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Conscientiousness, Extroversion, and Action Control: Comparing Moderate and Vigorous Physical Activity

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The present study explored the influence of the Big Five dimensions extroversion and conscientiousness on action control regarding both moderate and vigorous physical activity within the framework of the theory of planned behavior (TPB). Prospective data were available from 186 respondents, who completed measures of intention, cognitive and affective attitude, subjective norm, perceived behavioral control, extroversion, conscientiousness, and physical activity at T1. Four weeks later, physical activity was assessed again. Respondents were grouped into four profiles: nonintenders, successful nonintenders, unsuccessful intenders, and successful intenders. Logistic regression analyses revealed that successful enactment in moderate physical activity was associated with extroversion, subjective norm, and affective attitude, whereas successful enactment in vigorous physical activity was associated with conscientiousness. Findings illustrate the differential role played by personality dimensions and TPB concepts in the explanation of moderate and vigorous physical activity action control.

Keywords: extroversion, conscientiousness, theory of planned behavior, physical activity, action control

Public health guidelines suggest that adults should spend a minimum of 60 min per week in vigorous exercise to obtain health benefits, including decreased risk of overweight (Donnelly et al., 2003; Haskell et al., 2007; Kromhout, Bloemberg, Seidell, Nissinen, & Menotti, 2001). However, trend data from various countries indicate that participation in physical exercise is below recommended levels (Haskell et al., 2007; Kemper & Ooijendijk, 2004), indicating a need to develop health behavior change interventions aimed at increased exercise levels. Interventions are thought to be more successful when they are based on a sound theoretical framework that identifies determinants of regular exercise, which can subsequently be altered using persuasive health communication strategies (Van den Putte & Dhondt, 2005).

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A theoretical framework that has often been used to identify such determinants is the theory of planned behavior (TPB; Ajzen, 1991). The TPB postulates that the most immediate determinant of exercise behavior is the intention to exercise. In addition, intention is theorized to be predicted by three social-cognitive concepts, namely attitude, subjective norm, and perceived behavioral control (PBC). Attitude toward exercise is a person's positive or negative evaluation of engaging in exercise, whereas subjective norm refers to the perceived social pressure from significant others toward engaging in exercise. Perceived behavioral control refers to the perceived ease or difficulty of exercising. When perceived control matches actual control, the TPB also proposes a direct effect of behavioral control on exercise.

Even though evidence from reviews and meta-analysis (Godin, 1994; Godin & Kok, 1996; Hagger, Chatzisarantis & Biddle, 2002) supports the use of the TPB in understanding exercise intentions, there is considerable heterogeneity in the strength of the association between intention and behavior (Armitage & Conner, 2001). In fact, several studies have provided evidence for a differentiation in both intention formation (i.e., action planning) and translating these intentions into actual behavior (i.e., action control) (Abraham et al., 1999; Gollwitzer & Sheeran, 2006; Rhodes, Courneya, & Jones, 2003; Rhodes & Plotnikoff, 2006; Rhodes, Plotnikoff, & Courneya, 2008; Sheeran, 2002). Action control research was initiated by Kuhl's action control theory (Kuhl, 1985, 1992), which was developed to gain insight into the mechanisms that either facilitate or hamper the translation of intentions into actual behavior. According to this theory, successfully translating behavioral intentions into actual behavior necessitates establishing various self-regulatory volitional capacities, such as action planning and monitoring. In health behavior determinant research, however, predictors of action control have often been studied using social-cognitive concepts, such as variables derived from the TPB (Fishbein, Hennessy, Yzer, & Douglas, 2003; Rhodes et al., 2003), the theory of reasoned action (Godin, Shephard, & Colantonio, 1986), the transtheoretical model (Rhodes & Plotnikoff, 2006; Rhodes et al., 2008), and protection motivation theory (Orbell & Sheeran, 1998). Evidence has indicated that these concepts are strong predictors of action control (Rhodes et al., 2003; Rhodes & Plotnikoff, 2006; Rhodes et al., 2008). For instance, Rhodes et al. (2003) found that affective and instrumental attitude, and PBC differentiated successful and unsuccessful exercise intenders. Similarly, Rhodes et al. (2008) reported that cognitive processes and perceived severity could distinguish exercise nonintenders from exercise intenders.

Importantly, various studies have shown that the intention-behavior relationship is asymmetric, with very few people acting without positive intentions (Rhodes & Plotnikoff, 2006; Rhodes et al., 2008; Sheeran 2002). In contrast, recent findings suggest that about half of those with positive intentions fail to act (Rhodes & Plotnikoff, 2006; Rhodes et al., 2008), implying that the major variance of interest in the intention-behavior relationship is between unsuccessful intenders and successful intenders. These studies underline the importance of identifying profiles of individuals who are more likely to translate their intentions into action: understanding who are more likely to be successful at translating their initial exercise intentions into actual exercise behavior provides useful evidence for tailoring interventions (Gollwitzer & Sheeran, 2006; Rhodes & Plotnikoff, 2006; Rhodes et al., 2008). Importantly, due to the asymmetric nature of the intention-behavior relationship, understanding action control may need to go beyond traditional linear intention-behavior relationship analyses (Rhodes & Plotnikoff, 2006).

