Prioritizing Intentions on the Margins: Effects of Marginally Higher Prioritization Strategies on Physical Activity Participation

Author

Chatzisarantis, Nikos LD, Barkoukis, Vassilis, Petridis, Panagiotis, Thogersen-Ntoumani, Cecilie, Ntoumanis, Nikos, Gountas, Sandra, Gountas, John, Adam, Dimitrios, Hagger, Martin S

Published

2016

Journal Title

Journal of Sport and Exercise Psychology

Version

Accepted Manuscript (AM)

DOI

10.1123/jsep.2016-0130

Rights statement

Downloaded from

Griffith Research Online

Prioritising Intentions on the Margins: Effects of Marginally Higher Prioritisation Strategies on Physical Activity Participation

Nikos L. D. Chatzisarantis[1] and Vasilis Barkoukis[2]

Panagiotis Petridis[3]

Cecilie Thøgersen-Ntoumani[1]

Nikos Ntoumanis[1]

Sandra Gountas[4]

John Gountas[5]

Dimitrios Adam[1]

&

Martin S. Hagger[1]

Author Note

[1]Department of Psychology and Speech Pathology, Curtin University, Australia, email: nikos.chatzisarantis@curtin.edu.au (corresponding author is Nikos Chatzisarantis), martin.hagger@curtin.edu.au, Nikos.ntoumanis@curtin.edu.au, c.thogersen@curtin.edu.au, [2]Department of Physical Education and Sport Science, Aristotle University of Thessaloniki, Greece email: bark@phed.auth.gr.[3]Department of Physics, Aristotle University of Thessaloniki, Greece, email: a6945947888@gmail.com [4]Business School, Curtin University, Perth Australia email: S.Gountas@curtin.edu.au [5]Business School, Murdoch University, Perth Australia email: J.Gountas@murdoch.edu.au Correspondence regarding this manuscript should be addressed to Nikos L. D. Chatzisarantis, school of Psychology and Speech pathology 6003, Email: nikos.chatzisarantis@curtin.edu.au

Abstract

Previous research documented that 'extremely high prioritisation' strategies that involved allocation of all resources for time or energy on pursuing goals related to leisure-time physical activity and none of available resources on competing behavioural goals were the most optimal in terms of yielding highest levels of participation in physical activities. This study examined whether a 'marginally higher prioritisation' strategy that involved an intention to invest large but slightly more resources on physical activity than competing behaviours was optimal. In addition, we examined whether linear and quadratic models supported different conclusions about optimal prioritisations strategies. Response surface analyses of a quadratic model revealed that 'marginally higher prioritisation' was the most optimal strategy. In addition, a linear regression model led us to incorrectly reject a 'simultaneous goal pursuit' strategy in favour of an 'extremely high prioritisation' strategy. Findings suggest that prioritisation strategies that 'garner' low opportunity costs are the most optimal.

Keywords: Prioritisation, behavioural conflict, opportunity costs, quadratic model, response surface analysis

Prioritising Intentions on the Margins: Effects of Marginally Higher Prioritisation Strategies on Physical Activity Participation

Introduction

People do not intend to accomplish one but many behavioral goals in their lives (Clarke & Hunt, 2015). They may intend to improve their fitness levels by engaging in physical activities five times per-week, work harder in order to get promoted and spend more time with their children in order to improve emotional bonding within the family. However, due to limited resources for time, attention and energy that are required to pursue multiple behavioural goals, the pursuit of competing goals may impede progress at goals related to physical activity- a phenomenon that is known as behavioural conflict (Austin & Vancouver, 1996; Presseau et al., 2013; Riediger & Freund, 2004). As a result, individuals attempt to manage behavioural conflict by distributing personal resources across multiple behaviours to ensure that progress at competing behavioural goals does not impede progress at goals related to physical activity (Carver & Scheier, 1998; Riediger, & Freund, 2004). The process of deciding how much resources to invest in which behavioural goals is termed prioritisation (Austin & Vancouver, 1996).

The construct of prioritisation is measured through self-report instruments that prompt individuals to compare their intentions to engage in a behavioural goal with a separate measure of competing intentions to engage in a competing behavioural goal (Abraham et al., 1999; Ajzen, 1969; Chatzisarantis et al., 2016a). Prioritisation is measured at the level of intentions because (i) it captures the amount of effort people are inclined to invest across behaviours and (ii) according to Ajzen (1991), the construct of intentions captures how much effort individuals are planning to exert in order to engage in health behaviours (see also Geers et al., 2009). A wealth of data now confirm that the process of prioritisation proceeds by shifting resources for time and energy from behavioural goals towards which individuals experience satisfactory progress to behavioural goals towards which they experience unsatisfactory progress (Carver & Scheirer, 1998; Louro, Pieters, & Zeelenberg, 2007). Importantly, studies have shown that prioritisation is about changes on the margin (Carver & Scheirer, 1998). That is, satisfactory progress at a behavioural goal does not facilitate disengagement from that behavioural goal completely by, for example, motivating allocation of all resources to competing behavioural goals (Clarke & Hunt, 2015). The reason for this is that people are avert to opportunity costs that ensue from not progressing at important competing behavioural goals (Cheng et al., 2012; Clarke & Hunt, 2015). Rather, as Carver (2003; p. 243) pointed out, individuals are likely to adopt a 'marginally higher prioritisation' strategy and invest slightly more resources on behavioural goals towards which they experience unsatisfactory progress than competing behavioural goals. This strategy is adaptive and consistent with what Carver (2003) and Frijda (1994) defined as tendencies to "coast" on behavioural goals because they 'free up' the necessary resources that can be channelled towards other behavioural goals.

Although much is known about how individuals prioritise their various behaviours, surprisingly less research has been conducted in identifying optimal prioritisation strategies. In the context of leisure-time physical activity, previous studies have been comparing two prioritisation strategies. An 'extremely high prioritisation' strategy that involves an extremely strong intention to engage in physical activities and an extremely weak intention to engage in competing behaviours (Conner, Abraham, Prestwich, Hutter, & Hallam et al., in press). The second strategy is termed 'equal prioritisation' and involves an extremely strong intention to engage in physical activities and an equally strong intention to engage in competing behaviours (Chatzisarantis et al., 2016a). A general conclusion that emerges from the experimental literature is that individuals make good progress at behavioural goals when they are instructed to adopt an 'extremely high prioritisation' strategy and focus all their efforts on a single behavioural goal and none of their available resources on competing behavioural goals (Geers et al., 2009; Locke et al., 1994). In contrast, progress at behavioural goals slows down when people adopt an 'equal prioritisation' strategy and invest large and equal amounts of effort on multiple behavioural goals (Louro et al., 2007; Schmidt & DeShon, 2007). However, prospective studies using self-report measures of prioritisation have revealed inconsistent findings (Salmon et al., 2003). For instance, whereas Conner et al. (in press) found an 'extremely high prioritisation' strategy to be the most optimal (see also Rhodes & Blachard, 2008), a number of other studies did not find effects of prioritisation on physical activity participation (Chatzisarantis et al., 2016a; Li & Chan, 2008).

