GAMES FOR HEALTH JOURNAL: Research, Development, and Clinical Applications
Volume 7, Number 4, 2018

DOI: 10.1089/g4h.2017.0132

Original Article

Efficacy of the Fun For Wellness Online Intervention to Promote Well-Being Actions: A Secondary Data Analysis

Nicholas D. Myers, PhD,[1] Samantha Dietz, PhD,[2] Isaac Prilleltensky, PhD,[2] Ora Prilleltensky, PhD,[2] Adam McMahon, MS,[2] Carolyn L. Rubenstein, PhD,[3] and Seungmin Lee, MS[1]

Abstract

Objective: Fun For Wellness (FFW) is a new online intervention designed to promote growth in well-being by providing capability-enhancing learning opportunities (e.g., play an interactive game) to participants. The purpose of this study was to provide an initial evaluation of the efficacy of the FFW intervention to increase well-being actions.
Materials and Methods: The study design was a secondary data analysis of a large-scale prospective, double-blind, parallel-group randomized controlled trial. Data were collected at baseline and 30 and 60 days post-baseline. A total of 479 adult employees at a major university in the southeast of the United States of America were enrolled. Participants who were randomly assigned to the FFW group were provided with 30 days of 24-hour access to the intervention. A two-class linear regression model with complier average causal effect estimation was fitted to well-being actions scores at 30 and 60 days.
Results: Intent-to-treat analysis provided evidence that the effect of being assigned to the FFW intervention, without considering actual participation in the FFW intervention, had a null effect on each dimension of well-being actions at 30 and 60 days. Participants who complied with the FFW intervention, however, had significantly higher well-being actions scores, compared to potential compliers in the Usual Care group, in the interpersonal dimension at 60 days, and the physical dimension at 30 days.
Conclusions: Results from this secondary data analysis provide some supportive evidence for both the efficacy of and possible revisions to the FFW intervention in regard to promoting well-being actions.

Keywords: Complier average causal effect modeling, Intent to treat, I COPPE actions scale

Introduction

There is evidence that online interventions can improve well-being.[1–4] Some programs target only an aspect of physical or mental health,[2,3] whereas others address also interpersonal, community, occupational, and economic well-being.[4] Even though most domains of well-being are significantly correlated, it is important to seek avenues to improve each individual dimension of well-being because there is both psychometric and substantive evidence for the utility of multidimensional conceptualizations of well-being—even in the presence of correlations between individual dimensions of well-being.[5] The conceptual framework for well-being used in this article is consistent with a more general view that well-being can be conceptualized as entailing satisfaction with life as a whole and with specific subdomains of well-being.[6–9]

It is interesting to note that many online programs evaluate outcomes in terms of perceptions of well-being (e.g., rate your current satisfaction with your physical wellness). In our view, it is also important to assess outcomes in terms of well-being actions (e.g., how many days per week do you engage in moderate physical activity for at least 30 minutes and how often do you engage in mindful meditation as a way to combat stress). Online well-being interventions, therefore, should seek to change not just perceptions of well-being but also well-being actions. Some individuals who receive a well-being intervention may report improvements in how they perceive their own level of well-being, but these impressions may not be accompanied by behavioral changes, such as exercising more or eating more fruits and vegetables. Other individuals who receive a well-being intervention may report improvements in actions associated with well-being,

[1]Department of Kinesiology, Michigan State University, East Lansing, Michigan.
[2]School of Education and Human Development, University of Miami, Coral Gables, Florida.
[3]Department of Educational and Psychological Studies, University of Miami, Coral Gables, Florida.

such as mindfulness meditation, but may not report improvements in their perceptions of psychological well-being or levels of stress. In light of the possible complexities involved in producing change in various dimensions of well-being, and capturing them in reliable ways, we recommend measuring both perceptions of well-being and well-being actions.

As will be shown below, the literature on well-being outcomes tends to focus mainly on perceptions of well-being. Based on the need to promote well-being in multiple domains of life, the importance of measuring actions and not just perceptions, and the significance of developing games with multiple design features to attract various types of users,[10] we developed the Fun For Wellness (FFW) online intervention. Following a brief literature review on the impact of online interventions on perceptions and outcomes, we describe FFW and the specific objectives of this study.

The impact of online interventions on perceptions and outcomes across multiple domains of well-being

Well-being is conceptualized as a multidimensional construct in some recent studies.[4,5] In our review, we follow Prilleltensky et al.[5] in their definition of well-being as consisting of six interconnected domains: Interpersonal, Community, Occupational, Physical, Psychological, and Economic (I COPPE). We found that most online programs address perceptions, with very few measuring actions. Interventions targeting the promotion of interpersonal well-being (e.g., positive relationships, conflict resolution, and partner support) typically measured perception outcomes such as depression, relationship satisfaction, happiness, and romantic passion[11–13] rather than behavioral outcomes. One computer-based program found significant improvements in communication behaviors in a sample of young adults.[14]

When it comes to community well-being, we found a randomized controlled trial (RCT) of a 4-week e-learning mental health first aid intervention (computer CD). Participants who reviewed the content from the CD increased their use of community-based ''helper behaviors'' such as listening to people's problems and calming them down at 6 months postbaseline.[15] Although this was a computer-based program, it did not include game features. A review and meta-analysis of web-based psychological interventions delivered at the workplace described studies with outcomes measuring participant perceptions (e.g., work-related stress, work effectiveness, and psychological well-being) rather than work-related actions.[16]

Previous online intervention studies to promote physical well-being tended to measure actions such as healthy eating habits[17] and physical activity levels.[18,19] Small overall mean effects for interventions to promote physical activity have been reported in meta-analyses of online interventions that included goal setting, education, self-monitoring, and quizzes.[19,20] Children aged 10–12, between the 50th and 95th percentile for body mass index, who played videogames designed as epic adventures to promote healthy diet and physical activity behaviors, significantly increased their fruit and vegetable intake compared to controls.[21] Support has been found for moderate improvements in physical activity levels in youth who play videogames requiring physical activity (e.g., dancing or jumping) during the short term, but it is still unclear as to whether or not these games, generically called exergames, use leads to an increase in habitual physical activities for players.[22] Overall, research supports the use of exergames to improve weight-related outcomes when participants enact physical activities through a virtual format.[23,24] A systematic review of 29 studies of internet-based worksite wellness programs that varied in intervention type and components, found little to no support for improvement in physical activity outcomes.[18]

In terms of psychological well-being, studies typically measured only perceptions (e.g., happiness, stress, anxiety, depression, subjective well-being, gratitude, confidence in the future, and mindfulness).[25–29] For instance, one RCT of a smartphone/internet-based well-being program noted larger decreases in depression scores between intervention participants and controls.[2] Another RCT found support for an online intervention for anxiety management. This intervention taught action-oriented breathing exercises. Perception outcomes of anxiety, panic, hyperventilation symptoms, and quality of life were measured, but no action outcomes were reported (e.g., breathing practice behaviors).[29] In short, most studies we reviewed did not assess actions such as frequency of mindful meditation, cognitive reframing, or problem-solving actions aimed at reducing stress.[30,31] With respect to economic well-being, we could only locate online interventions measuring either perceptions (e.g., depression and health-related quality of life) or health behavior outcomes (e.g., tobacco and alcohol use), not behaviors related to saving money or taking steps to improve financial well-being.[32,33]

Overall, we can see that few studies measured actions across different domains of well-being, and not all online interventions were designed to induce fun or pleasure. While some actions might have been undertaken to obtain positive outcomes such as weight loss, we believe it is important to target and measure specific behaviors that drive a health-related change. In addition, we believe it is important to experiment with more engaging and fun online activities.[10] This study aimed to promote and evaluate behavioral and perceptual change in different domains of well-being through a new psychoeducational game.

Fun For Wellness

Although several online games have proven effective in promoting an aspect of well-being,[2,34] we could not identify one game that addresses concurrently multiple domains of well-being and combines several modalities of fun and learning using complementary theories of change. Consequently, FFW (see www.funforwellness.com) was created to (1) promote well-being in multiple domains of life (I COPPE), (2) leverage complementary theories of change, and (3) maximize user engagement through a combination of scenario-based and fun activities in a psychoeducational game.[4] Appendix Table A1 provides key characteristics of the FFW intervention.[35] In an effort to cover the major domains of well-being, FFW addresses all the I COPPE domains through 32 vignettes, 16 short educational videogames, and multiple self-reflection and mini coaching sessions. Overall, there are 152 challenges dealing with various aspects of well-being.