Despite the demonstrated usefulness of social-cognitive predictors of action control, researchers have also advocated the inclusion of additional predictors from other behavioral research fields to understand action control (Fishbein et al., 2003; Rhodes et al., 2003; Rhodes & Plotnikoff, 2006). In Kuhl's (1985, 1992) action control theory, the action-state orientation construct is regarded as a disposition that describes individual-level differences in action orientation (i.e., the ability to regulate emotions and behaviors needed to accomplish successfully translating intention into actions) and state orientation (the lack of these action orientation abilities). Although the usefulness of such an individual-level personality disposition has proven relevant in understanding health behavior (Palfai, 2002; Palfai, McNally, & Roy, 2002; Fuhrmann & Kuhl, 1998), personality research in the past two decades has been dominated by the five-factor model (FFM; McCrae & Costa, 1990; Rhodes & Smith, 2006). The FFM describes personality as individual differences in tendencies to show patterns of feelings, thoughts, and actions that are consistent over time and situation. According to the FFM, these tendencies can be sufficiently described in terms of five dimensions, which are often labeled as extroversion (the tendency to be outgoing, active, and energetic), openness to experience (high intellect, educational aptitude, and openness to new ideas), neuroticism (the tendency to be vulnerable to feelings of depression and anxiety), agreeableness (linked with generosity, altruism, and caring), and conscientiousness (the tendency to be goal directed and striving for achievement). Although the FFM has often been used in health behavior determinant research (Bogg & Roberts, 2004), including exercise determinants research (De Bruijn, Kremers, van Mechelen, & Brug, 2005; Rhodes, 2006; Rhodes & Smith, 2006), the influence of these FFM dimension has largely been overlooked in the action control research domain (Rhodes et al., 2003). Exploring FFM dimensions as psychological variables that influence action control may allow for the identification of individual-level dispositions next to those outlined in Kuhl's action control theory (1985, 1992).

Even though the FFM acknowledges five dimensions, extroversion (E) is thought to be particularly relevant dimension in the study of action control (Rhodes et al., 2003; Rhodes & Smith, 2006). Based on the premise that people high in E are more likely to find themselves in situations with exercise opportunities, high-E persons are thought to be better capable of translating their exercise intentions into actual exercise behavior than their low-E peers. Despite this apparent appeal, to date only one study has investigated E as a predictor of exercise action control. In a study among undergraduate students, Rhodes et al. (2003) found that those who were successful at translating their exercise intention into exercise behavior had higher scores on E. The limited evidence to date nevertheless warrants further research to confirm these findings before drawing more definite conclusions.

In addition to E, the FFM dimension conscientiousness (C) may also be relevant to further our understanding of exercise action control. Various studies have demonstrated that people with higher levels of C not only have better health practices (Bogg & Roberts, 2004), but they also live longer (Friedman et al., 1995). Linkages between C and health (behavior) have not been fully delineated, but because people high in C are thought to be more dutiful, orderly, and self-disciplined (McCrae & John, 1992), they are arguably more likely to follow through on their initial intentions. Some research using interaction and simple slope analysis has indeed shown stronger intention-exercise relationships for those higher in C (Chatzisarantis &

Hagger, 2008; Conner, Rodgers, & Murray, 2007; Rhodes, Courneya, & Hayduk, 2002). However, to our knowledge, no evidence exists that has explicitly modeled C as a predictor of exercise action control.

Next to the propagation of vigorous exercise, recent public health guidelines have also emphasized the need to raise moderate physical activity (PA). Moderate PA is more easily incorporated into daily lifestyles (Haskell et al., 2007), increases adherence to total PA recommendations (Berrigan, Troiano, McNeel, DiSogra, & Ballard-Barbash, 2006), and may be particularly relevant for the prevention of overweight and obesity (Westerterp, 2001). Nowadays, public health guidelines for sufficient activity recommend both minimum levels of vigorous exercise (i.e., 60 min per week) and moderate exercise (i.e., 150 min per week), the latter including activities such as transportation activity, leisure time activity, and household physical activity (Haskell et al., 2007; U.S. Department of Health and Human Services, 1996). However, the omnibus collection of various physical activity definitions may present problems when designing interventions because motivational and cognitive correlates may differ when behavioral categories are compared with specific single acts (Courneya & McAuley, 1993, 1994; Fishbein & Ajzen, 1975). The limited research to date indeed suggests that different motivational correlates exist between various activity modes, such as lifestyle moderate activities and structured exercise (Bellows-Riecken, Rhodes, & Hoffert, 2008; Eves, Hoppe, & McLauren, 2003). Nevertheless, none of these studies have contemporaneously looked at moderate and vigorous PA from an action control perspective. Furthermore, no evidence exists that has modeled both E and C as relevant predictors of action control across moderate and vigorous PA, although some research indirectly warrants such an investigation (Conner et al., 2007; De Bruijn, Brug, & van Lenthe, 2009; Rhodes et al., 2003). For instance, it has been argued that the dutiful nature of those high in C may not be relevant for behaviors that are generally part of one's normal daily patterns, such as moderate activities (Conner et al., 2007).

