Fiscal Year:	FY 2014	**Task Last Updated:**	FY 06/06/2014
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 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
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No. of PhD Candidates:	3	**No. of Master' Degrees:**	0
No. of Master's Candidates:	1	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	4	**Monitoring Center:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:			
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		
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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; (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 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: We have completed Aim 1 (developing SG exercise partners, interfaced with stationary bikes) to be used in Aim 2. We first demonstrated the software to a small group of astronauts and physical trainers at the Johnson Space Center to help refine the look of the SG partner and then conducted focus groups of highly active male and female athletes/exercisers over 35 years of age to further refine the appearance of the SG partners, the appearance of the exergame interface, and the nature and quality of interactions between participants and their SG partners (e.g., detail of introductions, greetings). Results showed that focus group participants desired a virtual partner who appeared to be fit but not overly muscular and were dressed age-appropriately. Females preferred partners who had muscle tone yet remained feminine while males indicated they wanted a partner who was both a peer and in appropriate shape for the task. Both males and females wanted the option of choosing their SG partner. Males focused on choosing a partner based on the specific workout while females focused on gender, ethnicity, and age. Lastly, in terms of the game interface, both genders preferred realistic scenery that matched the task to be completed (i.e., for a long, continuous bike ride participants preferred outdoor scenery and sounds vs. a track or velodrome simulation for interval training cycling). After conducting focus groups, the games were pilot tested on a convenience sample of eight highly active university students who played the game (i.e., rode a stationary bike on a simulated bike path) for 30 min. each day for 6 days. The first day was without the game and Days 2 – 6 were with the game. Watts (units for cycle power output) was the dependent measure of intensity. Preliminary results showed that participants put forth more effort when they cycled with an exercise video game on Days 2-6 than they did cycling alone without a game. Further, the Watts in the game environment stayed consistently higher. Impact of Key Findings on Hypotheses, Technology Requirements, Objectives, and Specific Aims: We had no hypotheses for Aim 1. However, our focus group findings suggest that participants want SG partners who look more like themselves. Our pilot work suggests that riding a stationary bike on simulated bike path results in more effort than riding without the simulation. Proposed Research Plan for the Coming Year: In Year 2, we will pursue Aims 2 and 3, first testing various design features of the SG partner in a short-term study (6 days) to determine the most effective partners to enhance exercise intensity. We will present an SG exercise partner in one of three modes: (a) a coacting mode, where the subject cycles with the SG partner but whose performance is independent of the SG partner (i.e., they are not teammates); (b) a conjunctive-teammate mode, where scores are based on the slower/weaker performer; and (c) a choice mode that has the option for the participant to choose coacting mode or conjunctive teammate mode for all trials. The experiment will use the aerobic routines developed by Ploutz-Snyder that consist of (a) 30 min. of continuous aerobic exercise on a stationary cycle at 75% heart rate max and (b) high-intensity interval training involving several repetitions of 4 min. at 90% heart rate max. Based on findings from the short-term study, we will design the long-term study to test how well the motivation gains we expect to find will persist across a 24-week period using a combination of the 30 min. continuous and various interval routines.
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 during Year 1 involved the development of the software to create a computerized version of a more capable exercise partner for stationary cycling training in two different modes: coaction or no interdependence and teammate or interdependent mode. First, male and female software-generated (SG) partners were developed to portray them as physically fit and roughly the mean age (48 years) of a long-duration crew member. The SG models were textured, rigged (i.e., attaching a skeleton system to a model), and animated to create life-like male and female humanoid characters. Male and female versions of the SG partner were demonstrated to a small group of astronauts and physical trainers at the Johnson Space Center to help refine their appearance and obtain ideas for the appearance of the stationary cycling exergame interface (i.e., a scenic bike trail, a velodrome track). Next, a second version of the SG partners was developed based on conversations with astronauts and Johnson Space Center trainers and exergame interfaces were developed to test with focus groups of highly active male and female athletes/exercisers over 35 years of age. Same-gendered focus groups viewed different versions of SG partners, the appearance of the exergame interface, and the nature and quality of interactions between participants and their SG partners (e.g., detail of introductions, greetings). Once the appearance, interactions of the SG partners, and appearance of the exergame were finalized, the custom software was designed to interfaced with a cycle ergometer (Monark LC4 stationary bike), as the cycle did not

	support a standard protocol such as ANT+. Originally, our software was designed to have the resistance of the bike fixed and use RPM as the dependent variation. However, we discovered that the resistance on the Monark LC4 bike could not be adjusted directly, rather Watts could be set and the bike auto-adjusted the resistance based on the current RPM. Adjustments were made using our software so that Watts were used as the dependent variable of intensity, where the participant can manually increase Watts via a keypad attached to the stationary cycle to keep up with the SG partner in the exergame. Two exergames were developed based on Ploutz-Snyder's aerobic training routines: (a) 30 min. of continuous aerobic exercise on a stationary cycle at 75% heart rate max and (b) high-intensity interval training involving several repetitions of 4 min. at 90% heart rate max. The exergames were pilot tested on a convenience sample of eight highly active university students who played the game (i.e., rode a stationary cycle on a simulated bike path) for 30 min. each day for 6 days. The first day was without the game and Days 2 – 6 were with the game. Watts was the dependent measure of intensity. The exergames are now ready for Study 1 (in Aim 2) and testing has begun.
Bibliography Type:	Description: (Last Updated: 02/11/2021)
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