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## Examinations of change in inhibitory and initiatory Self-Control in the context of endurance running

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### ABSTRACT

Endurance activities provide a key context for positive development. Using data from a longitudinal study of 398 adolescents and emerging adults participating in a charity marathon event, this study examined the multidimensionality of self-control, documented longitudinal change in inhibitory and initiatory self-control across program participation, and examined associations between inhibitory and initiatory self-control and sport performance. Initiatory self-control evidenced significant declines across the course of training and running the endurance race. Initial levels of initiatory self-control predicted faster race times, whereas initial levels of inhibitory control and declines in initiatory self-control predicted worse performance. Changes in both aspects of self-control differed based on the types of contingencies of self-worth runners reported. Results highlight the predictive utility of multidimensional accounts of self-control for program outcomes. Findings advance understanding of how involvement in sporting contexts contribute to within-person change in some, but not all, aspects of self-control.



*Lay summary:* The present study investigated the impact of marathon running on self-control in adolescents. Findings suggest that marathon running affected “start control” and “stop control” differently. Sources from which adolescents derived their self-worth mattered; those who based their self-worth on performance had lower levels of self-control than those who based their self-worth on virtues.

### IMPLICATIONS FOR PRACTICE

- A multidimensional view of self-control may help coaches and practitioners develop personalized strategies for young people to restrain from counterproductive behaviors and engage in activities consistent with goal attainment.
- Performance-enhancement strategies may be particularly strengthened by efforts to help sustain initiatory self-control over the course of training for an endurance event.
- Character and virtue development through sports may depend on the messages that young people internalize about where they derive their self-worth.

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Self-regulatory capacities are critical for young people when they pursue their athletic goals (e.g., Kolovelonis et al., 2012; Tedesqui & Young, 2017), especially when training for and running endurance races (e.g., half and full marathon). The natural tendency to avoid pain requires endurance athletes to resist the urge to slow down or quit when experiencing aerobic distress. Further, runners must consistently train in order to race longer distances and must make healthy choices that support their training and recovery. These activities depend on self-control, which is the capacity to inhibit undesirable impulses and to regulate behavior, thoughts, and emotions in order to initiate a desired action or work toward a longer-term goal (Baumeister et al., 1994; Carver & Scheier, 1998; Tangney et al., 2004). On average, individuals who report higher levels of self-control tend to show more engagement in practices (Tedesqui & Young, 2017), perform better in practice skills (e.g., Pfeffer et al., 2020), and take more action toward their athletic goals (Duckworth & Steinberg, 2015).

Self-control has been understood as a finite resource that can be depleted over time (Hagger et al., 2010), often employing a muscle metaphor to describe the momentary depletion of self-control when used as well as the ability to strengthen self-control with practice and repetition across time. However, relatively more of this research has examined situational self-control in a laboratory setting, and more research grounded in ecologically valid sport contexts (e.g., endurance training) is urgently needed to inform theory and practice related to self-control. Thus, the aims of this study are fourfold: (a) improve the measurement of self-control in sporting contexts by examining the multidimensional structure of self-control, (b) document within-person change in inhibitory and initiatory self-control across participation in a charitable endurance running training program, (c) examine the relationship between inhibitory and initiatory self-control and marathon performance indicators (e.g., sustained participation and marathon race times), and (d) examine how contingencies of self-worth predict changes in inhibitory and initiatory self-control.

### **Theories of self-control**

Definitions of self-control vary across literatures, but a common theme across conceptualizations and operationalizations is the view of self-control as multidimensional. Self-control involves two distinct but complementary processes: inhibitory and initiatory self-control.

Inhibitory self-control involves restraining impulses for immediate gratification (Baumeister et al., 1998), whereas initiatory self-control involves engaging in actions directed toward a desired goal. Despite agreement on the multidimensional nature of self-control, empirical work has largely measured self-control as a single, unidimensional construct (e.g., Tangney et al., 2004). As an exception, using confirmatory factor analyses, de Ridder et al. (2011) illustrated the predictive validity of considering self-control as representing both inhibitory and initiatory dimensions, providing an approach that more closely aligns with theoretical conceptualizations.

To perform at their best, athletes must learn how to regulate negative thoughts, emotions, and behaviors that undermine performance (i.e., inhibitory self-control) and proactively engage in activities (i.e., initiatory self-control) that move them closer to their long-term goal (Tedesqui & Young, 2017). In other words, athletes must inhibit feelings of physical strain; regulate performance anxiety and disappointment; and manage difficulties with reduced confidence, motivation, and concentration (e.g., Carver & Scheier, 2009; Lazarus, 2000; Martinent & Ferrand, 2009; McCormick et al., 2018; Vast et al., 2010) while engaging in goal-directed activities such as planning, pacing strategies, training schedules, nutrition plans, and recovery activities (Brick et al., 2016; McCormick et al., 2019; Scholz et al., 2008). Indeed, research with track-and-field athletes highlights the importance of distinguishing between types of self-control in athletic samples, as there is a need to inhibit impulses of starting too soon and, at the same time, to initiate movement of the sport (Englert & Bertrams, 2013; Englert et al., 2015; Englert & Rummel, 2016). Identifying different dimensions of self-control in sport contexts, potentially distinct patterns of within-person change, and differential predictions for sport performance contributes to theory by providing greater specificity in understanding how particular contexts may promote or hinder self-control and, in turn, affect sport performance. Thus, as the first aim of the study, we sought to improve the measurement of self-control in sporting contexts by examining the multidimensional structure of self-control in a sample of adolescents and emerging adults.

