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6 **How Physical Education Teachers' Interpersonal Behaviour is Related to Students' Health-**
7 **Related Quality of Life**

8

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1 **Abstract**

2 Grounded in self-determination theory (SDT), this cross-sectional study tested relations of
3 students' perceptions of autonomy-supportive and controlling behaviour from teachers in
4 physical education with students' health-related quality of life (HRQoL), and the potential role of
5 students' perceived need satisfaction and need frustration as a mediator of these relationships.
6 School students (N = 1031) completed self-report measures of perceived autonomy support,
7 perceived teachers' controlling behaviour, students' need satisfaction and need frustration, and
8 HRQoL. Results indicated that students' perceptions of autonomy support from teachers was
9 positively associated with HRQoL through need satisfaction. Students' perceptions of controlling
10 behaviour from teachers was negatively related with HRQoL through need frustration. There was
11 no significant association between autonomy support and need frustration, or between
12 controlling behaviour and need satisfaction. Findings provide evidence that perceived autonomy
13 support and controlling behaviour from the teacher in PE contributes to students' HRQoL
14 through unique pathways.

15 *Key Words:* autonomy support, controlling behaviour, psychological needs, health-related quality
16 of life.

1 **How Physical Education Teachers' Interpersonal Behaviour is Related to Students' Health-**
2 **Related Quality of Life**

3 Health-related quality of life (HRQoL) among adolescents has received increased
4 attention in the research literature on child and adolescent health given the importance of this
5 construct to overall health, psychological well-being, and optimal functioning (Bisegger et al.,
6 2005; Meade & Dowswell, 2016). HRQoL is described as “a person’s subjective evaluations of
7 the influences of their current health status, health care, and health promoting activities on their
8 ability to achieve and maintain a level of overall functioning that allows them to pursue valued
9 life goals and that is reflected in their general well-being” (Shumaker & Naughton, 1995, p. 7).
10 HRQoL has also been considered an important outcome in pediatric population health as it
11 encompasses a wide set of health concerns such as physical, social, emotional, and academic
12 functioning (Varni, Burwinkle, Seid, & Skarr, 2003). In particular, research suggests that
13 HRQoL is likely to be an important correlate of school performance (Durlak, Weissberg,
14 Dymnicki, Taylor, & Schellinger, 2011). While the primary goal of physical education (PE) is to
15 provide children with skills that improve physical literacy, skills, and competencies, an
16 increasingly important associated goal is to promote better physical and psychological health
17 and, related to this goal, better subjective well-being and quality of life. With appropriate support
18 and guidance from the PE teacher, PE can provide opportunities for students to develop
19 behaviours that promote a healthy lifestyle, experience feelings of physical and emotional well-
20 being arising from physical activity, and foster social interaction with classmates. Taken
21 together, these experiences derived from the ‘health promotion’ goal of PE are likely to result in
22 better HRQoL in students.

1 In school, teachers' behaviour is a factor that can have a considerable influence on
2 adolescents' HRQoL (Standage & Gillison, 2007; Standage, Gillison, Ntoumanis, & Treasure,
3 2012). This is based on the premise that what teachers say and do in PE lessons can have a
4 profound influence on students' motivation and other health outcomes (Reeve & Jang, 2006). In
5 particular, behaviours displayed by teachers, and students' interpretation of them, may signal
6 support for motivation toward key behaviours in PE. For example, research based on self-
7 determination theory (SDT; Deci & Ryan, 2000; Ryan & Deci, 2017), has shown that students'
8 perceptions that their teachers support their autonomy is related to their HRQoL (Koka, 2014;
9 Standage & Gillison, 2007; Standage et al., 2012). According to SDT, support for autonomy in
10 specific behavioural contexts is important because it provides students with a sense of ownership
11 and responsibility for their behaviour, and is related to engagement, interest and enjoyment in the
12 behaviour and, critically, persistence. Students' perceptions of autonomy support reflect the
13 behaviours that teachers display in lessons that support student autonomy such as conveying
14 confidence in students' ability to do well or listening to students (Reeve & Halusic, 2009).
15 Students that view their teachers as autonomy supportive are not only more likely to report better
16 HRQoL, but are also more likely to persist with behaviours that may promote better well-being
17 (e.g., Standage et al., 2012). Relations between perceived autonomy support on quality of life is
18 proposed to be attributable to psychological need satisfaction (Deci & Ryan, 2000).

19 However, it is important to note that teachers may also exhibit controlling interpersonal
20 behaviours in PE lessons. This is likely reflected in students' perceptions of their teacher as
21 controlling. Previous research has shown small-to-medium sized relations between displays of
22 autonomy-supportive and controlling behaviours by social agents operating in various contexts
23 (e.g., sport, and PE; Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-Ntoumani, 2011;

1 Tessier, Sarrazin, & Ntoumanis, 2008). This means that these types of behaviour may be
2 independent. In addition, teachers may be inconsistent in their display of these different sets of
3 teaching behaviours. For example, teachers may use autonomy-supportive behaviours such as
4 listening to students and responding to them when they express their opinion, but may also use
5 threat of punishment to keep students in line during lessons, a controlling behaviour. Recently,
6 several studies have demonstrated that students' perceptions of controlling behaviours are related
7 to their need frustration, which, in turn, are related to maladaptive outcomes like controlled
8 motivation and amotivation (Haerens, Aelterman, Vansteenkiste, Soenens, & Van Petegem,
9 2015) or anger (Hein, Koka, & Hagger, 2015). Such behaviours may, therefore, serve to
10 undermine students' autonomous motivation and well-being. However, there are no studies to
11 date that have examined the relationship between students' perceptions of their teachers'
12 controlling behaviour and their HRQoL, and whether this relationship is mediated by need
13 frustration. In the current study we aimed to fill this gap by testing whether or not relations
14 between students' perception of teachers' controlling behaviour and HRQoL is mediated by need
15 frustration. This is contrasted with the mediated relationship between students' perceptions of
16 their teachers' autonomy support and their HRQoL through need satisfaction (e.g., Koka, 2014;
17 Standage et al., 2012).