The purpose of the current study was therefore the test whether the FFM dimensions C and E can be used to categorize intention-PA profiles. An additional purpose was to examine whether the relevance of these two dimensions for PA action control differs between moderate and vigorous PA levels. Because of the structured and organized nature of vigorous activities and the importance of those variables in those scoring high in C, we hypothesized that higher C was associated with an increased chance to successfully translate intention into action for vigorous PA, but not for moderate PA. In contrast, because those high in E tend to be outgoing and active, we hypothesized that respondents with high levels of E had an increased chance to successfully translate intention into action for both moderate and vigorous PA.

Methods

Subjects and Procedures

A prospective design was used in which PA was assessed at two time points (T2 = T1 + 4 weeks), whereas TPB concepts and FFM dimensions were assessed at T1. Participants were recruited through an online survey tool, comprising (mainly) university students and employees. Informed consent was obtained from all

participants, and the institution at which the study was conducted approved the study protocol. At T1, 313 participants responded to our request to fill out an online questionnaire (42.49% males; mean age = 29.52 [*SD* = 6.71]). At T2, data were available from 186 respondents (mean age = 28.89 [*SD* = 5.91]; 41.9% males), which exceeded the required sample size of 175 needed to detect a small effect size at 80% power with $\alpha = .05$ (Hsieh, Bloch, & Larsen, 1998). Attrition analyses (0 = dropped out after T1; 1 = data available from T1 and T2) using logistic regression analysis indicated that dropout was not related with age and gender, but also not with personality dimensions (E: OR = 1.07; 95% CI = .87–1.32; C: OR = 1.11; 95% CI = .91–1.36). Furthermore, attrition was not related with TPB constructs and with moderate PA at T1, but those who dropped out were (borderline) significantly less vigorously active at T1 (OR = .99; 95% CI = .98–1.00).

Measures

The Dutch version of the International Physical Activity Questionnaire (IPAQ) was used to assess PA at both time points. The IPAQ is commonly used as a standardized measure of physical activities in populations from different countries and cultural contexts and has been validated against CSA accelerometers (Craig et al., 2003) and doubly labeled water techniques (Maddison et al., 2007). Respondents were asked to indicate on how many days per week in the past month they were active in both moderate activities (such as cycling and common household chores) and vigorous activities (such as sporting activities and heavy lifting). In addition, they were asked to indicate the usual amount of time they were active for each of these activities on such a day. An average time in minutes per day was calculated by multiplying frequency and duration for moderate PA and vigorous PA separately, using IPAQ recommendations.

Concepts from the TPB were assessed at T1 for moderate and vigorous PA separately regarding the reference period "in the coming month." Regarding intention, respondents were asked to indicate (i) on how many days per week they would be moderately/vigorously physically active for a minimum of 10 min per day, and (ii) for how long (in minutes) they intended to be moderately/vigorously active on such a day. Computing frequency and duration calculated an average intended amount of moderate and vigorous PA in minutes per day. Cognitive attitude was assessed with three items regarding the stem "I find being moderately / vigorously physically active for a minimum of 10 min per day in the coming month" with the following answering categories on 7-point scales (+3 = *totally agree* to –3 = *totally disagree*) "useful–useless, wise–foolish, and beneficial–harmful" (moderate PA: $\alpha = .83$; vigorous PA: $\alpha = .92$). Affective attitude was assessed regarding the same stem with answering categories on 7-point scales (+3 = *totally agree* to –3 = *totally disagree*) "enjoyable–not enjoyable, pleasant–unpleasant, interesting–boring, and relaxing–stressful (moderate PA: $\alpha = .91$; vigorous PA: $\alpha = .92$). Subjective norm was assessed with the item "most people who are important to me feel I should be moderately / vigorously active for a minimum of 10 min per day in the coming month" (+3 = *yes definitely* to –3 = *no, definitely not*), whereas PBC was assessed with the item "I will succeed in being moderately / vigorously physically active for a minimum of 10 min per day in the coming month" (+3 = *yes definitely* to –3 = *no, definitely not*).

Extroversion and conscientiousness were assessed with an abbreviated and translated version of Goldberg's adjective list (Gerris et al., 1998; Goldberg, 1992). Respondents were asked to indicate on 7-point scales whether they fully agreed (+3) or fully disagreed (–3) with such statements as "I am thorough; I am orderly; I am outgoing." Internal reliabilities were good (conscientiousness: α = .90; extroversion: α = .89).

Analyses

Initially, bivariate correlations were conducted to investigate associations between all study variables. To compare those who intended to be active according to public health guidelines (i.e., 150 min per week for moderate PA; 60 min per week for vigorous PA) with those who did not intend to be active according to public health guidelines, two intention groups were created (separately for moderate and vigorous PA), using suggestions from Rhodes et al. (2008). Regarding moderate PA, respondents who intended to be active for a minimum of 150 min per week of moderate PA were coded as "1"; those who did not intent to be active for a minimum of 150 min per week of moderate PA were codes as "0." Likewise, respondents who intended to be active for a minimum of 60 min per week of vigorous PA were coded as 1; those who did not intent to be active for a minimum of 60 min per week of vigorous PA were coded as 0. Multivariate analysis was employed to investigate differences in study variables between intenders and nonintenders and chi-square analyses were performed to test for the intention-behavior asymmetry.