The strong link between self-control and performance has led to a growing body of research in sport and performance psychology (e.g., Englert, 2016; McCormick et al., 2019; Wagstaff, 2014). The strength-energy model employs a muscle metaphor to describe the momentary depletion of self-control when used (ego-depletion hypothesis) as well as the ability to strengthen self-control with practice and repetition across time (building capacity hypothesis). Laboratory experiments assessing the influence of ego depletion typically assign participants to one of two conditions—an ego depletion condition involving a self-control task or a control condition involving a neutral task—with both followed by a second, unrelated self-control task. Ego-depleted participants show declines in a range of tasks indicative of self-control, including having less persistence in tasks (e.g., Muraven et al., 1998), displaying difficulty in regulating emotions (e.g., Schmeichel, 2007), making more mistakes in the Stroop task (e.g., Richeson & Shelton, 2003), and exhibiting impaired performance in dexterity tasks (e.g., Englert & Bertrams, 2013); these effects have replicated in more than 300 studies.

There is also evidence that engaging in regular self-control activities leads to increased self-control in both experimental and field studies (Englert & Bertrams, 2013; Gailliot et al., 2007; Muraven et al., 1998). For example, participants randomly assigned to regular engagement in self-control tasks (e.g., modifying speech to avoid certain words, using the nondominate hand, modifying postures, monitoring diet, using aversive mouthwash) show higher levels of exercise adherence (Gailliot et al., 2007; Hui et al., 2009; Muraven et al., 1999). Likewise, in a study with previously sedentary college undergraduates, participants assigned to engage in a physical fitness training program showed increases in a variety of self-control-related outcomes and tasks compared with changes that occurred during their wait period for the exercise program (Oaten & Cheng, 2006).

Empirical studies on the strength-energy model often focus on short-term self-control capacities, often operationalized as task persistence. A small but growing body of work has begun examining the role of more trait-based self-control in the strength-energy model (e.g., Dvorak & Simons, 2009). Although traits have historically been considered stable individual differences, more recent work from both personality theory (e.g., Fleeson & Jayawickreme, 2015) and self-control research (e.g., Wills & Dishion, 2004) employs a transactional approach, suggesting that traits, including self-control, represent density distributions of states that develop over time as a result of an interaction between biologically based factors and adaptation, socialization, and contextual influences. Thus, both state-like and trait-like aspects of self-control have the capacity for change across time in adolescents and emerging adults, especially when youth are participating in positive developmental contexts—such as sports—that offer opportunities for goal-setting, emotion regulation, and self-regulation (Hansen et al., 2003).

### ***Sport as a developmental context for self-control***

Endurance sporting events (e.g., 5-km and 10-km runs, half and full marathons, triathlons, cyclosporives) provide an ideal context for examining self-control across time, as they hold potential for both capacity building (i.e., growth) and depletion effects (i.e., declines) that are hypothesized by various strength or motivational social psychological models of self-control (e.g., Englert et al., 2015; Friese et al., 2017; Hagger et al., 2010) and developmental research (e.g., Linver et al., 2009; Vandell et al., 2015). Given the need for young people to both inhibit impulses and initiate behaviors toward meeting specific goals (Taylor et al., 2018; Tedeschi & Young, 2017), endurance sports hold potential for both self-control depletion and capacity building. This is especially true for more novice runners who are training and running the marathon outside of their normal school and work schedules. In addition to the self-control required to follow the scheduled practice runs building up to the 26.2-mile race, there is a need for sustained self-control to eat healthily, refrain from substance use, and follow a sleep schedule in order to recover from training and prepare the body. Further, marathon runners must use self-control to complete the race because they often face adversity and challenges that they must overcome during the race. Thus, marathon activities may build self-control over time by helping increase capacity and skill, or they may lead to depletion effects and exhaust self-control by placing too many demands on young people. There is a need to better understand how sporting activities enhance or undermine the self-regulatory capacities of young people (Terwiel et al., 2019). Thus, as a second aim of the study, we examined how participation in an endurance running training program contributes to within-person change in inhibitory and initiatory self-control across marathon training.

### ***Self-control and performance***

The strength-energy model of self-control has clear implications for sport performance. Research has found short-term declines in self-control (i.e., ego depletion) are related to higher intention-behavior gaps in exercise programs (e.g., Martin Ginis & Bray, 2010),

diminished physical strength on endurance tasks (Dorris et al., 2012; Englert & Wolff, 2015; Wagstaff, 2014), and decreased performance-related accuracy and impulse control in the lab (McEwan et al., 2013). Although there is an ongoing debate as to the actuality of true ego-depletion effects (as opposed to motivational explanations; Carter et al., 2015; Hagger et al., 2010), existing literature points to the potential for prior acts of self-control impairing sport performance. Whether long-term changes (i.e., across the course of marathon training) in self-control will demonstrate similar associations with sport performance as more short-term, laboratory-induced effects is an open empirical question. Thus, as a third aim of the study, we examined how long-term within-person changes in inhibitory and initiatory self-control predicted marathon performance indicators (i.e., sustained participation and race times).