18 ***Theoretical Framework***

19 SDT has been widely used to explain the influence of social-contextual factors on human
20 psychological experiences and behaviour across multiple contexts (Deci & Ryan, 2000),
21 including educational contexts (Van de Berghe, Vansteenkiste, Cardon, Kirk, & Haerens, 2014;
22 Pihu, Hein, Koka, & Hagger, 2008). One of the most prominent sub-theories of SDT is basic
23 psychological needs theory (BPNT; Deci & Ryan, 2002). According to BPNT, humans have

1 fundamental, basic psychological needs: the need for autonomy (i.e., to feel self-determined in
2 one's actions rather than feeling controlled), the need for competence (i.e., to feel competent in
3 interactions with the environment and experience opportunities in which to express their
4 capabilities), and the need for relatedness (i.e., to feel a secure sense of belongingness and
5 connectedness to others) (Deci & Ryan, 1985, 2000; Sheldon, Elliot, Kim, & Kasser, 2001).
6 Individuals strive to satisfy three needs in their everyday actions, and fulfilment of these needs is
7 related to optimal psychological well-being (e.g., Mouratidis, Vansteenkiste, Sideridis, & Lens,
8 2011). However, if these needs are frustrated (De Meyer et al., 2014), people are more likely to
9 experience activities as controlled by external events or contingencies, and express sub-optimal
10 functioning, ill-being, and maladaptive outcomes (Bartholomew et al., 2011; De Meyer,
11 Soenens, Aelterman, De Bourdeaudhuij, & Haerens et al., 2016; Vansteenkiste & Ryan, 2013).

12 In the school context, the extent to which students perceive that their needs are satisfied
13 or frustrated is partly dependent on the interpersonal behaviours adopted by their teachers.
14 According to BPNT, teachers' behaviour can be viewed in terms of the extent to which they
15 support student autonomy and, therefore, whether their actions facilitate satisfaction of students'
16 psychological needs. Teachers behaviours can, therefore, be viewed as autonomy supportive and
17 need satisfying, or controlling and need frustrating. The concept of autonomy support is
18 characterised by authoritative agents (e.g., teachers, leaders, managers) adopting specific
19 behaviours that support and promote autonomy among the groups for whom they are responsible
20 (e.g., students, staff, employees). Autonomy-supportive behaviours include adopting the
21 perspectives and feelings of students, giving a rationale for tasks, providing choice, and
22 encouraging self-endorsed action (Deci, Eghrari, Patrick, & Leone, 1994; Jang, Reeve, & Deci,
23 2010; McLachlan & Hagger, 2010; Reeve & Jang, 2006). Optimal well-being and healthy

1 functioning are facilitated if needs for autonomy, competence, and relatedness are met within a
2 social context (Ryan & Deci, 2008). According to SDT (Ryan & Deci, 2017), autonomy-
3 supportive behaviour is particularly important because it facilitates satisfaction of all three basic
4 psychological needs. Students' perceptions of their teachers' behaviour is critical in this regard.
5 Studies have found that students that perceive their teachers displaying autonomy-supportive
6 behaviours are more likely to report adaptive affective and behavioural outcomes such as
7 concentration in the PE classes and intention to participate in optional PE (Ntoumanis, 2005),
8 physical self-esteem and effort (Hein & Caune, 2014), and also HRQoL (Koka, 2014; Standage
9 & Gillison, 2007; Standage et al., 2012). The proposed mechanism for this effect is via the
10 student's perceptions of satisfaction of psychological needs and autonomous motivation, which
11 serve to mediate effects of perceived autonomy support on outcomes.

12 Consistent with SDT, teachers may also display controlling behaviours in school lessons.
13 Controlling behaviour from teachers can be characterised by using pressuring tactics to make
14 students think, feel, or behave as required, with disregard to students' opinions and needs
15 (Reeve, 2009). Such behaviours are likely to undermine autonomous motivation and lead to
16 maladaptive outcomes such as anxiety (Assor, Kaplan, Kanat-Maymon, & Roth, 2005),
17 depersonalisation (Soenens, Sierens, Vansteenkiste, Dochy, & Goossens, 2012), oppositional
18 defiance (Haerens et al., 2015), and anger and bullying (Hein et al., 2015). The mechanism for
19 these relations is through students' perceived frustration of psychological needs and controlled
20 motivation. It is important to note that teachers' could display both controlling and autonomy-
21 supportive behaviours within a single lesson (Amoura, Berjot, Gillet, Caruana, & Finez, 2015).
22 Haerens et al. (2015) demonstrated that students' perceptions of their teachers' behaviour as
23 autonomy-supportive and controlling were related to adaptive and maladaptive motivational

1 outcomes through separate pathways. Specifically, relationships between of students' perception
2 of teachers' autonomy-supportive teaching was indirectly related to adaptive motivational
3 outcomes (i.e., autonomous motivation) in PE through need satisfaction, whereas students'
4 perception of teachers' controlling behaviour was indirectly related to maladaptive motivational
5 outcomes (i.e., controlled motivation and amotivation) in PE through need frustration. Despite
6 this evidence, there has been little attention paid to the relationship between students'
7 perceptions of their PE teachers' interpersonal behaviour (i.e., autonomy-supportive and
8 controlling behaviours) and their HRQoL.

9 *The Present Study*

10 Previous research has highlighted that the relationship between students' perception of
11 teachers' support for their autonomy on their HRQoL in PE is mediated by psychological need
12 satisfaction (Koka, 2014; Standage & Gillison, 2007; Standage et al., 2012). However, the
13 processes by which students' perception of teachers' controlling behaviour relates to students'
14 HRQoL has not been previously tested and warrants further investigation. We consider the
15 possibility that students' perception of their teachers' controlling behaviour will be negatively
16 related to their need satisfaction and HRQoL. Importantly, we aim to test the independence of
17 these two indirect effects¹. Such a test would enable us to demonstrate the pathways by which
18 students' perceptions of their teachers' autonomy-supportive and controlling behaviour in PE
19 affect their HRQoL. In the present study, in line with previous research in PE (Haerens et al.,
20 2015), we tested a model based on SDT in which students' perceptions that their teachers'

¹It is important to note that reference to indirect effects in the current study should not be taken to infer causal relations. The term used here is consistent with the analytic methods used – it is typical to refer to mediated relations between an independent variable (e.g., students' perception of their teachers' controlling behaviour) and a dependent variable (e.g., students' HRQoL) via a mediator (e.g., psychological need satisfaction) in regression or path analysis as an "indirect effect" (Hayes, 2018). Causal relations can only be inferred through the type of data used, not the analytic method.

1 autonomy-supportive and controlling behaviour was expected to be related to their HRQoL in
2 separate indirect effects. The hypothesised model is presented in Figure 1. First, we predicted
3 that students' perception of their teachers' autonomy-supportive behaviour in PE would be
4 indirectly related to their HRQoL through psychological need satisfaction (H1). Second, we
5 hypothesised that students' perception of teachers' controlling behaviour in PE would be
6 indirectly related to their HRQoL through psychological need frustration (H2). Third, we
7 predicted that teachers' autonomy-supportive behaviour would be negatively related to
8 psychological need frustration (H3), and teachers' controlling behaviour would be negatively
9 related to psychological need satisfaction (H4), consistent with previous research (Bartholomew
10 et al., 2011; Haerens et al., 2015). However, relationships H3 and H4 were expected to be less
11 pronounced than relationships H1 and H2. Finally, in line with previous studies showing that
12 motivational processes in PE are largely invariant across gender (e.g., Standage, Duda, &
13 Ntoumanis, 2005; Standage et al., 2012) and age (Wang, 2012), we expected our hypothesised
14 model also to be invariant across gender and grade groups (H5).