A limitation of previous research is that it has not evaluated effects associated with all forms of 'simultaneous goal pursuit' strategies such as the 'marginally higher prioritisation' strategy. The reason for this is, in part, statistical and it has to do with the fact that linear regression analysis does not capture effects associated with 'marginally higher prioritisation' strategies. Given this gap in the literature, the present study tested whether the 'marginally higher prioritisation' strategy was the most optimal in terms of yielding highest levels of participation in physical activities.

Conceptual Framework of the Present Study

The conceptual framework that guides the current study is based on Stephens and Krebs (1986) optimal foraging theory that has been developed, in the field of evolutionary ecology, to predict how animals search for food. When this model is applied to humans it states that individuals make progress at behavioural goals by investing available resources for time and energy on those goals (Smith, 1983). However, due to behavioural conflict that arises from limited resources for time and energy, effort expended on behavioural goals may incur opportunity costs. In the context of optimal foraging theory, opportunity costs occur when progress at a behavioural goal is perceived to be made in expense of competing behavioural goals (Segerstom and Nes, 2006). Given this, the theory suggests that the optimal decision rule, or individuals' best strategy, is one that yields greatest progress at behavioural goals at lowest opportunity costs and lowest levels of behavioural conflict (Pyke, 1984).

Optimal foraging theory has clear implications for understanding optimal prioritisation strategies. It leads to the prediction that the ‘marginally higher prioritisation’ strategy is more optimal than the ‘extremely high prioritisation’ strategy. The reason for this is that the former strategy is associated with lower opportunity costs as it allows people progress at competing behavioural goals. In contrast, the ‘extremely high prioritisation’ strategy is associated with higher opportunity costs as it requires from people to disengage completely from competing behavioural goals. Likewise, the ‘marginally higher prioritisation’ strategy should yield higher levels of participation in physical activities than the ‘equal prioritisation’ strategy that involves intentions to invest extremely large and equal amounts of resources on multiple goals. This is because under the assumption that resources for time and energy are limited, investing extremely large amounts of resources on multiple behaviours should yield extremely high levels of behavioural conflict.

To date, optimal foraging theory has not been tested extensively in the context of prioritisation research. In one notable exception, Segerstom and Nes (2006) pointed out that prioritisation strategies that reflected a tendency to balance opportunity costs, behavioural conflict and benefits were optimal as they yielded especially high levels of progress at behavioural goals, including goals related to health behaviours. The reason for this is that the combination of higher benefits and lower opportunity costs motivated people to persist in face of obstacles because this combination created a situation in which more benefits were at stake (Li & Chan, 2008; Orehek & Vazeou-Nieuenhuis, 2013). Although these studies did not examine whether a ‘marginally higher prioritisation’ was the most optimal self-regulatory strategy, their results point towards this direction. This is because the tendency to balance opportunity costs against benefits implies a tendency to make a compromise decision that manifests on decisions to invest marginally higher levels of effort on behavioural goals than competing goals (Cheng et al., 2012).

Why Previous Studies Could Not Capture Marginally Higher Prioritisation Strategies

In previous studies, effects associated with different prioritisation strategies have been estimated through linear regression analysis. However, a limitation of the linear regression model is that it does not capture effects associated with the 'marginally higher prioritisation' strategy. The reason for this is that linear functions yield highest levels of participation in physical activities when intentions are endorsed at lowest or highest possible levels (Ganzach, 1997). As a result, linear regression analysis always confirms that the 'extremely high prioritisation' or the 'equal prioritisation' strategies are the most optimal. In fact, linear analysis always shows that the 'marginally higher prioritisation' strategy is the second or third best self-regulatory strategy (see Appendix). Nevertheless, it is important to keep in mind that results from the linear regression model may be a statistical artefact and they may actually mask meaningful effects associated with 'simultaneous goal pursuit' strategies such as the 'marginally higher prioritisation' strategy (Edwards, 1994; 2001).

Problems associated with linear regression analysis can be overcome by employing a non-linear (quadratic) regression model and response surface analysis (Edwards, 1994). For instance, the quadratic model may indicate that 'marginally higher prioritisation' is the most optimal self-regulatory strategy if its regression coefficients support an increasing linear relationship and a concave relationship for physical activity intentions and competing intentions respectively (see Appendix). The reason for this is that increasing linear functions 'return' highest levels of participation in physical activities when physical activity intentions are endorsed at the highest possible levels. In contrast, concave functions yield highest levels of participation in physical activities when competing intentions are endorsed at moderate levels (Edwards & Parry, 1993). This is because concave functions 'return' high levels of engagement in vigorous physical activities as competing intentions increase but only up to a given point beyond which any further increases in competing intentions yield lower (or the same) levels of physical activity participation (Edwards & Parry, 1993).

To date, a considerable number of studies have shown that the relationship between physical activity intentions and physical activity behaviour is positive and linear (Hagger et al., 2002) – a finding that suggests that intentions yield high levels of participation in physical activities when they are endorsed at extremely high levels. However, to our knowledge, studies have not examined as yet whether the relationship between competing intentions and physical activity participation is concave. Despite this, numerous studies conducted in organisational settings demonstrated that the relationship between competing behaviours (i.e., workplace leisure behaviour) and productivity was concave. Broadly speaking, studies showed that time-spent on competing behaviours actually increased productivity when it averaged 12% or less of employees total work hours (Brisswalter, Collardeau, & René, 2002). The effects of competing behaviours on productivity were negative when time-spent on competing activities exceeded the 12% threshold (Tomporowski, 2003). However, it is important to note that previous studies observed a concave relationship between competing behaviours and productivity (Briswalter et al., 2002; Tomporowski, 2003) but not between competing intentions and physical activity participation. The present study adds to this literature by examining whether a similar concave relationship describes engagement in physical activities.