### ***Contingencies of self-worth***

Much of the recent research calls for a more process-oriented view of self-control failure (e.g., Inzlicht & Marcora, 2016). Specifically, these models argue that shifts in motivation and attention rather than a depletion of resources undermine sustained self-control. In other words, self-control is not a tangible resource that is depleted; instead, people become less motivated to exercise self-control across time because they find rewards from other actions more appealing and rewards of self-control less appealing (Inzlicht & Friese, 2019). Empirical evidence supports this explanation by demonstrating that depletion effects diminish or disappear when immediate rewards for exerting control increase (e.g., when participants paid more money for exerting control; Muraven & Slessareva, 2003), but the utility of such extrinsic rewards diminishes across time because of hedonic adaptation. Alternatively, research demonstrates affirming core values through self-affirmation exercises diminishes depletion effects (Schmeichel & Vohs, 2009), likely by activating core values as the basis for motivation that reenergize self-control.

Motivation is particularly important to consider for endurance sports (Taylor et al., 2018). Previous work suggests that intrinsic or autonomous motivation may sustain self-control efforts, whereas extrinsically motivated young people may be more vulnerable to depletion and burnout (Gould & Whitley, 2009; Jordalen et al., 2016). The identity-value model of self-regulation maintains that people will be more highly motivated to engage in goal-relevant behaviors that are more central to identity (Berkman et al., 2017). Although a variety of constructs can assess the extent to which particular domains are central to identity, contingencies of self-worth may be particularly relevant to sporting contexts given their link to goal-related behaviors (e.g., Kanat-Maymon et al., 2016; Shirk et al., 2005; Wouters et al., 2014).

Contingencies of self-worth represent the different domains in which goals are linked to feelings of self-worth or self-esteem (Crocker & Wolfe, 2001), and young people are highly motivated to achieve success and avoid failure in domains that are linked to their self-worth. Drawing on self-determination theory, changes in self-control are more likely to be optimized when adolescents and emerging adults evaluate their self-worth in a particular context based on more internal, personal standards than on external achievements or competitiveness (e.g., Wouters et al., 2014). Based on this literature, we predict

that young people training for a charitable purpose are more likely to inhibit negative emotions and behaviors and initiate goal-directed pursuits when their feelings of worth depend on their own virtues and values rather than on performing better than others in the competition. As a final aim of the study, we examined how contingencies of self-worth contributed to changes across time in inhibitory and initiatory self-control. We expected that self-worth based on an individual's moral values (e.g., virtue) would contribute to growth in both dimensions of self-control, whereas self-worth based on competition would contribute to declines in their self-control.

### **Current study**

Endurance running holds the potential for both capacity building (i.e., growth) and depletion effects (i.e., declines) hypothesized by developmental research (e.g., Linver et al., 2009; Vandell et al., 2015) as well as various strength or motivational social psychological models of self-control (Carter & McCullough, 2013; Friese et al., 2017; Hagger et al., 2010; Huizenga et al., 2013). Examining self-control in more multidimensional and ecologically valid ways offers a step forward for theory, as most research has been in a laboratory or focused on the unidimensional view of self-control at one point in time (Jordalen et al., 2018). In the current study, we first examine the multidimensional structure of self-control and compare the results of a two-factor model of self-control with a unidimensional measure of self-control to provide further evidence of the utility of measuring multiple dimensions of self-control.

We also specifically investigate the context of a charitable marathon to study within-person change of both inhibitory and initiatory self-control. Previous research suggests that novice runners are more likely to complete their training and finish a marathon when they find intrinsic value in pursuing the goal (Havenar & Lochbaum, 2007). Charitable marathon training may allow participants to connect their involvement to a more transcendent sense of purpose (Jeffery & Butryn, 2012; Schnitker et al., 2020). In this way, charitable running may offer a context for strengthening young athlete's motivation for the activity in ways that prevent self-control depletion. To explore these possibilities, we examined the within-person changes in inhibitory and initiatory self-control and then examined whether changes in both dimensions predicted race performance indicators.

As a final aim, we examine the role of contingencies of self-worth in relation to both inhibitory and initiatory self-control. Previous research shows links between self-regulatory capacities and contingencies of self-worth in academic settings (e.g., Crocker et al., 2003, 2006), but this would be the first study to examine the relation between contingencies of self-worth and self-control in sports. Charitable running events provide an opportunity for young people to be motivated by a good cause and grow in their self-control. However, these events are still competitive and require young people to work toward improvements in training runs. For some young people, the results of the competition may begin to override the motivation to be a better person. We hypothesized that young people who based their self-worth on their moral values (e.g., virtue) would experience growth in both dimensions of self-control. On the other hand, we expected that young people who attached their self-worth to the results of competition would experience declines in their self-control throughout training and running the charitable marathon.



