss-based information. More research is needed to examine the contexts in which gain-framed messages are most effective, and the processes that mediate the effects of framing on behavior (Notthoff & Carstensen, 2014). Although exercise is known to increase positive affect and decrease depression, a new direction would be to investigate how emotion regulation and positive affect influence behavior change in terms of increased activity.

Social Support

The association between social ties and health is well established (Berkman et al., 2003; Seeman et al., 2011; Uchino, 2013; Umberson & Montez, 2010; Walen & Lachman, 2000); those with greater social connections have lower rates of morbidity and mortality (Holt-Lunstad, Smith, & Layton, 2010; House, Landis, & Umberson, 1988) and engage in more healthy behaviors. Social networks play a key role in promoting healthy and unhealthy behaviors (Smith & Christakis, 2008). A number of mechanisms are thought to link social engagement and healthy outcomes: social influence/social comparison, social control, role-based purpose and meaning (mattering), self-esteem, sense of control, belonging and companionship, stress reduction, and perceived support availability (Thoits, 2011). A major unanswered question raised by Cohen and Janicki-Deverts (2009) is whether we can improve health by improving social relationships. Much of the evidence has been based on survey research (Thoits, 2011), showing longitudinal and cross-sectional associations between social support and physical activity among older adults (Lindsay Smith, Banting, Eime, O'Sullivan, & van Uffelen, 2017). Although the social epidemiological evidence is sound, more experimental and intervention work is needed. Interventions with existing social relationships, however, can be challenging and somewhat unnatural, and do not always lead to changes in health (Berkman et al., 2003) because it may be difficult to change ingrained interaction patterns. Some of the more successful social support interventions have been with caregivers or with support groups for those with illness (e.g., cancer). Few studies have focused on social support for promoting new health behaviors, although some well-established programs such as Weight Watchers and Alcoholics Anonymous are built on a social support framework.

One effective social approach is to engage in exercise with a partner to increase commitment and accountability (King, 2001; King & Sallis, 2009). Social support from a coach, peer leader, trainer, or mentor, can motivate, provide incentives and rewards, and also address questions and concerns (Mead, Hilton, & Curtis, 2001). Supportive others can encourage, model, and monitor changes, and provide assistance as needed (Mead, Hilton, & Curtis, 2001).

Working with others is expected to be motivating and helpful for staying on track. Knowing there is someone who cares and can help if needed is valuable for maintaining behavioral changes. What is likely most beneficial about social support is knowing there is someone available in case there is a need, even if help is never mobilized (Antonucci, 2001; Walen & Lachman, 2000). Sharing ideas and goals and feedback about the best approaches to achieving them is empowering and holds potential as an effective means to promote self-care behaviors with personal meaning, purpose, and a sense of belonging.

A key goal is to incorporate social support, either virtual, remote, or in person, as a means to increasing self-efficacy and control. There is growing observational evidence that experiencing social support can lead to increases in self-efficacy, a sense of empowerment and control (Antonucci, 2001; Chen & Feeley, 2012, 2013; Gerstorf, Röcke, & Lachman, 2011; Kouvonen et al., 2012), and adherence to new treatments (Maeda, Shen, Schwarz, Farrell, & Mallon, 2013). Yet this has not been sufficiently translated and tested in interventions, especially in the domain of physical activity. This process can operate through modeling, stress reduction, promoting feelings of security, positive emotions, and vicarious feedback (Bandura, 1997; Thoits, 2011). Targeted social support can also increase positive behavior change through monitoring progress, and providing feedback and assistance. Such motivational interventions also can include a personalized approach that enables participants to set their own goals both for proximal as well as for more distal goals. Those providing social support ideally make use of resources readily available in the community settings and support can be web-based. In such cases, the costs can be contained to make it affordable and realistic to transfer to a wide variety of settings.

Personalized Approaches to Motivation and Behavior Change

Asking adults to adopt specific exercise regimens has had only limited success, especially for increasing physical activity over the long term (Corder et al., 2009). In contrast, a personalized approach has the potential to change behavior in ways that are realistic and meaningful. Table 1 summarizes the key features that are recommended for taking exercise promotion and behavior change to the next level with widespread and long-lasting benefits. Rather than a "one size fits all" approach to exercise programs, a more personalized approach involving participants' decisions and choices, tailored to subgroups (e.g., socioeconomic status) or individuals (e.g. personality) and their contexts (e.g., neighborhoods) is a promising way forward. As there is increasing recognition in medicine that treatments are more effective if they are tailored to individual characteristics and needs, a personalized approach can also be applied in behavioral interventions (Robinson & Lachman, 2016). Motivation is a critical factor for success in behavior change

