The Power of Play: Innovations in Getting Active Summit 2011

A Science Panel Proceedings Report From the American Heart Association

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Background—To examine the influence active-play video gaming (also referred to as exergaming, exertainment, and active gaming) might have on improving health-related skills, enhancing self-esteem and self-efficacy, promoting social support, and ultimately motivating positive changes in health behaviors, the American Heart Association convened The Power of Play: Innovations in Getting Active Summit. The summit, as well as a follow-up science panel, was hosted by the American Heart Association and Nintendo of America.

Methods and Results—The science panel discussed the current state of research on active-play video gaming and its potential to serve as a gateway experience that might motivate players to increase the amount and intensity of physical activity in their daily lives. The panel identified the need for continued research on the gateway concept and on other behavioral health outcomes that could result from active-play video games and considered how these games could potentially affect disparate populations.

Conclusions—The summit represented an exciting first step in convening healthcare providers, behavioral researchers, and professionals from the active-play video game industry to discuss the potential health benefits of active-play video games. Research is needed to improve understanding of processes of behavior change with active games. Future games and technologies may be designed with the goal to optimize physical activity participation, increase energy expenditure, and effectively address the abilities and interests of diverse and targeted populations. The summit helped the participants gain an understanding of what is known, identified gaps in current research, and supported a dialogue for continued collaboration. **(*Circulation*. 2011;123:2507-2516.)**

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Sedentary lifestyle, unhealthy diet, and consequent overweight and obesity increase the risk of cardiovascular diseases. Regular moderate- to vigorous-intensity physical activity (45 to 60 minutes per day) can help prevent unhealthy weight gain and obesity, whereas sedentary behaviors such as watching television or sitting at a desk promote increased adiposity. Regular exercise can markedly reduce body weight and fat stores without caloric restriction in overweight individuals.[1] The American Heart Association (AHA) recommends that for substantial health benefits, adults perform at least 150 minutes (2 hours 30 minutes) per week of moderate-intensity or at least 75 minutes (1 hour 15 minutes) per week

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Table. Definitions for Levels of Physical Activity From the Centers for Disease Control and Prevention[5]

Never physically active	Inactive during usual daily activities and never able and/or unable to engage in leisure-time physical activity
Low physical activity level	Moderately active during usual daily activities and never able and/or unable to engage in leisure-time physical activity *or* inactive during usual daily activities and engaged in some leisure-time physical activity but less than regular
Medium physical activity level	Very active during usual daily activities and never able and/or unable to engage in leisure-time physical activity *or* moderately active during usual daily activities and engaged in some leisure-time physical activity but less than regular *or* inactive during usual daily activities and engaged in regular leisure-time physical activity
Medium-high physical activity level	Very active during usual daily activities and engaged in some leisure-time physical activity but less than regular *or* moderately active during usual daily activities and engaged in regular leisure-time physical activity
High physical activity levels	Very active during usual daily activities and engaged in regular leisure-time physical activity

of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Children and adolescents should participate in 60 minutes (1 hour) or more of daily physical activity.[2]

On average, children and adults in the United States get inadequate amounts of physical activity. More than one third of adolescents in grades 9 through 12 do not regularly engage in vigorous physical activity at all. Forty-three percent of students in grades 9 through 12 watch television >2 hours per day. Physical activity declines dramatically over the course of adolescence, and adolescent girls are significantly less likely than boys to participate regularly in vigorous physical activity.[3]

As Americans age, daily physical activity gradually declines. Fewer than 50% (45.4%) of adults ≥18 years of age participate in ≥30 minutes of moderate-intensity physical activity on ≥5 days per week.[4]

According to the Centers for Disease Control and Prevention, only approximately one fifth of adults (19.0%) engage in a high level of overall physical activity and close to 10% (9.6%) are never physically active. Men (21.3%) are more likely than women (16.9%) to engage in a high level of overall physical activity. Men (23.3%) and women (23.8%) are about equally likely to engage in a medium-high level of overall physical activity. The rate of engaging in a high or medium-high level of overall physical activity is lower for Hispanic adults and single-race black or African American adults.[5] The Table describes the definitions for levels of physical activity from the Centers for Disease Control and Prevention.[5]

Among older Americans, sedentary behaviors continue to increase. Approximately one third of people ≥65 years old lead a sedentary lifestyle, with older women generally less physically active than older men. Among people ≥75 years of age, 54% of men and 66% of women are sedentary, engaging in no leisure-time physical activity.[6] In general, black older adults are less active than white older adults.[7]

