

The Motivational Effects of Social Contagion on Exercise Participation in Young Female Adults

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Young inactive healthy-weight females ($n = 42$) were randomly assigned to exercise at a self-selected pace on a treadmill beside a confederate who was providing either intrinsic or externally regulated verbal primes. Heart rate (HR), rating of perceived exertion (RPE), percentage of time spent in moderate-to-vigorous physical activity (MVPA), and exercise continuance were recorded. Participants completed a self-report questionnaire assessing mood pre- and postexercise session and postexercise motivational outcomes. The intrinsic motivation group reported higher RPE values after 8 min of exercise, had higher recorded HR measures at all 5 recorded time points, exercised at a higher %HR max, spent more time in MVPA, and were more likely to continue to exercise than participants in the externally regulated motivation group. A time effect was noted for vigor. Based on these findings, exercise motivation can be “contagious” through verbal primes, suggesting that exercising with or around intrinsically motivated individuals may have beneficial outcomes.

Keywords: physical activity, motivation priming, contagion, social facilitation

Participation in regular physical activity (PA) helps to initiate and maintain a healthy lifestyle (Warburton, Nicol, & Bredin, 2006). PA that is performed at moderate-to-vigorous intensity (MVPA) provides numerous physical and psychosocial benefits (Lombard, Deeks, Jolley, & Teede, 2009; Penedo & Dahn, 2005) and is associated with the prevention of many health conditions, such as diabetes, hypertension, cardiovascular disease, some cancers, and obesity (Warburton et al., 2006). According to national guidelines, adults should accumulate at least 150 min a week of MVPA to achieve health benefits (Colley et al., 2011; Haskell et al., 2007). Unfortunately, fewer than 15% of adults are meeting these recommendations (Colley et al., 2011). In addition, women have been shown to engage in less PA than men regardless of age (Colley et al., 2011). Low levels of PA may be explained in part by motivation, in particular among women.

Motivation and Physical Activity

Lack of motivation is ranked as one of the top five barriers to PA participation (Brownson, Baker, Housemann, Brennan, & Bacak, 2001). Based on self-determination

theory (SDT; Ryan & Deci, 2000), motivation regulations exist along a continuum ranging from amotivation (i.e., an individual lacks a sense of intention to participate) at the one end, extrinsic motivation (i.e., one's reason to engage in the behavior is to satisfy an external demand or a socially constructed contingency) in the middle, and intrinsic motivation (i.e., a drive that is determined by an interest or enjoyment in the task itself and exists within the individual) at the apex. Extrinsic motivation is further differentiated as four regulations that range in level of self-determination and internalization. External regulation is described as an individual's behavior(s) that is/are controlled by constraints or incentives and participation to satisfy external demands (Ryan & Deci, 2000) and is the least self-determined form of extrinsic motivation. Introjected regulation is characterized by behaviors that are reinforced by internal pressures or to avoid guilt, ego threat, or shame (Ryan & Deci, 2000). Identified regulation is described as behaviors that are thought to be important and are done willingly yet still for extrinsic reasons (Ryan & Deci, 2000). Integrated regulation, which is the most self-determined form of extrinsic motivation, is characterized by performing activities that are personally important to the individual and are directed toward a valued outcome.

In addition to ranging in level of self-determination and internalization, the motivation regulations also differ in their link to adaptive outcomes such as participation in health behavior and positive psychosocial factors. For example, introjected regulation has been associated with more maladaptive outcomes such as anxiety and

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poor coping (Duncan, Hall, Wilson, & Jenny, 2010). Identified and integrated regulation have been positively associated with exercise frequency (Duncan et al., 2010) and PA behavior assessed using self-report (e.g., Sabiston et al., 2010; Wilson, Rodgers, Loitz, & Scime, 2007) and accelerometer (Standage, Sebire, & Loney, 2008). Furthermore, individuals who report being intrinsically motivated demonstrate greater adherence and task persistence (Edmunds, Ntoumanis, & Duda, 2009; Ryan, Frederick, Lipes, Rubio, & Sheldon, 1997), higher levels of enjoyment (Frederick & Morrison, 1996), more positive emotions, more effort, and greater interest (Pelletier et al., 1995), less fatigue (Parfitt & Gledhill, 2004; Vallerand, 2007), higher perceptions of competence (Deci & Ryan, 2002; Wilson, Mack, & Grattan, 2008), and less pressure from others (Mullan & Markland, 1997) compared with individuals who are extrinsically motivated. It is particularly important to focus on understanding and developing intrinsic motivation in women, since women tend to report lower levels of exercise enjoyment, competence, and adherence compared with their male counterparts (Amorose & Horn, 2000).

Motivational Priming

One way to understand the development of intrinsic motivation in women may be through priming in an experimental context (Levesque & Pelletier, 2003; Wild, Enzel, Nix, & Deci, 1997; Wild et al., 1992). For example, in a study by Wild and colleagues (1997), participants reported higher levels of intrinsic motivation after reading stories depicting an intrinsically motivated person (e.g., volunteer) compared with an extrinsically motivated person (e.g., paid worker). In a study focused on teachers' perceptions of students' motivational orientations, Pelletier and Vallerand (1996) reported a complimentary effect such that when teachers were told that a student was intrinsically motivated to learn, they perceived the student to behave in intrinsically motivated ways. Contrarily, when teachers were told that students were extrinsically motivated to learn, they perceived those students to behave in extrinsically motivated ways. In another study, individuals given an intrinsic motivation prime (using a scrambled sentence task) experienced greater interest in the task and performed better on a puzzle than those who received an extrinsic motivation prime (Levesque & Pelletier, 2003). Similar results were reported in a study examining subliminal primes on a new motor task (Radel, Sarrazin, & Pelletier, 2009). Specifically, when participants were primed with subliminal words depicting autonomous self-motivation (a combination of identified and integrated regulation and intrinsic motivation), they reported positive outcomes such as greater persistence, performance on the task, effort, and enjoyment (Radel et al., 2009). Consideration of these findings for PA environments may be helpful in fostering intrinsic motivation, and in facilitating positive PA outcomes. For example, it may be that an exerciser labeled or perceived as intrinsically motivated may affect the motivational orientation of

her exercise partner or group, who may develop intrinsic motivation to exercise, resulting in greater exercise adherence and enjoyment.