## Method

### Participants

There were 398 adolescent and emerging adult participants (age range = 12–22 years,  $M_{\text{age}} = 18.42$  years,  $SD = 2.03$ ) recruited from the Team World Vision (TWV) marathon running training team. The majority of participants were female (63%) and Christian (88%). Participants were ethnically diverse: 61% Caucasian, 17% Latino/a, 10% African/African American, 6% Asian/Asian American, and 6% other ethnic groups. Participants were also diverse in terms of self-reported socioeconomic status: 0.8% very poor, 5.4% poor, 23.2% lower middle class, 48.7% middle class, 19.6% upper middle class, and 2.3% upper class/rich.

Given the intensity and obstacles that arise from training and completing marathons, attrition rates were high (Fletcher & Eadie, 1986). Of the 396 participants at Time 1, 248 participants completed measures at Time 2, 235 at Time 3, and 170 at Time 4; 164 participants had full data from all four time points. However, those with complete data did not differ from those with missing data at one or more waves when compared on gender or socioeconomic status. Of the participants who participated in the marathon, 89 completed the half marathon, 129 completed the full marathon, and 17 participated in but did not finish the race.

### Procedure

TWV staff recruited adolescent and emerging adult participants from the TWV running teams who were training for a half or full marathon in Los Angeles (LA) and Chicago. Chicago participants were recruited mainly from a public high school and a private college in May and June of 2015 to run the Chicago Marathon on October 11, 2015. LA participants were recruited from public and private high school running teams and Christian church youth groups in September and October of 2015 to run in the LA Marathon on February 14, 2016. Two public high schools received Title 1 funding. This study received approval from the Institutional Review Board, and the research team complied with standards for the ethical conduct of research with human subjects. TWV staff introduced the study to potential participants at recruitment meetings in schools and churches, and individuals were given a chance to request contact from the research team for more information. The research team followed up with these individuals and attained consent from adult participants and informed assent and parental consent from minor participants. After receiving assent/consent, participants completed online questionnaires via Qualtrics at four time points: pretraining (T1; 0 weeks), midtraining (T2; about 15 weeks), 1-week postmarathon (T3;  $\approx 18$  weeks), and 2 months postmarathon (T4; about 26 weeks). In the time leading up to the race, participants engaged in weekly training sessions with their teams under the supervision of trained TWV leaders.

### Measures

#### Self-control

Self-control was assessed utilizing the Brief Self-Control Scale (Tangney et al., 2004). This 13-item scale included items such as “I am good at resisting temptation.” Items

were rated on a 5-point Likert scale from 1 (*not at all*) to 5 (*very much*). Following de Ridder et al. (2011), six items for inhibitory self-control referred to overriding immediate impulses (e.g., refuse negative things), whereas four initiatory self-controls referred to items reflecting initiating goal-directed behavior (e.g., working toward goals). Three items were uncategorized (e.g., I wish I had more self-discipline), as they were generic and did not explicitly refer to either inhibiting impulses or initiating goal-directed behaviors. Negatively worded items were reverse scored to reflect higher self-control.

### **Contingencies of self-worth**

Participants reported on the degree to which they regard their self-worth as contingent upon their behaviors and achievements. Two subscales of the Contingencies of Self Worth Scale were used (Competition, Virtue; Crocker et al., 2003), and each subscale had five items. Competition contingencies included statements such as “My self-worth is affected by how well I do when I am competing with others.” Virtue contingencies included statements such as “I couldn’t respect myself if I didn’t live up to a moral code.” Items were rated on a 7-point Likert scale from 1 (*strongly disagree*) to 7 (*strongly agree*).

### **Sociodemographic controls**

Participants reported demographic information on their gender (0 = *male*, 1 = *female*) and age (in years); these variables were used as controls.

### **Marathon type**

Marathon type was coded 0 = *relay/half marathon*, 1 = *full marathon*.

### **Marathon performance**

For individuals who completed the full marathon, we pulled race times from the official Chicago/LA marathon website. Marathon performance was standardized for each group (official full, individual relay time) to ensure comparability, lower scores on marathon performance indicated better race times.

### **Analytic plan**

All correlations among study variables are available in Table 1. To address the first aim of the study (i.e., examining the multidimensional structure of self-control), confirmatory factor analysis was first conducted to determine whether the factor structure identified by de Ridder et al. (2011) would replicate in an athletic sample. The two-factor inhibitory and initiatory self-control model was compared with a unidimensional model of self-control. Change in comparative fit index (CFI), where values of 0.01 or greater indicate worse fitting models (Cheung & Rensvold, 2002), was used to compare the two models because a two-factor model is nested within a one-factor model. As further evidence of validity, unconditional and conditional latent growth models (see the details next) were also estimated using the unidimensional scale of self-control for comparison