FFW is based on self-efficacy theory[36] and seven drivers of change summarized in the acronym BET I CAN (behaviors, emotions, thoughts, interactions, context, awareness, and next steps). Each one of these drivers has considerable support from diverse bodies of research in behavior modification,

positive psychology, cognitive behavioral therapy, social support, behavioral economics, knowledge-based influence, and stages of change.[4,37] Users learn two key skills associated with each BET I CAN driver of change. For example, in the module dealing with emotions, players learn how to ''collect positive emotions'' and ''cope with negative emotions.''

Purpose of this study

FFW has been found effective in improving *perceptions* of well-being in four domains of life: interpersonal, community, psychological, and economic.[4] In this study, we evaluate the degree of initial supportive evidence for the efficacy of the FFW intervention to increase well-being *actions* in a universal sample (i.e., participants were not selected based on distress or risk level). In light of the shortage of studies evaluating the impact of online games on actions, we believe it is important to specifically target the potential effect of FFW on behaviors related to various domains of well-being. A priori hypotheses regarding the efficacy of the FFW intervention to increase well-being actions, however, were not specified because this was the initial evaluation of the efficacy of FFW intervention to influence well-being actions.

Materials and Methods

Design

The study design was a secondary data analysis of a large-scale prospective, double-blind, parallel-group RCT.[4] The results reported in subsequent sections of this article were viewed by the authors of this article as an empirical study of original research because empirical studies of original research include ''secondary analyses that test hypotheses by presenting novel analyses of data not considered or addressed in previous reports.''[38(p10)] The well-being action data reported in subsequent sections as primary outcomes have not been considered in any previous report. The covariates and compliance data briefly reported in subsequent sections of this article, however, have been considered in previous reports.[4,37] Because all of the aforementioned data within this paragraph were collected within the same large-scale RCT, we provide only an overview of the study design and methods and refer readers to a previous report for a fuller description of the study design, methods, and data collection details (e.g., participant flow from screening to randomization to retention).[4]

The intervention. An overview of some key features of the FFW intervention is provided to contextualize the summary of the study design that follows. The target audience of the FFW intervention is the adult population who would be comfortable with the online platform within which FFW is delivered. The issue targeted by the FFW intervention is the promotion of multidimensional well-being. Self-efficacy theory provided the theoretical framework that guided the creation of 152 capability-enhancing learning opportunities (i.e., challenges) for participants to engage with. The challenges in the FFW intervention were designed to promote growth in well-being and require participants to do one or more of the following activities: play an interactive game; watch a vignette performed by professional actors; listen and/or read a mini-lecture narrated by a coach; and engage in a self-reflection exercise and/or a chat room.

Permissions. The institutional review board at the University of Miami provided necessary permission to conduct the study, IRB No. 20150237. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and the 1964 Helsinki declaration and its later amendments, or comparable ethical standards. All eligible employees at a major research university in the southeast of the United States of America were recruited through e-mails that they received from the Human Resources department. Eligibility criteria were (1) greater than or equal to age 18 years and (2) employed at the University. Participants had to be employed by the University so that (1) participants were sampled from the intended population and (2) access to the intervention was controlled in accord with the eligibility criteria. Participants were told that they would be assigned to one of two online well-being interventions. Informed consent was obtained by an electronic signature from each of the individual participants included in the study. More specifically, immediately after passing the inclusionary criteria, screened respondents were presented with the IRB approved consent form to read and sign electronically. Those who clicked ''decline to consent'' were locked out of the remaining program activities.

Procedures. Recruitment, eligibility verification, and data collection were conducted online. Data on proposed demographic covariates of well-being were collected at baseline (T1) and included participant gender, age, race, education level, marital status, and salary.[39] Well-being actions data were collected at T1, 30 days post-baseline (T2), and 60 days postbaseline (T3). Upon completion of the battery, each participant received an Amazon electronic gift card worth $10 at T1, an additional $15 at T2, and an additional $25 at T3. Participants were randomly assigned to the intervention (FFW) or usual care (UC) groups by a computer software that was specified to achieve a 1:1 group (i.e., FFW:UC) assignment, which, in practical terms, sought a random allocation of an equal number of participants to both groups. Upon assignment to the UC group, a participant was given a unique and secure log-in that provided 30 days (i.e., from T1 to T2) of 24-hour access to a webpage that provided links to several well-established and freely available websites (e.g., www.centreforconfidence.co.uk/flourishing-lives.php?pid=454) that focused on well-being. A complete list of the links that were provided to participants assigned to the UC group is available upon request to the corresponding author.

Upon assignment to the FFW group, a participant was given a unique and secure log-in that provided 30 days (i.e., from T1 to T2) of 24-hour access to 152 capability-enhancing learning opportunities (i.e., challenges) that were designed to promote growth in well-being. Each of the 152 challenges was designed by the FFW research team and required participants to do one of the following activities: (1) play an interactive game; (2) watch a vignette performed by professional actors; (3) listen and/or read a mini-lecture narrated by a coach; and (4) engage in a self-reflection exercise and/or a chat room. Four challenges focused on introductory material (e.g., orientation to the website and an introduction to the characters that appear in the vignettes)

and had to be completed to gain access to the remaining 148 postintroductory challenges. Postintroductory challenges were organized on the website by the seven proposed BET I CAN drivers of potential change in multidimensional well-being. Participants were not told how many challenges to complete and self-selected which postintroductory challenges to complete. Challenges completed by each participant were tracked by computer software to provide data for a participation scoring system. This tracking was possible because accessing the intervention always required each participant to use her/his unique and secure log-in information.

Participants

A total of 479 eligible participants were randomized to UC ($n = 242$) or FFW ($n = 237$). A total of 462 participants, which was equal to 96.5% of participants who were randomized, provided at least partial data during the RCT ($n_{UC} = 226$ and $n_{FFW} = 236$). A total of 429 participants, which was equal to 89.6% of participants who were randomized, provided data at T1 ($n_{UC} = 217$ and $n_{FFW} = 212$). A total of 303 participants, which was equal to 63.3% of participants who were randomized, provided data at T2 ($n_{UC} = 163$, $n_{FFW} = 140$). A total of 267 participants, which was equal to 55.7% of participants who were randomized, provided data at T3 ($n_{UC} = 161$, $n_{FFW} = 126$). There were no statistically significant differences in the demographic characteristics (i.e., gender, race, ethnicity, education level, marital status, and salary) by the randomization group. A majority of the participants ($M_{age} = 41.75$, $SD_{age} = 11.67$) were full-time employees (96.6%), female (76.0%), Hispanic or White, non-Hispanic (81.8%), and earned a salary greater than or equal to $50,000 (65.3%). Approximately one-half of the participants had a graduate degree (48.2%) and were married (47.8%).

Well-being actions

Well-being actions were measured with the 12 items that define the I COPPE actions scale at T1, T2, and T3.[40] Validity evidence for close model-data fit, $\chi^2(39) = 82.98$, $P < 0.001$, RMSEA = 0.05 (90% confidence interval [CI] = 0.04–0.07), $P = 0.42$, TLI = 0.94, CFI = 0.96, SRMR = 0.04, of the proposed measurement model for responses to the I COPPE actions scale at T1 has been reported.[40] Each of the six dimensions of well-being actions—interpersonal, community, occupational, physical, psychological, and economic—was measured with two items. For example, the two items for interpersonal well-being actions were (1) *engage in positive interactions with people close to you* and (2) *make attempts to repair relationships following conflict*. Each of the 12 items began with the same item stem: *how often do you*. Responses to all items followed a 5-category rating scale structure: from 0 (*very rarely or never*) to 4 (*very often or always*) (see Appendix Table A2 for I COPPE Action Scale item content). An average observed score for each of the six dimensions of well-being actions was created and was consistent with previous research.[4,37] The test-retest reliability coefficient, as measured by the intraclass correlation coefficient, ranged from 0.79 (interpersonal) to 0.93 (economic). As depicted in Table 1, there were no statistically significant differences in mean well-being actions scores at T1 (or T2 or T3) for participants by the randomization group.