15 [Figure 1 near here]

16 **Method**

17 ***Participants and Procedure***

18 Participants in the current study comprised 1031 secondary school students (448 boys and
19 583 girls), aged between 12 and 15 years ($M_{age} = 13.39$; $SD = 1.02$) from the same cultural
20 group, who share a common ethnicity and language. The students were enrolled from randomly
21 selected schools in Estonia. Students participated in mandatory PE lessons twice per week.
22 Information about the survey was provided to students by their class teachers, and the survey was
23 completed via the internet with a unique url generated for each student. The purpose of the

1 research and instructions for completing the questionnaire were provided on the survey landing
2 page. Students were also informed that their responses would be confidential and anonymous and
3 were required to complete an informed consent form prior to completing the questionnaire.
4 Approval to conduct the study was received from the head-teacher and students' parents in
5 advance of data collection. The Ethical Committee of Tartu University approved the study
6 protocol.

7 *Measures*

8 *Teachers' Autonomy-Supportive Behaviour*

9 Students' perception of teachers' autonomy-supportive behaviour was measured using
10 the multidimensional perceived autonomy support scale for physical education (MD-PASS-PE;
11 Tilga, Hein, & Koka, 2017). Students were presented with a common stem: "My PE teacher...",
12 followed by the items tapping the three subscales: organisational autonomy support (e.g., "...
13 allows me to choose exercise place"), procedural autonomy support (e.g., "... explains the effect
14 of exercises"), and cognitive autonomy support (e.g., "... understands my needs"). Each subscale
15 comprised five items with responses provided on 7-point scales (1 = *strongly disagree* and 7 =
16 *strongly agree*). Previous research has supported the factor structure and reliability of the current
17 measure (Tilga et al., 2017).

18 *Teachers' Controlling Behaviour*

19 An adapted version (Hein et al., 2015) of the multidimensional controlling coach
20 behaviours scale (CCBS; Bartholomew, Ntoumanis, & Thøgersen-Ntoumani, 2010) was used to
21 measure the students' perception of the PE teachers' controlling behaviour. Students were
22 presented with a common stem: "My PE teacher...", followed by the items tapping the three
23 CCBS subscales: negative conditional regard (e.g., "... pays me less attention if I have displeased

1 him/her”), intimidation (e.g., “... uses the threat of punishment to keep me in line during
2 lesson”), and the controlling use of grades (e.g., “... promises to give me a good grade if I do
3 well”). Each subscale comprised three items with responses provided on 7-point scales (1 =
4 *strongly disagree* and 7 = *strongly agree*). Previous studies have supported the factorial validity
5 of the adapted version of the CCBS as well as the acceptable reliability of the scales (Hein et al.,
6 2015; Hein, Emeljanovas, & Mieziene, 2018).

7 *The Need Satisfaction and Need Frustration Scale*

8 Students' perceptions of need satisfaction and need frustration in PE were assessed by the
9 basic psychological need satisfaction and need frustration scale (BPNSNF; Chen et al., 2015)
10 adapted and validated for PE (Haerens et al., 2015). Each subscale comprised four items and was
11 presented with a common stem (“During the PE lesson...”) followed by the set of items: need
12 satisfaction for autonomy (e.g., “...I felt that the exercises reflect what I really want”),
13 competence (e.g., “...I felt capable at what I did”), and relatedness (e.g., “...I felt that the class
14 members I care about also cared about me”), and need frustration for autonomy (e.g., “...I felt
15 pressured to do too many exercises”), competence (e.g., “...I felt insecure about my abilities”),
16 and relatedness (e.g., “...I felt excluded from the group I want to belong to”). Participants'
17 responses were provided on 7-point scales (1 = *strongly disagree* and 7 = *strongly agree*).

18 *HRQoL*

19 Students' HRQoL was measured using an adapted, validated version (Viira & Koka,
20 2011) of the 23-item pediatric quality of life inventory 4.0 generic core scales (PedsQL™ 4.0;
21 Varni, Seid, & Kurtin, 2001). The PedsQL™ 4.0 comprises five dimensions: physical health
22 (eight items, e.g., “I have low energy”), social functioning (five items, e.g., “I have trouble
23 getting along with other kids”), emotional functioning (five items, e.g., “I feel angry”), school-

1 related functioning (three items, e.g., “I forget things”), and days missed from school due to
2 illness (two items, e.g., “I miss school because of not feeling well”). Students were asked to
3 indicate how much of a problem has this been during the past one month. Responses were
4 provided on 5-point scales (0 = *strongly disagree* and 4 = *strongly agree*). Prior to data analysis,
5 items were reverse-scored and linearly transformed to a 0 – 100 scale (0 = 100, 1 = 75, 2 = 50, 3
6 = 25, and 4 = 0). Previous studies have supported the factorial validity of PedsQL™ 4.0 as well
7 as the reliability of total score of HRQoL (e.g., Koka, 2014; Standage et al., 2012).

8 ***Data Analysis***

9 The SPSS Version 23.0 and AMOS Version 23.0 statistical packages were used to
10 analyse the data. Multiple goodness-of-fit indices suggested by Hu and Bentler (1999) were used
11 to evaluate fit of the proposed factor structure of the scales with the data. The following indices
12 were used: the comparative fit index (CFI), the Bentler–Bonett non-normed fit index (NNFI),
13 and the root mean square error of approximation (RMSEA). An acceptable fit of the data with
14 the hypothesised model is indicated by values $\geq .90$ for the CFI and NNFI, and value $\leq .08$ for
15 the RMSEA (Hu & Bentler, 1999).

16 In the first stage of our analyses, we conducted a series of separate confirmatory factor
17 analyses (CFAs) to test the adequacy of the proposed factor structure of the scales used to tap
18 study constructs. Next, composite scores for the cognitive, procedural, and organisational
19 autonomy support; negative conditional regard, controlling use of grades, and intimidation;
20 autonomy, competence, and relatedness satisfaction; autonomy, competence, and relatedness
21 frustration; physical health, social functioning, emotional functioning, school-related
22 functioning, and days missed from school due to illness constructs were calculated as the average
23 of the item scores for each scale. Latent autonomy support, controlling behaviour, need

1 satisfaction, and need frustration constructs were indicated by the three composite variables for
2 each latent construct, and the latent HRQoL construct was indicated by five composite variables
3 for the physical health, social functioning, emotional functioning, school-related functioning, and
4 days missed from school due to illness scales.