Overview of the Study and Hypotheses

The objective of the current study was to test whether a 'marginally higher prioritisation' strategy was the most optimal in terms of yielding highest levels of participation in physical activities. In addition, we examined whether linear and quadratic models supported different conclusions about optimal prioritisations strategies. Given that the linear regression model revealed inconsistent findings about optimal prioritisation strategies in previous research (i.e., Rhodes & Blanchard, 2008; Li & Chan, 2008), we expected the linear regression analysis to show that either (i) 'extremely high prioritisation' was the most optimal self-regulatory strategy or (ii) there were no effects of prioritisation on performance of physical activity. However, based on Segerstom and Nes (2006), we expected the quadratic regression model to show that 'marginally higher prioritisation' was the most optimal self-regulatory strategy. At an empirical level, this hypothesis is confirmed if the functional relationships between physical activity intentions and competing intentions are linear and concave respectively. We tested this hypothesis in the context of a prospective study that aimed to predict vigorous-intensity physical activity participation from measures of prioritisation.

Finally, in keeping with previous prioritisation research, we measured behavioural conflict in order to clarify prioritisation effects further (Li & Chan, 2008; Presseau et al., 2013; Rhodes & Blanchard, 2008). In the context of the present study, the construct of behavioural conflict aimed to capture the extent to which a competing behaviour impeded participation in vigorous physical activities (Presseau et al., 2013; Riediger & Freund, 2004). As we have mentioned in the introduction, 'marginally higher prioritisation' motivates people to maintain goal pursuit even in difficult circumstances that are characterised by high levels of behavioural conflict (Orehek & Vazeou-Nieuenhuis, 2013). At an operational level, this hypothesis is confirmed if the 'marginally higher prioritisation' strategy yields highest levels of engagement in vigorous physical activities even after controlling for negative effects associated with behavioural conflict (Segerstom & Nes, 2006; Stephens & Krebs, 1986). Accordingly, we statistically controlled for behavioural conflict in our analysis in order to examine whether 'marginally higher prioritisation' added to the prediction of physical activity participation after controlling for effects associated with behavioural conflict.

Method

Participants and Design

The research protocol was approved by a University's ethics committee. We employed a prospective design that measured component measures of prioritisation (intentions and competing intentions) at the first wave of data collection. After five weeks, we measured retrospective conflict and physical activity participation at the second wave of data collection. Participants were young students who participated in the study in return for extra course credit (Male = 105, Female = 98, Age = 22.96, SD = 1.91). Participants did not have to be physically active. One hundred and seventy two participants voluntarily participated in the second wave of data collection (Male = 89, Female = 83, Age = 22.21, SD =1.90).

Procedure

Measures were completed in quiet rooms of no more than 20 individuals. Each participant was provided with an information sheet, a consent form and a survey that measured component measures of prioritisation, age and gender. This survey also asked participants to provide their date of birth. Approximately 5 weeks after the first wave of data collection, participants completed a second survey that assessed behavioural conflict retrospectively and participation in vigorous physical activities the last 5 weeks. The second survey also prompted participants to report their date of birth. We also defined physical activity as participation in vigorous-intensity physical activities for at least 4 times per-week, and for at least 45-minutes each time, during leisure-time. This amount of physical activity participation is consistent with the World Health Organisation (2010) position statement for recommended weekly physical activity that confers health benefits among younger adults. Participants were also provided with examples of leisure-time physical activity[1].

Measures

[1] In the current study, we also measured past behaviour and component measures of the theory of planned behaviour. However, additional analysis that accounted for effects of these variables on physical activity participation did not change results of the current study. Given this, we decided to not include past behaviour and component measures of the theory of planned behaviour in our analysis.

Prioritisation. We employed Ajzen and Fishbein's (1969) method in measuring prioritisation. Specifically, participants were prompted first to report a competing behaviour or a set of behaviours that conflicted with participation in vigorous physical activities. Following Austin and Vancouver (1996), a competing behaviour was defined as a high priority activity that participants were inclined to perform most of the days per week over the next five weeks. Participants could list any type of behaviour including health-related behaviours. Next, participants reported their intention towards the competing act. Immediately after, participants were requested to report and compare their physical activity intentions with their intentions toward the competing act. Competing intentions and physical activity intentions were measured through three items each, and on 7-point scales ranging from "not at all" (1) to "very much" (7). An example item of competing intentions was: "To what extent are you determined to engage in the alternative behaviour over the next 5 weeks, during your leisure-time?" An example item of physical activity intentions was: "Comparing to your determination to engage in the alternative behaviour, by how much more or less are you determined to engage in vigorous physical activities over the next 5 weeks, during your leisure time?".

Retrospective behavioural conflict. Following Ajzen and Madden (1985) and Presseau et al. (2013), this variable was measured through two items (in the second survey) that indicated the frequency with which conflicting acts prevented physical activity participation. Specifically, at the second wave of data collection, participants were prompted first to report a behaviour, or a set of behaviours, that they actually prevented them from engaging in vigorous physical activities the last 5 weeks, during their leisure-time. Next, participants were instructed to report the frequency with which the alternative act interfered with participation in vigorous physical activities. An example item for retrospective conflict was: "In a typical week, how often did the alternative behaviour prevent you from engaging in vigorous physical activities for at least 45 minutes, during your leisure-time?" This item was measured on a 5-point scale ranging from “not at all” (1) to “most days of the week” (5). The correlation between the two items measuring behavioural conflict was satisfactory (r = .68).

Physical activity. We used an item from Godin’s leisure-time exercise questionnaire to measure vigorous-intensity physical activity at follow up (Godin & & Sheppard, 1985). The questionnaire prompted participants to think of a typical week from the previous five weeks and then report how often they engaged in vigorous-intensity physical activity for at least 45 minute, during their leisure time, the last five weeks. Responses to this item could range from zero to 7 days. One deviation from Godin and Shephard’s (1985) original questionnaire was that it prompted participants to indicate how often they engaged in vigorous activity for more than 45 minutes in a typical week, whereas the original questionnaire targeted vigorous physical activity that was executed for more than 15 minutes. In addition, in the current study, we did not measure mild or moderate physical activity. This is because the aim of the present study was to predict participation in vigorous physical activities rather than engagement in mild or moderate physical activity.