Regular moderate-to-vigorous physical activity in conjunction with a healthy diet and avoidance of unhealthy weight gain are effective ways to help treat and prevent cardiovascular disease and reduce premature mortality in all population groups.[1] Increasing regular physical activity is especially important in light of the current rates of overweight and obesity in the United States. Although obesity-associated morbidities occur most frequently in adults,[8] children and youth experience serious consequences of excess weight, many of which are antecedents of adult disease.[9] Over the past 20 years, obesity rates in US children and youth have skyrocketed. Today, approximately 1 in 3 American children and teens is overweight or obese. Obesity is associated with a broad range of health problems, including high blood pressure, type 2 diabetes mellitus, and elevated blood cholesterol or dyslipidemia. There are also psychological effects: Obese children are more prone to low self-esteem, negative body image, and depression. Excess weight at young ages has been linked to higher and earlier death rates in adulthood.[10,11]

The Power of Play: Innovations in Getting Active Summit

The AHA uses 3 strategies to help prevent cardiovascular disease and stroke: primordial prevention (prevention of the development of risk factors by changing environmental and social conditions, often at the population level), primary prevention (interventions designed to modify adverse levels of risk factors once they are present, with the goal of preventing the occurrence of a first cardiovascular disease event), and secondary prevention (interventions initiated after a first cardiovascular disease event and designed to reduce the risk of a subsequent event). The AHA has a significant interest in examining new innovations that might offer tools to help improve risk factors and health behaviors of all Americans.[12]

The Power of Play: Innovations in Getting Active Summit was a fundamental first step taken by the AHA in January 2011 to begin examining the potential opportunities and benefits of the use of active-play video games to help children and adults avoid sedentary behavior and find enjoyable, accessible ways to be more physically active. As leaders in their respective fields, the AHA and Nintendo of America are working together to promote physically active play as part of a healthy lifestyle. The 2 organizations come from different worlds but share a common goal: to collaborate on multiple fronts to help consumers discover how active-play video games may contribute to healthy living.

The summit took place at the University of California, San Francisco, with ≈75 attendees representing stakeholders from the fields of game design, active games development, technology, medicine, public health, fitness, behavioral health, research, communication, psychology, education, cardiovascular nursing, and cardiac rehabilitation. As a first-time event that brought together a video game company and a voluntary healthcare organization, this was a defining moment that began with open minds and no fixed expectations and ultimately served to provide a future direction for the AHA in advancing its mission, while also helping set a research agenda for the active-play video games field.

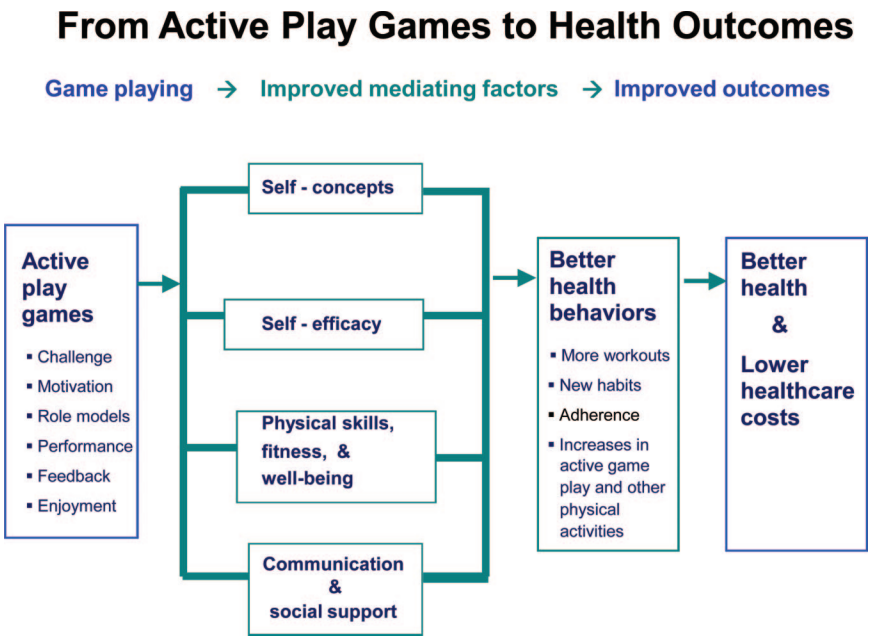

Figure. Model of health outcomes with active-play games. Adapted with permission from Debra Lieberman, © 2000.[13a–13c]