Compliance

The operational definition for compliance with the FFW intervention was based on the FFW compliance scoring system, where the impact of completing a particular challenge was first classified as low (7 points), moderate (14 points), or high (21 points), and then participation points were further allocated by the dimension of well-being action that the challenge was focused on.[4]

For example, completing challenge 6 earned a participant 7 participation points in physical well-being actions because this challenge was classified as low impact and focused on physical well-being only.

More broadly, the definition of full participation was based on both substantive (e.g., it would take ~ 2 hours of interacting with the FFW intervention to earn sufficient participation points) and methodological (e.g., the presence of some compliers) considerations.[41] More specifically, full participation was defined as (1) completing the four introductory challenges and (2) earning at least 21 additional participation points by completing challenges related to a particular dimension of well-being actions. In summary, while our definition of compliance was undoubtedly imperfect, it was consistent with both relevant methodological recommendations[41] and measurement of compliance in previous research on the FFW intervention.[4] Limitations related to the measurement of compliance will be provided in the Discussion section.

The number of participants randomized to the FFW group and classified as a complier varied by dimension of well-being actions and ranged from 37 (or 15.6%) for community well-being actions to 120 (or 50.6%) for physical well-being actions. A comparison of observed demographic characteristics and well-being actions scores at baseline for participants who were randomized to the FFW group by compliance classification revealed that 6 out of 48 of these comparisons were statistically significant. The proportion of females was significantly larger in the complying group compared to the noncomplying group for community (i.e., 89.2% vs. 72.5%), psychological (i.e., 86.7% vs. 71.2%), and economic (i.e., 89.7% vs. 72.2%) well-being actions. The proportion of participants earning a salary $\geq$ $50,000 was significantly smaller in the complying group compared to the noncomplying group for community (i.e., 45.9% vs. 68.0%) and economic (i.e., 48.7% vs. 67.7%) well-being actions. The proportion of married participants was significantly smaller in the complying group compared to the noncomplying group for community well-being actions (i.e., 24.3% vs. 50.5%). As depicted in Table 2, there were no statistically significant differences in mean well-being actions scores at T1 for participants who were randomized to the FFW group by compliance classification (i.e., compliers vs. noncompliers).

Data analytic approach

Three general models were fit in M*plus* 7.4 under maximum-likelihood (ML) estimation with robust standard errors.[42] The primary purpose of each model was to estimate the effect of the FFW intervention to increase well-being actions over time and under some alternative model specifications.[43] Model 0 estimated the effect of being assigned to the FFW intervention, that is the intent-to-treat (i.e., γ) effect.[44] Model 1 estimated the effect of being assigned to the

Table 1. Comparison of Well-Being Actions Scores for Participants by Randomization Group

Variable	*Usual care*		*Fun For Wellness*		P *value of difference*	*Cohen's* d *(95% CI)*
	M	*SD*	*M*	*SD*		
Baseline (time 1)						
Interpersonal WB actions	3.04	0.70	3.06	0.67	0.810	0.03 (–0.16 to 0.22)
Community WB actions	1.50	1.02	1.58	1.02	0.427	0.08 (–0.11 to 0.26)
Occupational WB Actions	3.40	0.60	3.45	0.57	0.373	0.09 (–0.10 to 0.27)
Physical WB actions	2.31	1.05	2.26	1.03	0.753	–0.05 (–0.23 to 0.14)
Psychological WB actions	2.57	0.79	2.58	0.84	0.763	0.01 (–0.17 to 0.20)
Economic WB actions	2.47	0.97	2.40	0.94	0.447	–0.07 (–0.26 to 0.11)
30 days (time 2)						
Interpersonal WB actions	3.08	0.69	3.09	0.63	0.913	0.02 (–0.17 to 0.20)
Community WB actions	1.52	1.06	1.61	1.01	0.457	0.09 (–0.10 to 0.27)
Occupational WB actions	3.35	0.58	3.33	0.60	0.945	–0.03 (–0.22 to 0.15)
Physical WB actions	2.35	0.98	2.41	0.97	0.519	0.06 (–0.12 to 0.25)
Psychological WB actions	2.63	0.77	2.65	0.75	0.782	0.03 (–0.16 to 0.21)
Economic WB actions	2.52	0.96	2.44	0.91	0.282	–0.09 (–0.27 to 0.10)
60 days (time 3)						
Interpersonal WB actions	3.00	0.68	3.12	0.63	0.119	0.18 (0.00 to 0.37)
Community WB actions	1.60	1.04	1.68	1.01	0.467	0.08 (–0.11 to 0.26)
Occupational WB actions	3.32	0.61	3.38	0.55	0.327	0.10 (–0.08 to 0.29)
Physical WB actions	2.40	0.89	2.49	1.00	0.449	0.10 (–0.09 to 0.28)
Psychological WB actions	2.69	0.73	2.71	0.74	0.829	0.03 (–0.16 to 0.21)
Economic WB actions	2.46	0.92	2.47	0.97	0.871	0.01 (–0.18 to 0.20)

CI, confidence interval; WB, well-being.

FFW intervention for those who fully participated in the FFW intervention (i.e., γ_c). Model 2 estimated γ_c and the effect of being assigned to the FFW intervention for those who did not fully participate in the FFW intervention (i.e., γ_{nt}). Model 1 and Model 2 employed complier-average causal effect (CACE) estimation, where noncompliers were conceptualized as never-takers consistent with CACE methodology-based assumptions detailed in relevant literature.[45–47]

Model 1 relied on a set of key assumptions to estimate γ_c and these CACE methodology-based assumptions are briefly summarized in this paragraph.[45–48] First, the stable unit treatment value assumption was adopted and implied that well-being actions at T2 and T3 for each participant were not affected by the treatment assignment of any other participant.[48] Second, it was assumed that being given the opportunity to participate was randomly assigned. Third, it was assumed that being assigned to the FFW intervention would induce at least some of these individuals to fully participate. Fourth, the monotonicity assumption was adopted and implied that assignment to the FFW group could only increase participation in the intervention (i.e., there were no defiers). Finally, the exclusion restrictions were adopted and implied that there was no effect of treatment group assignment for never-takers (i.e., individuals who would not participate in the FFW intervention irrespective of group assignment) or always-takers (i.e., individuals who would participate in the FFW intervention irrespective of group assignment). Furthermore, the fact that the study design required a participant to have a unique and secure log-in to access the FFW intervention may have made the presence of always-takers unlikely in the UC group. Model 2 removed the exclusion restriction for never-takers and estimated γ_{nt}.

Effect size and missing data. In each of the models, an effect size was calculated by dividing the mean difference by the square root of the variance pooled across the UC and FFW groups. This effect size was equal to Cohen's *d* (1988) in Model 0 and was viewed as an analog to Cohen's *d* in Model 1 and Model 2 in a mixture model framework.[43] For the sake of continuity, we refer to the effect size as Cohen's *d* throughout the article and we adopt commonly

Table 2. Comparison of Well-Being Actions Scores at Baseline for Participants who were Randomized to the Fun For Wellness Group by Compliance Classification

Variable	*Compliers*			*Noncompliers*			P *value of difference*	*Cohen's* d *(95% CI)*
	n	*M*	*SD*	n	*M*	*SD*		
Interpersonal WB actions	64	3.08	0.74	173	3.05	0.65	0.789	0.04 (–0.24 to 0.33)
Community WB actions	37	1.71	1.05	200	1.56	1.01	0.529	0.15 (–0.20 to 0.50)
Occupational WB actions	77	3.53	0.54	160	3.42	0.57	0.184	0.20 (–0.08 to 0.47)
Physical WB actions	120	2.32	1.07	117	2.20	0.97	0.382	0.12 (–0.14 to 0.37)
Psychological WB actions	60	2.65	0.84	177	2.56	0.83	0.445	0.11 (–0.19 to 0.40)
Economic WB actions	39	2.45	0.96	198	2.39	0.93	0.807	0.06 (–0.28 to 0.41)

used heuristics to assist in the interpretation of an absolute value of Cohen's *d*: 0.20 (small), 0.50 (medium), and 0.80 (large).[49] Missing data were initially handled with a full information ML approach under the assumption that data were missing at random (MAR), conditional on the observed data.[50]