Priming effects have been reported in a limited number of studies focused on PA settings. In one study on motivational priming, participants cycling on a stationary bicycle were primed with sentences that were either extrinsically or intrinsically focused (Banting, Dimmock, & Grove, 2011). Compared with the participants in the extrinsic prime group, those who received the intrinsically focused primes enjoyed the exercise session more, exercised at a greater percentage of heart rate (HR) maximum, and reported a lower rating of perceived exertion (RPE). In addition, participants exposed to the extrinsic primes did not continue to exercise and had lower intentions to exercise than did the participants in the intrinsic experimental group (Banting et al., 2011). In another study employing a hypothetical exercise scenario, Ng, Thøgersen-Ntoumani and Ntoumanis (2012) found that primes (e.g., quotes varying in motivation quality) perceived to be from obese exercisers influenced exercise science students' perceptions of the hypothetical exercisers' beliefs and capabilities. If the exerciser was perceived to be autonomously self-motivated, the students thought they would be more capable of overcoming barriers. Furthermore, Hodgins, Yacko, and Gottlieb (2006) found that rowers who were primed with intrinsically focused cues demonstrated the least self-handicapping behaviors and best performance compared with those primed with extrinsic cues. Based on these exercise-related studies, priming effects may influence exercisers' own beliefs, behaviors, and physiological outcomes during exercise and may affect the way professionals work with fitness clients and/or patients seeking exercise routines.

While the PA-related studies have indirectly advanced our understanding of priming effects, the use of scrambled sentences and hypothetical scenarios limit the real-world effects related to primes. For example, PA participation often occurs in the presence of others, and priming effects may occur based on the presence or casual statements provided by other exercisers in the PA environment. Based on the seminal social facilitation work of Norman Triplett (1898), Salvy and colleagues (2009) reported that an individual's motivation to be physically active increased in the presence of a friend compared with engaging in PA alone. The presence of another individual therefore seems to be a viable way to improve PA participation (and possibly underlying motivational regulations). Taken together, the mix of sport and exercise psychology findings on motivational priming, social facilitation, and priming suggest that the strongest effects of motivation primes may be observed in the presence of other exercisers who themselves are providing primes.

Social Contagion Effects

One way to understand priming and the development of intrinsic motivation in women may be through social

contagion. Specifically, an individual's motivational orientation¹ toward an activity can be spontaneously spread from person to person solely on the foundation of interpersonal primes (Wild et al., 1992). Different expectancies are formed by perceiving others' reasons for engaging in an activity and are related to the quality of involvement, such as effort, interest, and enjoyment in the task (Freidman, Deci, Elliot, Moller, & Aarkes, 2009). These expectancies form a "cognitive set" that is used to understand subsequent activity involvement as well as interpersonal relationships, and results in affecting the perceivers' own intrinsic (and extrinsic) drive (Wild et al., 1992). For example, in dyadic relationships (e.g., a personal trainer and client or two exercising friends), the perception of the trainer/friend's motivational orientation may influence the development of the others' expectancies and behaviors. Based on social contagion effects, if individuals display characteristics that are consistent with being either intrinsically or extrinsically motivated to participate in PA, the individuals around them may also adopt this motivation orientation. This phenomenon of social contagion has not been tested in the PA context.

The Current Study

A strong first step in testing social contagion in PA would be to examine the effects of primes that are directed at the extremes of the motivational continuum (Ryan & Deci, 2000). As such, the current study aimed to compare externally and intrinsically regulated cues provided during a short exercise session on important motivation and PA outcomes among inactive women. Given the paucity of research on the effectiveness of verbal primes, the current study examined the effects of external and intrinsic verbal primes provided by another individual. Based on the work of Banting and colleagues (2011), differences between externally and intrinsically regulated verbal primes were examined on PA outcomes of HR and RPE. It was hypothesized that participants in the intrinsic motivation group would report lower RPE scores and have higher recorded HR and %HR max than participants in the externally regulated motivation prime group. Given the findings that intrinsically motivated individuals are more likely to exert more energy during a task (Pelletier et al., 1995; Radel et al., 2009) and adhere to a PA routine (Edmunds et al., 2009; Ryan et al., 1997), mean-group comparisons were made on percentage of time spent in MVPA (i.e., exercise intensity) and exercise continuance, which was defined as continuing to exercise when given the choice of stopping. Compared with women who were randomly assigned to the externally regulated motivation group, it was hypothesized that women in the intrinsically primed group would exercise at a greater intensity and that a higher percentage of them would continue to exercise when given the opportunity to stop. Since individuals who are intrinsically motivated are more likely to report enjoyment and persistence of exercise compared with externally motivated individuals, who are more likely to report feelings of fatigue (Parfitt & Gledhill, 2004;

Vallerand, 2007), a comparison was also made on pre- to postchange in vigor and fatigue. It was hypothesized that participants in the intrinsic motivation prime group would report increased vigor and lower levels of fatigue after the exercise session compared with the participants in the extrinsic motivation group. Finally, postexercise motivation outcomes of perceived competence, interest, effort, and pressure/tension were assessed in order to examine intrinsically and externally regulated verbal prime differences on common outcomes of motivation (Deci & Ryan, 2002; Mullan & Markland, 1997; Pelletier et al., 1995; Wilson et al., 2008). It was hypothesized that participants in the intrinsic motivation group would report greater levels of perceived competence, interest, and effort and lower levels of pressure/tension postexercise compared with participants in the externally primed group.