**Table 1.** Correlations among study variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
1. Inhibitory T1	–																	
2. Inhibitory T2	0.59**	–																
3. Inhibitory T3	0.60**	0.69**	–															
4. Inhibitory T4	0.57**	0.75**	0.77**	–														
5. Initiatory T1	0.49**	0.41**	0.40**	0.39**	–													
6. Initiatory T2	0.37**	0.57**	0.49**	0.51**	0.67**	–												
7. Initiatory T3	0.31**	0.42**	0.48**	0.46**	0.66**	0.79**	–											
8. Initiatory T4	0.29**	0.45**	0.46**	0.55**	0.62**	0.68**	0.75**	–										
9. Comp. CSW T1	–0.11	–0.06	–0.04	–0.14	–0.02	–0.02	–0.04	–0.13	–									
10. Comp. CSW T2	–0.08	–0.09	–0.08	–0.15	0.03	–0.09	–0.12	–0.09	0.62**	–								
11. Comp. CSW T3	–0.13	–0.06	–0.10	–0.09	–0.05	–0.11	–0.15	–0.05	0.60**	0.74**	–							
12. Comp. CSW T4	–0.09	–0.10	–0.09	–0.14	–0.08	–0.10	–0.08	–0.1	0.57**	0.68**	0.75**	–						
13. Virtue CSW T1	0.21**	0.22**	0.16*	0.19**	0.18**	0.13	0.17*	0.09	0.23**	0.22**	0.21**	0.21**	–					
14. Virtue CSW T2	0.18*	0.23**	0.14	0.10	0.25**	0.19**	0.16*	0.17*	0.15	0.45**	0.32**	0.34**	0.62**	–				
15. Virtue CSW T3	0.00	0.13	0.06	0.05	0.11	0.06	0.08	0.14	0.21**	0.34**	0.48**	0.46**	0.57**	0.72**	–			
16. Virtue CSW T4	0.10	0.22**	0.14	0.10	0.20**	0.15*	0.17*	0.19**	0.18**	0.32**	0.36**	0.49**	0.59**	0.72**	0.77**	–		
17. Age	–0.11	–0.09	–0.15*	–0.14*	0.04	–0.01	0.00	0.06	0.07	0.11	0.19**	0.23**	0.11	0.21**	0.21**	0.16**	–	
18. Gender	0.18**	0.19**	0.12	0.16*	0.12	0.09	0.09	0.13	–0.07	–0.13	–0.12	–0.06	–0.06	0.02	0.02	0.03	–0.02	–
19. Race time	0.15*	0.10	0.10	0.02	0.00	–0.07	0.07	–0.01	–0.09	0.00	–0.02	0.03	0.00	0.07	0.06	0.15*	–0.08	0.26**
M	3.49	3.46	3.46	3.44	3.22	3.20	3.24	3.21	4.65	4.62	4.63	4.68	5.37	5.38	5.40	5.40	18.20	1.60
SD	0.78	0.72	0.70	0.78	0.62	0.62	0.59	0.63	1.15	1.13	1.22	1.23	0.93	0.95	1.06	1.00	2.06	0.49

Note. CSW = contingencies of self-worth.

\* $p < .05$ . \*\* $p < .01$ .

with the two-factor models. These analyses provide evidence of the advantages of considering self-control as two distinct dimensions as opposed to a single dimension.

To address the second aim of the study (i.e., documenting within-person change in inhibitory and initiatory self-control), latent growth curve modeling was used to estimate a developmental trajectory of within-person changes in both inhibitory and initiatory self-control for participants who completed the marathon. Participants who did not participate in the race were excluded from analyses because their T3 and T4 data were missing not at random because of the study design; the full analytic sample included 235 participants. Given the individually varying times of observation, the *t*-scores option in Mplus was used for both models. Mplus provides only the Akaike information criterion (AIC) and Bayesian information criterion (BIC) fit indexes for models using the *t*-scores option, and smaller values of both indices indicate better fitting models. We compared models that included only growth factors for initial level and linear slope (i.e., linear change) with models that included growth factors for initial level, linear slope, and quadratic slope (i.e., curvilinear change). Results from growth curve modeling provide estimates of how, on average, participants' inhibitory and initiatory self-control changes during marathon training.

To address the third and fourth aims of the study (i.e., links between inhibitory and initiatory self-control and marathon performance indicators and self-worth), conditional growth models were estimated to include contingencies of self-worth as time-varying covariates, age and gender as predictors of growth factors, race type as a control variable, and race time as an outcome of growth factors in self-control. Results provide evidence of how contingencies of self-worth contribute to changes in inhibitory and initiatory self-control and if initial levels (i.e., intercept) and changes (i.e., growth factor) in inhibitory and initiatory self-control predict indicators of marathon performance.

## Results

### *Aim 1: Examining the multidimensional structure of self-control*

#### *Unidimensional versus multidimensional models*

To address the first aim of the study, we first used confirmatory factor analysis to compare the two-factor structure of self-control with a unidimensional structure of self-control. Using the 10 items of the self-control scale, a two-factor model demonstrated relatively poor fit,  $\chi^2(34) = 169.77$ ,  $p < .001$  (CFI = 0.82, Tucker–Lewis index [TLI] = 0.76, root mean square error of approximation [RMSEA] = 0.10). After examining factor loadings and modification indices, one item (“I refuse things that are bad for me”) was dropped because of to low factor loadings; all other factor loadings ranged from 0.40 to 0.70, and the residuals of two negatively worded items were allowed to correlate. The final model included nine items, resulting in improved model fit,  $\chi^2(25) = 67.38$ ,  $p < .001$  (CFI = 0.94, TLI = 0.91, RMSEA = 0.07). Next, a unidimensional model was compared with the two-factor solution. The unidimensional model provided a poor fit to the data,  $\chi^2(26) = 87.58$ ,  $p < .001$  (CFI = 0.91, TLI = 0.87, RMSEA = 0.08) and significantly worsened model fit,  $\Delta\chi^2(1) = 20.20$ ,  $p < .001$  ( $\Delta$ CFI = 0.03), providing evidence for the need to distinguish between the two types of self-control.