Analysis

We initially conducted a content analysis to examine content of competing behaviours. We also carried out a multivariate analysis of variance to examine whether participants who completed the measure of physical activity differed from those who did not on competing intentions, physical activity intentions and age. In addition, we calculated descriptive statistics and Pearson’s correlations for all psychological variables. For the main analysis, we conducted two separate regression analyses. First, we carried out a linear regression analysis to examine whether the ‘extremely high prioritisation’ strategy or the ‘equal prioritization’ strategy were the most optimal. In that regression analysis, we estimated main effects of intentions, competing intentions and behavioural conflict by testing the following regression equation (Aiken & West, 1991):

$$PA = \beta_0 + \beta_1 I + \beta_2 CI + \beta_6 C + e10 \quad (1)$$

In Equation 1, PA represents the measure of actual engagement in vigorous physical activities. The term C represents participants' responses (ratings) to the instrument that measures behavioural conflict. The terms I and CI represent participants' responses to the instrument that measures component measures of prioritisation that reflect physical activity intentions (I) and competing intentions (CI). The coefficients β_0 and e_{10} capture the intercept and residual variance of the regression equation respectively. The unstandardized regression coefficients β_1 and β_2 capture main effects associated with the two measures of intentions. Broadly speaking, Equation 1 shows that 'extremely high prioritisation' is the most optimal self-regulatory strategy if (i) the regression coefficients that capture the main effects associated with intentions (β_1) and competing intentions (β_2) are positive and negative respectively (see Chatzisarantis et al., 2016b; Li & Chan, 2008; Rhodes & Blanchard, 2008). In contrast, the regression coefficients support the conclusion that 'equal prioritisation' is the most optimal self-regulatory strategy if (i) the main effects associated with intentions (β_1) and competing intentions (β_2) are positive and statistically significant (Chatzisarantis et al., 2016b).

Second, we tested the following quadratic model to examine whether 'marginally higher prioritisation' was the most optimal self-regulatory strategy: (Edwards, 1994):

$$PA = \beta_0 + \beta_1 I + \beta_2 CI + \beta_3 I^2 + \beta_4 IxCI + \beta_5 CI^2 + \beta_6 C + e_{10} \quad (2)$$

In Equation 2, the product term IxCI represents the interaction between intentions and competing intentions. This product term is estimated by multiplying participants' standardised responses to the instruments that measure physical activity intentions (I) and competing intentions (CI) (Aiken & West, 1991). The terms I^2 and CI^2 are quadratic terms. These terms are estimated by squaring participants' standardised responses to instruments measuring intentions and competing intentions. The regression coefficient β_4 captures effects associated with the interaction between intentions and competing intentions. The coefficients β_3 and β_5 capture non-linear (quadratic) effects associated with intentions and competing intentions. In the context of the present study, Equation 2 supports a concave relationship between competing intentions and physical activity participation if β_5 is negative and statistically significant. A concave functional relationship expresses our hypothesis because it means that levels of engagement in vigorous physical activities increase as competing intentions increase but only up to a given point beyond which any further increases in competing intentions yield lower (or the same) levels of physical activity participation (Edwards & Parry, 1993).

Following Edwards' recommendations (1994), we estimated coefficients of Equation 2 by using multiple regression analysis coupled with 10000 bootstrap replications. In addition, we utilised the unstandardized coefficients from Equation 2 to plot and analyse a three-dimensional response surface in which physical activity intentions and competing intentions were represented on perpendicular axes and participation in vigorous-intensity physical activity was represented on a vertical axis. We also identified optimal prioritisation strategies by conducting a response surface analysis to locate the first principle axis of the response surface. This axis addresses our hypothesis because, for concave surfaces, it captures optimal prioritisation strategies (Edwards & Parry, 1993).

Based on Edwards and Parry (1993), we reasoned that if the functional relationships for intentions and competing intentions were linear and concave respectively, then the slope and the intercept of the first principal axis would be zero. In this case, the first principle axis would capture three distinct prioritisations strategies: (i) a "marginally higher prioritisation' strategy in which physical activity intentions are marginally stronger than competing intentions, (ii) a prioritisation strategy that involves moderate intentions and moderate competing intentions and (iii) a prioritisation strategy that involves moderate competing intentions and low intentions. In addition, we estimated the slope of the surface that corresponded to the first principal axis (Edwards & Parry, 1993). In the context of the current study, this slope indicates which of the three prioritisation strategies, that run along the first principal axis, exhibit maximum levels of participation in vigorous physical activities (Edwards & Parry, 1993). In the present study, we expected the slope of the surface that corresponded to the first principal axis to be positive – a finding that will be consistent with our hypothesis that the 'marginally higher prioritisation' strategy is the most optimal. In all analysis, missing data were treated by using a multiple imputation procedure that replaced missing values with predicted values that were estimated on the basis of regression models (Graham, 2009).

Results

Preliminary Analysis

A content analysis of competing behaviours revealed that 47% of the students reported homework as a competing behaviour. Eighteen per-cent of the students reported 'going to 'work' as a competing behaviour whereas 22% reported other hobbies such as 'watching TV', 'playing TV games', 'going to cinema or theatre' as competing behaviours. In addition, 13% of the students reported 'going out with friends' as a competing behaviour. Further, a multivariate analysis of variance revealed that participants who did not complete measures of physical activity participation and those who completed measures of physical activity participation did not differ on physical activity intentions (F (1,170) = 1.17, p = .28), competing intentions (F (1,170) = .03, p = .87) or age (F (1,170) = 2.42, p = .12).

Table 1 presents descriptive statistics, Cronbach's alpha reliability coefficients and correlations between psychological variables. As it is shown, the alpha coefficients for physical activity intentions and competing intentions were satisfactory. In addition, the pattern of correlations lends some preliminary support to the conclusion that the 'extremely high prioritisation' strategy is the most optimal self-regulatory strategy. This is because the correlation between intentions and physical activity participation was positive and statistically significant whereas the correlation between competing intentions and physical activity participation was negative and statistically significant. Further, the negative correlation between behavioural conflict and vigorous physical activity suggests that high levels of behavioural conflict yielded lower levels of participation in vigorous physical activities. This negative correlation also supports our decision to include measures of behavioural conflict in the regression analysis.

Main Analysis

Following Edwards' (1994) recommendations, measures of physical activity intentions and competing intentions were standardised by subtracting the midpoint of the scale. In addition, we estimated Cook's D and leverage values to identify potential outliers. However, no individual response exceeded the threshold suggested by Bollen and Jackman (1990). Table 2 presents results from the linear and quadratic regression analyses. As it is shown, both analyses revealed negative relationships between retrospective measures of behavioural conflict and physical activity participation. Most relevant, in accordance with our expectations, the linear model showed that the main effects of physical activity intentions and competing intentions were positive and negative respectively. With this pattern of regression coefficients, the linear model forces us to conclude that 'extremely high prioritisation' is the most optimal strategy. However, the quadratic model showed that this conclusion is false.

As it is shown in Table 2, parameters of the quadratic model pointed out that the linear (main) effect of physical activity intentions on physical activity participation was positive and statistically significant. In addition, in accordance with our initial hypothesis, the negative quadratic effect, associated with competing intentions, entails that competing intentions related to vigorous-intensity physical activity by a concave function. Further, Figure 1 shows that the first principle axis run almost in parallel with the axis that represented responses to physical activity intentions. The reason for this was that the slope and the intercept of the first principal axis were not statistically different from zero. Most crucial, in accordance with our hypothesis, the slope of the surface that corresponded to the first principal axis was positive (see Table 2). Hence, in stark contrast to the linear model, the quadratic model shows that a 'simultaneous goal pursuit' strategy, that corresponded to the 'marginally higher prioritisation' strategy, was the most optimal self-regulatory strategy.