Method

Participants

Forty-two female university students were recruited through posted advertisements on the university classifieds and in local buildings. Inclusion criteria included (a) between 18 and 30 years of age, (b) healthy weight (body mass index [BMI] 18.5–24.9 kg per meter squared), and (c) inactive (i.e., exercised <3 times per week for 30 min a day).

Measures

Demographics. Age was reported, and height (in meters) and weight (in kilograms) were measured by the experimenter using standard protocol (Ross & Marfell-Jones, 1991) to calculate body mass index (BMI). As a measure of recent PA participation, participants reported the number of minutes that they engaged in each of light, moderate, and strenuous PA in the previous 7 days. Examples of each activity intensity were provided based on a commonly used protocol (Godin & Shephard, 1985).

Fitness Level. The 6-min walk test was used as an objective measure of the participants' fitness level (American Thoracic Society, 2002). Participants were instructed to walk back and forth along a 15-m long hallway as quickly as possible for a period of 6 min. The total distance covered by the participant over the 6-min assessment was recorded. Fitness was examined as a covariate in the current study given the possible association with HR and RPE outcomes as well as effectiveness of the motivational primes.

Exercise Motivation. Measured as a potential covariate in the current study because motivation orientation may protect from or potentiate the priming effects, a relative autonomy index (RAI; Ryan & Connell, 1989) was assessed using the amotivation ($N_{items} = 4$), external ($N_{items} = 4$), introjected ($N_{items} = 3$), identified ($N_{items} = 4$), and intrinsic regulation ($N_{items} = 4$) subscales of the Behavioral Regulation in Exercise Questionnaire 2 (BREQ-2;

Markland & Tobin, 2004). The RAI is an index of self-determination, with higher scores representing more self-determined regulation (Wilson, Sabiston, Mack, & Blanchard, 2012). According to motivation scholars and theoretical principles (Deci & Ryan, 1985; Markland & Tobin, 2004; Wilson et al., 2012), the calculation of the RAI is done only when the data present a simplex pattern such that regulation scores closer on the continuum (e.g., external and introjected regulation) should be more highly correlated than regulation scores farther away on the continuum (e.g., external and identified regulation). If the data conform to a simplex pattern, the RAI is obtained by summing the weights of each behavioral subscale using standard criteria [i.e., amotivation $\times (-3)$, external regulation $\times (-2)$, introjected regulation $\times (-1)$, identified regulation $\times (+2)$, intrinsic regulation $\times (+3)$] (Markland & Tobin, 2004; Wilson et al., 2012). The questionnaire scale scores have been shown to be reliable (e.g., Markland & Tobin, 2004), and Cronbach's alpha reliabilities for the subscale scores were calculated to be above .79 in the current study.

Heart Rate (HR), Exertion, and Intensity. HR was measured using the FT4 polar HR monitor (Polar Electro, Inc., Woodbury, NY) worn by the participant, who was blind to the output on the accompanying watch. The level of exertion was measured using the Rating of Perceived Exertion Scale (RPE; Borg, 1982), and intensity of PA was assessed as percent of time spent in MVPA, which was recorded by a GT3 $\times$ accelerometer (Actigraph, Pensacola, FL) worn at the hip. Data from the accelerometer were collected and downloaded in 60-s epochs. Counts acquired from the accelerometer greater than 1952 were coded as MVPA (Matthews, Ainsworth, Thompson, & Bassett, 2002), providing a percentage of time in which the participant engaged in PA that was considered at least moderate in intensity. HR and RPE were assessed and analyzed for the 10-min study period; percent of time spent in MVPA was assessed for the 10-min exercise period as well postexercise (10–12 min) period.

Exercise Continuance. The study confederate noted whether the participant continued to exercise once the experimenter left the room. Initially this variable was conceptualized as a continuous time variable; however, none of the participants ceased exercising in between the time the experimenter left the room and the time she asked to stop the study protocol (i.e., 10–12 min). This variable was therefore changed to a dichotomous variable (stopped or continued to exercise).

Mood. The vigor ($N_{items} = 6$) and fatigue ($N_{items} = 5$) subscales of the Profile of Mood States-SF (POMS-SF) were used to assess the participants' mood before and after the experimental manipulation (Shacham, 1983). The internal consistency estimates of the scale scores have ranged from .80 to .91 (Curran, Andrykowski, & Studts, 1995), which is comparable to the internal consistency coefficients from this study ($\alpha = .85$ and .89, respectively).

Motivational Outcomes. The Intrinsic Motivation Inventory (IMI; McAuley, Duncan, & Tammen, 1989) was used to assess the participants' interest in the task ($N_{items} = 7$), perceived competence ($N_{items} = 6$), effort ($N_{items} = 5$), and felt pressure/tension ($N_{items} = 5$) postexercise session. The internal consistency of the subscales of this measure have been reported to range from .78 to .91 (Deci, Eghrari, Patrick, & Leone, 1994; McAuley et al., 1989), and in the current study the coefficients ranged from $\alpha = .73$ to .91.

Funnel Debriefing. Following the experiment, the participants were asked to answer two open-ended funnel debriefing questions that were developed for this study as a probe for suspicion of the true nature of the research (Bargh & Chartrand, 2000). The questions were as follows: *What do you believe was the purpose of the study? How did you feel while participating in the study? Explain.* Participant responses were reviewed by the lead and corresponding authors. If there was suspicion that a woman felt her behavior was manipulated by the verbal comments provided by the confederate (or if any participant felt the confederate was part of the research team), her data were excluded from the analyses.