### ***Comparison of unidimensional models***

Next, we conducted the unconditional and conditional growth analyses outlined using the unidimensional scale of self-control as a final check of the utility of examining multiple dimensions of self-control. Latent growth models revealed no change in overall self-control across time, although there were significant variances in the slope, suggesting that patterns of change may differ across individuals. The slope negatively and significantly predicted race time ( $B = -15.52, p < .05$ ), suggesting that individuals who decreased in self-control performed worse than those who did not. Compared with models using the multidimensional approach reported next, unidimensional models were less informative, which further supports the superiority of the multidimensional approach.

### ***Aim 2: Documenting within-person change in inhibitory and initiatory self-control with unconditional latent growth models***

To address the second aim of the study, linear and nonlinear latent growth curve models of inhibitory and initiatory self-control were estimated. The linear model provided the best fit to the data ( $AIC = 2281.60, BIC = 2357.71$ ) as neither quadratic factor was significant. Inhibitory self-control at the beginning of marathon training was 3.47 on the 5-point scale, and the slope was not significant, suggesting stability in levels of inhibitory self-control across training. The variances of both the intercept and the slope were significant, indicating significant variability in the initial levels and changes in inhibitory self-control between participants. Initiatory self-control at the beginning of marathon training was 3.47 on the 5-point scale; the slope ( $\alpha = -0.003, p = .05$ ) was significant, suggesting initiatory self-control declined slightly across time. The variance of the intercept, but not the slope, was significant. The intercepts of each factor were positively and significantly associated, as were the slopes. The intercept of inhibitory self-control was negatively associated with the slope of initiatory self-control. That is, individuals who were higher in initial levels of inhibitory self-control were more likely to be higher in initial levels of initiatory self-control but showed steeper declines in initiatory self-control.

### ***Aims 3 and 4: Links between self-worth, inhibitory and initiatory self-control, and marathon performance in full predictor models***

To address aims three and four, full, conditional latent growth curve models were estimated that included contingencies of self-worth as time-varying covariates (TVCs), marathon performance as an outcome variable, and demographics and race type as time-invariant control variables (see Table 2). By including repeatedly measured TVCs in the model, growth curves describe the predicted trajectory of self-control when all TVCs are held constant (Bollen & Curran, 2006; Preacher et al., 2008). Competition contingencies of self-worth negatively predicted both inhibitory and initiatory self-control, whereas virtue contingencies of self-worth positively predicted both. Initial levels of inhibitory self-control positively predicted race time, but the slope did not. Both initial levels and linear change in initiatory self-control negatively predicted race time.<sup>1</sup> In

**Table 2.** Final latent growth curve models.

	Factor 1: Inhibitory $\gamma$ (SE)	Factor 2: Initiatory $\gamma$ (SE)
Time-invariant covariates		
<i>Intercept</i>		
Age	-0.06*	-0.02
Female	0.26	0.14
Race type	0.11	0.13
<i>Slope</i>		
Age	0.00	0.00
Female	0.00	0.00
Race type	0.00	0.00
Time-varying covariates		
Competition self-worth	-0.09**	-0.07**
Virtue self-worth	0.11**	0.08**
Outcome variable (marathon performance)		
Intercept	0.32*	-0.30*
Slope	-22.03†	85.08**
Age		-0.103
Female		0.57*
Race type		0.47*

Note. † $p < .10$ . \* $p < .05$ . \*\* $p < .01$ .

summary, when athletes reported feeling that their self-worth was more highly based on competition, they tended to report less inhibitory and initiatory self-control. In contrast, when participant's self-worth was based more highly on virtue, they reported more inhibitory and initiatory self-control. Individuals with higher levels of inhibitory self-control finished the race slightly slower. In other words, individuals who started higher in initiatory self-control performed better in the race (i.e., faster), but individuals who exhibited declines in initiatory self-control performed worse (i.e., slower).

## Discussion

Our study provides new empirical evidence of the dimensionality of self-control and within-person changes across time in young endurance runners. Initiatory self-control evidenced patterns of significant declines across time, providing support that some, but not all, aspects of self-control decline during participation in sport contexts. Initial levels of inhibitory self-control and changes in initiatory self-control predicted race performance. Changes in both aspects of self-control across time corresponded to the sources from which runners derived their self-worth. Findings contribute to theory and advance understanding of how involvement in sporting contexts contribute to within-person changes in dimensions of self-control for young people.