After a full-day meeting that brought together an invited group of experts in health care, health promotion, behavioral sciences, technology, and game development to discuss the potentials for integration of active-play video games into physical activity promotion and programs, a half-day science panel was convened. The science panel discussed current trends and future directions in the research on active-play video games and the translation of this research into improvements in future game designs and implementation. Three experts in this field gave presentations, and then approximately 2 dozen participants who had attended the previous full-day meeting engaged in dialogue to identify research gaps and to specify areas in which future research related to increasing physical activity with active-play video games would be especially useful.

Some science panel discussion focused on the potential "gateway effect" of active-play video games, addressing how these games might encourage and enable individuals who are sedentary or are not engaging in moderate-to-vigorous physical activity on most days to increase their amount and intensity of physical activity. Active-play video games show promise to involve these individuals in more frequent physical exertion than they might usually engage in; help them increase the intensity of their activity levels; and build confidence, social relationships, and skills that could support them in developing and sustaining lifelong involvement in a physically active lifestyle. The panel presentations also addressed other health behaviors and outcomes that might be influenced by active-play video games, such as those related to cognitive function and physical therapy. Speakers and breakout session participants identified important opportunities and challenges and offered suggestions related to "bold ideas" they had heard in earlier summit presentations.

The Nintendo of America–AHA relationship is an important effort in support of the AHA's 2020 impact goal, which is to improve the cardiovascular health of all Americans by 20% while reducing deaths due to cardiovascular disease and stroke by 20%. Success toward this goal will be measured by 7 health factors, one of which includes Americans' level of participation in regular physical activity.[12]

Effects of Active-Play Video Games

Active-play video games, also referred to as exergames, exertainment, active games, or technology-mediated physical activity, have an interface that requires physical exertion to play the game. Exergames also include games played in the physical world supported by technologies that require the player to move from place to place to advance in the game, in some cases tracked by an accelerometer or by a Global Positioning System (GPS) that monitors the player's geolocation. The games use balance boards, dance pads, gym equipment, cameras, remote controls with accelerometers, heart rate monitors, and other types of sensors and inputs that keep the player moving to play and win the game. Research has found that active-play video games, including exertion-based games and technology-supported games, can help make physical activity more appealing and engaging for many people across age groups and can increase daily activity levels.[13]

The Figure is a model illustrating some of the major ways active-play games can lead to improved health behaviors and outcomes, according to current research in the field cited widely in this report. The model presents some fundamental, impactful ways that active-play games can improve behavior by influencing four types of mediating factors, which are known to improve the health behaviors (in this case related to physical activity) that improve health outcomes and lower healthcare costs. The mediating factors are drawn from well-established behavioral health theory and research findings. More about the integration of theory and research findings into the design of digital games for health and learning can be found in Lieberman 2009, 2006.[13a,13b]

The four types of mediating factors are:

- Self-concepts. A game can be designed to improve players' self-concepts. For example, through a wide variety of game

dynamics, it can help reduce personal feelings of stigma, improve self-esteem, and reduce the social anxiety that might inhibit engagement in active-play video games.

- Self-efficacy. This is the level of confidence one has about one's ability to carry out a specific behavior. In the case of active-play games, self-efficacy for a behavior such as engaging in vigorous exercise for 5 minutes, and then more minutes as time goes on, might rise after playing a vigorous game several times a week for several weeks. Gains in self-efficacy can help people initiate a health behavior change they previously considered too difficult to do, and can then motivate them to strive to do more.
- Physical skills, fitness, and well-being. As people become more involved and successful with active-play games, they develop the skills that make it easier to engage in physical activity. They enjoy perceiving that their bodies are becoming more fit, and they experience more physical and emotional well-being. These rewards and benefits are motivating and can lead to more engagement in physical activity.
- Communication and social support. When people play active-play games with others and share them socially, they begin talking more about their workouts and their health with family and friends. This leads to encouragement, applause, social comparison, coaching, sharing thoughts and feelings, and giving and receiving social support for being physically active, all of which are known to improve health behaviors. In this case the behaviors involve becoming more physically active and integrating physical activity into one's daily life.

