Fiscal Year:	FY 2015	**Task Last Updated:**	FY 07/07/2015
PI Name:	Feltz, Deborah L. Ph.D.		
Project Title:	Cyber Partners: Harnessing Group Dynamics to Boost Motivation for More Efficient Exercise		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Musculoskeletal Alterations Team		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **BHP**:Behavioral Health & Performance (archival in 2017)		
Human Research Program Risks:	(1) **Aerobic**:Risk of Reduced Physical Performance Capabilities Due to Reduced Aerobic Capacity (2) **BMed**:Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	48824-3711	**Congressional District:**	8
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2012 Crew Health NNJ12ZSA002N
Start Date:	06/01/2013	**End Date:**	07/31/2016
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	5	**No. of Master' Degrees:**	2
No. of Master's Candidates:	5	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	45	**Monitoring Center:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:	NOTE: End date changed to 7/31/2016 per NSBRI (Ed., 7/6/16) NOTE: End date changed to 6/30/2016 per NSBRI (Ed., 6/29/16) NOTE: Extended to 7/31/2016 per NSBRI (Ed., 6/16/16)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Ploutz-Snyder, Lori (Universities Space Research Association, Columbia) Winn, Brian (Michigan State University) Pivarnik, James (Michigan State University) Kerr, Norbert (Michigan State University)		
Grant/Contract No.:	NCC 9-58-MA03401		
Performance Goal No.:			
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Task Description:	Original Project Aims/Objectives: The focus of the proposed research is to use recently documented motivation gains in task groups (dyads in particular) to heighten the exercise experience for astronauts and help keep them motivated to exercise at levels necessary to reduce loss of aerobic fitness and muscle over long space missions. A secondary focus is to determine the most effective features in exercise partners for enhancing, enjoyment, confidence, and social connectedness. The specific aims of the proposed project are to: (1) Develop software to create Software Generated (SG) exercise partners and interface with exercise equipment (stationary bike) similar to what is available on the International Space Station (ISS); (2) Test various design features of the SG partner within designed exercise video games to determine the most effective features for enhancing motivation to exercise, enjoyment, confidence, and connectedness; and (3) Test whether exercising with an SG partner over a 24-week time period, compared to exercising alone, leads to better aerobic capacity and muscle strength, adherence to the exercise regimen, and enhanced enjoyment in the activity, self-efficacy, and sense of social connectedness. Key Findings since last report: In Year 2, we worked on Aims 2 and 3, first testing various design features of the SG partner in an exercise video game: Train Like an Astronaut. Aim 2 was a short-term study (6 days) to determine the most effective partners to enhance exercise intensity. In Aim 2, we tested an SG exercise partner in one of three modes: (a) a coacting mode, where the subject cycled with the SG partner but whose performance was independent of the SG partner (i.e., they are not teammates), (b) a conjunctive-teammate mode, where scores were based on the slower/weaker performer, and (c) a choice mode that had the option for the participant to choose coacting mode or conjunctive teammate mode for all trials. We tested these modes against an individual control condition. The experiment used the activity routines developed by Ploutz-Snyder that consist of (a) 30 min. of continuous aerobic exercise on a stationary bike at or above 75% of maximum heart rate and (b) high-intensity interval training involving several repetitions of 4 min. at or above 90% maximum heart rate. Thus far in Aim 2, we have tested 19 male and 25 female chronic exercisers ages 30-62 yrs (M = 49.31; ± = 7.77). Subjects were allowed to change intensity (in watts) during each workout, and effort was measured by average watts cycled. Subjects in all conditions increased watts significantly from baseline, but the conjunctive condition (M = 7.47 ± 8.40) trended toward a greater increase compared to the control (M = 5.66 ± 9.11). Thus, with the small sample tested so far, exercising with a conjunctive partner showed a small effect (d = .20) over exercising alone. By end of 6 days, increases in effort above target watts were positively correlated with Enjoyment (r = .47), Self-efficacy (r = .49), and Feelings toward partner (r = .36). Although testing is not finished in the short-term study, there was enough evidence to design the long-term study (Aim 3). Feedback from subjects revealed that they wanted more varied scenery, that an interactive dialogue with the partner during the introduction phase would help in making a social connection, that subjects should match the virtual partner longer during exercise sessions, and that the conjunctive task demand should be more obvious. In Aim 3, we added more social interactions throughout the sessions, more varied scenery, a longer time where the subject could lessen the gap between him/her and the SG partner, and we added a catch-up and surpass condition. We also added features that made the conjunctive task demand more obvious to the subject. Thus, in the Aim 3 long-term study, we are testing an SG exercise partner in one of two modes: (a) a conjunctive-teammate mode, where scores were based on the slower/weaker performer, and (b) a conjunctive teammate who is sometimes surpassed by the subject, plus an individual control condition. The first cohort of subjects (N = 23; 11 women, 