As an example, had we used the regression coefficients from the linear model to estimate predicted levels of physical activity participation, we would predict that an individual who adopted an 'extremely high prioritisation' strategy engaged in vigorous physical activity 5.70 times per-week whereas a person who adopted a 'simultaneous goal pursuit' strategy, analogous to equal prioritisation, engaged in vigorous physical activity 4.54 times per-week. Hence, the linear model would have forced us to predict that the 'simultaneous goal pursuit' strategy yielded lower levels of vigorous-intensity physical activity participation. However, based on the regression coefficients of the quadratic model, we predict that a person who adopted a 'simultaneous goal pursuit' strategy, analogous to the 'marginally higher prioritisation' strategy, engaged in vigorous-intensity physical activity 5.68 times per-week - an increase (rather than decrease) in physical activity participation by almost one bout of vigorous physical activity per-week[2]. Interestingly, in accordance with our expectations and previous research (Orehek & Vazeou-Nieuenhuis, 2013; Segerstom & Nes, 2006; Stephens & Krebs, 1986), the quadratic model showed that the 'marginally higher prioritisation' strategy motivated participation in vigorous physical activities in situations of behavioural conflict. This is because, in the quadratic model, the linear and concave functions

---

[2] The predicted levels of physical activity were estimated by (i) multiplying the regression coefficients from the linear or quadratic models with values that represent extremely high, equal or marginally higher prioritisation strategies and (ii) add the product of those multiplications to the intercept of the linear or quadratic model. For example, the predicted levels of physical activity associated with the extremely high prioritisation strategy were estimated as follows: $.95x(2) - .29\,x(-2) + 3.22$. Analogously, the predicted levels of physical activity associated with the equal prioritisation strategy were estimated as follows: $.95x(2) - .58\,x(2) + 3.22$. The predicted levels of physical activity associated with the marginally higher prioritisation strategy were estimated as follows: $.88x(2) - .32\,x(0) + .14(2^2)+.02(2x0)-.27(0^2)+3.36$.

for intentions and competing intentions were statistically significant even after controlling for behavioural conflict (see Table 2).

Discussion

The purpose of the present study was to examine whether a ‘simultaneous goal pursuit’ strategy that corresponded to the ‘marginally higher prioritisation’ was the most optimal self-regulatory strategy. In addition, we examined whether linear and quadratic models supported different conclusions about optimal prioritisation strategies. In accordance with our initial expectations and previous research, the linear model showed that ‘extremely high prioritisation’ was the most optimal self-regulatory strategy. At that juncture, therefore, the linear model might have led us to reject the ‘simultaneous goal pursuit’ strategy and suggest that individuals who disengaged from competing behaviours, and focused all their efforts on physical activity participation, were the ones who engaged in physical activities the most.

Contrary to the conclusion that ‘extremely high prioritisation’ is the most optimal strategy, the quadratic model supported a concave relationship between competing intentions and participation in vigorous physical activities. In addition, the response surface analysis pointed out that the most optimal self-regulatory strategy was the ‘marginally higher prioritisation’ strategy even after controlling for the negative effects associated with behavioural conflict. Given these findings, the current study suggests that the linear model can mislead researchers to reject a ‘simultaneous goal pursuit’ strategy when, in fact, there is an alternative model that supports the notion that the most optimal prioritisation strategy is a ‘simultaneous goal pursuit’ strategy analogous to ‘marginally higher prioritisation’. This misleading conclusion may happen when researchers analyse observations by way of using linear regression models (Ganzack, 1997). Therefore, researchers who test prioritisation effects are advised to employ non-linear (quadratic) models and conduct response surface analysis.

Apart from confirming utility of the quadratic model in identifying optimal prioritisation strategies, the present study makes several other contributions to the literature. At a theoretical level, the current study supports Carver's (2003) and Frijda's (1994) models of self-regulation that predict 'marginally higher prioritisation' to constitute a unique self-regulatory strategy that is distinct from extremely high or equal prioritisation strategies. However, due to inappropriate research designs or data analytic techniques, previous experimental and prospective studies could not examine whether the 'marginally higher prioritisation' strategy was the most optimal (Chatzisarantis et al., 2016a; Conner et al., in press). Hence, the current findings go beyond the prioritisation literature by demonstrating that the 'marginally higher prioritisation' strategy is the most optimal in terms of yielding highest levels of participation in vigorous physical activities.

Most critical, current findings compare favourably with Segerstom and Nes (2006) model of self-regulation that states prioritisation strategies that 'garner' lower opportunity costs and higher benefits are adaptive because they motivate people to persist in the face of obstacles (Li & Chan, 2008; Stephens & Krebs, 1986). The present study supports Segerstom and Nes (2006) model because the 'marginally higher prioritisation strategy', which by definition involves lower opportunity costs, yielded higher levels of engagement in physical activities than the 'extremely high prioritisation' strategy that involves higher opportunity costs. These findings are essential for theoretical progress in physical activity research because some recent studies have overlooked opportunity costs that ensue from abandoning competing behaviours. For example, there is emerging evidence to suggest that disengaging from competing behaviours is an adaptive self-regulatory strategy and that persistence in competing behaviours is futile (Conner et al., in press; Locke et al., 1994; Ntoumanis, Healy, Sedikidis, Smith, & Duda, 2016; Wrosch, Scheirer, Miller, Schulz, & Carver, 2003).

However, it is impossible to infer from those published studies whether measures of disengagement (and corresponding effects) represented tendencies to abandon competing behaviours or tendencies to engage in those behaviours in moderation (Wrosh et al., 2003). The reason for this is that some of the items used to measure ‘disengagement’ captured tendencies to reduce effort toward competing behaviours (i.e., It is easy for me to reduce my effort toward the goal, Wrosh et al., 2003, p. 1497). Hence, the current study makes an important contribution to the literature because it shows that reluctance to disengage from competing behaviours is not a futile self-regulatory strategy at least in the context of leisure-time physical activity. Rather, present findings suggest that reluctance to disengage from a competing behaviour may be an adaptive self-regulatory strategy that is most likely driven by tendencies to reduce opportunity costs.