5 We followed the following procedure to test study hypotheses. First, the adequacy of data
6 fit for the measurement confirmatory factor analytic model with five latent constructs and 17
7 indicators was estimated. This step is important to ensure the discriminant validity of the study
8 measures and confirm their treatment as separate constructs in the proposed model (Anderson &
9 Gerbing, 1988; Hagger, 2014). Next, a structural equation model in which direct paths from
10 autonomy support and controlling behaviour to HRQoL, and the indirect paths from autonomy
11 support through need satisfaction to HRQoL, and from controlling behaviour through need
12 frustration to HRQoL, were estimated. We also specified the direct path from autonomy support
13 to need frustration, and from controlling behaviour to need satisfaction. In addition, the structural
14 model included correlations between autonomy support and controlling behaviour, and a
15 correlation between the disturbance terms, also known as errors in prediction, of need
16 satisfaction and need frustration. Parameter estimates and bias-corrected bootstrapped confidence
17 intervals were calculated for each of the proposed pathways consistent with recommendations
18 (Cerin & MacKinnon, 2008; Hayes & Scharkow, 2013). Finally, we tested whether or not our
19 proposed model was invariant across gender and grade following the invariance routine
20 recommended by Byrne (2010). An initial unconstrained model was compared to successive
21 constrained models to examine the equality of factor loadings, intercepts, structural paths, and
22 structural covariances across grade and gender groups. Changes in CFI and NNFI values of .01
23 or less was considered indicative of invariance of each set of parameters in the routine, as

1 suggested by Cheung and Rensvold (2002) and Widaman (1985). The data file and analysis
2 scripts are available online at <https://osf.io/fb74u/>

3 **Results**

4 *Preliminary Analysis*

5 The online survey required participants to respond to all items; thus, there was no missing
6 data. In total, 1031 participants provided complete data suitable for statistical analysis. Results of
7 a series of confirmatory factor analyses for each of the study measures demonstrated acceptable
8 goodness-of-fit statistics: MD-PASS-PE (CFI = .94; NNFI = .92; RMSEA = .08), CCBS (CFI =
9 .97; NNFI = .96; RMSEA = .06), BPNSNF (CFI = .94; NNFI = .93; RMSEA = .06), and
10 PedsQL™ 4.0 (CFI = .92; NNFI = .91; RMSEA = .05). We estimated the skewness and kurtosis
11 estimates of each item, which ranged between -2 to +2 and were considered acceptable to
12 support normal univariate distribution (George & Mallery, 2010). However, Mardia's normalised
13 coefficient value indicated deviations from multivariate normality (48.01, critical ratio = 34.13).
14 As a consequence, we used a bootstrapping procedure to provide a more accurate estimation of
15 the parameter estimates (Byrne, 2010; Preacher & Hayes, 2008). Descriptive statistics including
16 non-latent correlations among averaged scales, and Cronbach's α reliability coefficients for all
17 the scales, are presented in Table 1. Correlations among latent study variables are presented in
18 Table 2.

19 [Table 1 near here]

20 [Table 2 near here]

21 *Main Analysis*

22 An initial fit of the measurement model fell short of acceptable fit according to the
23 multiple criteria adopted: $\chi^2 = 1046.99$, $df = 109$, $p < .001$; CFI = .89; NNFI = .86; RMSEA =

1 .09. Analysis showed that items from the “social functioning” subscale of the PedsQL™ 4.0
2 inventory, and items from the relatedness need satisfaction and relatedness need frustration
3 subscales of the BPNSNF scale displayed high modification indices and high standardised
4 residual covariances ($> \pm 2$), indicating considerable redundancy across items from the measures.
5 We therefore decided to omit the “social functioning” (e.g., “Other kids do not want to be my
6 friend”) subscale from the PedsQL™ 4.0 inventory because items from this subscale overlap
7 with those from the relatedness need frustration (e.g., “During the PE lesson I had the impression
8 that the class members I spend time with disliked me”) and relatedness need satisfaction (e.g.,
9 “During the PE lesson I felt close and connected to the class members who are important to me”)
10 subscales of the BPNSNF scale (Haerens et al., 2015). In addition, the “days missed from school
11 due to illness” subscale from the PedsQL™ 4.0 inventory exhibited sub-optimal internal
12 consistency ($\alpha = .55$), so we excluded it from subsequent analyses. We also allowed the
13 “relatedness need frustration” and “relatedness need satisfaction” subscales to covary based on
14 the modification indices. As a result, the final measurement model of all five latent constructs
15 and 15 indicators yielded good fit with the data ($\chi^2 = 547.87$, $df = 79$, $p < .001$; CFI = .94; NNFI
16 = .92; RMSEA = .08; CI₉₀ RMSEA = .07-.08).

17 Results of the structural model estimated in the full sample demonstrated good fit with
18 the data ($\chi^2 = 547.87$, $df = 79$, $p < .001$; CFI = .94; NNFI = .92; RMSEA = .08; CI₉₀ RMSEA =
19 .07-.08). Factor loadings of the indicators across all latent variables in the model ranged between
20 .55 and .91. In our model (see Figure 2), direct relationships between teaching behaviours and
21 HRQoL were not significant. Relationships between teaching behaviours and the mediators (i.e.,
22 need satisfaction and need frustration), and between mediator and HRQoL are reported in Table
23 3 and are displayed in Figure 2. Table 3 also presents the point estimates as well as the bias-

1 corrected bootstrapped 95% confidence intervals for the mediated effects. The relationship
2 between perceived autonomy support and HRQoL was mediated only by need satisfaction ($\beta =$
3 $.24, p < .001$) and not by need frustration ($\beta = .00, p = .91$). The relationship between perceived
4 controlling behaviour and HRQoL, mediation occurred only through need frustration ($\beta = -.30, p$
5 $< .001$) and not through need satisfaction ($\beta = .01, p = .31$). These indirect effects resulted in
6 significant total indirect effects of perceived autonomy support ($\beta = .24, p < .01$) and controlling
7 behaviour ($\beta = -.29, p < .001$) on HRQoL. Also, a significant negative relationship between the
8 latent constructs for need satisfaction and need frustration ($\beta = -.32, p < .001$), and between the
9 latent constructs for perceived autonomy support and perceived controlling behaviour ($\beta = -.54,$
10 $p < .001$) was found. The structural model accounted for 40% of the variance in HRQoL, and
11 66% and 30% of the variance in need satisfaction and need frustration, respectively.