### *Multidimensionality of self-control*

Our findings extend the rich history of self-control research in sports psychology (see Englert, 2016, for review) by showing types of self-control differentially predict sports performance. Finding that higher levels of initiatory self-control predicted better race times suggests that individuals who are more adept at working toward specific, structured goals may be more likely to undertake and adhere to endeavors of intense

endurance activity participation. Those habits may translate into better performance. Declines in initiatory self-control were related to worse performance in the marathon. Results are consistent with work on psychological interventions showing that mental fatigue and suppressing emotions can undermine performance in endurance activities (Van Cutsem et al., 2017; Wagstaff, 2014). Moreover, these findings highlight the importance of sustained engagement in self-regulatory behaviors aimed toward a longer-term goal to avoid impairment in sports performance. Of interest, athletes with higher initial levels of inhibitory control performed worse in the marathon. The context of changes in initiatory control may best explain this somewhat surprising finding. Athletes with higher initial levels of inhibitory control showed steeper declines in initiatory control across the context of training for and running a marathon, which also predicted worse performance, perhaps suggesting that these declines in initiatory self-control contributed to worsened performance.

In contrast to previous work showing dimensions of self-control offered no predictive value over and above a unidimensional model of self-control (e.g., Tangney et al., 2004), our findings highlight the utility of a multidimensional approach. Unidimensional self-control showed, on average, no change in self-control, masking the finding that some, but not all, aspects of self-control are likely to change during endurance activity participation. Likewise, initial levels of unidimensional self-control did not predict endurance running performance, suggesting measuring self-control as unidimensional construct likely washes out the effects of different types of self-control. These findings contribute to theory and research by documenting the greater precision and specificity of a dimensional approach to self-control in contextualized situations where individuals are working toward specific, structured goals (i.e., competing in a marathon). Future work would benefit from investigating whether this exact factor structure would replicate in other sport and nonathlete samples. However, findings support the importance of considering the separable dimensions of self-control in sport.

### ***Contingencies of self-worth as predictors of within-person change in self-control***

Finding that domains of contingencies of self-worth predicted different trajectories of both inhibitory and initiatory self-control highlights the importance of motivational constructs in self-regulatory capacities. Even though, on average, participants reported declines in initiatory self-control, self-worth derived from virtues and values adherence protected athletes from these declines. In contrast, runners who based their self-worth on how they competed with others showed slightly more declines in self-control, suggesting that they may have more difficulty inhibiting negative impulses and initiating behaviors that allowed them to work toward athletic performance goals. Although motivation was not measured directly, these findings align with work from self-determination theory suggesting evaluation of performance based on internal, personal standards are more likely to optimize self-regulatory capacities than evaluations based on external achievements or competitiveness (Deci & Ryan, 1980), particularly in contexts that may be vulnerable to ego-depletion effects.

### ***No evidence for uniform gains in self-control***

Of interest, we found little evidence that charitable endurance activities provide a context for significant developmental gains in any aspect of self-control. Previous studies have shown that intense involvement in sports is promotive of numerous indicators of positive adjustment in young people, including psychological flourishing, civic engagement, and educational attainment (e.g., Mahoney & Vest, 2012), yet our findings illustrate that the same may not be true of self-control capacities. These disparate findings may highlight the importance of a thorough consideration of developmental timing, as longitudinal work establishing the benefits of sport often uses a much longer time frame (i.e., annually repeated measurements). Assessing positive adjustment indicators in shorter time frames over a more extended period may reveal a much more dynamic and nonlinear pattern of change. That is, there may be more fluctuations in self-control during shorter intervals, but over a longer course of time, gains may become more apparent—an idea ripe for future research.

### ***Implications for theory and practice***

Documenting within-person change in self-control and its predictors offer important implications for theory. Although ego-depletion is typically characterized as a temporary state, results from the current study inform theory by providing evidence that some types of trait self-control display depletion effects that persist across time and activity context—articulating when and which aspects of self-control are likely to be depleted offers a step forward for theory. Moreover, results highlight the role of motivational constructs in buffering against depletion effects. Future research may benefit from an in-depth examination of how integrating goals, such as marathon participation, into a sense of self allows individuals to override desires that are incongruent with higher-order goals.

The current findings also offer several implications for practice. First, it may be helpful for practitioners to help young people understand the different dimensions of self-control in order to design specific interventions toward the dimension in which the young person should grow. For example, a young athlete may have high “stop control” that allows them to avoid negative behavior or stop eating junk food but lack “start control” to be proactive in planning when they train. Our research would suggest that helping young athletes develop higher start control could have a performance benefit, which coincides with developmental research on the importance of autonomy in young people’s goal pursuits (e.g., Vansteenkiste et al., 2005). It could be beneficial for coaches and practitioners to empower young athletes to be involved in the planning of training sessions and to design strategies for exercising initiatory self-control, especially at times it may be more difficult (e.g., bad weather, weekends). Requiring the young athlete to record their experiences throughout the season could provide an opportunity for self-monitoring and evaluation of what works well. Further, sharing success stories with the team of when the young athlete exercised start control and highlighting them in the moment may also be a way to reinforce more initiatory self-control.