Procedures

Female university students responded to posted study advertisements by contacting the experimenter, who reviewed eligibility criteria and scheduled laboratory visits. The participants provided informed consent, participated in a 6-min walk test, and completed a self-report questionnaire that assessed demographic details, mood, and exercise motivation. The participants were randomly assigned to either an intrinsically or externally regulated motivation group based on a table of numbers but were not informed of this procedure. Blinding to the experimenter was not possible because the manipulation involved overt statements provided by the confederate during the exercise session. The participants were set up on a Star Trac s-TRC treadmill (Irvine, CA) and fitted with the HR monitor and accelerometer. A confederate who was acting as another participant (upper-level undergraduate, healthy-weight female student) was also set up on a treadmill with the HR monitor and accelerometer; all participants exercised at a treadmill speed of 3 mph. The treadmills were positioned such that the display panels were not visible to the other participant/confederate. Participants were asked to walk or run at a self-selected pace for the scheduled 15-min exercise bout. They were instructed to keep the treadmill incline at zero.

For the individuals in the externally regulated motivation group, the confederate was directed to provide an externally focused verbal prime after 3 min of exercise: "I don't like to exercise; I am just here for the \$20" (the amount of compensation for the study participation). This first prime is emphasizing being motivated by external factors such as reward, which is consistent with external regulation. After 6 min of

exercising, the confederate was directed to provide another externally focused verbal prime: “If I were to exercise more often I would do so only to look better, I really don’t like this.” The second prime was designed to emphasize the reward of gain (i.e., looking better), which is in accordance with external regulation. Similarly, in the intrinsic motivation group, the confederate provided an intrinsically focused verbal prime after 3 min: “I love exercising, I signed up for this study because I find running so enjoyable, I wish I had more time to do it.” After 6 min, the confederate was directed to provide another intrinsically focused verbal prime: “I am really enjoying this exercise.” These verbal primes were developed to be consistent with the primes used in other social contagion and motivation priming studies (e.g., Banting et al., 2011; Levesque & Pelletier, 2003; Ng, Thøgersen-Ntoumani, & Ntoumanis, 2012; Pelletier & Vallerand, 1996; Wild et al., 1992).

At baseline, and every 2 min, the lead researcher recorded HR and RPE. After the 10-min assessment of HR and RPE, the researcher mentioned that she forgot something in another room and she instructed the participants and confederate that they could stop if they desired because she had collected enough data from them, or they could continue to exercise. While exercising with participants in the externally regulated motivation group, the confederate stopped immediately, without saying another word. She continued to exercise without saying a word with the participants in the intrinsic motivation group. At 12 min, the researcher returned and asked all participants to stop exercising. The participants were then asked to complete a postexperimental self-report questionnaire. This protocol was approved by the McGill University Behavioral Research Ethics Board.

Data Analysis

Following observation of data and tests of assumptions, preliminary analyses were conducted to test whether there were significant differences ($p < .05$) between the intrinsic and external motivation priming groups on descriptive data (age, BMI, previous PA), including the potential covariates (fitness, RAI). If there were significant group differences, baseline variables were included in the main analyses as covariates. Pearson correlation coefficients were also calculated among all study variables. The first study objectives were assessed using mixed-model ANOVAs and ANOVAs. Specifically, to compare intrinsic and external motivation groups on RPE and HR at each of the 5 time points during the exercise session, as well as average RPE and HR and percentage of maximal heart rate ($\%HR_{max}$),^{2,3} separate mixed-model ANOVAs were estimated. The percentage of time spent in MVPA during the exercise session (0–10 min) between the intrinsic and external motivation groups was tested using ANOVA. Effect sizes (Cohen’s d) were calculated (Cohen, 1988). To test the second objectives (i.e., to compare exercise continuance and time spent in MVPA between 10 and 12

min), chi-square and ANOVA analyses were performed, respectively. The third objective (i.e., to examine time, group, and group by time interaction effects on vigor and fatigue) was tested using mixed-model ANOVA. Finally, the fourth objective (i.e., to examine group differences on postexperimental perceptions of competence, interest, effort, and pressure/tension) was tested in multivariate analysis of variance (MANOVA). Follow-up univariate analyses were conducted to further explore significant multivariate effects. In all analyses, where appropriate, effect sizes (Cohen, 1988) were calculated. All statistical analyses were performed using SPSS v20.

Results

Description of Sample

Participants ranged in age from 18 to 30 ($M = 21.6$, $SD = 3.3$) years. Participants’ weights ranged from 42 to 70 ($M = 56.42$, $SD = 6.82$) kilograms and their heights ranged from 1.54 to 1.78 ($M = 1.64$, $SD = 0.06$) meters. The mean BMI was 21 ($SD = 2.11$) kg/m². Women reported participating in an average of 29.21 ($SD = 16.51$) minutes of total PA in the last week, at predominantly light intensity. Participants reported a mean RAI value of 6.10 ($SD = 7.49$). None of the participants reported being aware of the true nature of the study following the postexperimental debriefing.

Preliminary Analyses

To determine sample size, a priori power calculations were performed for the most comprehensive model (mixed-model ANOVA with 5 time points). For a small effect ($d = 0.25$), alpha of .05, and power of 0.80, 16 women per group were needed.