12 [Table 3 near here]

13 [Figure 2 near here]

14 ***Invariance Analysis***

15 We tested the measurement invariance of our model across students from grades 6 ($n =$
16 389) and 8 ($n = 322$), and across boys ($n = 448$) and girls ($n = 583$). Results for the analyses in
17 which factor loadings, intercepts, structural paths, and structural covariances were constrained to
18 be invariant across grade and gender are presented in Table 4. Results revealed that the changes
19 in CFI and NNFI were $< .01$ for each successive step in the invariance routine providing
20 evidence that each set of parameters in the routine was invariant across grade and gender.

21 [Table 4 near here]

22 **Discussion**

1 The purpose of the current study was to examine whether the perceptions of PE teachers'
2 autonomy-supportive and controlling behaviours were related to students' HRQoL in PE through
3 their respective pathways via experienced need satisfaction and need frustration. The analysis
4 revealed that students' perceptions of their teachers' autonomy-supportive and controlling
5 behaviours in lessons were associated with their HRQoL. In line with our hypothesis (H1), we
6 found a significant indirect effect of students' perceptions of their teachers' autonomy-supportive
7 behaviours on their HRQoL through need satisfaction in PE. Similarly, in line with our
8 hypothesis (H2), we found a significant indirect effect of the perceived controlling behaviour of
9 the teacher on students' HRQoL through need frustration. Our proposed model accounted for
10 substantive variance in HRQoL. The findings of the current study suggest that students' HRQoL
11 is an outcome of a "motivationally adaptive" pathway instigated by autonomy support and
12 experiences of need satisfaction (Deci & Ryan, 2000). In contrast, a controlling "motivationally
13 maladaptive" pathway also exists mediated by perceived controlling behaviours from teachers
14 (Vansteenkiste & Ryan, 2013) and experiences of need frustration (Bartholomew et al., 2011).

15 Results of the present study revealed no significant negative relationships between
16 perceived autonomy support and students' need frustration, or relationships between perceived
17 controlling behaviour and students' need satisfaction in PE, findings which were not in line with
18 hypotheses H3 and H4. These results are inconsistent with previous findings showing relations
19 between perceived teachers' behaviours and students' psychological needs in a context of PE
20 (Haerens et al., 2015). More precisely, Haerens et al. (2015) found significant negative
21 correlations between students' perceptions of their teachers' autonomy support and students'
22 need frustration, and between students' perceptions of their teachers' controlling behaviour and
23 need satisfaction. The inconsistencies across studies may be attributed to age differences in the

1 participants. Participants in Haerens et al.'s study were more than two years older than
2 participants in the current study. Older students may have more comprehensive, differentiated
3 motives for participating in PE, which may be more distinct from those of their PE teacher.
4 Nevertheless, taken together, both studies provide support for the notion that need satisfaction
5 might be the unique pathway that mediates relations between the autonomy support from the
6 teacher and PE related adaptive outcomes, and that teachers' controlling behaviour undermines
7 students' HRQoL through a separate pathway. Our findings provide insight into the potentially
8 negative relation between teachers' display of perceived controlling behaviours in PE, such as
9 negative conditional regard, intimidation, and controlling use of grades, on students' need
10 frustration and, ultimately, HRQoL (Hein et al., 2015). This finding is important for practice
11 because it suggests that interventions aimed at promoting adaptive motivational outcomes and
12 HRQoL should not only focus on promoting teachers' autonomy-supportive behaviours, but on
13 reducing the display of controlling behaviours.

14 We also found a significant negative correlation between PE teachers' perceived
15 autonomy-supportive behaviours and controlling behaviour, and between students' perceived
16 need frustration and need satisfaction. This is consistent with the same relations identified in
17 previous research (Haerens et al., 2015), although the strength of these relationships in the
18 current study was stronger. This might be the case because we used multidimensional scales to
19 assess teachers' autonomy-supportive and controlling behaviour, which encompassed more
20 aspects of teachers' behaviours, increasing precision. Also, Haerens et al. assessed students'
21 perception of their teachers' behaviour following a specific lesson, while in the current study,
22 students were asked to refer to the PE lessons in general. Focusing on a more general context
23 might allow students to recall more occasions where they interacted with their teacher. Finally,

1 the proposed model was also found to be invariant across gender and grade (H5), which indicates
2 that boys and girls, and students in grades 6 – 8, responded to the items in a similar fashion. It
3 also indicates that the pattern of relations between constructs in the proposed model is consistent
4 across gender and grade and, therefore, the relations may generalise to these age groups and
5 across boys and girls.

6 While previous studies have tested the indirect effect of perceived PE teachers' autonomy
7 support on students' HRQoL (Koka, 2014; Standage & Gillison, 2007; Standage et al., 2012), the
8 current study adds to the literature by providing the evidence that perceived teachers' controlling
9 behaviour was found to be negatively associated with students' HRQoL through psychological
10 need frustration. Based on current findings, future studies might focus on examining effects of
11 potential interventions aimed at decreasing students' perceptions of their teachers' controlling
12 behaviour. For example, it is argued by De Meyer et al. (2014) that controlling behaviour could
13 be perceived by students strongly despite the relatively infrequent use of controlling behaviour
14 by teachers. It is possible that even minimal exposure to controlling behaviour might impact
15 students' perceived need frustration and HRQoL. Therefore, one might argue that it is important
16 not only to increase teachers' autonomy-supportive behaviour but also decrease teachers'
17 controlling behaviour to minimise frustration of psychological needs. Results of the current study
18 suggest that PE teachers' behaviour with respect to increasing students' HRQoL does not involve
19 only increasing autonomy-supportive strategies, but also decreasing controlling behaviour. This
20 finding might have implications for the design of intervention programs aimed at promoting
21 adaptive outcomes in PE. Such interventions should focus on fostering teachers' autonomy-
22 supportive behaviours as well as minimising teachers' display of controlling behaviours.
23 Although there is a stipulation that autonomy-support interventions programs for PE teachers

1 should minimise controlling behaviour (Su & Reeve, 2011), little attention has been paid to this
2 aspect.