At an applied level, the present study clearly shows that data analytic strategies determine theoretical conclusions and recommendations for practise (Ganzach, 1997). In particular, we would recommend adoption of ‘extremely high prioritisation’ strategies, if we analysed observations by ways of using the linear model. In addition, given that these strategies require from people to disengage from competing goals, the linear model would have forced us to propose intervention strategies that prompt individuals to focus all their efforts on vigorous physical activity and none of their efforts on competing goals. However, it can be argued that, in some cases, it may be inappropriate to ask young people to disengage from competing behaviours such as when competing behaviours are related to academic goals. Most critical, given that the ‘extremely high prioritisation’ strategy did not yield the highest levels of participation in vigorous physical activities, the linear model would have led us to recommend sub-optimal intervention programs.

In contrast, the quadratic model enables us to draw practical recommendations that are much more feasible to implement in real-life settings. This is because the statistically significant concave function observed for competing intentions implies that practitioners do not need to require from people to disengage completely from competing goals. Rather, the quadratic model suggests that optimal levels of engagement in vigorous physical activities can be attained by prompting individuals to pursue competing goals in moderation. This can be achieved by asking individuals to select in advance a level of pursuing competing goals that is believed to not impede participation in vigorous physical activities (Cheng et al., 2012). Alternatively, as others have noted (Carver & Scheirer, 1998; Louro, Pieters, & Zeelenberg, 2007), marginal prioritisation strategies can be encouraged by changing perceptions of progress at competing behaviours or goals related to vigorous physical activity. For instance, it may be possible to promote adoption of ‘marginally higher prioritisation’ strategies by emphasising lack of progress at goals related to vigorous physical activity without actually dissuading progress at competing goals. By not actively dissuading pursuit of competing goals, individuals may accelerate progress at goals related to vigorous physical activity while at the same time they may pursue competing goals in moderation.

Finally, it will be remiss to not mention limitations of the current study and provide directions for future research. Current findings may not generalise to younger students or older adults because the sample of the present study comprised university students. In addition, the present study may underestimate effects of prioritisation on physical activity participation because prioritisation was measured at the level of intentions and intentions do not always lead to physical activity participation (Sniehotta, Presseau, & Araújo-Soares, 2014). Further, we assessed physical activity participation through a self-report measure. As a consequence, absolute levels of physical activity participation, observed in the present study, are open to biases. Hence, it may be important to replicate current findings by using more objective measures of physical activity participation.

In the current study, measures of physical activity participation and behavioural conflict may be unreliable because each measure comprised less than three items. Relatedly, the regression coefficients observed in the present study were not corrected for attenuation because we did not use latent variables in the analysis. Unfortunately, in the current study we could not conduct response surface analyses with latent factors because such analysis would require measuring physical activity participation through at least three items (Edwards, 2007). Further, in the current study, the regression analysis showed that the 'marginally higher prioritisation' strategy added to the prediction physical activity participation after controlling for effects associated with behavioural conflict. This additive effect implies that the 'marginally higher prioritisation' strategy motivates people to pursue goals related to physical activity even in difficult circumstances that are characterised by high levels of behaviour conflict. However, this conclusion should be treated cautiously because levels of behavioural conflict were not manipulated in the current study.

In conclusion, the current study demonstrated that in the context of physical activity participation, the most optimal prioritisation strategy is the 'marginally higher prioritisation' strategy that involves a strong intention to engage in physical activities and a slightly less strong (or moderate) intention to engage in competing behaviours. In addition, we showed that the linear regression model can mislead researchers to conclude that an 'extremely high prioritisation' strategy is optimal when in fact the most optimal prioritisation strategy is a 'simultaneous goal pursuit' strategy that corresponds to the 'marginally higher prioritisation' strategy. At a methodological level, current findings suggest that the quadratic model is a viable data analytic technique that assists researchers in identifying optimal prioritisation strategies. At a theoretical level, findings suggest that prioritisation strategies that garner low opportunity costs and high benefits are the most optimal self-regulatory strategies.

References

Abraham, C., Sheeran, P., Norman, P., Conner, M., De Vries, N., & Otten, W. (1999). When good intentions are not enough: Modelling postdecisional cognitive correlates of condom use. *Journal of Applied Social Psychology, 29*, 2591-2612.

Ajzen, I., & Fishbein, M. (1969). The prediction of behavioural intentions in a choice situation. *Journal of Experimental Social Psychology, 5*, 400-416.

Ajzen, I., & Madden, T. J. (1986). Prediction of goal directed behavior: Attitudes, intentions and perceived behavioural control. *Journal of Experimental Social Psychology, 22,* 453-474.

Austin, J. T., & Vancouver, J. B. (1996). Goal constructs in psychology: Structure, process and content. *Psychological Bulletin, 3*, 338-375.

Brisswalter, J., Collardeau, M., & René, A. (2002). Effects of acute physical exercise characteristics on cognitive performance. *Sports Medicine*, 32, 555–566.

Carver, C. S. (2003). Pleasure as a sign you can attend to something else: placing positive feelings within a general model of affect. *Cognition and Emotion, 17*, 241-261.

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behaviour*. New York: Cambridge University Press.

Chatzisarantis, N. L. D., Barkoukis, V., Yli-Pipari, S., Thøgersen-Ntoumani, C., Ntoumanis, N., & Hagger, M. S. (2016a). Equal prioritisation does not yield lower levels of participation in physical activities than higher prioritisation. *Psychology of Sport and Exercise, 22*, 123-130. doi: 10.1016/j.psychsport.2015.07.001.

Chatzisarantis, N. L. D. Thogernsen-Ntoumani, C., Ntoumanis, N., & Hagger, M. (2016b). Sensitivity of statistical models in detecting effects of prioritization on physical activity participation. *International Journal of Sport Psychology, 2,* 13-20.

Cheng, Y. H., Chang, S. S., & Yu, M. W. (2012). The impact of purchase quantity on the compromise effect: The balance heuristic. *Judgement and Decision-Making, 7*, 499-512.

Clarke, A., & Hunt, A. (2015). Failure of intuition when choosing whether to invest in a single goal or split resources between two goals. *Psychological Science, 1*, 1-11.

Coker, B. L. S. (2011). Freedom to surf: The positive effects of workplace internet leisure browsing. *New Technology, Work, and Employment, 26*, 238-247.

Edwards, J. R. (1994). The study of congruence in organisation behaviour: Critique and a proposed alternative. *Organisational Behavior and Human Decision-Making Processes, 58*, 51-100. doi: 0749-5978/94.

Edwards, J. R. (2001). Ten difference score myths. *Organisational Research Methods, 3*, 265-287.

Edwards, J. R. (2007). Latent variable modelling in congruence research: Current problems and future directions. *Organisational Research Methods, 28*, 1-29.

Edwards, J. R., & Parry, M. E. (1993). On the use of polynomial regression equations as an alternative to difference scores in organizational research. *Academy of Management Journal, 36,* 1577-1613.