Every active-play game can be represented by some version of this model, which may exclude some of the mediating factors or include others, depending on how the particular game is designed. Every health game should be designed on the basis of a model that shows how the game will influence players cognitively, emotionally, socially, and/or physically, and how these influences will serve as mediating factors that ultimately will lead to better behaviors and outcomes. Not only can a model influence the design and early testing of a game, it can guide the development of outcome studies and clinical trials that test the game's effectiveness. A game's model shows what the game is designed to accomplish, and how it will achieve its goals, and specifies the outcomes to measure in tests of the game's effectiveness with the target population.

Active-play video games often provide built-in assessment and coaching along with estimates of heart rate and caloric expenditure. Some examples include Wii Fit Plus, Wii Sports Resort, Kinect Sports, and Dance Dance Revolution. Active games like these have been used to enhance players' motor ability, balance, agility, and core strength. As mentioned previously in this report, it has been suggested that they might also serve as gateways to a physically active lifestyle, promoting the habits that can lead to lifelong regular physical activity.[14]

On the gateway effect, a 2010 AHA–Nintendo of America survey found that playing active-play video games might lead players to increase their real-world physical activity. The online consumer research survey was conducted in the fall of 2010 with the Consumer Opinion Panel of research firm Synovate. Results from the 2284 respondents, 22 to 55 years of age, were balanced to be representative of the general population on the basis of region, sex, age, and household income data from the US Census Bureau. The survey found that 58% of people who played active-play video games said they began a new fitness activity such as walking, tennis, or jogging after they started playing the games. Additionally, 68% of those who played active-play video games said they became more physically active after they got involved in the games. Also, 82% of those who engaged in active-play video games said they then played more with family and friends, which suggests that these types of video games might bring people together for social fun. Men were more likely than women to play active-play video games with their children (men 65% versus women 56%). Men were also more likely than women to play active-play video games with someone else on the same console (men 51% versus women 36%). However, women were more likely than men to agree that active-play video games enabled them to stay active at home (women 61% versus men 50%), be active day or night (women 49% versus men 40%), try activities they would not normally do (women 47% versus men 36%), and challenge their physical limits (women 24% versus men 19%).

Active-Play Video Games: The Newest Intervention for Increasing Physical Activity

Ernie Medina, Jr, DrPH, Certified Health Fitness Specialist, Preventive Care Specialist with Beaver Medical Group, Assistant Clinical Professor at Loma Linda University School of Public Health, and Cofounder of MedPlay Technologies (http://www.medplaytech.com) made the first science panel presentation, providing an overview of active-play video games as an intervention for increasing physical activity. MedPlay Technologies works with schools, local governments, fitness centers, gyms, senior centers, and retirement and medical facilities to provide active-play video game equipment, exercise and nutrition curricula, consultation services, training, and ongoing support.

There are currently 3 general genres of active gaming: (1) screen-based programs such as Dance Dance Revolution, Wii games, and Xbox Kinect games, which are generally played on consoles and are most commonly played in the home; (2) light-sensor–based games such as Makoto, a 3-column–with-lights system that combines the speed and fun of video games with the explosive movement of aerobic exercise; and (3) games that are active but not digitally based, such as rock climbing or Frisbee golf, that use light sensors. In addition, a fourth genre is emerging in the form of mobile games that use smart phones, handheld GPS hardware, and other devices that combine the virtual world with the real world via some sort of online game. Although not specifically covered in panel presentations, this genre bears mentioning.

A significant advantage of active-play video games is that they can be introduced into a wide variety of settings, such as senior centers, fitness centers, homes, and medical and community-based settings. For most games, minimal space is needed. Active-play video games can be made adaptable to enable people of different ages and physical abilities to play together. The games can also be adapted for people with special needs, cognitive challenges, physical disabilities, and rehabilitative needs, including older adults (eg, Wii bowling leagues in senior centers and Wii balance and exercise games). Current

studies are examining the impact of older adults' use of Wii games on the prevention of falls. For example, researchers at Loma Linda University are using the Wii Fit as a field tool for testing balance and as an intervention for improving balance in seniors.

The President's Council on Fitness, Sports, and Nutrition currently includes Nintendo's Wii console on the President's Challenge "My Favorites" activity log list.[15] The achievement program includes this type of active-play video game for credit toward completing the Presidential Active Lifestyle Award, a President's Challenge program for people of all ages, backgrounds, and abilities. The goal is 60 minutes of physical activity per day for children and 30 minutes per day for adults, 5 days per week for 6 weeks.