3 *Implications for Practice*

4 The perceived autonomy support construct comprised three different dimensions,
5 organisational, procedural, and cognitive (Tilga et al., 2017). Considering the importance of all
6 three dimensions and current findings, we suggest some specific implications for practising PE
7 teachers to promote HRQoL in students. First, PE teachers are encouraged to adopt
8 organisational autonomy support (e.g., allowing students to choose their sport equipment;
9 accepting students' solutions to learning exercises). This form of autonomy support has been
10 shown to be related students' feelings of autonomy need satisfaction in PE lessons (Tilga et al.,
11 2017), and may further enhance students' levels of HRQoL. Second, PE teachers are
12 recommended to display cognitive autonomy support (e.g., allowing students to express their
13 own opinions; providing responses to students when they express their opinion). This form of
14 autonomy support may facilitate students' competence need satisfaction in PE lessons (Tilga et
15 al., 2017) and their HRQoL. Third, teachers should adopt behaviours categorised as procedural
16 autonomy support (e.g., explaining the effect of exercise on health; guiding students toward
17 finding solutions to problems without directly revealing the answer) that is associated with
18 higher perception of students' feelings of relatedness and may result in higher levels of HRQoL.

19 Similar to the perceived autonomy support construct, the perceived teachers' controlling
20 behaviour construct also comprised three dimensions (Hein et al., 2015). Accordingly, some
21 specific suggestions can be provided to practising PE teachers on which behaviours should be
22 avoided in their classes so as not to diminish their students' HRQoL. PE teachers would do well
23 to avoid behaviours such as being less supportive to students when they do not perform well (i.e.,

1 negative conditional regard); shouting at students in front of others to make them comply (i.e.,
2 intimidating behaviour); and promising to give students a good grade if they behave well (i.e.,
3 controlling use of grades). Such behaviours have shown to be related to higher basic
4 psychological need thwarting in students (Hein et al., 2015), which may undermine HRQoL.

5 Drawn from the above, teachers must be aware that students' perceptions of the
6 autonomy-supportive and controlling behaviours that they display in PE lessons will be have
7 positively and negatively related, respectively, to their students' HRQoL. Moreover, teachers
8 must consider that the mechanism behind effects of teachers' autonomy-supportive and
9 controlling behaviour in PE on students' HRQoL is via the perceived satisfaction and frustration
10 of psychological needs, respectively, in the context of PE. This knowledge is important for PE
11 teachers because if they display autonomy-supportive behaviours to their students in lessons,
12 their students are likely experience higher levels of HRQoL. The mechanism behind this
13 relationship is that autonomy-supportive behaviour is likely to fulfil students' psychological
14 needs in lessons. On the other hand, if PE teachers display controlling behaviours to their
15 students, their students are likely to report lower levels of HRQoL. The process behind this
16 relationship is that controlling behaviours frustrate students' psychological needs in lessons.

17 ***Strengths and Limitations***

18 The current study used a large sample size of secondary school children and tested an a
19 priori specified model based on theory using a rigorous confirmatory approach (Hagger,
20 Gucciardi, & Chatzisarantis, 2017). However, the study is not without limitations, and these
21 should be acknowledged. First, our study was conducted on a sample of students with a
22 relatively narrow age range. Future analyses should seek to test the validity of our model in a
23 sample of students with a more diverse age range. Second, our model was tested in a sample

1 from a single cultural group. Further evidence for the validity and reliability of our proposed
2 model would be provided by testing the invariance of the model across different cultural groups
3 (c.f., Hagger, Biddle, Chow, Stambulova, & Kavussanu, 2003; Sheldon et al., 2004). Third, the
4 current study provided a cross-sectional examination of our proposed model, which is not
5 informative of the causal relations between these constructs. Longitudinal studies adopting panel
6 designs are needed to determine whether the model is consistent across time and to test
7 reciprocal effects among model constructs. Fourth, we relied exclusively on self-report measures
8 of study constructs, which has potential to introduce common method variance and may inflate
9 associations among constructs (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Future research
10 should consider alternative measures, for example, behavioural observation to provide
11 converging evidence for the proposed relationships. Another limitation is that the subscale “days
12 missed from school due to illness” from the PedsQL™ 4.0 inventory exhibited sub-optimal
13 internal consistency ($\alpha = .55$), also evident by previous studies (e.g., Reinfjell, Dishet, Veenstra,
14 & Vikan, 2006; Viira & Koka, 2011). The reason for this might be that one item (i.e., “I miss
15 school to go to the doctor or hospital”) of this subscale might not express the reason of illness for
16 the absence from school, because regular health check might also be the case for seeing the
17 doctor. Future studies should consider revising this item to provide sufficient internal
18 consistency of subscale “days missed from school due to illness”. Finally, the current model was
19 tested only in a PE context. The future studies could test whether or not our proposed model is
20 applicable to students of other subjects (e.g., math, science, humanities; Hagger, Sultan,
21 Hardcastle, & Chatzisarantis, 2015; Hagger & Hamilton, 2018; Wang, 2012), and in other
22 settings such as sport or social interactions.

23

Conclusions

1 In conclusion, current findings suggest that teachers should not only display autonomy
2 supportive behaviours in PE lessons but also minimise displays of controlling behaviours.
3 Together, these adjustments to teaching style may maximise the potential for students'
4 psychological needs to be satisfied, minimise need thwarting, and facilitate perceived HRQoL.

5 ***Disclosure Statement***

6 No potential conflict of interest was reported by the authors.

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Table 1

Descriptive Statistics and Scale Reliabilities for Study Variables

Variable	Correlation														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Cognitive autonomy support	-														
2. Procedural autonomy support	.72	-													
3. Organisational autonomy support	.80	.72	-												
4. Negative conditional regard	-.48	-.36	-.38	-											
5. Controlling use of grades	-.13	-.03	-.06	.47	-										
6. Intimidation	-.45	-.33	-.34	.61	.46	-									
7. Autonomy satisfaction	.70	.63	.66	-.37	-.05	-.32	-								
8. Competence satisfaction	.59	.53	.53	-.33	-.04	-.25	.75	-							
9. Relatedness satisfaction	.37	.33	.30	-.15	.06	-.15	.48	.48	-						
10. Autonomy frustration	-.27	-.18	-.20	.36	.33	.31	-.26	-.21	-.05	-					
11. Competence frustration	-.27	-.15	-.18	.39	.28	.30	-.27	-.40	-.17	.51	-				
12. Relatedness frustration	-.16	-.10	-.09	.26	.17	.27	-.13	-.21	-.40	.27	.53	-			
13. Physical health	.22	.17	.16	-.19	-.09	-.17	.25	.38	.23	-.20	-.43	-.34	-		
14. Emotional functioning	.22	.18	.16	-.22	-.13	-.21	.25	.33	.22	-.21	-.43	-.35	.57	-	
15. School-related functioning	.18	.12	.11	-.14	-.11	-.16	.17	.19	.24	-.09	-.26	-.25	.48	.47	-
<i>M</i>	4.85	4.93	4.29	3.39	3.47	2.34	4.35	4.91	4.90	4.18	3.46	2.63	73.08	69.99	67.21
<i>SD</i>	1.32	1.24	1.28	1.57	1.46	1.54	1.43	1.36	1.47	1.18	1.51	1.46	18.03	21.15	21.55
<i>α</i>	.86	.81	.83	.78	.71	.84	.88	.87	.88	.64	.86	.89	.81	.75	.69

Note. $N = 1031$. Bivariate correlations $|\geq .06|$ and above are significant at the $p < .05$ level; bivariate correlations $|\geq .09|$ and above are

significant at the $p < .01$ level.