12 men) started in January, 2015 (M age = 46.74; ± = 6.98). Baseline fitness measures of aerobic capacity, body fat, and thigh strength were obtained. Subjects exercise 6 days per week, using the complete aerobic routines developed by Ploutz-Snyder that consist of (a) 30 min. of continuous aerobic exercise on a stationary cycle at or above 75% of maximum heart rate, (b) 4 x 4 min. intervals at or above 90% maximum heart rate with 3 minutes active rest, (c) 6 x 2 minute intervals at varying intensities with 2 minutes active rest, and (d) 30 sec. sprint intervals at maximal effort with 20 seconds active rest. Subjects are in Week 15 of the 24-week testing period. Thus far, one participant in the control condition (female), dropped out at Week 3. We do not have performance or physiological data for Aim 3, as yet. However, initial data on team perceptions and feelings toward one's SG partner indicate that when subjects feel a connection to the partner, they identify more as a team (r = .56) and have more confidence in their partners to help them achieve their own goals (r = .32). Impact of Key Findings on Hypotheses, Technology Requirements, Objectives, and Specific Aims: Aim 2: The preliminary findings in Aim 2 provided the basis to continue building on the conjunctive task condition, enhance the design effects of the training game, and make the dialogue with the SG partner more interactive. Proposed Research Plan for the Coming Year: In Year 3, we will continue to pursue Aim 3 with a second cohort, using the same research and training design. Because of summer vacations, we most likely will need to stagger the start dates for subjects, and thus, will not try to change any design aspects of the study.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Exercising for purely personal concerns (for improving health, losing weight, physical rehabilitation, etc.) can be a powerful motivator to continue exercise and to exercise at intensity levels high enough to realize greater health benefits, but interpersonal and social concerns (for comparing favorably with others or for not letting a partner down) have the potential to add equally powerful new sources of motivation. These sources of motivation could open up a powerful set of new tools in exercise video game design for fitness especially for those with social physique anxiety, those who lack the time and/or resources to join an exercise group, and those in exercise rehabilitation therapies. Although current commercial exercise video games have been shown to have some health benefit in terms of increased caloric expenditure and cardiorespiratory endurance, few games have been based on theoretical knowledge of exercise motivation. Moreover, none of the extant exercise games (e.g., Wii Fit, PS-2's EyeToy: Kinetic) incorporate the critical design features suggested by contemporary social psychological research, particularly research on motivation gains in task groups (viz., immediate feedback on performance of one or more other players, the ability to control the discrepancy in abilities of players, and most importantly, the indispensability of individual player effort for determining team outcomes). Thus, our research has the potential for Earth-based commercial applications to build more engaging and enjoyable exercise video games for various populations.

Task Progress:	The major emphasis in Year 2 was first to conduct Study 1, a 6-day pilot study (Aim 2), using our Train Like an Astronaut exergame. Second, we used information from Study 1 to further develop the game software, software-generated partners, software-generated trainers, and partner communications for Study 2, a 24-week study (Aim 3). Third, we are conducting Study 2 with the first cohort of subjects. Study 1 involved two aerobic training routines in our exergame: (a) 30 min. of continuous aerobic exercise on a stationary bike at 75% VO2 max, and (b) high-intensity interval training involving 4 repetitions of 4 min. at 90% VO2 max with 3 min. active rest between intervals. We have collected and analyzed data on 44 subjects (female = 25) in Study 1. We surpassed the number of women we hoped to recruit to the study, and subjects were similar in age (M = 49.31; SD = 7.77) and aerobic fitness to experienced astronauts. We were not able to recruit as many subjects as we wanted before our deadline for starting Study 2 (Aim 3), but had enough data and feedback from subjects to design the long-term study (Study 2). For Study 2, we varied the scenery of the bike paths, added interactive dialogue with the partner in the introduction phase, allowed the subject to match the partner's exercise intensity for longer periods of time during sessions, and made the connection between subject and partner more obvious. Study 2 involved two additional high intensity training routines in our exergame: (a) 8 repetitions of 30 s sprints and (b) 6 repetitions of 2-min. each in a ladder fashion of 70, 80, 90, 100, 90, 80% VO2max intervals. High intensity sessions are alternated with 30 min. of continuous aerobic sessions for 6 days per week of training for the 24-week study. Study 2 data collection began in January, 2015, with a cohort of 23 subjects (female = 11, including one dropout). Subjects are similar in age (M = 46.74; ± = 6.95) and aerobic fitness to experienced astronauts. Baseline and midway fitness data have been collected as well as measures of enjoyment, self-efficacy, perceived autonomy, and social connectedness. We are a little more than halfway through data collection for this first cohort and expect to have the second cohort going by July.
Bibliography Type:	Description: (Last Updated: 02/11/2021)
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