Transportation Research Part F 62 (2019) 615–625

Contents lists available at ScienceDirect

Transportation Research Part F

journal homepage: www.elsevier.com/locate/trf

Understanding the motivational processes involved in adolescents' active commuting behaviour: Development and validation of the Behavioural Regulation in Active Commuting to and from School (BR-ACS) Questionnaire

Rafael Burgueño [a,*], David González-Cutre [b], Javier Sevil-Serrano [c], Manuel Herrador-Colmenero [d], José Manuel Segura-Díaz [e], Jesús Medina-Casaubón [f], Palma Chillón [e]

[a] Department of Education, University of Almeria, Almeria, Spain
[b] Department of Sport Sciences, Sport Research Center, Miguel Hernández University of Elche, Elche, Spain
[c] Faculty of Health and Sport Sciences, University of Zaragoza, Huesca, Spain
[d] PROFITH "PROmoting FITness and Health through physical activity" research group, La Inmaculada Teacher Training Centre, University of Granada, Granada, Spain
[e] PROFITH "PROmoting FITness and Health through physical activity" research group, Department of Physical Education and Sport, Faculty of Sport Sciences, University of Granada, Granada, Spain
[f] Department of Physical Education and Sport, Faculty of Sport Sciences, University of Granada, Granada, Spain

ARTICLE INFO

Article history:
Received 2 July 2018
Received in revised form 1 December 2018
Accepted 20 February 2019
Available online 4 March 2019

Keywords:
Self-determination theory
Motivation
Psychometric analysis
Active transport to school
Active travel to school
Young people

ABSTRACT

The motivational processes involving active commuting to and from school (ACS) are not yet well understood. Grounded in self-determination theory, the objective of this study was to adapt the Spanish version of the Behavioural Regulation in Exercise Questionnaire-3 to ACS, and to examine the psychometric properties of the resulting version called Behavioural Regulation in Active Commuting to and from School (BR-ACS). The participants were 404 secondary students (207 girls; M_{age} = 14.25, SD = 1.32) from different Spanish cities. The confirmatory factor analyses revealed adequate fit indices both for a six-factor structure (intrinsic motivation, integrated, identified, introjected and external regulation, and amotivation) and a hierarchical three-factor structure (autonomous, controlled motivation, and amotivation). The factor structure was invariant across gender and age. The internal consistency and temporal stability analyses showed adequate values for each factor. The binary logistic regression analysis reflected that intrinsic motivation, integrated, and identified regulation positively and significantly predicted ACS behaviour. The BR-ACS contributes to a better understanding of the motivational processes implied in adolescents' ACS behaviour.

1. Introduction

Despite numerous health benefits derived from regular physical activity, epidemiological studies reveal that the broad majority of adolescents do not meet the recommendations of daily physical activity (World Health Organization, 2017). Active commuting (i.e., mainly walk and cycling) to and from school (ACS) represents an opportunity to increase the adolescents' level

* Corresponding author at: Departamento de Educación, Facultad de Ciencias de la Educación, Universidad de Almería, Ctra. Sacramento, s/n, 04120 Almeria, Spain.
E-mail address: rbm288@ual.es (R. Burgueño).

https://doi.org/10.1016/j.trf.2019.02.016
1369-8478/

of physical activity (Martin, Kelly, Boyle, Corlett, & Reilly, 2016) and also to improve cardiorespiratory fitness and a healthier body composition (Larouche, Saunders, John-Faulkner, Colley, & Tremblay, 2014). Thus, ACS promotion has been recognised as a global health priority in children and adolescents (Villa-González, Barranco-Ruiz, Evenson, & Chillón, 2018).

In order to effectively promote ACS, there is an urgent need to identify the determinants of ACS behaviour. Consistent with the social-ecological model (Sallis, Owen, & Fotheringham, 2002), it is probably that ACS behaviour is influenced by individual, social and physical environmental, and policy factors. From an individual approach, motivation represents the individual's strength, direction, and stimuli to act (Ryan & Deci, 2017), which is a key influence on behaviour in spite of few studies have considered this variable in the analysis of ACS behaviour (Niven & Markland, 2016). While there is a wide number of psychological theories of motivation, self-determination theory (SDT; Ryan & Deci, 2017) has become progressively popular in physical activity settings, given that it provides a comprehensive explanatory framework to study antecedents and outcomes of motivation to be physically active (Teixeira, Carraça, Markland, Silva, & Ryan, 2012).