Table 2

Correlations Among Latent Study Variables

Variable	Correlation			
	1	2	3	4
1. Autonomy support	-			
2. Controlling behaviour	-.54	-		
3. Need satisfaction	.81	-.41	-	
4. Need frustration	-.30	.55	-.39	-
5. HRQoL	.29	-.32	.41	-.60

Note. $N = 1031$. All the correlations are significant at the $p < .01$; HRQoL = Health-related quality of life.

Table 3

Standardised Parameter Estimates and Variability Statistics for the Multiple-Mediator Model of the Effect of Students' Perceptions of Their Teacher's Behaviour on Their HRQoL with Need Satisfaction and Frustration as Mediators

H	Independent variable	Dependent variable	Mediator(s)	β	95% CI	
					LL	UL
Direct effects						
	Perceived autonomy support	Need satisfaction	–	0.83***	0.77	0.88
	Perceived autonomy support	HRQoL	–	-0.08	-0.25	0.09
H3	Perceived autonomy support	Need frustration	–	-0.00	-0.09	0.08
H4	Perceived controlling behaviour	Need satisfaction	–	0.03	-0.03	0.10
	Perceived controlling behaviour	HRQoL	–	0.06	-0.07	0.18
	Perceived controlling behaviour	Need frustration	–	0.55***	0.45	0.64
	Need satisfaction	HRQoL	–	0.29***	0.12	0.46
	Need frustration	HRQoL	–	-0.55***	-0.65	-0.44
Indirect effects						
H1	Perceived autonomy support	HRQoL	Need satisfaction	0.24***	0.09	0.39
	Perceived autonomy support	HRQoL	Need frustration	0.00	-0.04	0.05
H2	Perceived controlling behaviour	HRQoL	Need frustration	-0.30***	-0.42	-0.22
	Perceived controlling behaviour	HRQoL	Need satisfaction	0.01	-0.01	0.04
Sum of indirect effects						
	Perceived autonomy support	HRQoL	Need satisfaction	0.24***	0.09	0.39
	Perceived controlling behaviour	HRQoL	Need frustration	-0.29***	-0.39	-0.21
			Need satisfaction			
Total effects						
	Perceived autonomy support	HRQoL		0.16**	0.06	0.25
	Perceived controlling behaviour	HRQoL		-0.23***	-0.33	-0.13

Note. ** $p < .01$; *** $p < .001$. H = Hypothesis; β = Standardised parameter estimate; HRQoL =

Health-related quality of life; 95% CI = 95% confidence intervals of parameter estimates; LL =

Lower limit of 95% CI; UL = Upper limit of 95% CI.

Table 4

The Goodness-of-Fit Indices for Structural Models and Comparisons for Multisample Structural Equation Models

Models	χ^2	df	CFI	NNFI	RMSEA	CI ₉₀ RMSEA	Δ CFI	Δ NNFI
Gender								
SEM for boys	317.204	79	.928	.905	.082	.073-.092		
SEM for girls	358.346	79	.935	.914	.078	.070-.086		
Baseline	675.563	158	.932	.910	.056	.052-.061		
FL invariant	696.980	168	.931	.913	.055	.051-.060	.001	.003
FL, intercepts invariant	736.868	183	.927	.917	.054	.050-.058	.004	.004
FL, intercepts, structural paths invariant	752.808	191	.926	.919	.053	.049-.058	.001	.002
FL, intercepts, structural paths, FV invariant	753.977	193	.926	.920	.053	.049-.057	.000	.001
Grade								
SEM for 6 th Grade students	299.390	79	.922	.896	.085	.075-.095		
SEM for 8 th Grade students	251.787	79	.931	.909	.083	.071-.094		
Baseline	551.178	158	.926	.902	.059	.054-.065		
FL invariant	564.212	168	.926	.907	.058	.052-.063	.000	.005
FL, intercepts invariant	602.871	183	.921	.910	.057	.052-.062	.005	.003
FL, intercepts, structural paths invariant	619.045	191	.920	.912	.056	.051-.061	.001	.002
FL, intercepts, structural paths, FV invariant	619.252	193	.920	.913	.056	.051-.061	.000	.001

Note. χ^2 = chi square; df = degrees of freedom; CFI = comparative fit index; NNFI = non-normed fit index; RMSEA = root mean

square error of approximation; CI₉₀RMSEA = 90% confidence intervals for the RMSEA; Δ CFI = the change in CFI; Δ NNFI = the

change in NNFI; SEM = structural equation model; FL = factor loading; FV = factor covariance.