Frijda, N. H. (1994). Emotions are functional most of the time. In P. Ekman & R. J. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 112-126). New York: Oxford University Press.

Ganzach, Y. (1997). Misleading interaction and curvilinear terms. *Psychological Methods, 3*, 235-247.

Geers, A, L., Wellman, J. A., & Lassiter, G. D. (2009). Dispositional optimism and engagement: The moderating influence of goal prioritisation. *Journal of Personality and Social Psychology, 4*, 913-932. doi:10.1037/a0014830.

Godin G., & Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. *Canadian Journal of Applied Sport Science, 10,* 141-146.

Graham, J. W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology, 60*, 549-576.

Hagger, M., Chatzisarantis, N., & Biddle, S. (2002). A meta-analytic review of the theories of reasoned action and planned behavior: Predictive validity and the contribution of additional variables. *Journal of Sport and Exercise Psychology, 24*, 3-32.

Li, K. K, & Chan, D. S. (2008). Goal conflict and the moderating effects of intention stability in the intention-behavior relations: Physical activity among Hong Kong Chinese. *Journal of Sport and Exercise Psychology, 30*, 39-55.

Locke, E. A., Smith, K. G., Erez, M., Chah, D. O., Schaffer, A. (1994). The effects of intraindividual goal conflict on performance. *Journal of Management*, *1*, 67-91.

Louro, M. J., Pieters, R., & Zeelnberg, M. (2007). Dynamics of multiple-goal pursuit. *Journal of Personality and Social Psychology 2*, 174-193. doi: 10.1037/022-3514.93.2.174.

Ntoumanis, N., Healy, L.C., Smith, A.L., Sedikides, C., & Duda, J.L. (2014). Self-regulatory responses to unattainable goals: The role of goal motives. *Self and Identity, 13,* 594-612.

Orehek, E., & Nieuwenhuis, A. V. (2013). Sequential and concurrent strategies of multiple goal pursuit. *Review of General Psychology, 17*, 339-349.

Powers, W. T. (1992). *Living control systems*. Gravel Switch, KY: Control Systems Group.

Presseau, J., Tait, R., Johnston, D. W., & Sniehotta, F. F. (2013). Goal conflict and goal facilitation as predictors of daily accelerometer-assessed physical activity. *Health Psychology, 12*, 1179-1187.

Pyke, G. A. (1984). Optimal foraging theory: A critical review. *Annual Review of Ecological Systems, 15*, 523-575.

Rhodes, R. E., & Blanchard, C. M. (2008). Do sedentary motives adversely affect physical activity? Adding cross-behavioural cognition to the theory of planned behaviour. *Psychology and Health, 7*, 789-805.

Riediger, M., & Freund, A. M. (2004). Interference and facilitation among personal goals: Differential associations with subjective well-being and persistent goal pursuit. *Personality and Social Psychology Bulletin, 30*, 1511-1523.

Salmon, J., Owen, N., Crawford, D., Bauman N., & Sallis, F. J. (2003). Physical activity and sedentary behaviour: A population-based study of barriers, enjoyment, and preference. *Health Psychology, 2*, 178-288.

Schmidt, A. M., & DeShon, R. P. (2007). What to do? The effects of discrepancies, incentives, and time on dynamic goal prioritisation. *Journal of Applied Psychology, 4*, 928-941. doi: 10.137/0021-9010.92.4.98.

Smith, E. A. (1983). Anthropological applications of optimal foraging theory: A critical review. *Current Anthropology, 24*, 625-651.

Segerstrom, S. C., & Nes, L. S. (2006). When goals conflict but people prosper: The case of dispositional optimism. *Journal of Research in Personality, 40*, 675-693.

Sniehotta, F. F., Presseau, J., & Araújo-Soares, V. (2014). Time to retire the theory of planned behaviour. *Health Psychology Review, 8*, 1-7.

Stanton-Rich, H. M. & Iso-Ahola, S. E. (1998). Burnout and Leisure. *Journal of Applied Social Psychology, 28*, 1931-1950.

Stephens, D. W., & Krebs, J. R. (1986). *Foraging theory*. Princeton, NJ: Princeton University Press.

Tomporowski, P. D. (2003). Effects of acute bouts of exercise on cognition. *Acta Psychologica*, 112, 297–324.

World Health Organisation (2010). *Global recommendations on physical activity for health.*

Wrosh, C., Scheier, M. F., Miller, G. E., Schulz, R., & Cerver, C. S. (2003). Adaptive self-regulation of unattainable goals: Goal disengagement, goal reengagement and subjective well-being. *Personality and Social Psychology Bulletin, 29*, 1494-1508. doi:10.1177/0146167203256921.

Table 1

Descriptive statistics and correlations between psychological variables

	M	SD	1	2	3	4
1. Competing intentions	4.84	1.47	.90			
2.Physical activity intentions	4.32	1.59	-.11	.94		
3.Retrospective conflict	3.03	1.78	.02	-.14	-	
4.Physical activity	3.22	1.74	-.23*	.60*	-.35*	-

Note. Correlations with an asterisk are statistically significant at $p < .05$ level.
Cronbach's alpha coefficients are presented along the diagonal of the correlation matrix.