Next, two groups (again separately for moderate and vigorous PA) were created based on PA levels at T2. Regarding moderate PA, respondents who accumulated a minimum of 150 min per week in moderate PA at T2 were coded as 1; those who did not meet these guidelines were coded as 0. Regarding vigorous PA, respondents who accumulated a minimum of 60 min per week in vigorous PA at T2 were coded as 1; those who did not meet these guidelines were coded as 0. Finally, two sets of hierarchical logistic regression analyses were used (separately for moderate and vigorous PA) to calculate odds ratios (with 95% confidence intervals) for successful (1) and unsuccessful intenders (0) among those who intended to be active according to public health guidelines. (For moderate and vigorous PA, three and five respondents, respectively, indicated at T1 that they had no intention to meet the minimum required activity levels, but were subsequently sufficiently active at T2. These respondents were not used in the logistic regression analysis.) Following the ordering assumptions of the TPB model (Ajzen, 1991), stepwise regression analysis was performed with age and gender (Step 1); attitude, subjective norm, and PBC (Step 2); C and E (Step 3); and PA in minutes per week at T1 (Step 4) as independent variables

Results

Descriptives and Univariate Analysis

Table 1 presents the descriptives and bivariate correlations for study variables. Mean vigorous PA at T1 was 143.75 min per week (*SD* = 161.14) and 137.70 min per week (*SD* = 157.24) at T2, while mean moderate PA at T1 was 261.89 min per

Table 1 Mean Scores, Standard Deviations (in Parentheses) and Bivariate Correlations for Study Variables and Demographics (n = 186)

	Mean (*SD*)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 VPA T1	143.75 (161.14)	—																
2. VPA T2	137.70 (157.24)	.65[c]	—															
3. MPA T1	261.89 (222.49)	.43[c]	.27[c]	—														
4. MPA T2	228.91 (203.48)	.30[c]	.31[c]	.58[c]	—													
5. Intention VPA	354.52 (236.95)	.58[c]	.56[c]	.31[c]	.37[c]	—												
6. Cognitive attitude VPA	1.72 (1.24)	.17[a]	.25[b]	.05	.09	.22[b]	—											
7. Affective attitude VPA	.95 (1.42)	.34[c]	.39[c]	.19[a]	.18[a]	.33[c]	.59[c]	—										
8. Subjective norm VPA	-.62 (1.81)	.05	.06	.07	.06	-.01	.37[c]	.20[a]	—									
9. PBC VPA	1.19 (1.62)	.18[a]	.21[a]	.11	.06	.13	.39[c]	.31[c]	.25[b]	—								
10. Intention MPA	330.24 (221.68)	.36[c]	.24[b]	.82[c]	.53[c]	.31[c]	.07	.17[a]	.02	.12	—							
11. Cognitive attitude MPA	2.48 (.65)	-.03	.12	.15[a]	.18[a]	.04	.48[c]	.31[c]	.09	.24[b]	.17[a]	—						
12. Affective attitude MPA	1.31 (1.24)	.21[b]	.27[c]	.30[c]	.29[c]	.20[b]	.33[c]	.65[c]	-.02	.13	.27[c]	.45[c]	—					
13. Subjective norm MPA	-.09 (1.90)	-.01	-.01	.12	.05	-.11[a]	.23[b]	.07	.73[c]	.19[a]	.03	.16[a]	.07	—				
14. PBC MPA	1.73 (1.32)	.19[a]	.19[a]	.28[c]	.18[a]	.18[a]	.22[b]	.19[a]	.17[a]	.62[c]	.23[b]	.33[c]	.23[b]	.23[b]	—			
15. Extroversion	.95 (1.07)	.11	.01	.01	.09	.07	-.01	-.09	-.03	-.11	.02	.01	-.10	.04	-.12	—		
16. Conscientiousness	.79 (1.13)	.11	.16[a]	.09	.16[a]	.07	.01	.04	.08	.05	.07	.06	.04	.01	.01	-.19[b]	—	
17. Age	28.89 (1.13)	-.18[a]	-.17[a]	-.08	.01	-.22[a]	-.09	-.02	-.07	-.13	-.06	-.03	.02	.01	-.17[a]	.04	.07	—
18. Gender *		-.19[a]	-.27[b]	.02	.03	-.16[a]	-.10	-.25[b]	-.08	-.14	-.02	.12	.00	.13	-.03	-.04	-.02	-.01

Note. MPA = moderate physical activity; VPA = vigorous physical activity; PBC = perceived behavioral control. *0 = male, 1 = female; [a] = $p < .05$; [b] = $p < .01$; [c] = $p < .001$.

week (*SD* = 222.49) and 228.91 min per week (*SD* = 203.48) at T2. One hundred and twenty-two (65.6%) and 117 (62.9%) respondents were sufficiently active at T1 and T2, respectively, whereas 116 (62.4%) and 109 (58.6%) respondents were sufficiently moderately active at T1 and T2, respectively. In addition, respondents intended to be vigorously active for an average of 354.52 (*SD* = 235.95) minutes per week and to be moderately active for an average of 330.24 (*SD* = 221.68) minutes per week.