Active-play video games offer promise as tools to reach individuals who might not be engaged in regular physical activity. A key to the potential of active-play video games is that they can reach adults who are inactive for a variety of reasons, including cost, physical limitations, lack of interest, or time constraints.

More research is needed to investigate the health effects of active-play video games. Some promising areas to study include biometric outcomes, potential negative effects on health, impacts on cognitive function, and ways that gaming might lead to adoption of healthy behaviors. More evidence related to these areas would provide valuable information to the medical and public health fields and to active-play game developers.

Research in Active-Play Video Games: What We Know So Far

An overview of current research on active-play video games was presented by Barbara Chamberlin, PhD, Director of the Learning Games Laboratory at New Mexico State University (http://www.learninggameslab.org). The Learning Games Laboratory provides an exploratory environment where gamers play and evaluate games, including those designed strictly as entertainment, educational titles, and games in development. One of the Learning Games Laboratory programs is a national exergames research and education initiative, Exergames Unlocked, funded by the US Department of Agriculture. In the Exergames Unlocked initiative, researchers are evaluating caloric expenditure during use of active-play video games in various situations, psychological and social impacts, and new tools for the evaluation and assessment of the uses and effects of active-play video games. In addition, the project translates research to practice by providing case studies of successful uses of active-play video games in a variety of settings, reviewing and recommending games for specific audiences, and providing buying guides and other suggestions for use of active-play video games in schools, after-school programs, in the home, and in community programs.

Peer-reviewed research found in published journal articles and conference proceedings addresses a broad range of issues related to active-play video games. A review of the research literature found studies on (1) physiological impacts; (2) psychological, social, and motivational processes with active-play video games; (3) impacts on academic outcomes and cognitive functioning; and (4) uses and effects of active-play video games in physical therapy and in work with senior populations.

Physiological Impacts

Many commercial active-play video games can be effective in increasing energy expenditure from sedentary or light levels to moderate levels,[13,16] but few games are active enough to lead to vigorous levels of energy expenditure. Currently, most active-play video games are primarily entertainment games not designed to demand highly vigorous physical activity to win the game. Therefore, the research findings cited here do not rule out the possibility that games designed to increase energy expenditure could be developed. One promising area is the emergence of games that require both upper- and lower-limb movement, because this type of game appears to have the potential to allow players to reach vigorous levels of physical activity.[17,18] One study, in healthy adults, reported a wide range of metabolic equivalent values (1.3 to 5.6 metabolic equivalents) of Wii Sports and Wii Fit Plus game activities with use of an open-circuit indirect metabolic chamber.[19] Current published research represents a wide selection of physiological measures, including oxygen consumption, vertical jump distance, systolic and diastolic blood pressure, heart rate, respiratory rate, endothelial function, energy expenditure, and reductions of body weight and fat stores.[18,20] Research also finds that experienced players who enjoy a particular game the most tend to experience the strongest physiological and workout benefits from playing the game, such as increased heart rate and respiratory rate.[21] Furthermore, some players appear to be unaware of the discomfort of their physical exertion while playing, or their discomfort threshold appears to become higher, especially if they enjoy the game or are engaged in collaborative or competitive social play. The distraction from discomfort enables them to work harder or persevere longer, and the engagement in competition or collaboration among game players also spurs the player and results in an improvement in activity levels and beneficial physiological effects.[22]

The extended time between research and publication is significant in that current reports do not present any timely data about impacts from longer-term studies. Other issues that increasingly are being addressed in emerging research include questions focusing on the influence of types of game players, the specific games played, role of competition versus collaboration, and other environmental factors that influence physiological responses.[21–24]

Psychological, Social, and Motivational Processes and Effects

An important and underresearched area of the field is the study of psychological, social, and motivational processes that occur with exergaming and how they serve as mediating factors that contribute to behavioral and health outcomes such as initial participation in and longer-term adherence to physical activity.[14,25] Active-play video games appear to offer beneficial social interaction for girls and seniors, particularly when the physical activity and social aspects of a game are linked, such as in games that require collaborative play.[25,26] Players tend to rank active-play video games positively[14,25] and have demonstrated a preference for physically active video games over comparable sedentary versions,[17,27,28] with lower ratings of perceived exertion during active game play than with other types of physical activities. Additionally, active-play video games have increased participation in physical activity studies compared with similar nongaming

activities.[18] Video games might provide psychosocial benefits for many players, including strong bonding, group socialization, higher-self esteem, mutual support, and intergenerational socializing for older women.[25] Likewise, young girls favorably rated the social aspects of video gaming.[26]