1.1. Self-determination theory

SDT is a macro-theory of human motivation that includes six mini-theories revolved around the development of autonomous motivation (Ryan & Deci, 2017). A mini-theory that considers not just the *amount* of motivation towards a target behaviour, but also the *quality* of motivation, is organismic integration theory (Ryan & Deci, 2017). This mini-theory establishes three general types of motivation (autonomous, controlled, and amotivation) that are located along a *continuum* based on their degree of self-determination, reflecting to what extent behaviour would be willingly undertaken and according to the individual's own interests (Ryan & Deci, 2017). At one end of this *continuum*, autonomous motivation stems from the inherent enjoyment, pleasure, curiosity, and seeking new challenges (intrinsic motivation), from its alignment with the person's system of values, needs, and goals constituting the "self" (integrated regulation), or from its social importance and personal values (identified regulation).

In the central part of the self-determination continuum, controlled motivation emerges from the fulfilment of internal contingencies such as the improvement of self-esteem or the avoidance of guilty (introjected regulation), or from the compliance with external demands such as obtaining rewards or avoiding punishments (external regulation). In the opposite end of the self-determination continuum, amotivation represents the full absence of self-determination or volition to engage in a target behaviour.

SDT proposes that autonomous forms of motivation are positively associated with adaptive behavioural, cognitive, and affective outcomes, while controlled forms of motivation and amotivation are positively related to maladaptive outcomes (Ryan & Deci, 2017). Previous research in physical activity settings with adolescents has shown a moderate positive association between autonomous motivation and physical activity level, and a week negative association or no association between controlled motivation or amotivation and physical activity level (McDavid, Cox, & McDonough, 2014; Owen, Smith, Lubans, Ng, & Lonsdale, 2014; Taylor, Ntoumanis, Standage, & Spray, 2010).

1.2. Measuring motivation for active commuting to school from a self-determination theory perspective

White et al. (2018) have recently developed an instrument to measure motivation in ACS with adolescents from a SDT approach. However, these authors only considered the measure of three general types of motivation (i.e., autonomous motivation, controlled motivation, and amotivation). To deeply analyse the motivational processes involving ACS behaviour, it would be needed the development of instruments aimed at measuring the six motivational regulations outlined by SDT (Ryan & Deci, 2017). To fill this gap in the literature, this study aimed to adapt and validate the Spanish version of the Behavioural Regulation in Exercise Questionnaire-3 (BREQ-3; González-Cutre, Sicilia, & Fernández, 2010) to the ACS context, in order to develop the first instrument that assesses the six behavioural regulations proposed by SDT in this context.

The BREQ-3 is the latest version of the instrument initially created by Mullan, Markland, and Ingledew (1997) to measure motivation in exercise. The first version (BREQ; Mullan et al., 1997) considered the measure of four motivational regulations (intrinsic motivation, identified, introjected, and external regulation); the second version (BREQ-2; Markland & Tobin, 2004) added the assessment of amotivation; and the BREQ-3 included integrated regulation (Wilson et al., 2006) to measure the six motivational regulations proposed by SDT. The Spanish version of BREQ-3 (González-Cutre et al., 2010) revealed appropriate fit indices for the six-factor correlated model as well as acceptable Cronbach's alpha values for each factor. Evidence supporting both the factor invariance across gender and the instrument's temporal stability were also provided.

1.3. The present study

The objective of this research was to adapt the Spanish version (González-Cutre et al., 2010) of BREQ-3 (Markland & Tobin, 2004; Wilson et al., 2006) to ACS and to examine the psychometric properties of the resulting version called Behavioural Regulation in Active Commuting to and from School (BR-ACS) questionnaire. For this aim, four steps were conducted according previous recommendations (Hair, Black, Babin, & Anderson, 2010; Sireci & Padilla, 2014). First, validity evidence based on test content (i.e., degree to which the content of a test is congruent with testing purposes) was provided via an instrument adaptation process from exercise to ACS. Second, validity evidence based on test internal structure (i.e., degree to which the relationships among test items and test components conform to the construct on which the proposed test score interpretations are

based) was given by means of two confirmatory factor analyses and two multi-group factor analyses of invariance. Third, reliability evidence (i.e., degree of consistency and stability of test scores obtained in different specific measurements over time with a same instrument) was conducted via internal consistency and temporal stability analysis. Finally, validity evidence based on relations to other variables (i.e., degree to which test scores accurately predict performance of a criterion variable) was provided by a binary logistic regression analysis. In this regression analysis, we expected that intrinsic motivation, integrated, and identified regulation would positively and moderately predict ACS, while introjected, external regulation, and amotivation would show a weak negative relation or no relation with ACS, according to the tenets outlined by SDT (Ryan & Deci, 2017) and previous research (McDavid et al., 2014; Owen et al., 2014; Taylor et al., 2010).