Those who were more active at vigorous intensity levels were also more active at moderate intensity levels and intended to be active for more minutes per week in both vigorous and moderate activities. Likewise, those who more active at moderate intensity levels intended to be active for more minutes in both vigorous and moderate activities. Furthermore, higher vigorous exercise levels were associated with more positive affective and cognitive attitudes toward PA, as well as with higher perceived behavioral control toward PA. Higher levels of moderate activity were associated with more positive affective and cognitive attitudes toward PA, and with higher perceived behavioral control toward PA. Younger age, male gender, and higher C were associated with higher levels of vigorous activity at T2, but not at T1. Higher scores on C were also associated with higher levels of moderate activity at T2, but not at T1.

Multivariate Analyses

Moderate Physical Activity. Regarding moderate PA, 164 respondents (88.17%) intended to be sufficiently moderately active (i.e., meeting public health guidelines for moderate PA) in the next four weeks: 104 (63.41%) of these respondents had been sufficiently moderately active at T2. Of the remaining 22 nonintending respondents (11.83%) at T1, 17 (77.27%) were not sufficiently moderately active at T2, demonstrating the asymmetry in the intention-moderate PA relationship ($\chi^2 = 13.24$, $df = 1$, $p < .0001$). Those who intended to be sufficiently moderately active had a more positive affective and cognitive attitude toward moderate PA, perceived more behavioral control toward moderate PA, and were more moderately active at T1 than those who did not intend to be sufficiently moderately active (Table 2). Nonsignificant differences were found for C and E. Table 3 shows that successful intenders were more active at moderate intensity at T1 and had a more positive affective attitude toward moderate PA than unsuccessful intenders.

Table 4 presents the results from the hierarchical logistic regression analysis for moderate PA. The final model shows significant associations for successful enactment in moderate PA at T2 with subjective norm (OR = .76; 95% CI = .62–.94), affective attitude (OR = 1.49; 95% CI = 1.02–2.17), and E (OR = 1.48; 95% CI = 1.03–2.13), but not with C (OR = 1.25; 95% CI = .90–1.74). A median split for E revealed nonsignificant differences (all *P* values > .198) for study variables between low E ($n = 85$) and high E ($n = 101$).

Vigorous Physical Activity. Regarding vigorous PA, 145 respondents (78.01%) intended to be sufficiently vigorously active (i.e., meeting public health guidelines for vigorous PA) in the next four weeks: 112 (77.24%) of these respondents were sufficiently vigorously active at T2. Of the remaining 41 nonintenders (22.76%), 36 (87.80%) were not sufficiently vigorously active at T2, demonstrating the asymmetry in the intention-vigorous exercise relationship ($\chi^2 = 57.95$, $df = 1$,

Table 2 Multivariate Analyses for Moderate Physical Activity. Mean Scores, Standard Deviations (in Parentheses), and *F* Test Between Intention Groups Regarding Moderate Physical Activity

	Intention < 150 min per week (*n* = 22)	Intention ≥ 150 min per week (*n* = 164)	*F* test (1, 184)	*p* value
Moderate activity at T1	64.77 (55.72)	288.34 (201.82)	21.785	<.001
Cognitive attitude toward moderate activity	2.17 (1.03)	2.52 (.58)	5.943	<.001
Affective attitude toward moderate activity	.35 (1.57)	1.43 (1.13)	16.067	<.001
Subjective norm toward moderate activity	–.23 (1.77)	–.07 (1.92)	.138	.711
PBC toward moderate activity	.75 (1.53)	1.86 (1.24)	14.621	<.001
Conscientiousness	.65 (1.19)	.81 (1.12)	.371	.543
Extroversion	1.01 (1.06)	.95 (1.07)	.045	.832

Table 3 Multivariate Analyses for Moderate Physical Activity. Mean Scores, Standard Deviation (in Parentheses), and *F* Test Between Unsuccessful Intenders and Successful Intenders Regarding Moderate Physical Activity

	Unsuccessful (*n* = 60)	Successful (*n* = 104)	*F* test (1, 162)	*p* value
Moderate activity at T1	191.38 (181.69)	344.28 (226.55)	19.921	<.001
Cognitive attitude toward moderate activity	2.47 (.61)	2.55 (.56)	.766	.383
Affective attitude toward moderate activity	1.12 (1.26)	1.62 (1.01)	7.798	.006
Subjective norm toward moderate activity	.25 (1.90)	–.25 (1.91)	2.609	.109
PBC toward moderate activity	1.79 (1.30)	1.90 (1.21)	.283	.596
Conscientiousness	.67 (1.06)	.89 (1.15)	1.393	.240
Extroversion	.80 (1.04)	1.03 (1.09)	1.847	.176

Note. PBC = perceived behavioral control.