Impacts on Academic Outcomes and Cognitive Function

Although very little research has been published on the impact of active gaming on academic performance or the cognitive benefits of active-play video games, a great deal is already known about the benefits of physical activity on these outcomes; in particular, a positive correlation has been shown among standardized exams and physical activity or fitness.[29–31] Emerging research has shown that exergame interventions in schools can improve academic performance; reduce classroom absenteeism, tardiness, and negative classroom behaviors; and increase physical activity levels. A growing body of research focuses on the association between school-based physical activity, including physical education, and academic performance among students. Promoting physical fitness and increasing time spent in physical education can lead to improved grades and standardized test scores.[31,32] However, few studies have documented the impact of exergames in the physical education environment.

Active-Play Video Games in Therapy

Gaming is increasingly being used in the treatment of patients with stroke and Parkinson disease and with patients who have mental or developmental disorders.[33–37] More research and outcome data are warranted in these areas. For older patients, active-play video games have increased reaction time, eye-hand coordination, feelings of success, overall physical activity levels, and social involvement.[38–40] Studies of youth have addressed hand function and forearm bone health for children with cerebral palsy and have found improvements related to game play.[34,41–44]

It is well established that certain population subsets, such as those who have low socioeconomic status, lower levels of education, lower health literacy, and lesser disease self-management skills, have more adverse risk factor profiles,[45,46] including lower levels of habitual physical activity and cardio-respiratory fitness.[47–49] Data are limited but emerging on how active-play video games can help close gaps in risk factors, including physical activity/fitness, in these populations. For example, low-income African American adolescents who played the Nintendo Wii tennis exergame for 25 minutes, either alone or against a peer, expended more energy than the sedentary control group.[22] A 4-week interactive video "exertainment" program in underserved children, as part of an after-school program, resulted in improvements in cardiovascular endurance and academic performance, and a reduction in absenteeism.[50]

Future Directions for Research, Design, and Implementation

Debra Lieberman, PhD, Director of Health Games Research (http://www.healthgamesresearch.org) addressed future directions for the research, design, and implementation of active-play video games. Health Games Research is a national program that provides scientific leadership and resources to advance the research and effectiveness of digital games and game technologies that promote health. It is funded by the Robert Wood Johnson Foundation's Pioneer Portfolio and headquartered at the University of California, Santa Barbara. Health Games Research assists its grantees at 21 US universities and medical centers and conducts its own research to help build the field and to discover and integrate well-founded principles of learning and health behavior change into digital games that motivate players to improve their health habits. Many of the Health Games Research grantees are studying active-play video games.

Active-play video games are increasingly popular in the United States. A growing body of research suggests active-play video games that require moderate-to-vigorous physical exertion to play, such as balance board games, camera-based games that require physical movement as the interface, dance pad games, gym equipment games on stationary bicycles and sport walls, and mobile games that help players monitor and track their workouts or that challenge them to go physically to certain geolocations, can improve players' cardiovascular health by increasing their frequency and intensity of physical workouts both during game play and away from game play in other forms of physical activity.

Essentially, a game is a rule-based activity that involves a challenge to reach a goal and provides feedback on progress made toward the goal. Games are immersive and experiential, and when well designed they can be highly motivating. Digital games use technology completely or use it to support real-world activity. To involve the player in active play, video games can include exertion interfaces that involve, for example, balance boards, remote controllers, camera interfaces, and gym equipment. To support real-world activity, games can be supported, for example, via mobile applications, alternate reality games, and robots. Game designers can use game elements such as social and interpersonal influences, coaching (virtual characters that coach directly or games that connect people so they can coach each other), nurturing of characters (taking care of a character's health), competition, and collaboration to motivate active play.

Exergaming active-play video game genres include sports challenges (eg, Wii Sports Resort), fitness/workouts (eg, Wii Fit Plus), dance contests (eg, Dance Dance Revolution or iDance), adventure games with exertion interfaces (eg, Winds of Orbis), treasure hunts (eg, Geocaching), and social networks and rewards (eg, Zamzee). Current tools that can input data into a game to advance the story or achieve the game goal or monitor the player's progress include websites with diaries to track players' daily habits, accelerometers to track movements, GPS systems to identify the player's location, activity and sleep meters, and a wide variety of other sensors that measure everything from brain waves to blood sugar to heart rate.