Data for each measure were normally distributed based on skewness (skewness_{max} = 2.66 [$SE = 1.81$] and skewness_{min} = -1.3 [$SE = 0.36$]) and kurtosis (kurtosis_{max} = 5.55 [$SE = 0.72$] and kurtosis_{min} = -1.1 [$SE = 0.72$]) values (Tabachnick & Fidell, 2007). Moreover, assumptions of linearity and homoscedasticity were also met, and the assumption of homogeneity of variance was not violated. The data (i.e., correlations among the exercise motivation regulations) conformed to a simplex pattern. No between-group differences on age, BMI, exercise motivation (RAI), fitness, or prior PA participation were observed (see Table 1). Age, resting HR, and fitness showed no significant ($p < .05$) correlations with any of the study variables. PA participation in past week was correlated with pre- and postvigor ($r = .39$ and $.41$, respectively). BMI was significantly correlated with heart rate during exercise ($r = .47$) and RAI ($r = -.34$). Given that there were no group differences noted and no significant correlations among possible independent variables or covariates and outcomes in this study, no variables were included in the main analyses as covariates to maintain parsimonious models.⁴

Table 1 Exercise Motivation, Fitness, and Physical Activity–Related Characteristics of 42 Female Participants by Experimental Group

	Total <i>M</i> (<i>SD</i>) <i>n</i> = 42	Intrinsic <i>M</i> (<i>SD</i>) <i>n</i> = 21	Extrinsic <i>M</i> (<i>SD</i>) <i>n</i> = 21	<i>F</i>	<i>p</i>
Age	21.59 (3.31)	20.95 (2.87)	22.24 (3.64)	1.61	.21
BMI	21.01 (2.11)	21.72 (1.90)	20.31 (2.12)	5.17	.09
Exercise Motivation					
RAI	6.10 (7.49)	5.55 (6.64)	6.66 (8.39)	0.23	.64
Fitness					
Distance walked in 6-min walk test (m)	593.39 (50.36)	586.34 (43)	600.55 (56.81)	0.84	.34
Physical Activity Participation					
Strenuous (min)	8.10 (9.84)	7.20 (9.51)	9.00 (10.52)	0.32	.57
Moderate (min)	11.34 (10.36)	10.50 (8.72)	10.14 (11.89)	0.25	.62
Mild (min)	10.68 (7.93)	12.71 (8.79)	8.55 (6.48)	2.95	.64

* $p < .05$.

Experimental Group Differences During the Exercise Session

The descriptive data for the outcome measures are presented in Table 2. A mixed-model ANOVA showed a significant time effect for RPE [$F(1,38) = 20.51$, $p < .001$, $\eta^2 = 0.69$]. Follow-up univariate analyses revealed that RPE increased significantly for all successive time points starting with baseline (Table 2). The group effect [$F(1,38) = 3.05$, $p = .08$, $\eta^2 = 0.07$] and Group $\times$ Time interaction were not significant [$F(1,38) = 0.30$, $p = .88$, $\eta^2 = 0.007$]. ANOVAs with Bonferroni correction were also performed in order to examine group differences at each RPE measure, given the priming effects were provided at specific times. RPE at 8 min was significantly higher in the intrinsic motivation group (Table 2). Small effect sizes were detected for RPE at 2, 4, 6, and 10 min between the intrinsic and external motivation groups. Medium effect sizes were detected for RPE at 8 min as well as for average RPE (Table 2).

Heart rate means were significantly higher for the intrinsic group across all measurements, compared with the externally-regulated motivation group (Table 2). A mixed-model ANOVA showed a significant time effect for HR [$F(1,38) = 15.55$, $p < .001$, $\eta^2 = 0.63$]. Follow-up univariate analyses showed HR significantly increased at each point of data collection except for between 6 and 8 min, and 8 and 10 min. A significant group effect [$F(1,38) = 6.35$, $p = .02$, $\eta^2 = 0.14$] was observed such that participants in the intrinsic motivation group had higher HR than participants in the externally regulated motivation prime group. A nonsignificant Group $\times$ Time interaction [$F(1,38) = 0.37$, $p = .83$, $\eta^2 = 0.001$] was observed. ANOVAs with Bonferroni correction were performed in order to examine group differences at each HR measure,

given the priming effects were provided at specific times. Reported HR at each of the five time points, average HR scores, and %HR_{max} were significantly higher in the intrinsic motivation group than in the externally regulated motivation group (Table 2). Medium effects were detected for HR at all five time points as well as for average HR and %HR_{max} (Table 2).

As a test of group differences for exercise intensity, the participants in the intrinsic motivation group spent a greater percentage of time engaging in MVPA during the exercise session compared with the externally regulated motivation group. A medium effect size was detected (see Table 2). Furthermore, the confederate's accelerometer data were compared with women in both experimental groups. In both the intrinsically and externally regulated motivation group, the study confederate spent 100% of her time in MVPA during the original 10 min of the study when jogging at a steady speed of 3 mph on the treadmill, whereas the participants' average times spent in MVPA for the intrinsic and extrinsic group were 91.8% and 68.78%, respectively (see Table 2). The average steps for the confederate in the intrinsic group were 1301 and 1320 steps in the extrinsic group, whereas the participants' average step count was 1376.89 for the intrinsic group and 1263.14 steps in the extrinsic group.

Postexercise Session

After the 10-min exercise session, all 21 participants (100%) in the intrinsic motivation group continued to exercise compared with 6 of the 21 (29%) participants from the externally regulated motivation group, $\chi^2(1) = 7.00$, $p = .01$. Among participants who continued to exercise during the 10–12 min period, women in the intrinsic motivation group spent a significantly greater

Table 2 Experimental Group Differences During and After the Exercise Session on RPE, HR, and Percentage of Time in MVPA