Table 4 Odds Ratios (OR), 95% Confidence Interval (CI), and R^2 From Hierarchical Logistic Regression for Successful (n = 104) and Unsuccessful (n = 60) Among Those Who Intended To Be Sufficiently Moderately Active (n = 164)

	OR	95% CI	R^2	OR	95% CI	R^2	OR	95% CI	R^2	OR	95% CI	R^2
Age	.99	.94–1.05	.01	.99	.93–1.05	.10	.98	.92–1.04	.15	.98	.92–1.05	.28
Gender	1.14	.60–2.17		1.29	.64–2.59		1.41	.69–2.91		1.44	.67–3.11	
Cognitive attitude moderate PA				.90	.47–1.73		.99	.45–1.70		.90	.45–1.81	
Affective attitude moderate PA				1.59	1.12–2.25		1.69	1.18–2.41		1.49	1.02–2.17	
Subjective norm moderate PA				.83	.69–1.00		.81	.67–.97		.76	.62–.94	
PBC Moderate PA				1.05	.79–1.40		1.10	.82–1.48		.99	.72–1.36	
Extroversion							1.47	1.04–2.08		1.48	1.03–2.13	
Conscientiousness							1.32	.97–1.81		1.25	.90–1.74	
Moderate PA at T1										1.00	1.00–1.01	

Note. PBC = perceived behavioral control; PA = physical activity.

$p < .0001$). Those who intended to be sufficiently vigorously active had a more positive affective and cognitive attitude toward vigorous PA, perceived more behavioral control toward vigorous PA, and were more vigorously active at T1 than those who did not intend to be sufficiently vigorously active (Table 5). Table 6 shows that successful intenders had a more positive affective attitude toward vigorous PA, were more vigorously active at T1, and had higher scores on C than unsuccessful intenders.

Finally, Table 7 presents the results from the hierarchical logistic regression analysis for vigorous PA. The final model shows significant associations for successful enactment in vigorous PA at T2 with vigorous PA at T1 (OR = 1.02; 95% CI = 1.01–1.03) and C (OR = 1.82; 95% CI = 1.15–2.89), but not for E (OR = .84; 95% CI = .53–1.34). A median split for C revealed nonsignificant differences (all *P* values > .209) for study variables between low C ($n = 84$) and high C ($n = 102$).

Discussion

The present study aimed to explore whether the FFM dimensions extroversion and conscientiousness could be linked with action control profiles across both moderate and vigorous PA levels using a prospective design. In line with the relations outlined in the TPB, bivariate analyses showed that attitude and PBC were significant correlates of both moderate and vigorous PA intentions, whereas intention was a significant correlate of moderate and vigorous PA at both time points. In addition to the positive associations of C and E with vigorous and moderate PA, respectively, results also showed that both subjective norm and affective attitude were significantly associated with successful enactment in moderate PA. Notably, a large proportion of respondents in our sample intended to be physically active, with more than three-quarters intending to be vigorously active for at least 60 min per week. Regarding moderate PA, almost 90% of the respondents intended to be moderately physically active for at least 150 min per week, underlining the relevance of studies and interventions focusing on the intention-behavior relationship rather than focusing on antecedents of intention (De Bruijn, Brug, et al., 2009; De Bruijn, Kremers, Singh, van den Putte, & van Mechelen, 2009; Rhodes et al., 2003; Rhodes & Plotnikoff, 2006; Rhodes et al., 2008; Sheeran, 2002).

Confirming our first hypothesis and in line with results that have been found in comparable samples in other countries (Chatzisarantis & Hagger, 2008; Conner et al., 2007; Rhodes, Courneya, & Hayduk, 2002), our results showed that those high in C were significantly more likely to successfully act upon their intentions to be vigorously active than those low in C, even though nonsignificant differences in intention were found between low and high C. Such findings suggest that similar motivational levels lead to different behavioral outcomes across levels of C: these effects were found even when TPB cognitions and physical activity levels at T1 were taken into account. This would indicate that, when developing health behavior change interventions that aim to increase vigorous physical activity levels, practitioners may benefit from including C as an adjunct to TPB concepts. That is, whereas attitude and PBC are relevant variables to target to increase intention to be vigorously active, the inclusion of C in an intervention may identify relevant subgroups that are low in C and therefore less likely to successfully translate their

Table 5 Multivariate Analyses for Vigorous Physical Activity. Mean Scores, Standard Deviations (in Parentheses) and *F* Test Between Intention Groups Regarding Vigorous Physical Activity