Table 1. New Directions for Physical Activity Interventions: Targets and Strategies

Intervention features	Targets	Implementation strategies
Personalized	Tailor to individuals or groups	Specify needs, goals, contextual factors
Broad Reach	Include those at risk for poor health: vulnerable, frail, sedentary	Community-based interventions where people live, work, and receive services
Long-term Changes	Monitor progress, multiple follow-ups, ongoing support	Booster sessions, coaches, use of technology

and there are wide individual differences in why and how people want to make changes. One approach to individualizing interventions is to focus on goal setting (Freund & Hennecke, 2012). Identifying short term and long term goals can facilitate adoption of new behaviors for achieving specified outcomes. Goal setting can encourage participants to think about the future to motivate behavior change (Hershfield et al., 2011; Samanez-Larkin et al., 2007). For example, participants can be given opportunities to envision desirable results such as attending important family events, working longer, taking a vacation, going out with friends to social events or entertaining friends and family. Participants can develop their goals in consultation with peer advisors, partners, or coaches, either in person or remotely, to create a roadmap to reach their goals. To facilitate long-term behavior change it is helpful to provide regular feedback on goal achievement. There is clear evidence that focusing on and planning for the future affects decision making, health, and well-being (Hershfield et al., 2011; Prenda & Lachman, 2001; Samanez-Larkin et al., 2007).

As illustrated in Figure 1, personalizing treatments based on personality, neurological conditions, ethnicity, and other background and environmental factors, can reveal what techniques work best for whom and can strengthen motivation if goals are personally meaningful (Yap & Lee, 2013). The linkages between psychosocial, motivational, and behavioral factors in the context of personalized approaches to behavior change and health has promise for the design and effectiveness of future behavior change interventions.

Targeting Those at Greatest Risk for Poor Health

Those at risk for poor aging outcomes are not typically included in exercise intervention studies, which often focus on well-functioning, relatively well-off adults. Those who are already active and motivated to exercise are typically the ones who respond to recruitment efforts. Those who could benefit most from the programs (e.g., sedentary adults) are often the hardest to recruit.

There is a need to focus on those who are vulnerable and at risk for health problems and premature aging (e.g.,

those with low educational attainment), in part because they do not regularly engage in health-promoting behaviors such as physical activity. As a result, they are more likely to suffer from functional limitations, obesity, diabetes, and chronic illness at higher rates than more well-educated or active adults. Such target groups could include vulnerable populations such as frail elders, those in the early stages of neurodegenerative diseases, those with depression, and hourly wage workers at risk of not being able to continue their demanding jobs due to physical limitations.

There is good evidence that among those who are vulnerable there is variability and not everyone has poor health outcomes. The key question is why some are healthier than expected, i.e., are resilient (Lachman & Weaver, 1998; Miller, Chen, & Cole, 2009). Basic research has shown the possibilities for resilience among those who are low in socioeconomic status (SES), with chronic diseases, or from disadvantaged childhood backgrounds (Ryff et al., 2012). One powerful factor is how life circumstances and situations are appraised and accompanying beliefs about whether one can change or whether their actions will make a difference (Miller et al., 2009). A direct focus on these appraisals of self-efficacy and self-control especially as applied to physical activity is a promising approach.

Although those from low SES backgrounds are at risk and vulnerable for accelerated aging, they also are likely to be responsive to psychosocial and behavioral changes. “Differential susceptibility” refers to individual differences in the response to adversity (NIA, 2012). It suggests that the same attributes that make an individual particularly sensitive to adversity may also make him or her more responsive to interventions designed to offset the effects of adversity. There is evidence across multiple domains that those who are at risk for poor aging outcomes are the ones who benefit most from psychosocial moderators (Lachman & Weaver, 1998; Miller et al., 2011; Ryff et al., 2012; Turiano, Chapman, Agrigoroaei, Infurna, & Lachman, 2014). This may be in part because the individuals have more room to show improvement, but also could be because they may be more motivated to change. In survey studies, however, those from disadvantaged groups who are resilient are typically a selective group, and not necessarily representative. Intervention work using an experimental paradigm is an ideal forum to test hypotheses about ways to promote new

adaptive behaviors and whether it can have a significant and lasting impact for those at risk.