Type I error rate. Type I error rate was set to equal 0.05 for each null hypothesis test. No adjustment was made for familywise error rate, given that the study design was a secondary data analysis of an RCT with multiple secondary outcomes.[51] To address, however, a reasonable concern with the possibility of an inflated type I error rate, when statistical significance was observed for a focal parameter (e.g., mean difference on a dimension of well-being actions), we emphasized estimates of Cohen's *d*; provide a 95% CI for Cohen's *d*; and, explicitly note, in this study, that caution should be exercised with regard to observed statistical significance until confirmatory studies become available in the future.[51]

Model 0 in more detail. Model 0 imposed a regression model for each dimension of well-being actions with well-being actions at T2 and T3 as the outcome variables. The demographic covariates, well-being actions at T1 and group assignment (UC = 0, FFW = 1), were specified as predictors of well-being actions at T2 and T3 and these regression coefficients were freely estimated. The intercepts for well-being actions at T2 and T3 were freely estimated. Residual (co-)variance between well-being actions at T2 and T3 was freely estimated. The direct effects from group assignment to well-being actions at T2 (γ_{T2}) and T3 (γ_{T3}) were the focal parameters and a positive value indicated that the FFW group had a higher adjusted mean for well-being actions compared to the UC group. The expression ''adjusted mean,'' is used to acknowledge the statistical adjustment made by including the covariates in the model. Model 0 can be summarized in equation form for participant *i* as follows:

$$y_i = \alpha + \gamma z_i + \lambda_1 x_{1i} + \lambda_2 x_{2i} + \lambda_3 x_{3i} + \lambda_4 x_{4i} + \lambda_5 x_{5i} + \lambda_6 x_{6i} + \lambda_7 x_{7i} + \lambda_8 x_{8i} + \varepsilon_i, \text{ where} \quad (1)$$

y_i is a dimension of well-being actions at T2 or T3,
α is an intercept,
γ is the intent-to-treat effect,
z is treatment assignment (UC = 0 and FFW = 1),
λ_k is the regression coefficient for the *k*th covariate,
x_1 is the relevant dimension of well-being actions at T1,
x_2 is female (male = 0 and female = 1),
x_3 is age,
x_4 is Hispanic (not Hispanic = 0 and Hispanic = 1),
x_5 is White non-Hispanic (not White non-Hispanic = 0 and White non-Hispanic = 1),
x_6 is graduate degree (no graduate degree = 0 and graduate degree = 1),
x_7 is married (not married = 0 and married = 1),
x_8 is salary (<$50,000 = 0 and $\geq$ $50,000 = 1) and
ε_i is the residual.

In Equation 1 and in subsequent equations, we adopted a notation system used in previous research.[43] For textual parsimony, only unique notations are defined from this point forward.

Model 1 in more detail. Model 1 imposed a two-class regression model with CACE estimation for each dimension of well-being actions, with well-being actions at T2 and T3 as outcome variables. Class 1 was conceptualized as the never-taking class. Class 2 was conceptualized as the complier class. A binary latent class indicator was created where compliers (i.e., at least 21 postintroductory participation points) in the FFW group had a value of 1, noncompliers (i.e., less than 21 postintroductory participation points) in the FFW group had a value of 0, and participants in the UC group had a missing value. The categorical latent variable representing compliance classification was regressed on the demographic covariates. The demographic covariates, well-being actions at T1 and group assignment, were specified as predictors of well-being actions at T2 and T3 and these regression coefficients were freely estimated in each class. The two direct effects from group assignment to well-being actions at T2 and T3 were fixed to 0 in Class 1 (i.e., the exclusion restrictions: $\gamma_{ntT2} = \gamma_{ntT3} = 0$), and were freely estimated in Class 2 (i.e., γ_{cT2} and γ_{cT3}). The intercepts for well-being actions at T2 and T3 were freely estimated in each class. Residual (co-)variances for well-being actions at T2 and T3 were freely estimated in each class. The direct effects from group assignment to well-being actions at T2 and T3 in Class 2 (i.e., γ_{cT2} and γ_{cT3}) were the focal parameters and a positive value indicated that compliers in the FFW group had a higher adjusted mean for well-being actions compared to potential compliers in the UC group. The ''potential complier'' phrase is commonly used in CACE modeling to acknowledge that, while an estimate of the proportion of compliers is directly observed in the treatment group (i.e., FFW group in this article), this value is unobserved (although mathematically assumed to be equal to the value observed in the treatment group due to random assignment) in the control group (i.e., UC group in this article).[41]

The logistic regression of compliance for each dimension of well-being on the demographic covariates within Model 1 can be summarized in equation form as follows:

$$\begin{aligned} P[i \in C(c)|\mathbf{x}_i] &= \pi_{ci} \\ P[i \in C(n)|\mathbf{x}_i] &= 1 - \pi_{ci} \\ logit(\pi_{ci}) &= \beta_0 + \boldsymbol{\beta}'\mathbf{x}_i, \end{aligned} \quad (2)$$

where *c* is complier, π_{ci} is the probability of being a complier for participant *i*, *n* is never-taker, $\mathbf{x}_i$ is a vector of demographic covariates (i.e., x_2 through x_8 as defined in Equation 1) for participant *i*, β_0 is an intercept, and $\boldsymbol{\beta}$ is a vector of regression coefficients.

Building off Equation 2, and letting $c_i = 0$ and $n_i = 1$ if $i \in C(n)$, and $c_i = 1$ and $n_i = 0$ if $i \in C(c)$, the outcome regression model for each dimension of well-being within Model 1 for participant *i* with compliance status c_i and n_i can be summarized in equation form as follows:

$$y_i = \alpha_n n_i + \alpha_c c_i + \gamma_{nt} n_i z_i + \gamma_c c_i z_i + \boldsymbol{\lambda}'_n n_i \mathbf{x}_i + \boldsymbol{\lambda}'_c c_i \mathbf{x}_i + \varepsilon_{in} n_i + \varepsilon_{ic} c_i, \quad (3)$$

where subscripts *n* and *c* denote the never-taker class and the complier class, respectively, γ_c is the $CACE_c$ effect, and γ_{nt} is the $CACE_{nt}$ effect, and is fixed to zero in Model 1.

Model 2 in more detail. Model 2 estimated all the parameters specified in Model 1, while removing the exclusion restriction for never-takers. More specifically, the γ_{nt} (i.e., the $CACE_{nt}$ effect) in Equation 3 was freely estimated in Model 2 along with all of the other parameters estimated in Model 1. Model 1 was nested within Model 2 and these models were empirically compared with the change in the likelihood ratio χ^2 (robust) test, $\Delta\chi^2_R$. Considering the possibility that the exclusion restriction may not hold in the current social-behavioral FFW intervention was viewed as reasonable for two reasons. First, from a methodological perspective, it has been shown that an estimate of γ_c can be biased if the true γ_{nt} effect is nonzero, but is fixed to zero in a model and compliance is low.[52] Second, from a conceptual perspective, the research team expected that at least some of the participants assigned to the FFW group would earn more than 0 participation points, but not enough participation points to be considered to be fully participating. The γ_{cT2} and γ_{cT3} effects and the γ_{ntT2} and γ_{ntT3} effects were the focal parameters. Model 2 also was viewed as a sensitivity analysis with regard to Model 1.

Results

Model 0

Table 3 provides the adjusted mean difference estimates (i.e., the focal parameters) for each dimension of well-being actions for FFW versus UC participants over time. For each dimension of well-being actions, the focal parameter at T2, γ_{T2}, and at T3, γ_{T3}, was statistically nonsignificant and ranged from –0.04 (Cohen's $d = -0.07$) for occupational well-being actions at T2 to 0.11 (Cohen's $d = 0.12$) for physical well-being actions at T3. More broadly, the FFW group had an approximately equal adjusted mean for well-being actions compared to the UC group at T2 and at T3 for each dimension of well-being actions. In summary, there was evidence that the effect of simply being assigned to the FFW intervention, without considering actual participation in the FFW intervention, had a null (with regard to hypothesis testing) and negligible (with regard to effect size) effect on each dimension of well-being actions at 30 days and 60 days since the onset of the intervention. Table 4 provides covariate estimates (i.e., nonfocal parameters) for each dimension of well-being actions at T2 and T3, but these results are not discussed in the text due to spatial limitations.