	Intention < 60 min per week (*n* = 41)	Intention ≥ 60 min per week (*n* = 145)	*F* test (1, 184)	*p* value
Vigorous activity at T1	35.49 (115.79)	174.36 (159.23)	27.088	<.001
Cognitive attitude toward vigorous activity	1.01 (1.65)	1.93 (1.01)	19.715	<.001
Affective attitude toward vigorous activity	–.05 (1.49)	1.24 (1.27)	30.893	<.001
Subjective norm toward vigorous activity	–.75 (1.92)	–.59 (1.78)	.258	.612
PBC toward vigorous activity	.59 (1.74)	1.35 (1.55)	7.101	.008
Conscientiousness	.75 (1.05)	.81 (1.15)	.070	.792
Extroversion	.95 (.93)	.96 (1.11)	.003	.954

Table 6 Multivariate Analyses for Vigorous Physical Activity. Mean Scores, Standard Deviations (in Parentheses) and *F* test Between Unsuccessful Intenders and Successful Intenders Regarding Vigorous Physical Activity

	Unsuccessful (*n* = 33)	Successful (*n* = 112)	*F* test (1, 162)	*p* value
Vigorous activity at T1	63.41 (65.63)	207.05 (164.05)	24.068	<.001
Cognitive attitude toward vigorous activity	1.65 (1.22)	2.02 (.93)	3.509	.063
Affective attitude toward vigorous activity	.63 (1.05)	1.42 (1.27)	10.696	<.001
Subjective norm toward vigorous activity	–.76 (1.75)	–.54 (1.80)	.363	.548
PBC toward vigorous activity	1.15 (1.60)	1.41 (1.54)	.687	.409
Conscientiousness	.35 (1.20)	.93 (1.11)	6.860	.010
Extroversion	1.12 (1.10)	.91 (1.11)	.884	.349

PBC = perceived behavioral control.

Table 7 Odds Ratios (OR), 95% Confidence Intervals (CI), and R^2 From Hierarchical Logistic Regression for Successful (n = 111) and Unsuccessful (n = 33) Among Those Who Intended To Be Sufficiently Vigorously Active (n = 144)

	OR	95% CI	R^2	OR	95% CI	R^2	OR	95% CI	R^2	OR	95% CI	R^2
Age	.96	.90–1.02	.02	.95	.89–1.02	.12	.93	38–2.29	.21	.92	.84–1.01	.47
Gender	.79	.36–1.76		.98	.41–2.32		.94	.38–2.29		.84	.29–2.42	
Cognitive attitude vigorous PA				1.09	.66–1.82		1.16	.69–1.97		1.21	.66–2.21	
Affective attitude vigorous PA				1.67	1.13–2.46		1.71	1.14–2.56		1.16	.70–1.93	
Subjective norm vigorous PA				1.00	.77–1.30		.95	.72–1.25		.92	.67–1.27	
PBC vigorous PA				.91	.67–1.23		.89	.65–1.22		.98	.69–1.39	
Extroversion							1.00	.66–1.51		.84	.53–1.34	
Conscientiousness							1.77	1.18–2.64		1.82	1.15–2.89	
Moderate PA at T1										1.02	1.01–1.03	

PBC = perceived behavioral control; PA = physical activity.

intention into actual behavior. The subgroups that are low in C may benefit from the inclusion of strategies based on characteristics that typify those high in C, such as time-management and goal-setting strategies (Conner et al., 2007; Rhodes, Courneya, & Hayduk, 2002).

Regarding moderate PA, results showed that successful enactment was negatively associated with the TPB construct subjective norm. Thus, those who perceived more subjective norm to be moderately active were less likely to successfully translate their intention into sufficient moderate PA. Reasons for these findings are unclear, but may indicate the operation of reactance mechanisms resulting from the perception of social norms (Orbell & Hagger, 2006). Affective attitude was also significantly associated with successful enactment, with those who reported to find moderate PA more enjoyable and pleasant more likely to follow up on their intentions. The role of affect in the present and other studies (Keer, van den Putte, & Neijens, in press; Lawton, Conner, & McEachan, 2009; Lawton, Conner, & Parker, 2007) indicate the need for careful considerations when designing interventions: typical instrumental (such as persuading the benefits of adopting an active lifestyle) and planning strategies may need to be supplemented with affect-based strategies to increase the likelihood of translating positive intentions into actual physical activity.

In contrast, and also confirming our hypothesis, no effect of C was found for successful enactment in moderate activities. Thus, whereas the organized and disciplined nature of those high in C is relevant for successfully translating one's intentions into actual behavior for vigorous activities, these characteristics are not sufficient and/or adequate for behaviors that tend to blend into one's daily patterns. Similar findings (Conner, et al., 2007) and notions have been reported (Bandura, 1989) and suggest that everyday behavioral patterns require less cognitive control, but may rather be regulated by lower-control systems (Bandura, 1989), such as the automatic activation of schemas in stable environmental contexts (Bargh & Chartrand, 1999; Conner et al., 2007; De Bruijn et al., 2009; Gardner, 2009; Ouellette & Wood, 1998). Although no data on automaticity were available in the current study, recent evidence points to the relevance of including measures of automaticity and habit strength in the study of moderate activities (De Bruijn et al., 2009; Gardner, 2009) and future studies may need to examine whether moderate and vigorous activities differ in automaticity. It should also be noted that a recent study among Canadian older adults (Rhodes, Courneya, Blanchard, & Plotnikoff, 2007) did report moderating effects of C in the intention-behavior relationship, with a stronger relationship at higher levels of C ($\beta = .49$) than at lower levels of C ($\beta = .24$). These latter findings may reflect the influence of age; in older people, walking may require more cognitive control than in younger people, possible owing to the fear of falling (Deeg, Knipscheer, & van Tilburg, 1993). Future research may also need to explore this possibility.