To facilitate recruitment of diverse populations, who are at risk for accelerated aging and poor health outcomes, and who are often reluctant to participate in exercise research programs, it is ideal to partner with community organizations that serve vulnerable middle-aged and older adults (low income, minorities). Conducting interventions in the community settings where the adults live, work, and receive health services can increase the reach of programs to those with the greatest needs (see [Table 1](#)).

Towards Behavior Change for the Long-Term

It is challenging to change exercise behavior especially among older adults from economically disadvantaged populations, who have been sedentary for many years. It is even more difficult to achieve long-term maintenance of changes. A cognitive behavioral framework for physical activity interventions using cognitive restructuring and reframing of negative views and promoting a sense of control over aging has met with some success, at least in the short run ([Lachman, 2006](#); [Lachman et al., 1997](#); [Lachman et al., 2011](#)). One example is the *Matter of Balance* program ([Tennstedt et al., 1998](#)), which addresses fear of falling and associated activity curtailment with adults in senior housing buildings. The program incorporated a cognitive behavioral model and included strength training and restructuring of fear of falling. The results showed significant improvements in intended activity, control over mobility, mobility range, and social contacts, but these changes were short-lived, suggesting the need for booster sessions to promote maintenance. Nevertheless, this translational program is effective for behavior change and continues to be widely used nationally and internationally. Another intervention, the *Strong for Life* ([Jette et al., 1999](#)) program of resistance training, achieved changes in physical functioning and upper and lower body strength among adults with functional limitations. Participation and adherence rates were higher than in previous studies that did not use motivational strategies. Participants who rated exercise as more desirable and beneficial for their health and felt they had greater control over their exercise behavior were more likely to meet their exercise goals than those with lower ratings ([Jette et al., 1998](#)). Self-efficacy beliefs were the best predictor of intensity of exercise and whether or not exercise was maintained up to 12 months after the intervention ([Neupert et al., 2009](#)). It is possible to change attitudes about controllability and self-efficacy beliefs about exercise for some individuals, as well as to increase the intention to exercise and to become more active. However, more effort (e.g., monitoring, boosters) is needed to produce sustained behavior changes (see [Table 1](#)).

A recent study of middle-aged adults who were working full time found that a personalized implementation intention intervention increased daily walking and active time

by helping participants develop concrete plans to increase activity for the next day ([Robinson & Lachman, 2016](#)). The use of specific implementation intentions, such as planning when, where, and how to increase daily walking, also increased participants' confidence that they would engage in physical activity even under perceived time constraints. However, the effects of the intervention were not maintained after the intervention was over, and participants reverted to their earlier levels of activity. There is a need to develop and evaluate evidence-based strategies that can be applied in interventions to produce sustained and broad behavior change. Continued monitoring or booster sessions may be useful for encouraging long-term effects (see [Table 1](#)). The use of technology can assist with promoting long-lasting changes in physical activity as activity trackers and apps are doing more to integrate behavioral strategies such as goal setting, reminders, feedback, competition, and accountability ([Middelweerd, Mollee, van der Wal, Brug, & te Velde, 2014](#); [Sullivan & Lachman, 2017](#)). The overall goal is to increase activity while preventing disability and enhancing quality of life. Application of psychosocial mechanisms and behavior change strategies are expected to increase the likelihood of successful and enduring changes.

Summary and Recommendation for Future Research

Intervention programs for healthy aging often target one behavior or set of outcomes in one domain and they often focus on those who are already doing well. A multipronged approach to interventions with the goal of affecting behavior change in physical activity that can influence multiple systems (physical, cognitive, and psychological health) was presented. The guiding framework is derived from cognitive-behavioral and motivational approaches to increase the likelihood of enduring behavior change by increasing motivation, self-efficacy, and sense of control over physical activity, using a personalized approach, with social support and setting of meaningful goals. It is important to operationalize constructs from the conceptual model with a set of reliable and well-validated measures, using both subjective and objective indicators.

The design of interventions can benefit from a multidisciplinary team including biomedical, social, and behavioral scientists from medicine, nursing, psychology, social work, physical therapy, epidemiology, and exercise science, drawing on the strengths of different perspectives and bringing them to bear on a shared set of goals. We also emphasize the importance of targeting those who are most in need of the behavior change interventions, even though they are often the most difficult to recruit, if we are to have a substantial impact on both individual and population health. Those who have constraints such as cognitive or physical impairments or mental health issues (e.g., depression, anxiety) will likely require customized interventions to maximize

the impact. Such work has great potential to make a large impact on the health and well-being of adults who are on a pathway towards disability or chronic diseases and premature aging by intervening to make lifestyle changes that are highly beneficial.

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Conflict of Interest

None reported.

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