Model 1 and Model 2

Model 2 never fit the data statistically significantly better than Model 1. Similarly, the focal parameter results for compliers in Model 2 (i.e., γ_{cT2} and γ_{cT3}) were quite consistent with the focal parameter results for compliers in Model 1. Given this consistency, and the plausibility of the exclusion restrictions in this study, the results from only Model 1 are discussed from this point forward. A full set of parameter estimates from each model is available by request to the corresponding author.

Compliance. None of the demographic covariates were statistically significant predictors of compliance for interpersonal, community, occupational, physical, and psychological well-being actions. Identifying as married was a statistically significant predictor, $b = -1.38$, $P = 0.019$, of compliance for economic well-being actions. The estimated odds of being a complier were 0.25 times as great as for those

Table 3. Adjusted Mean Difference Estimates for Each Dimension of Well-Being Actions for Fun For Wellness Versus Usual Care Participants

	Model 0: intent to treat analysis			*Model 1: CACE estimates*			
				Never-takers	*Compliers*		
WB actions	*Estimate (SE)*	P	*Cohen's* d *(95% CI)*	*Estimate (SE)*	*Estimate (SE)*	P	*Cohen's* d *(95% CI)*
Interpersonal							
Time 2	–0.01 (0.06)	0.911	–0.02 (–0.20 to 0.17)	fixed to 0	0.16 (0.18)	0.382	0.24 (0.06 to 0.43)
Time 3	0.09 (0.07)	0.176	0.14 (–0.05 to 0.32)	fixed to 0	0.51 (0.17)	0.003	0.78 (0.59 to 0.98)
Community							
Time 2	0.03 (0.07)	0.728	0.03 (–0.16 to 0.22)	fixed to 0	0.46 (0.34)	0.178	0.44 (0.26 to 0.63)
Time 3	0.01 (0.08)	0.873	0.01 (–0.18 to 0.20)	fixed to 0	–0.36 (0.50)	0.470	–0.35 (–0.54 to –0.16)
Occupational							
Time 2	–0.04 (0.05)	0.464	–0.07 (–0.25 to 0.12)	fixed to 0	0.12 (0.13)	0.341	0.20 (0.02 to 0.39)
Time 3	0.03 (0.05)	0.631	0.05 (–0.13 to 0.24)	fixed to 0	0.31 (0.19)	0.115	0.53 (0.35 to 0.72)
Physical							
Time 2	0.09 (0.06)	0.156	0.09 (–0.09 to 0.28)	fixed to 0	0.20 (0.10)	0.044	0.21 (0.02 to 0.39)
Time 3	0.11 (0.08)	0.156	0.12 (–0.08 to 0.30)	fixed to 0	0.20 (0.11)	0.073	0.21 (0.03 to 0.40)
Psychological							
Time 2	0.01 (0.07)	0.856	0.01 (–0.17 to 0.20)	fixed to 0	–0.04 (0.18)	0.814	–0.05 (–0.24 to 0.13)
Time 3	0.00 (0.07)	0.965	0.00 (–0.19 to 0.19)	fixed to 0	0.23 (0.36)	0.531	0.31 (0.13 to 0.50)
Economic							
Time 2	–0.04 (0.07)	0.590	–0.04 (–0.23 to 0.14)	fixed to 0	0.11 (0.16)	0.482	0.12 (–0.07 to 0.30)
Time 3	0.07 (0.08)	0.327	0.07 (–0.11 to 0.26)	fixed to 0	0.28 (0.26)	0.269	0.30 (0.11 to 0.48)

CACE, complier-average causal effect.

Table 4. Covariate Estimates for Each Dimension of Well-Being Actions at Time 2 (T2) and Time 3 (T3) from Model 0 (i.e., the Intent to Treat Analysis)

WB actions	*WB actions at time 1*	*Female*	*Age in years*	*Hispanic*	*White, non-Hispanic*	*Graduate degree*	*Married*	*Salary ≥ $50,000*
Interpersonal, T2	0.62 (0.05)***	−0.03 (0.07)	0.002 (0.003)	−0.14 (0.09)	−0.15 (0.09)	−0.07 (0.06)	−0.05 (0.07)	0.00 (0.07)
Interpersonal, T3	0.45 (0.05)***	0.04 (0.09)	−0.001 (0.003)	0.02 (0.10)	−0.09 (0.10)	0.02 (0.08)	−0.19 (0.08)*	−0.12 (0.08)
Community, T2	0.80 (0.04)***	−0.08 (0.09)	0.004 (0.003)	−0.23 (0.12)	−0.13 (0.12)	−0.05 (0.08)	0.04 (0.09)	0.08 (0.09)
Community, T3	0.75 (0.04)***	−0.18 (0.11)	0.006 (0.004)	−0.20 (0.13)	−0.31 (0.13)*	−0.0 1 (0.09)	0.06 (0.08)	−0.06 (0.09)
Occupational, T2	0.62 (0.05)***	0.17 (0.07)*	0.007 (0.003)*	0.01 (0.08)	−0.06 (0.08)	0.00 (0.05)	−0.12 (0.06)*	−0.03 (0.07)
Occupational, T3	0.64 (0.05)***	0.06 (0.07)	0.007 (0.003)*	0.04 (0.10)	−0.14 (0.09)	0.12 (0.06)*	−0.08 (0.06)	0.00 (0.06)
Physical, T2	0.79 (0.03)***	−0.03 (0.08)	−0.001 (0.003)	−0.01 (0.09)	−0.05 (0.09)	0.01 (0.07)	0.00 (0.07)	0.13 (0.09)
Physical, T3	0.70 (0.04)***	−0.03 (0.09)	0.001 (0.003)	0.08 (0.11)	0.06 (0.11)	0.07 (0.08)	0.04 (0.08)	−0.08 (0.09)
Psychological, T2	0.62 (0.04)***	0.13 (0.09)	0.003 (0.003)	−0.04 (0.09)	−0.07 (0.11)	−0.01 (0.08)	−0.09 (0.08)	0.08 (0.09)
Psychological, T3	0.54 (0.05)***	0.12 (0.08)	0.005 (0.003)	−0.03 (0.10)	−0.26 (0.09)	0.09 (0.07)	−0.18 (0.07)*	−0.08 (0.08)
Economic, T2	0.84 (0.04)***	0.12 (0.09)	0.005 (0.003)	−0.05 (0.11)	−0.18 (0.12)	0.02 (0.08)	0.03 (0.08)	−0.06 (0.08)
Economic, T3	0.77 (0.04)***	0.22 (0.10)*	−0.001 (0.003)	−0.08 (0.12)	−0.03 (0.14)	0.00 (0.09)	0.11 (0.09)	−0.09 (0.09)

Values in parentheses are standard errors. WB Actions at Time 1 refers to the relevant domain specific score at Time 1.
$^{*}P<0.05$; $^{**}P<0.01$; $^{***}P<0.001$.

who identified as married versus those who did not identify as married for economic well-being actions.

Well-being actions. Table 3 provides adjusted mean difference estimates (i.e., the focal parameters) from Model 1 for each dimension of well-being actions at T2 and T3. A positive value for an adjusted mean difference (i.e., γ_{cT2} and γ_{cT3}) estimate indicated a higher adjusted mean for compliers in the FFW group compared to potential compliers in the UC group. The paragraphs below briefly interpret these estimates for each dimension of well-being actions. Table 5 provides estimates of covariates (i.e., nonfocal parameters) for each dimension of well-being actions at T2 and T3, but these results are not discussed in the text due to spatial limitations.

Interpersonal well-being actions. The estimate of γ_{cT2} was equal to 0.16 (Cohen's $d=0.24$) and was statistically nonsignificant, $P=0.382$. The estimate of γ_{cT3} was equal to 0.51 (Cohen's $d=0.78$; 95% CI = 0.59–0.98) and was statistically significant, $P=0.003$. In summary, and compared to potential compliers in the UC group, there was evidence that compliers in the FFW group had an approximately equal model-implied interpersonal well-being actions mean (i.e., $M_{FFW}=3.79$ vs. $M_{UC}=3.63$) at 30 days, and a considerably higher model-implied well-being actions mean (i.e., $M_{FFW}=3.73$ vs. $M_{UC}=3.22$) at 60 days, since the onset of the intervention.