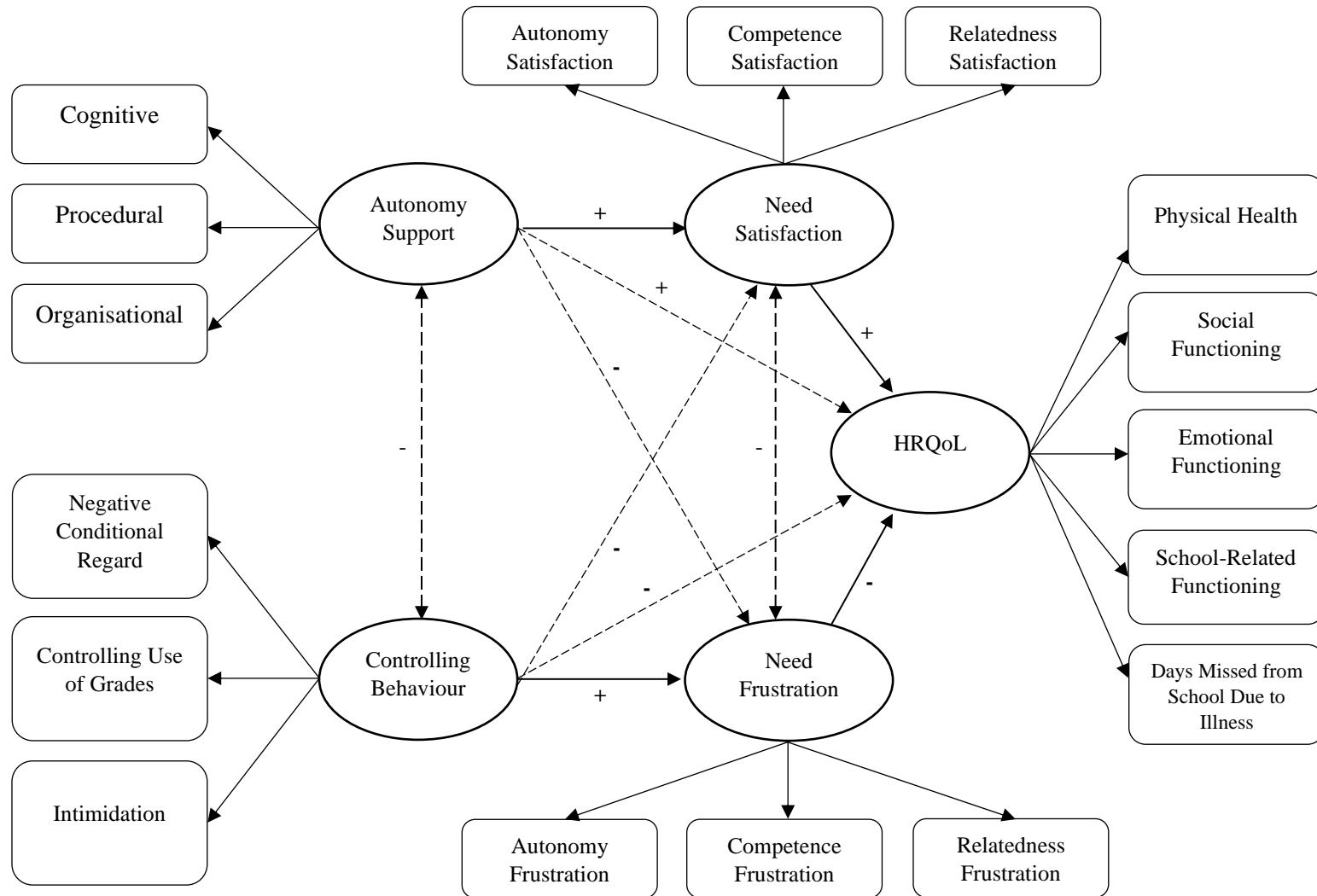


Figure 1. The hypothesised model demonstrating expected relationships. Broken lines point to paths that are set free in the test of the model. Note. HRQoL = Health-related quality of life.

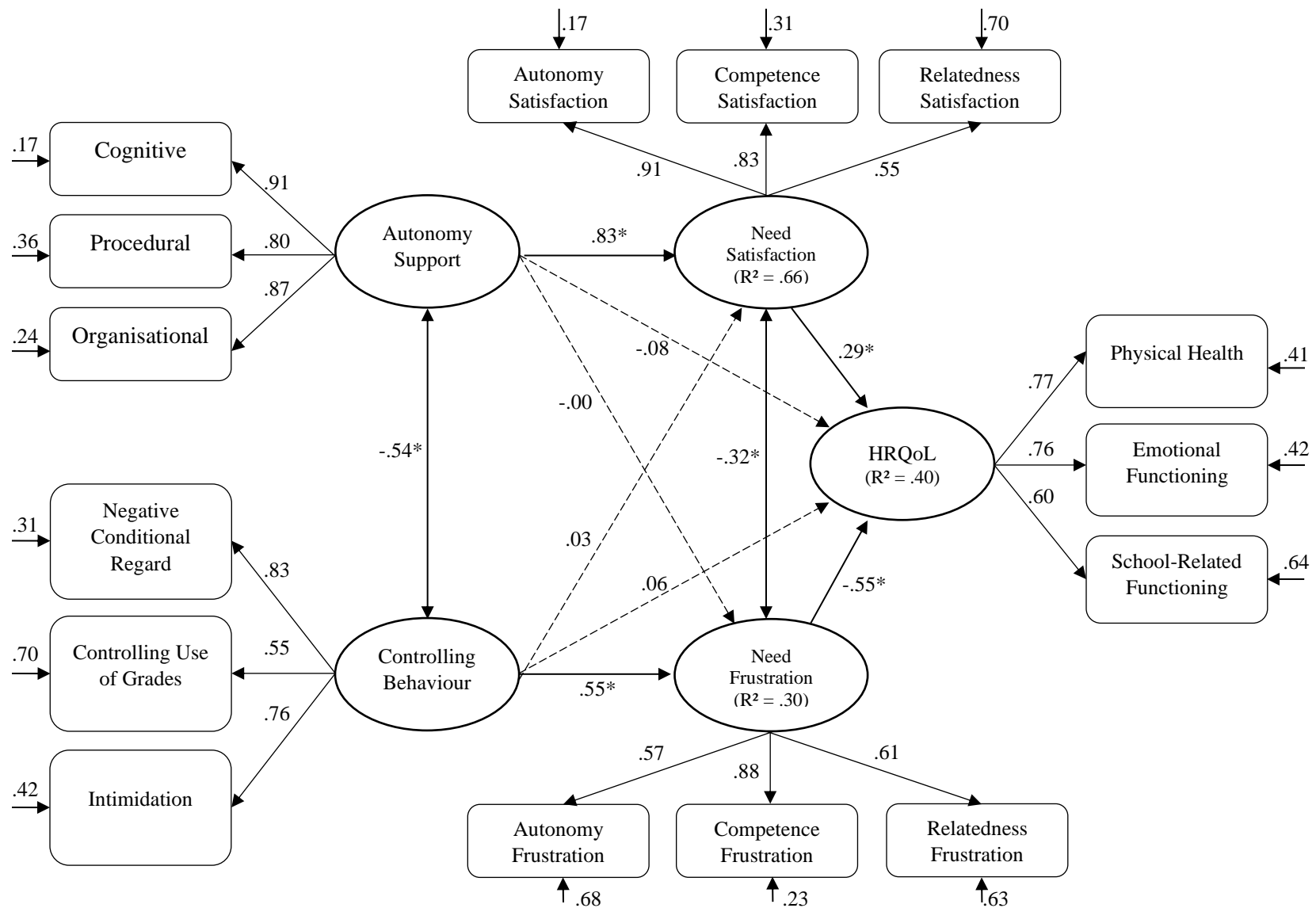


Figure 2. The structural equation model measuring the relationships from students' perceived autonomy supportive and controlling behaviour to HRQoL through need satisfaction and need frustration. Note. $*p < .001$; Broken lines represent not significant relations. HRQoL = Health-related quality of life.