	Total <i>M (SD)</i> <i>n</i> = 42	Intrinsic <i>M (SD)</i> <i>n</i> = 21	Extrinsic <i>M (SD)</i> <i>n</i> = 21	<i>F</i> _a	<i>p</i>	Partial η^2	Cohen's <i>d</i>
RPE 2 min	11.07 (2.19)	11.57 (2.23)	10.57 (2.08)	2.26	.14	0.05	0.46
RPE 4 min ^b	12.00 (1.94)	12.38 (1.69)	11.62 (2.13)	1.65	.17	0.05	0.21
RPE 6 min ^{b,c}	12.88 (1.97)	13.28 (1.52)	12.47 (2.29)	1.82	.19	0.04	0.42
RPE 8 min ^{b, c, d}	13.47 (1.64)	14.00 (1.31)	12.95 (1.80)	4.66*	.04	0.10	0.67
RPE 10 min ^{b, c, d, e}	13.85 (1.65)	14.14 (1.49)	13.57 (1.77)	1.27	.27	0.03	0.35
Average RPE	12.66 (1.59)	13.08 (1.42)	12.23 (1.68)	3.05	.08	0.07	0.55
HR 2 min	144.19 (19.78)	150.76 (15.75)	137.62 (21.53)	5.10*	.03	0.11	0.67
HR 4 min ^f	149.92 (21.26)	157.57 (14.75)	142.28 (25.39)	5.69*	.02	0.12	0.73
HR 6 min ^{f, g}	154.57 (21.26)	162.19 (15.39)	146.95 (23.83)	6.06*	.02	0.13	0.75
HR 8 min ^{f, g}	156.33 (22.32)	164.57 (16.93)	148.09 (24.34)	6.48*	.01	0.14	0.78
HR 10 min ^{f, g, h}	158.26 (25.85)	166.80 (16.86)	149.71 (30.53)	5.04*	.03	0.11	0.69
Average HR	152.65 (21.12)	160.38 (15.09)	144.93 (23.70)	6.35*	.02	0.14	0.78
%HR _{max}	76.91 (10.42)	80.57 (7.51)	73.26 (11.74)	5.93*	.02	0.13	0.74
% time in MVPA 0–10 min	80.29 (30.11)	91.80 (7.16)	68.78 (39.11)	7.04*	.01	0.15	0.82
% time in MVPA 10–12 min	66.67 (44.40)	89.29 (28.03)	71.15 (39.32)	14.18	.001	0.27	0.53

**p* < .05.^a*df* = (1, 41)^bSignificant (*p* < .05) difference from RPE at 2 min.^cSignificant (*p* < .05) difference from RPE at 4 min.^dSignificant (*p* < .05) difference from RPE at 6 min.^eSignificant (*p* < .05) difference from RPE at 8 min.^fSignificant (*p* < .05) difference from HR at 2 min.^gSignificant (*p* < .05) difference from HR at 4 min.^hSignificant (*p* < .05) difference from HR at 6 min.

percentage of time in MVPA than the women in the externally regulated motivation group; a medium effect size was detected (Table 2).

Pre- and Postexercise Session

As presented in Table 3, vigor was significantly higher postexercise, independent of group. The main effect and interaction were not significant for vigor or fatigue. Small effects were detected for fatigue values in the intrinsic (*d* = 0.23) and external groups (*d* = 0.06) as well as for vigor in the intrinsic (*d* = 0.33) and external groups (*d* = 0.46).

Postexercise

The multivariate model for motivation was significant: Wilks's Λ = 0.73, *F* (5, 35) = 2.61, *p* = .04. In follow-up univariate analyses, there were no significant group differences in self-reported perceptions of competence,

effort, interest, and pressure/tension. These results and respective effect sizes are presented in Table 4.

Discussion

Given the importance of fostering intrinsic motivation and the limited research on social contagion and exercise behavior, the overall purpose of this study was to determine whether motivation to participate in PA can be transmitted through verbal primes. Based on the study findings, and in line with theoretical rationale, it may be possible that exercise motivation is "contagious" through verbal priming. These findings support theoretical tenets, provide considerations for experimental designs in sport and exercise, and may inform practice in the way exercise psychology professionals work with clients.

The first hypothesis was that, compared with the externally regulated motivation priming group, par-

Table 3 Mean Pre- and Postexercise Group Differences in Vigor and Fatigue

	Vigor	Fatigue						
Total sample ($N = 42$)								
Pre	1.28 (1.73)	0.89 (0.79)						
Post	1.62 (0.88)	1.01 (0.76)						
Cohen's $d_{\text{pre} = \text{post}}$	0.25	0.16						
Intrinsic group ($n = 21$)								
Pre	1.34 (0.73)	0.76 (0.77)						
Post	1.64 (0.99)	0.94 (0.77)						
Cohen's $d_{\text{pre} = \text{post}}$	0.34	0.23						
d pre and post Cohen's d^a	0.16	0.34						
Extrinsic group ($n = 21$)								
Pre	1.22 (0.75)	1.03 (0.80)						
Post	1.60 (0.82)	1.08 (0.76)						
Cohen's d pre and post	0.48	0.06						
Cohen's d^b	0.04	0.18						
	df F Partial η^2 p df F Partial η^2 p							
Time	(1, 41)	11.23	0.02	.002*	(1, 41)	0.75	0.04	.39
Group	(1, 41)	0.12	0.03	.73	(1, 41)	0.99	0.02	.32
Time $\times$ Group	(1, 40)	0.16	0.04	.69	(1, 40)	0.26	0.01	.62

* $p < .05$.

^aCohen's d values for group differences on preexercise scores.

^bCohen's d values for group differences on postexercise scores.

Table 4 Differences in Postexercise Measures of Competence, Interest, Effort, and Pressure/Tension Between the Intrinsic and Extrinsic Motivation Group

Subscales	Means (<i>SD</i>)		<i>F_a</i>	<i>p</i>	Partial η^2	Cohen's <i>d</i>
	Intrinsic	Extrinsic				
Competence	4.11 (1.52)	4.86 (0.91)	3.68	.06	0.08	0.60
Interest	4.69 (1.40)	5.10 (1.34)	0.93	.34	0.02	0.30
Effort	5.01 (1.28)	4.30 (1.09)	3.68	.06	0.08	0.60
Pressure/Tension	2.39 (1.26)	2.23 (1.04)	0.21	.65	0.01	0.14

* $p < .05$.