Additionally, our results suggest that practitioners and coaches should avoid focusing on building stop control only. The sole focus on restraint may not be sustainable over time and



could even undermine performance efforts. There could be a cost for exercising high stop control when it is not accompanied by start control. Further research is needed here, but it may be that young athletes have less energy to invest in proactive strategies when focused on avoiding behaviors and actions. This is also consistent with research from positive youth development that has highlighted the shortcomings of deficit-oriented models of youth development (e.g., Larson, 2000). Youth sport programming may benefit from making sure their focus moves beyond inhibitory self-control. This could be as simple as ensuring that team rules and policies are not just a list of behaviors that athletes are expected to avoid or changing coaching practices to include emphasizing initiatory self-control.

Our results also highlight the importance of where young people derive their sense of self-worth. Adolescence and emerging adulthood is a formative time of identity development where young people are building their sense of self-worth around the things most important to them (Reese et al., 2010), and our results suggest these views impacted the stability of self-control for runners throughout their endurance training. This has several potential implications to consider for youth sports. The major aims of youth sports are to help young people grow in character virtues like self-control and perform at their best. Parents and caring adults often assume that self-discipline required in sports will lead to better self-control for young people. However, in our sample, we found that growth in self-control happened only for young people who valued living with virtue or character. A performance-based self-worth had a negative impact on self-control throughout training and running a marathon. Therefore, if coaches, parents, and practitioners want young people to develop character strengths and virtues like self-control in sports, adults may need to start with addressing what young people value or where they derive their sense of self-worth. Motivational climates in sports that primarily emphasize winning may reinforce the message that self-worth is based on competition results and undermine the ability of new athletes to develop self-control. The fact that we found the deleterious effects of performance-based self-worth even in an environment that was rich with potential for character and virtue growth underscores the need for future inquiry on how to help young people internalize a positive motivational climate.

### ***Limitations and future directions***

Several features of the study limit inferences made from the present findings. First, although the change in initiatory self-control was significant, the amount of change was relatively small. Given, however, that self-control is often considered a relatively stable construct, finding significant change over a relatively short time span points to the potential plasticity of the construct in adolescence and young adulthood. Moreover, although the current measure of self-control is widely cited, it may not fully capture nuances between initiatory and inhibitory self-control, particularly for inhibitory control, which included items that appear more general than initiatory. Future research may benefit from including other measures that better tap into both general and marathon-specific inhibitory and initiatory self-control. Additionally, there are likely many other factors that predict race performance (e.g., training load, general health). However, the strength of our finding that changes in types of self-control significantly

predicted performance suggest that initiating goal-directed behavior may be an important factor in overall performance.

Although there was some ethnic and socioeconomic diversity in the sample, participants were primarily Caucasian. Moreover, participants were part of a religiously affiliated training team and, as such, were exposed to spiritual messages throughout the training. Previous work suggests that baseline levels of transcendent motivations correlate with self-control in marathon runners (Schnitker et al., 2020), so findings may slightly shift in less spiritually oriented marathon training teams. Similarly, we were not able to test differences between half and full marathon training as age and choice of the marathon were confounded (i.e., adolescent participants were more likely to run half marathons). Likewise, it is unknown if these findings would replicate in more competitive, non-charity-based contexts. Future research should examine similarities and differences across sporting contexts—especially attending to differences between team and individual sports. Studies might also compare athletic versus nonathletic competitive training contexts to test if there is something distinct about physical exertion in relation to self-control depletion or capacity building. Finally, these analyses relied on self-report data that may be subject to social desirability. Although we were able to examine race completion and race performance as behavioral outcomes of self-control, future studies should employ multiple assessment methods. Informant reports of self-control from teammates or coaches, physiological assessments of functioning, and behavioral indicators of performance throughout training (e.g., splits on practice runs) are prime candidates.

## Conclusion

Addressing questions in the literature on the multidimensionality of self-control, the current study contributes to theory and research by documenting the structure of self-control in the context of charity marathons and highlighting the predictive utility of a multidimensional approach. Findings extend current research on self-regulatory processes during endurance activities, showing that initiatory, but not inhibitory, aspects of self-control display extended declines across time during participation in these programs. However, these declines were buffered by contingencies of self-worth that are more intrinsically motivated (i.e., based on virtue) and exacerbated by those that were more extrinsically motivated (i.e., based on competition performance). These findings may open the door for future research assessing the implications of declines in aspects of self-control in other domains and contexts.

## Note

1. Given the inclusion of random effects because of individually varying time points, standardized coefficients and  $R^2$  values were not available in *Mplus*. Following recommendations by (Muthén, 2007), we estimated these values from unconditional models: The standardized coefficients are as follows: Competition SW predicted initiatory self-control ( $\beta = -0.14$ ) and inhibitory self-control ( $\beta = -0.15$ ), virtue SW predicting initiatory self-control ( $\beta = 0.13$ ) and inhibitory self-control ( $\beta = 0.16$ ); the intercept ( $\beta = -0.15$ ) and slope ( $\beta = 0.40$ ) of initiatory self-control and the intercept ( $\beta = -0.17$ ) and slope ( $\beta = -0.26$ ) of inhibitory self-control predicted marathon performance. The  $R^2$  value of marathon performance was 0.34.

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