It is anticipated that in the future, sensors that contribute data to active-play video games will become more powerful, feature-rich, and varied and will include more emotional and attitudinal measures. For example, face recognition software can detect minute facial muscle movements to detect emotions, and this input could enable an exergame to adjust the level of exertion it demands, or change the way the coach provides instructions. In addition, more games are becoming connected to networks, linking players with each other for

social play and linking their game outcome data to their clinicians and caregivers. Furthermore, television and active play are likely to converge in interesting ways to enhance the entertainment experience and to link active-play games to the television-viewing experience. Workplaces may provide game play opportunities that offer rewards and incentives when employees engage in active-play video gaming.

More behavioral health strategies such as leveraging social influence and increasing self-efficacy will be built into active-play video games. Future games will be more effective in health promotion as developers understand how to improve game design based on what works and what players want. Games will stand alone as interventions or will be integrated into larger health promotion interventions as vehicles for echoing and emphasizing campaign messages. Behavioral health specialists will be on game development research teams to help integrate and improve the mediating factors that are known to lead to motivation and behavior change.

Social networking will support active-play video game playing, enabling individuals to work out together even if they are at different locations. Examples include Geocaching and Expresso fitness bikes, both of which can support communication between players no matter where they live, while they compete and collaborate in a game in real time.

Healthcare providers will be able to prescribe active-play video games, and technology will support tracking of patients' progress. Data collected by the game will enhance game play and will also be saved automatically in players' personal health records. Individuals will be able to track their physical activity in more sophisticated and powerful ways, and data will be used to help medical professionals counsel and advise patients. Current examples of tracking technology are the Nike+ sports watch, Fitbit Trackers, and the RunKeeper fitness tracking software and social network.

Summary of Discussion

After the presentations, science panel participants discussed opportunities and challenges related to active-play video games and brainstormed bold ideas for the future. Following are some of the ideas that emerged.

Opportunities

- Use sensors, pedometers, and other monitoring devices to measure and collect physiological health outcome information.
- Evaluate educational components of active-play video games in terms of executive function (brain processes that are responsible for planning, cognitive flexibility, abstract thinking, rule acquisition, initiating appropriate actions and inhibiting inappropriate actions, and selecting relevant sensory information), cognition, and workplace productivity.
- Correlate the aerobic requirements associated with energy expenditure (calories) with the ability to perform specific activities or sports.
- Utilize and optimize technology to increase communication between healthcare providers and patients.
- Develop demonstration projects using active-play video games, with long-term follow-up.
- Formulate processes to provide assistance for implementation, coaching, and sustaining active-play video games in multiple environments such as schools, community centers, and senior centers.
- Although some work has been done to provide greater access, more effort is needed to make active-play video games more available to the least fit, least active population cohort (the bottom 20%) and engage them in interaction. This might be achieved through workplace interventions, after-school or work programs, libraries, churches, or community centers (eg, YMCAs).
- Currently, active-play video game activities are not covered or considered therapeutic by healthcare providers, and often, patients in most need can least afford elaborate gaming setups. If research supports the benefits of active-play video games as tools to promote health behaviors, future gaming platforms need to be affordable and accessible.
- To engage some individuals, a game must be simple and easily mastered. It should also be easy for them to find out which games are available, how to obtain them, and how to play them (eg, after-school programs, community centers, workplaces).

Challenges

- Funding
  - — Address the affordability of active-play video games for sites such as schools, community centers, senior centers, and workplaces to enable them to provide active gaming opportunities to their constituents.
  - — Research funding is needed to better understand how active-play video games might be used as a gateway tool to physical activity and/or to help people achieve moderate levels of physical activity. Funding should also support research for best practices of exergame use, translating research findings for users to use exergames efficiently and effectively. Because of the multidisciplinary nature of designing and implementing active-play video games, a mechanism is needed to convene scientists, medical professionals, game developers, and game producers so that together they can identify best practices in the design and use of active-play video games for health.
- Develop games that address behavioral health issues, including comorbidities (medical conditions existing simultaneously but independently with another condition), mental health, and adherence. Because of the multidisciplinary nature of designing and implementing active-play video games, a mechanism is needed to convene scientists, medical professionals, game developers, and game producers so that together they can identify best practices in the design and use of active-play video games for health.
- Game developers and manufacturers might not want to be identified with medical interventions or have games identified as medical devices.
- Privacy issues need to be considered when and if active-play video game users record personal data electronically during active-play video game use.
- Policy issues related to the integration of active-play video games in schools or the workplace need to be considered,

especially in light of collection of health and behavioral data related to game use.