^a $df = (1, 41)$.

ticipants who were randomly assigned to the intrinsic motivation group would report lower RPE values, have higher measured HR values, exercise at a higher %HR_{max}, and spend a higher percentage of time engaging in MVPA during the exercise session. The results from this study partially support the first hypothesis. While RPE values after 2, 4, 6, and 10 min of exercise were not significantly different between the two groups (albeit consistently higher in the intrinsic motivation group), the intrinsic group reported significantly higher RPE values after 8 min of exercise. It is possible that the internalization of intrinsic motivation, and the effectiveness of verbal primes, may be a process that takes some time (Deci & Ryan, 2012). For example, the first verbal prime was provided after 3 min of exercising, which means that the participant had only about 1 min to process the prime before the 4-min assessment of RPE, whereas the second verbal prime, which was provided after 6 min of exercising, may have had a potentiated effect on RPE since the participants may have processed the first verbal prime and received confirmation in the second verbal prime. However, this significant group difference was not maintained at 10 min. Based on the current data, it may be that RPE was leveling off for the intrinsic group at this point, whereas the externally regulated motivation group may continue to report heightened RPE. Further data at time points beyond 10-min are needed in order to test this proposition. Consistent with Banting and colleagues (2011), RPE was expected to be lower in the intrinsic group, and it may be that, among inactive women, it takes some time before they begin to report lower RPE in spite of workload intensity (or HR). For example, the HR data show that the participants in the intrinsic motivation group were working at a higher HR over the study period than the externally regulated motivation group and, as such, the priming effects may still be evident. Finally, the lack of significant difference at 10 min for RPE may show a short priming effect. Little is known about the effectiveness of primes over time, and future research directives may explore the timing of effectiveness of various types of prime delivery, including hypothetical, nonverbal (i.e., reading sentences or quotes), and verbal.

The participants' recorded HR at all 5 time points, as well as %HR_{max}, were significantly higher in the intrinsic motivation group. In addition, participants in the intrinsic group spent a greater percentage of time engaging in MVPA compared with those randomly assigned to the external motivation group. There is limited research on the effects of social contagion in PA, and the mechanisms explaining the effects of verbal primes on performance outcomes are not known. This being said, researchers have indicated that verbal persuasion and primes can have an effect on PA perceptions and participation through effects on self-efficacy and social support. First, verbal persuasion can be a powerful way to increase self-efficacy (Samson & Solmon, 2011), which in turn affects an individual's activity choice, effort, intensity, and persistence (Bandura, 2000). Perhaps the intrinsic motivation verbal primes were interpreted as a form of verbal persuasion

whereby increasing the self-efficacy of the exercising participant resulted in higher RPE and HR scores, exercising at a higher % HR max, and spending a greater percentage of time in MVPA. Future research should be conducted in order to examine this potential mediating role of self-efficacy in the relationship between verbal primes and PA outcomes. Nonetheless, findings from this study suggest that verbal primes may be effective in fostering self-determined motivation. Therefore, exercise trainers and psychology consultants may consider providing intrinsically motivating verbal primes to their beginner exercisers. Second, participating in PA with an exercise partner may also have beneficial outcomes on one's own PA behaviors by increasing motivation to participate and adherence (Darlow & Xu, 2011). For individuals who are not physically active, such as the current study sample participants, an exercise partner may be perceived as providing support for PA (Darlow & Xu, 2011). As such, another potential mediating variable between motivational verbal priming and exercise outcomes may be perceived social support, and future research endeavors could examine this proposition.

The findings from this study confirmed the second hypothesis in that a greater percentage of participants in the intrinsic motivation group continued to exercise after the 10-min exercise session and during that time spent a greater percentage of time engaging in MVPA compared with the externally regulated motivation group. In fact, all of the participants in the intrinsic motivation group continued to exercise. Drawing on previous findings, it may be that social influences and facilitation can persuade healthy behaviors such as exercise (Plante, Madden, Mann, & Lee, 2010; Salvy et al., 2009). Research by Luszczynska and colleagues (2005) found that individuals are likely to mimic the behaviors of those around them. It has also been shown that individuals feel the need to engage in socially acceptable behaviors, such as exercise, especially when they observe others around them doing the same (Luszczynska et al., 2005; Plante et al., 2010; Salvy et al., 2009). In the current study, the participants may have observed the confederate continue to exercise after the experimenter left the room in the intrinsic motivation group and the participants perceived that it was socially unacceptable to stop exercising, whereas in the extrinsic group the participants perceived that it was more socially acceptable to stop exercising and mimicked that behavior. Furthermore, Dijksterhuis, Chartrand, and Aarts (2007) suggest that motivated behaviors are stimulated automatically via mimicry. Behavior mimicry has been shown to be affected by speech patterns (Neumann & Strack, 2000), facial expressions (Hatfield, Cacioppo, & Rapson, 1994) and behaviors themselves (Chartrand & Bargh, 1996). For example, Chartrand and Bargh (1996) demonstrated that participants were likely to mimic the actions of a study confederate such as face touching and foot shaking, even though they were completely unaware of the study confederates' subtle mannerisms during the interaction. This study supports the concept that mimicry can occur as a direct result of behavior perception, and

consequently individuals change their own behaviors to blend with their current environment (Chartrand & Bargh, 1996). This being said, it is important to note that the participants in the study did not display mimicry throughout the research protocol. The confederate exercised on average at a higher intensity than women in the externally regulated motivation group and at a lower intensity than the participants in the intrinsic motivation group. Future research is needed in order to tease apart the possible social facilitation and motivational priming effects provided by others as social contagion. This may have implications for experimental studies in sport and exercise domains in that studies designed to have more than one person training or testing at the same time may be contaminated by these contagion effects. Furthermore, exercise trainers and consultants should be aware of the possible contagion effects (Ng et al., 2012), especially if they use group-based programs since one extrinsically motivated person, or just one comment of that nature, may influence the achievements of the group.