Community well-being actions. The estimate of γ_{cT2} was equal to 0.46 (Cohen's $d=0.44$) and was statistically nonsignificant, $P=0.178$. The estimate of γ_{cT3} was equal to –0.36 (Cohen's $d=-0.35$) and was statistically nonsignificant, $P=0.470$. In summary, and compared to potential compliers in the UC group, there was evidence that compliers in the FFW group had an approximately equal model-implied community well-being actions mean at 30 days (i.e., $M_{FFW}=1.53$ vs. $M_{UC}=1.07$) and 60 days (i.e., $M_{FFW}=1.67$ vs. $M_{UC}=2.03$) since the onset of the intervention.

Occupational well-being actions. The estimate of γ_{cT2} was equal to 0.12 (Cohen's $d=0.20$) and was statistically nonsignificant, $P=0.341$. The estimate of γ_{cT3} was equal to 0.31 (Cohen's $d=0.53$) and was statistically nonsignificant, $P=0.115$. In summary, and compared to potential compliers in the UC group, there was evidence that compliers in the FFW group had an approximately equal model-implied occupational well-being actions mean at 30 days (i.e., $M_{FFW}=2.89$ vs. $M_{UC}=2.77$) and 60 days (i.e., $M_{FFW}=2.72$ vs. $M_{UC}=2.41$) since the onset of the intervention.

Physical well-being actions. The estimate of γ_{cT2} was equal to 0.20 (Cohen's $d=0.21$; 95% CI = 0.02–0.39) and was statistically significant, $P=0.044$. The estimate of γ_{cT3} was equal to 0.20 (Cohen's $d=0.21$) and was statistically nonsignificant, $P=0.073$. In summary, and compared to potential compliers in the UC group, there was evidence that compliers in the FFW group had a slightly higher model-implied physical well-being actions mean (i.e., $M_{FFW}=2.59$ vs. $M_{UC}=2.39$) at 30 days, and an approximately equal (although nearly a statistically significantly higher) well-being actions mean (i.e., $M_{FFW}=3.03$ vs. $M_{UC}=2.83$) at 60 days, since the onset of the intervention.

Table 5. Covariate Estimates for Each Dimension of Well-Being Actions at Time 2 (T2) and Time 3 (T3) from Model 1 (i.e., the Complier-Average Causal Effect Analysis)

WB actions	*WB actions at time 1*	*Female*	*Age in years*	*Hispanic*	*White, non-Hispanic*	*Graduate degree*	*Married*	*Salary ≥ $50,000*
Interpersonal								
Compliers, T2	0.50 (0.10)***	0.06 (0.20)	–0.010 (0.007)	–0.29 (0.19)	–0.24 (0.20)	–0.25 (0.17)	0.25 (0.19)	–0.07 (0.18)
Never-takers, T2	0.68 (0.07)***	–0.03 (0.09)	0.009 (0.003)**	–0.02 (0.12)	–0.10 (0.13)	0.04 (0.09)	–0.17 (0.07)*	0.03 (0.08)
Compliers, T3	0.37 (0.12)**	0.03 (0.26)	–0.009 (0.009)	–0.18 (0.18)	–0.29 (0.21)	0.07 (0.20)	–0.31 (0.18)	0.12 (0.17)
Never-takers, T3	0.48 (0.07)***	0.04 (0.10)	0.002 (0.004)	0.05 (0.15)	–0.05 (0.15)	–0.02 (0.08)	–0.15 (0.09)	–0.28 (0.09)**
Community								
Compliers, T2	0.68 (0.14)***	0.13 (0.45)	–0.001 (0.018)	0.07 (0.31)	0.15 (0.34)	–0.02 (0.32)	–0.02 (0.40)	–0.08 (0.33)
Never-takers, T2	0.85 (0.05)***	–0.08 (0.09)	0.003 (0.004)	–0.38 (0.14)**	–0.25 (0.14)	–0.10 (0.08)	0.04 (0.08)	0.07 (0.09)
Compliers, T3	0.44 (0.16)**	–0.10 (0.49)	–0.002 (0.021)	0.26 (0.43)	0.21 (0.41)	0.14 (0.40)	0.03 (0.26)	–0.09 (0.36)
Never-takers, T3	0.80 (0.05)***	–0.14 (0.09)	0.006 (0.004)	–0.31 (0.16)*	–0.39 (0.15)**	–0.02 (0.10)	0.09 (0.09)	–0.06 (0.10)
Occupational								
Compliers, T2	0.66 (0.12)***	0.44 (0.13)***	0.005 (0.005)	0.11 (0.12)	0.07 (0.13)	–0.09 (0.11)	–0.15 (0.13)	–0.12 (0.13)
Never-takers, T2	0.57 (0.06)***	0.05 (0.10)	0.010 (0.004)**	–0.09 (0.13)	–0.21 (0.11)*	0.11 (0.07)	–0.04 (0.10)	0.02 (0.10)
Compliers, T3	0.66 (0.10)***	0.33 (0.12)**	0.007 (0.004)	0.31 (0.15)*	–0.10 (0.15)	0.09 (0.16)	0.12 (0.10)	–0.09 (0.10)
Never-takers, T3	0.61 (0.06)***	–0.03 (0.09)	0.007 (0.004)	–0.17 (0.10)	–0.26 (0.09)**	0.12 (0.07)	–0.10 (0.08)	0.04 (0.09)
Physical								
Compliers, T2	0.81 (0.05)***	–0.03 (0.12)	–0.002 (0.006)	–0.15 (0.14)	–0.14 (0.14)	0.04 (0.11)	–0.15 (0.10)	0.17 (0.14)
Never-takers, T2	0.78 (0.06)***	–0.05 (0.14)	0.004 (0.007)	0.17 (0.21)	0.07 (0.21)	0.04 (0.13)	0.19 (0.16)	0.05 (0.17)
Compliers, T3	0.74 (0.05)***	–0.33 (0.14)*	–0.003 (0.005)	0.02 (0.18)	–0.14 (0.17)	0.07 (0.14)	–0.01 (0.11)	–0.09 (0.13)
Never-takers, T3	0.65 (0.08)***	0.20 (0.13)	0.008 (0.006)	0.20 (0.24)	0.27 (0.25)	0.10 (0.14)	0.08 (0.15)	–0.04 (0.19)
Psychological								
Compliers, T2	0.47 (0.18)**	0.32 (0.32)	–0.004 (0.017)	0.07 (0.26)	0.34 (0.45)	0.02 (0.25)	0.11 (0.18)	0.08 (0.21)
Never-takers, T2	0.66 (0.08)***	0.08 (0.14)	0.006 (0.008)	–0.08 (0.23)	–0.23 (0.28)	0.00 (0.12)	–0.12 (0.16)	0.05 (0.15)
Compliers, T3	0.35 (0.16)*	0.08 (0.26)	0.005 (0.010)	0.05 (0.20)	0.04 (.31)	0.34 (0.24)	–0.22 (0.24)	–0.22 (0.29)
Never-takers, T3	0.63 (0.06)***	0.15 (0.10)	0.005 (0.005)	–0.13 (0.19)	–0.40 (0.14)**	–0.03 (0.11)	–0.15 (0.10)	0.01 (0.16)
Economic								
Compliers, T2	0.76 (0.14)***	0.64 (0.32)*	–0.002 (0.008)	–0.05 (0.22)	0.38 (0.19)*	0.21 (0.24)	0.31 (0.21)	0.03 (0.23)
Never-takers, T2	0.84 (0.04)***	0.12 (0.09)	0.005 (0.003)	–0.05 (0.11)	–0.18 (0.12)	0.02 (0.08)	0.03 (0.08)	–0.06 (0.08)
Compliers, T3	0.48 (0.17)**	–0.63 (0.24)**	–0.017 (0.012)	0.45 (0.31)	0.35 (0.30)	0.66 (0.29)*	–0.11 (0.22)	–0.28 (0.33)
Never-takers, T3	0.77 (0.04)***	0.22 (0.10)*	–0.001 (0.003)	–0.08 (0.12)	–0.03 (0.14)	0.00 (0.09)	0.11 (0.09)	–0.09 (0.09)

Values in parentheses are standard errors.
*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Psychological well-being actions. The estimate of γ_{cT2} was equal to –0.04 (Cohen's $d = -0.05$) and was statistically nonsignificant, $P = 0.814$. The estimate of γ_{cT3} was equal to 0.23 (Cohen's $d = 0.31$) and was statistically nonsignificant, $P = 0.531$. In summary, and compared to potential compliers in the UC group, there was evidence that compliers in the FFW group had an approximately equal model-implied psychological well-being actions mean at 30 days (i.e., $M_{FFW} = 2.51$ vs. $M_{UC} = 2.55$) and 60 days (i.e., $M_{FFW} = 2.58$ vs. $M_{UC} = 2.35$) since the onset of the intervention.