- Gaps in research
  - — Game developers are motivated to produce newer games at a fast pace to meet investor and consumer demands and expectations, whereas academic research requires time for measurement and evaluation. This creates a challenge for health and behavioral researchers and for the application of research findings into game development.
  - — Access to and integration of demographic data for health and behavioral researchers is needed. There is a need to study the potential synergistic impact of playing more than one kind of active-play video game.
  - — There is a need to study the potential synergistic impact of more than one kind of active-play video game.
  - — Unstructured, imaginative free play (home, school, work) needs to be studied, with a focus on what works in certain settings and environments.
  - — Research needs to be conducted with randomized, controlled methods to identify how active-play video games influence behavior.
  - — Health impacts based on age, developmental level, sex, socioeconomic status, and comorbid conditions of the player need to be better understood.
  - — We need to better understand game design strategies that can lead to more regular participation in daily physical activity (gateway effect).
  - — Further investigate barriers, perceived barriers, and motivation related to behavioral outcomes.
  - — Biometric outcomes, negative effects, and impact on cognitive functions need to be studied.
  - — We need to discover ways to enhance long-term compliance to the use of active-play video games.
- Collaboration between healthcare providers, active-play video gaming groups, and the video game industry needs to be supported.

Bold Ideas

- Incentivize users to play games based on known health status (using specific health markers). Improvements in indicators of health status would result in allowing them to advance to a higher level of the game. It is theorized that their ability to improve their health status in the game will influence how they perform in real life.
- Address the need for cross-disciplinary research and potential funding sources.
- Create a center for active-play video game research
- Develop a set of common metrics for measuring and evaluating active-play video games related to health behaviors and outcomes. This would lead to a database for evaluation and monitoring to facilitate multisite, multicomponent studies.
- Collect data on participation in active-play video games through national data set tools such as the National Health and Nutrition Examination Survey. The survey is designed to assess the health and nutrition status of adults and children in the United States. It combines interviews and physical examinations, so health data can be cross-referenced for people who use or have access to active-play video games.
- Support a symposium in health-related behavioral changes related to active-play video games.

Closing Remarks and Conclusions

There is growing enthusiasm for the potential of active-play video gaming in health promotion and disease prevention, noted Barry Franklin, PhD, as he summarized the science panel discussions. The challenge exists in terms of measuring the effectiveness of specific games or programs, as well as assessing the impact of active-play video games as a gateway to reduce sedentary behaviors in our society. As a potential gateway to moderate to vigorous physical activity, active-play video games might introduce sports or recreational activities, offer individuals experience in specific activities or sports, build confidence through skill development, encourage transfer to conventional activities (real play), improve healthy behaviors, and support adherence. In addition, the design of some active-play video games might consider addressing the sex, culture, and income of the participant, as well as at-risk populations, including the sedentary, obese, physically challenged, visually challenged, and children and adolescents. Open communication between game developers and healthcare professionals will be needed, with an understanding that these stakeholders will have different goals.

Few sets of data are available on the effectiveness and benefits of active-play video games in terms of facilitating healthy behaviors. Nevertheless, the reported energy expenditure of active gaming suggests a significant potential for positive health benefits. Working together, health organizations, health professionals, and game developers have an opportunity to make a profound contribution to public health.

Research is needed to identify and track the way specific games increase players' physical activity and to assess the effectiveness of active-play video games as gateways to increased moderate-to-vigorous physical activity. As active-play video game behavioral health interventions are developed and improved, emphasis on specific populations is needed, including the least fit, least active cohort (bottom 20%); those who are physically challenged; those who are visually challenged; women; children and adolescents; and low-income individuals. Research should also be conducted to understand how to design games, including targeting the specific needs of African American, Hispanic, and Latino children, adolescents, and adults, so that the games are adopted by all races.

The Power of Play: Innovations in Getting Active Summit offered a pivotal opportunity for health scientists, marketers, and active-play video games developers to come together. The dialogue initiated at the summit was instrumental in helping us begin to understand the current state of knowledge related to active-play video games and health behaviors. It helped us consider the gaps in current research and identify future research questions, and it supported ongoing dialogue for continued collaboration.

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Dorothea K. Vafiadis	American Heart Association	None	None	None	None	None	None	None

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*Modest.

†Significant.

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