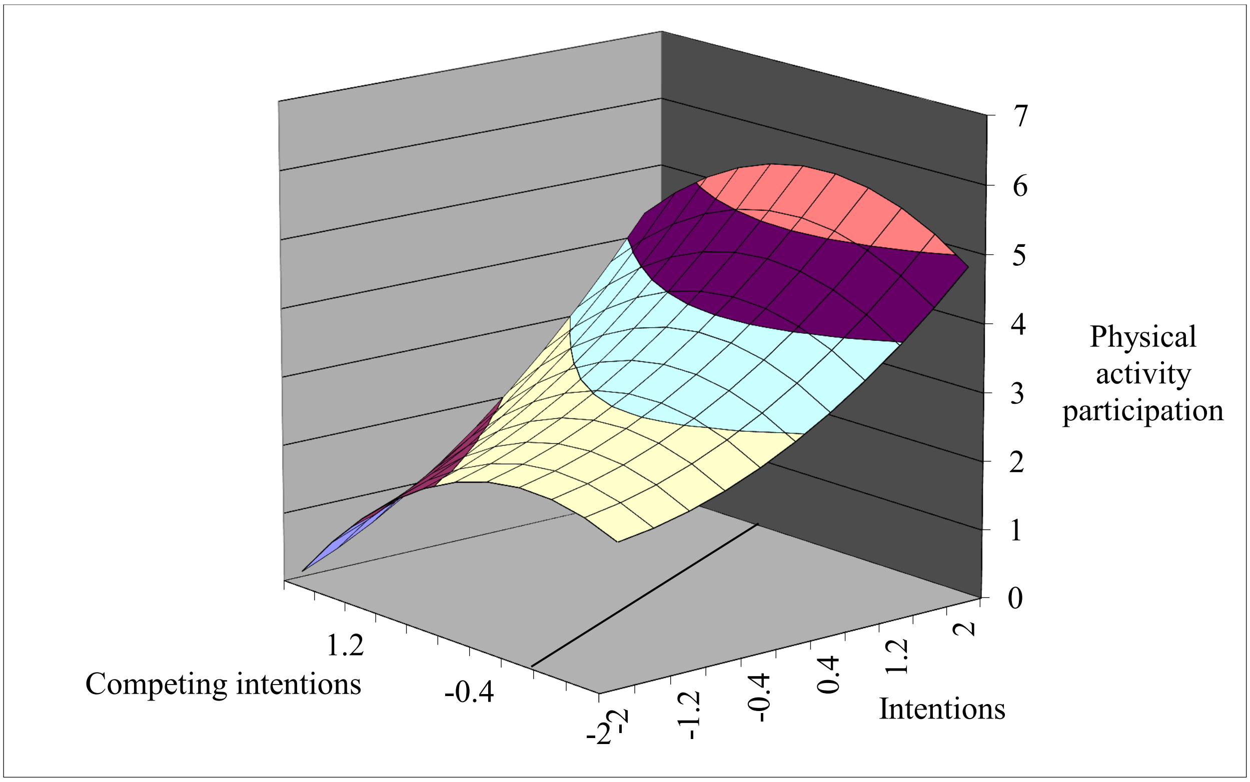
Table 2

Linear and quadratic regression models predicting physical activity participation from component measures of prioritisation and behavioural conflict

Variables	Linear model		Quadratic model	
	β	CI_{95}	β	CI_{95}
Intercept	3.22		3.36	
Intentions	.95*	[.76 1.15]	.88*	[.66, 1.14]
Competing intentions	-.29*	[-.50 -.08]	-.32*	[-.54, -.08]
$Intentions^2$			.14	[-.05, .31]
Intentions x competing intentions			.09	[-.10, .25]
Competing $intentions^2$			-.27*	[-.47, -.10]
Behavioral conflict	-.47*	[-.66 -.28]	-.51*	[-.70, -.32]
F	48.39*		26.79*	
R^2	.46		.49	
Slope of first principle axis			.11	[-.11, .33]
Intercept of first principle axis			-.76	[-2.42, .37]
Slope of the surface of first principle axis			.82*	[.62, 1.02]

Note. Parameters are unstandardized regression coefficients. Parameters with an asterisk are statistically significant at $p < .05$ level. The term β represents unstandardized regression coefficients. The term CI_{95} indicates the 95% biased corrected confidence intervals.

Figure 1. A response-surface capturing effects of prioritisation on physical activity participation.



Note: The line on the floor of the figure represents the first principal axis

Appendix (for online supplemental materials)

In this section, we aim to show that it is impossible to test the hypothesis that a 'marginally higher prioritisation strategy' is the most optimal by ways of using linear regression model. In the context of prioritisation research, the following linear regression model is used to examine effects of prioritisation on health-related behaviours such as physical activity (i.e., PA):

$$PA = b_0 + b_1I + b_2CI + b_4IxCI + e_{10} \quad (3)$$

The model underpinning Equation 3 is a linear, non-additive, model that estimates main and interactive effects of component measures of prioritisation on physical activity. We show first that this linear model does not capture effects associated with the 'marginally higher prioritisation' strategy. We achieve this by using the mean regression Equation 3 to estimate predicted levels of physical activity of hypothetical groups of individuals who endorsed: (i) an 'extremely high prioritisation' strategy, (ii) an equal prioritisation strategy and (iii) a 'marginally higher prioritisation' strategy. Assuming that component measures of prioritisation are expressed as deviations from their means on a transformed 5-point scale ranging from low (-2) to high (2), this procedure yields the following equations:

$$f(2,-2) = 2b_1 - 2b_2 + 4b_4 + b_0 \quad (3.1)$$

$$f(2,2) = 2b_1 + 2b_2 - 4b_4 + b_0 \quad (3.2)$$

$$f(2,0) = 2b_1 + b_0 \quad (3.3)$$

where f(..) is the predicted level of physical activity of individuals with a particular prioritisation profile. For example, the term f(2,0) describes the predicted level of physical activity of individuals who adopt a marginally higher prioritisation strategy that involves a strong intention (i.e., $I = +2$) and a moderate competing intention (i.e., $CI = 0$).

To show that linear models do not test the hypothesis that a 'marginally higher prioritisation' strategy is the most optimal, we assume that the predicted level of physical activity associated with this strategy is greater than the predicted level of physical activity associated with the equal prioritisation (f(2,2)) or the 'extremely high prioritisation' strategies (f(2,-2)). After solving these inequalities, this procedure yields:

$$2b_2 + 4b_4 > 0 \quad (3.4)$$

$$2b_2 + 4b_4 < 0 \quad (3.5)$$

Inequalities 3.4 and 3.5 reveal when regression coefficients support the hypothesis that the 'marginally higher prioritisation' strategy yields higher levels of physical activity than the 'extremely high' or equal prioritisation strategies. For example, Inequality 3.4 shows that the 'marginally higher prioritisation' strategy yields higher levels of physical activity than the 'extremely high prioritisation' strategy when regression coefficients satisfy the inequality: $2b_2 + 4b_4 > 0$. However, as it is shown, there is no unique set of regression coefficients that simultaneously solve Inequalities 3.4 and 3.5. This is because the sum of the main and interactive effects (i.e., $2b_2 + 4b_4$) cannot be greater and lower than zero at the same time. Hence, from an empirical standpoint, it seems pointless to use the linear model to test the hypothesis that 'marginally higher prioritisation' is the most optimal strategy. However, an analysis of the same hypothesis using the quadratic model (Equation 2) does not reveal contradictory conditions:

$$2b_2 + 4b_4 + 4b_5 < 0 \quad (2.1)$$

$$2b_2 + 4b_4 - 4b_5 > 0 \quad (2.2)$$

Inequalities 2.1 and 2.2 show that the quadratic model tests the hypothesis that the 'marginally higher prioritisation' strategy is the most optimal. For example, if the quadratic effect associated with competing intentions was negative (i.e., $b_5 = -2$), implying concave relationship with physical activity, and its absolute value was much greater than the size of the main (i.e., $b_2 = 1$) and interactive effects (i.e., $b_4 = 1$) then Inequalities 2.1 and 2.2 would be supported. In this case, the quadratic model is likely to show that 'marginally higher prioritisation' is the most optimal strategy.