Economic well-being actions. The estimate of γ_{cT2} was equal to 0.11 (Cohen's $d = 0.12$) and was statistically nonsignificant, $P = 0.482$. The estimate of γ_{cT3} was equal to 0.28 (Cohen's $d = 0.30$) and was statistically nonsignificant, $P = 0.269$. In summary, and compared to potential compliers in the UC group, there was evidence that compliers in the FFW group had an approximately equal model-implied economic well-being actions mean at 30 days (i.e., $M_{FFW} = 1.67$ vs. $M_{UC} = 1.56$) and 60 days (i.e., $M_{FFW} = 3.30$, $M_{UC} = 3.02$) since the onset of the intervention.

Post hoc sensitivity analyses

Because the mechanism underlying the missing outcome data was unknown, alternative missing data assumptions in the form of three models were imposed to produce a range of CACE estimates.[50] The first model assumed that the missing data were MAR, and CACE estimates from this model have already been reported (Table 3). The second and third models each imposed a weaker assumption than MAR and this assumption has been referred to as latent ignorability.[53] The second model imposed what has been referred to as the response exclusion restriction (RER) assumption. In summary, RER assumed that for never-takers, the probability of a well-being action outcome being observed was not associated with treatment assignment. The third model imposed what has been referred to as the stable complier response (SCR) assumption. In summary, SCR assumed that for compliers, the probability of a well-being action outcome being observed was not associated with treatment assignment. Considering the range of CACE estimates across these three models for each outcome was viewed as a sensitivity analysis.[50]

Table 6 provides CACE estimates under alternative missing data assumptions: MAR, RER, and SCR. For most dimensions of well-being actions, the CACE estimate at T2 and T3 was relatively stable, at least with regard to statistical significance, across the three models. For example, the CACE estimate (*SE*) for interpersonal well-being actions at T2 ranged from 0.10 (0.11), $P = 0.340$, to 0.16 (0.18), $P = 0.382$, across the three models, which suggested some level of stability in the CACE estimate across different assumptions regarding the unknown mechanism underlying the missing data. For physical well-being actions, however, the CACE estimate at T2 and T3 may be viewed as somewhat unstable, at least with regard to statistical significance, across the three models. For example, the CACE estimate (*SE*) for physical well-being actions at T2 ranged from 0.09 (0.08), $P = 0.267$, to 0.20 (0.10), $P = 0.044$, across the three models. Similarly, the CACE estimate (*SE*) for physical well-being actions at T3 ranged from 0.08 (0.11), $P = 0.470$, to 0.27 (0.11), $P = 0.018$, across the three models. Thus, there was evidence for some level of instability in the CACE estimate for physical well-being actions at both time points across different assumptions regarding the unknown mechanism underlying the missing data.

Discussion

The purpose of this study was to provide an initial evaluation of the efficacy of the FFW intervention to increase well-being actions in a universal sample. There was evidence that the effect of simply being assigned to the FFW intervention, without considering actual participation in the FFW intervention, was a null effect for each dimension of well-being actions at both postbaseline time points. For compliers with the intervention, however, results from this study provide some initial supportive evidence for the efficacy of the FFW online intervention to increase well-being actions in the interpersonal domain at 60 days and the physical domain at 30 days (although the latter finding was sensitive to assumptions about missing data and could be a type I error). That said, results from this study also provide some initial unsupportive evidence for the efficacy of the FFW online intervention to increase well-being actions in the following domains for compliers: community, occupational, psychological, and economic.

Earlier, FFW was found to be effective in changing *perceptions* in four domains of well-being (interpersonal, psychological, community, and economic).[4] In this analysis, FFW was found effective in generating well-being *actions* in only two areas (interpersonal and physical). Across the two sets of analyses, the only domain in which there was growth in both *actions* and *perceptions* was interpersonal well-being. Conversely, the only domain for which there was no growth whatsoever was occupational well-being. For the rest of the I COPPE domains, there was growth only in either perceptions (psychological, community, and economic) or actions (physical). Discrepancies between changes in perceptions of well-being (e.g., physical) versus changes in well-being actions (e.g., physical) within the FFW intervention may be explained by the theory of planned behavior,[54] where perceptions (e.g., physical well-being) affect actions (e.g., physical well-being actions) indirectly through intention (e.g., intention to change physical well-being actions).

With regard to interpersonal well-being, it is important to review the two items comprising this construct in the outcome measure: *engage in positive interactions with people close to you* and *make attempts to repair relationships following conflict*. Given the favorable influence of social and emotional support on physical and psychological health,[55] we are encouraged that participants engaged in more positive interactions and made efforts to heal relationships after a clash. Across the two sets of analyses, we can see that FFW had a positive effect on perceptions and actions dealing with relational wellness. This is consistent with a prior study, in which young adults using a computer-mediated program improved interpersonal skills related to expression of feelings, negotiation of differences, and respectful discussions.[14]

With respect to physical well-being, the outcome measure consisted of the following two items: *engage in moderate physical activity such as brisk walking for about 30 minutes*

Table 6. Complier Average Causal Effect Estimates from Model 1 under Alternative Missing Data Assumptions

	CACE estimates								
	MAR			*RER*			*SCR*		
WB actions	*Estimate (SE)*	P	*Cohen's* d *(95% CI)*	*Estimate (SE)*	P	*Cohen's* d *(95% CI)*	*Estimate (SE)*	P	*Cohen's* d *(95% CI)*
Interpersonal									
Time 2	0.16 (0.18)	0.382	0.24 (0.06 to 0.43)	0.10 (0.11)	0.340	0.15 (–0.04 to 0.34)	0.12 (0.12)	0.322	0.18 (0.00 to 0.37)
Time 3	0.51 (0.17)	0.003	0.78 (0.59 to 0.98)	0.26 (0.12)	0.030	0.40 (0.21 to 0.58)	0.31 (0.14)	0.028	0.47 (0.28 to 0.66)
Community									
Time 2	0.46 (0.34)	0.178	0.44 (0.26 to 0.63)	0.03 (0.20)	0.893	0.03 (–0.16 to 0.22)	0.06 (0.28)	0.842	0.06 (–0.13 to 0.24)
Time 3	–0.36 (0.50)	0.470	–0.35 (–0.54 to –0.16)	0.12 (0.23)	0.611	0.12 (–0.07 to 0.30)	0.14 (0.31)	0.648	0.14 (–0.05 to 0.32)
Occupational									
Time 2	0.12 (0.13)	0.341	0.20 (0.02 to 0.39)	–0.03 (0.09)	0.763	–0.05 (–0.24 to 0.14)	–0.12 (0.09)	0.158	–0.20 (–0.39 to 0.02)
Time 3	0.31 (0.19)	0.115	0.53 (0.35 to 0.72)	0.06 (0.10)	0.559	0.10 (–0.08 to 0.29)	–0.05 (0.08)	0.543	–0.09 (–0.27 to 0.10)
Physical									
Time 2	0.20 (0.10)	0.044	0.21 (0.02 to 0.39)	0.09 (0.08)	0.267	0.09 (–0.09 to 0.28)	0.12 (0.13)	0.386	0.12 (–0.06 to 0.31)
Time 3	0.20 (0.11)	0.073	0.21 (0.03 to 0.40)	0.08 (0.11)	0.470	0.09 (–0.10 to 0.27)	0.27 (0.11)	0.018	0.29 (0.10 to 0.47)
Psychological									
Time 2	–0.04 (0.18)	0.814	–0.05 (–0.24 to 0.13)	0.16 (0.13)	0.209	0.21 (0.02 to 0.40)	0.09 (0.14)	0.498	0.12 (–0.07 to 0.30)
Time 3	0.23 (0.36)	0.531	0.31 (0.13 to 0.50)	0.08 (0.13)	0.554	0.11 (–0.08 to 0.30)	0.03 (0.13)	0.799	0.04 (–0.15 to 0.23)
Economic									
Time 2	0.11 (0.16)	0.482	0.12 (–0.07 to 0.30)	–0.02 (0.15)	0.904	–0.02 (–0.21 to 0.16)	0.10 (0.14)	0.500	0.11 (–0.08 to 0.29)
Time 3	0.28 (0.26)	0.269	0.30 (0.11 to 0.48)	0.16 (0.17)	0.354	0.17 (–0.02 to 0.36)	0.15 (0.19)	0.420	0.16 (–0.03 to 0.35)