The participants reported greater vigor scores after the 10-min exercise session in both experimental conditions. It has been shown that exercise, specifically aerobic exercise, improves vigor and decreases fatigue in young adults (Dishman, Thom, Puetz, O'Connor, & Clementz, 2010). It may be that a self-selected 10-min exercise session was long enough to experience increases in vigor however was not long enough to affect fatigue levels in either experimental group. In the study by Dishman and colleagues (2010), participants engaged in PA for a total of 25 min (including a warm-up) compared with the current study PA period of 10–12 min. In addition, participants in Dishman et al.'s (2010) study had to exercise at 75% of their VO_{2max} , whereas the participants in the current study exercised at a self-selected pace and were able to change their pace as they wanted throughout the exercise bout, hence perhaps limiting fatigue. It has been shown that females tend to dislike and avoid exercise intensities that are more vigorous (Standage, Gillison, Ntoumanis, & Treasure, 2012). As such, differences in fatigue could have been found if participants were told to exercise for a greater amount of time and at a greater intensity. Furthermore, there were no group differences in vigor or fatigue in the current study, although fatigue scores were higher in the externally regulated motivation group. Based on the theoretical tenets of SDT, individuals who are extrinsically motivated to exercise were expected to report a greater perception of fatigue (Vallerand, 2007). It may be that a longer duration of exercise would further differentiate the experimental conditions on this measure.

The multivariate model for motivation was significant; however, there were no significant group differences detected in univariate analyses for perceived competence, effort, interest, and pressure/tension. Regardless of the lack of significant group differences, it is important to note that the mean values on competence and interest were higher in the externally regulated motivation group and the mean values for effort and pressure/tension were lower. In line with the current literature and hypothesis,

participants in the intrinsic primed group perceived that they exerted more effort (Ryan & Deci, 2000). However, it was not expected that competence and interest would be higher in the externally regulated motivation group. What may have occurred in this study was a form of downward social comparison whereby the study participants perceived that they were better off than the study confederate in the externally regulated motivation group (e.g., when the confederate stated that she didn't like to exercise, or she was doing the study only for money, the participants may have felt less strongly for these statements; Festinger, 1954). Therefore, this comparison may have elicited favorable exercise behaviors in the externally regulated motivation group (Dijkstra, Gibbons & Buunk, 2010). Researchers have shown that when self-enhancement is a prevailing motive, individuals favor to compare themselves downward with others who they feel are worse off than them (Dijkstra et al., 2010). Downward social comparisons tend to enhance self-esteem and positive affect (Dijkstra et al., 2010). It may therefore be that the participants' downward social comparison between themselves and the study confederate resulted in outcomes that are opposite of what was expected. Future research strategies are needed for further exploring the premise that social comparison effects occur in experimental studies with verbal cues and priming.

In spite of the novelty of the current findings, some limitations need to be acknowledged. First, the sample included self-selected young adult females who may have been more motivated to be physically active or to change their behaviors in the near future. Therefore, there is a need to explore these effects among other exercise groups and see how these priming effects are altered by exercise history. In addition, participants exercised next to the study confederate for 10 min and therefore this time could have limited the internalization of intrinsic motivation. Intrinsic motivation verbal primes and internalization may be a process that occurs over a longer time span or after exercising several times with a partner (Deci & Ryan, 2012) to affect mood and motivational outcomes. Furthermore this study examined group differences at the extremes of motivation (external and intrinsic motivation); however, researchers have found that identified regulation is a stronger predictor of various exercise outcomes (duration and intensity of exercise, adherence) and this would likely be an effective prime to test in future studies (Standage, Sebire, & Loney, 2008; Wilson & Rodgers, 2004), in addition to comparisons among primes directed at all regulations on the motivation continuum. Potential future directions include investigating whether the effects of verbal primes are long lasting and if similar primes could lead to changes in PA behaviors as well as motivation orientation. Furthermore, it would be important to tease out the role of social facilitation and priming in social contagion.

In conclusion, the current findings of the study offer new information on how the theoretical framework of social contagion may be used in an exercise setting to

promote PA. In addition, this study demonstrates that even simple primes can increase a woman's exercise intensity without the added perception that she worked out harder. Individuals exercising with novice exercise partners, personal fitness trainers, and exercise psychology consultants (among others) should therefore be cognizant of their verbal primes because these may affect their partners'/clients' exercise behaviors. Furthermore, verbal primes may also influence exercise behaviors in experimental studies when more than one participant is present, because potential unintended primes may affect exercise behaviors and performance outcomes by increasing bias in measurement. Fostering intrinsic motivation in inactive individuals may help beginning exercisers adopt more active lifestyles as well as adhere to an exercise regimen, leading to greater physiologic and psychological well-being (Biddle, Fox, & Boutcher, 2000). Developing ways to help sedentary individuals adopt and maintain more active lifestyles represents a public health priority, and proper pairing of exercise partners may result in more favorable exercise outcomes.

Notes

1. We used the term *motivational orientation* to align with the research of Levesque and Pelletier (2003), Freidman and colleagues (2009), and Banting, Dimmock, and Grove (2011). However, researchers may be familiar with terms such as *behavioral regulation* or *motivational regulations* that are used synonymously in this context.
2. The %HR_{max} was used as a composite indicator of HR given the exercise was self-selected and could be altered by the participant throughout the study.
3. HR_{max} was estimated using the most conventional formula of 220 minus the participant's age (cf. American College of Sports Medicine [ACSM], 2006).
4. The models were tested controlling for fitness and RAI, the predetermined possible covariates, and BMI and PA history, and there were no meaningful differences in the findings.

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