Results also partly confirmed our hypothesis regarding E. Higher scores on E were associated with a 48% increased chance to successfully act upon the intention to be sufficiently moderately active. However, no effect of E was found for successful enactment regarding vigorous activities. It would appear from these results that the active and outgoing nature of high-E individuals is more relevant for everyday activities than for vigorous activities, although some evidence exists for inverse relationships between E and such everyday activities as gardening and home improvements (Howard, 1987; Rhodes & Smith, 2006). Furthermore,

although there is a relatively consistent positive relationship between E and activity (Courneya & Hellsten, 1998; De Bruijn et al., 2005; Rhodes, 2006; Rhodes, Courneya, & Jones, 2002; Rhodes & Smith, 2006), a positive extroversion–PA link has been demonstrated mainly in North American samples, with evidence from the United Kingdom and various European countries being more limited and mixed (Rhodes & Smith, 2006). These findings suggest that a cross-national comparison of relevant personality dimensions across various intensity levels of PA may be a fruitful exploration to make more definitive conclusions regarding the extroversion–PA relationship.

The results of these findings should be viewed in the light of several limitations. First, we used a convenience sample rather that a population-based sample, thus making generalizations to other populations difficult or even impossible. Furthermore, we used an abbreviated version of Goldberg's adjective list, in which only 6 items instead of the original 20 items per dimensions are used (Gerris et al., 1998; Goldberg, 1990, 1992). Although it has been shown to be a reliable indicator of the FFM (Gerris et al., 1998), future studies may need to incorporate personality measures consisting of more items per dimension. On a similar note, we did not include measures from Kuhl's action-orientation state measure (Kuhl, 1994) to assess action control profiles. Because of its demonstrated usefulness (Kuhl, 1994), future studies may need to incorporate this validated measure to delineate the surplus value of this measure over and above intention-behavior profiling. In addition, we used self-reported data to assess both behavioral and cognitive variables, suggesting that consistency biases may have influenced our findings. While some evidence indicates that predictions from TPB variables are fairly similar for both self-reported and objective behavior (Armitage & Conner, 2001), more objective behavioral measures should be included in future research to confirm our findings. In addition, single-item measures were used for subjective norm and PBC. Single-item measures present problems with validity and reliability (Streiner & Norman, 2003) and may be a reason for the limited effect of subjective norm and PBC in the current study. Finally, dropout rates were considerable (i.e., around 40%): although attrition rate was only borderline significantly related to vigorous exercise at T1, unknown biases causing dropout hampers the generalizability of our findings to other populations. Finally, although various theoretical models emphasize the importance of awareness and knowledge as a prerequisite for motivational and behavioral change (e.g., McGuire, 1984) data on awareness and knowledge of physical activity guidelines were unavailable in the current study. Even though evidence indicates that the majority of the populace nowadays has sufficient knowledge about physical activity guidelines (Ronda, van Assema, & Brug, 2001; Warburton, Katzmarzyk, Rhodes, & Shephard, 2007), we were unable to statistically control for knowledge regarding physical activity guidelines or group participants based on adequate or inadequate knowledge of physical activity guidelines. Because grouping participants based on awareness of health behavior guidelines has proven useful in physical activity determinant research (Ronda et al., 2001) and physical activity intervention effectiveness (Kroeze, Werkman, & Brug, 2006), future studies on action control may need to incorporate measures of knowledge regarding physical activity guidelines to ascertain that the intention-behavior gap does not result from inadequate knowledge.

Despite these limitations, our study adds to a growing body demonstrating a particularly important role of C in the explanation of health behavior and health behavior intentions (Bogg & Roberts, 2004; Chatzisarantis & Hagger, 2008; Conner & Abraham, 2001; Conner et al., 2007; De Bruijn, Brug, et al., 2009; O'Cleirigh, Ironson, Weiss, & Costa Jr., 2007; Rhodes, Courneya, & Hayduk, 2002; Rhodes & Smith, 2006). Whereas variables from the TPB have demonstrated to be useful antecedents of intention (Hagger et al., 2002; Sheeran, 2002), successful translation of these intentions into actual behavior may be more dependent upon global behavioral tendencies, such as C and E. In line with several calls made over the past few years (Caspi et al., 1997; De Bruijn, Brug, et al., 2009; O'Cleirigh et al., 2007; Rhodes, 2006), intervention to increase vigorous activity levels may need to differentiate relevant personality subgroups to more effectively develop and deliver health behavior change strategies to the appropriate target groups. However, these effects may be limited to behaviors that require substantial cognitive control. Future research should therefore additionally focus on understanding which variables can sufficiently describe and explain the intention-behavior gap for more everyday and less cognitively controlled health behaviors.

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