MAR, missing at random; RER, response exclusion restriction; SCR, stable complier response.

at least five times a week, and *eat mostly a plant-based diet such as fruits, vegetables, nuts, and seeds*. Knowing the health benefits accruing from physical activity and healthy eating, it is very positive that participants engaged more in these actions at 30 days. It is disappointing that a statistically significant effect was not observed at the 60-day follow-up, but it is somewhat encouraging that the results did approximate significance at the 2-month point. The lack of sustained effort is consistent with previous literature showing that long-term adherence to exercise and healthy eating is very challenging for people.[56–59] In youths who play exergames, support has been found for moderate improvements in physical activity during the short term, but it is still unclear as to whether or not exergame use leads to increased habitual physical activity in the long term.[22] A systematic review of eHealth interventions targeting smoking, nutrition, alcohol, physical activity, and/or obesity for young adults found some support for these interventions specific to reducing alcohol consumption behaviors in the short term.[60]

Since occupational well-being is the only domain for which there was no growth in either perceptions (previous analysis) or actions (current study), it is worth exploring this domain in some depth. A systematic review and meta-analysis of digital interventions in the workplace found a few strategies to increase well-being and performance: guidance, multiple modalities of communication such as short message service and email, and the use of persuasive technologies such as self-monitoring and tailoring.[16] It is worth noting that FFW did not employ these techniques. Reminders were sent by e-mail, but they were not frequent. Another study offers more insight into why occupational well-being may not have changed in this investigation. In an online study designed to reduce occupational stress, participants were exposed to several interventions for 6 months—six times the exposure tested with FFW.[61] As such, the dosage offered by FFW may not be strong enough to show results in the occupational well-being domain.

We are aware of six primary limitations for this initial evaluation of efficacy of the FFW intervention to increase well-being actions. The first limitation is some uncertainty regarding the efficacy of our definition of ''full'' participation. While the construction of the definition of full participation in this study was consistent with previous research, we reiterate our suggestion for ongoing efforts (e.g., qualitative interviews) to deepen our understanding of compliance with the FFW intervention.[4] The second limitation is that we modeled only direct (or equivalently, overall) effects of the FFW intervention in an effort to first investigate the possible presence of an overall effect.[62] Future research that investigates possible mechanisms (e.g., well-being and self-efficacy) through which (i.e., decomposing an overall effect into possible direct and indirect effects) the FFW intervention may indirectly influence well-being actions (self-reported and/or observed) is recommended as an important next step to better understand why the FFW intervention may be efficacious in promoting well-being actions in some instances. Pairing the aforementioned future research with an additional focus on the construct validity of responses to the I COPPE scale (e.g., experience sampling methodology) may be especially worthwhile. The third limitation is that we assumed additivity of FFW effects for all demographic covariates. Future studies that explore the possibility of differential FFW effects for subgroups of participants on well-being actions are encouraged. The fourth limitation is that the data were not analyzed in a longitudinal framework, in part, because the ''sample size'' in the complier class was quite modest for some dimensions of well-being actions (e.g., 37 compliers in the FFW group for community), which made the potential quality and precision of the estimation of random effects uncertain. Future research with a large number of compliers in the FFW group that models growth trajectories, perhaps with several repeated measures of well-being actions, is encouraged. The fifth limitation is that data for possible clustering (e.g., department within which a participant was nested) were not collected, and thus, the degree of conditional nonindependence based on such clustering could not be evaluated or statistically corrected for if necessary. Future research that collects such data and estimates CACEs with methodological corrections for conditional nonindependence, as needed, would be worthwhile.[63] A final limitation is the relatively narrow population from which the sample was drawn. Given that the study was conducted with university employees and many participants held graduate degrees, a more diverse sample with a wider range of educational attainment may provide different results. Future research that samples from one or more broader populations would more fully evaluate the efficacy of the FFW intervention to promote well-being actions, particularly if objective (i.e., observed, and not only self-reported) measures of well-being actions also are measured.

Acknowledgments

The project described was supported by funds from the Erwin and Barbara Mautner Endowed Chair in Community Well-Being at University of Miami School of Education and Human Development.

Author Disclosure Statements

Two of the authors of this article, Adam McMahon and Isaac Prilleltensky, are partners in Wellnuts LLC, which may commercialize the FFW intervention described in this study. Potentially competing financial interests do not exist for the other authors of this article.

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Address correspondence to:
Nicholas D. Myers, PhD
Department of Kinesiology
College of Education
Michigan State University
201 IM Sports Circle
308 W Circle Drive
East Lansing, MI 48824

E-mail: myersni1@msu.edu

Appendix

Appendix Table 1. Characteristics of Fun For Wellness

Health topic(s)	I COPPE
URL	www.funforwellness.com
Targeted age group	18 years old and above
Short description	Users play interactive games (for example, shooting down junk food and capturing healthy foods); watch vignettes performed by professional actors ($\sim$90 second case studies illustrating challenges and solutions related to I COPPE domains of life); listen and/or read a mini-lecture narrated by a coach ($\sim$60 second clips); and engage in self-reflection exercise and/or chat rooms (for example, reviewing your goal and how a particular skill learned can help you make progress). FFW is organized according to seven modules that form the acronym BET I CAN (see below). Each module teaches two specific skills, for a total of 14 skills. Users are rewarded for making progress through visual and textual means. FFW consists of 152 challenges. Challenges vary in duration from 1 to 5 minutes.
Target player	Individual
Guiding knowledge of behavior change theories	FFW builds on integrative and complementary theories that leverage seven drives of change: BET I CAN. Two essential skills associated with each theory are taught in each module. For example, the Behaviors module teaches ''how to set a goal,'' and ''how to create positive habits,'' whereas the Context module teaches ''how to read cues'' in the environment and ''how to change cues.'' Self-efficacy is the main theoretical construct guiding the skill-building process.
Conceptual framework	FFW is designed to improve well-being in all the I COPPE domains of life
Intended health behavior changes	Changes in perceptions and actions related to I COPPE domains of life
Type of game	Psychoeducational
Player's objectives	To complete the seven modules and advance from novice to guru
Estimated play time	To achieve guru status, it takes $\sim$12 hours
Game platform	Web based and mobile (smartphone and tablet)

BET I CAN, behaviors, emotions, thoughts, interactions, context, awareness, and next steps; FFW, Fun For Wellness; I COPPE, Interpersonal, Community, Occupational, Physical, Psychological, and Economic.

Appendix Table 2. I COPPE Actions Scale

How often do you-	*(Select the most appropriate category for each item)*				
	Very rarely or never	*Rarely*	*Sometimes*	*Often*	*Very often or always*
1. Engage in positive interactions with people close to you?	0	1	2	3	4
2. Make attempts to repair relationships following conflict?	0	1	2	3	4
3. Volunteer in the community?	0	1	2	3	4
4. Participate in community events?	0	1	2	3	4
5. Persevere with work-related tasks?	0	1	2	3	4
6. Focus intently at work?	0	1	2	3	4
7. Engage in moderate physical activity such as brisk walking for about 30 minutes at least five times a week?	0	1	2	3	4
8. Eat mostly a plant-based diet such as fruits, vegetables, nuts, and seeds?	0	1	2	3	4
9. Engage in activities that you find meaningful?	0	1	2	3	4
10. Take concrete steps to experience peace of mind?	0	1	2	3	4
11. Save money?	0	1	2	3	4
12. Take steps to improve your financial situation?	0	1	2	3	4