2. Method

2.1. Participants

The participants were 404 secondary school students (197 boys and 207 girls), aged between 12 and 19 years old (M_{age} = 14.25, SD = 1.32), from three medium- to large-sized cities of the north-east, south, and south-east of Spain. Specifically, 105, 142, and 157 students respectively participated in the study. All schools were located in urban areas and were shown to be on average of Spanish standard school. Table 1 presents the relationship between the mode of commuting to and from school and distance to school. In particular, the students (n = 280, 69.31%) commuted actively to and from school rather than passively (n = 42, 10.40%) when distance to school was under 2.00 km. However, when distance to school was over 2.00 km, the students commuted passively to and from school (n = 67, 16.58%) rather than actively (n = 15, 3.71%). To analyse the temporal stability, the measurement instrument was administered twice in a time interval of two weeks to an independent sample of 67 secondary school students (34 boys and 33 girls) between 12 and 18 years old (M_{age} = 14.06, SD = 1.79) from one of three Spanish cities that participated in the previous measurement.

2.2. Measures

2.2.1. Motivation for ACS

The adaptation of the Spanish version (González-Cutre et al., 2010) of BREQ-3 (Markland & Tobin, 2004; Wilson et al., 2006) to active commuting to and from school was used. The instrument is preceded by the following statement: "I go or would go to and from school walking or cycling because…". It consists of a total of 23 items grouped into four items per factor to measure intrinsic motivation, integrated regulation, introjected regulation, external regulation and amotivation, and three items to measure identified regulation. Each item is responded using 5-point Liker-type scales, from 0 (*not true for me*) to 4 (*very true for me*).

2.2.2. ACS behaviour

The usual mode of commuting to and from school was measured using the Spanish version developed by Chillón et al. (2017). The survey respondents were asked to select one of the six response options: walking, cycling, by car, by motorcycle, by bus, or other. In the case of "other" the respondents were required to specify the mode. According to Chillón et al. (2017), the responses were categorised as "commuters" (i.e., active commuting to and from school walking or by cycling) and "non-commuters" (i.e., non-active commuting to and from school walking or by cycling).

2.3. Procedure

The methodological proposal established by Muñiz, Elosua, and Hambleton (2013) was followed for the instrument adaptation process from exercise to ACS. Firstly, four SDT and ACS experts adapted each of the respective items composing the Spanish version of BREQ-3 to ACS. To this end, the word "exercise" was substituted by "commuting to and from school walking or by cycling". Secondly, a panel of another four SDT and ACS experts reviewed such version, verifying understanding and content validity of each item composing the instrument. Thirdly, a pilot study was carried out in a sample of secondary school students (N = 12) with the purpose of checking the correct understanding of the items and estimating an average time for the instrument administration. As a whole, the results of the instrument adaptation process provided validity evidence based on test content.

Table 1
Participants and their relation between the mode of commuting to and from school and distance to school.

(N = 404)	<0.50 km	0.50–1 km	>1–2 km	>2–3 km	>3–5 km	>5 km
Walking	105	134	38	7	5	3
Cycling	0	0	3	0	0	0
Car	1	5	19	9	7	27
Motorcycle	1	0	0	0	0	1
Bus	1	10	5	3	5	15
Others	0	0	0	0	0	0

Consecutively, the research team began the participant recruitment process. Firstly, the research group from each zone selected secondary schools through a purposeful sampling method, in accordance to its previous collaboration in other studies. Secondly, the research team contacted with the principal and physical education teacher of each school to obtain the consent. Thirdly, data collection was conducted by the authors of the present work, who explained to the students that their participation was voluntary and anonymous. Only those students who returned the written informed consent took part in this study. The research team also explained them that there were no correct and wrong responses and that we only wanted to know their opinions. Likewise, all doubts raised by the students during the questionnaire administration were resolved. The present research had the approval of the Ethics Committee of the University of Granada (number 162/CEIH/2016).

2.4. Statistical analysis

The statistical data analyses were performed with the Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, version 22.0; Armonk, NY, USA) and its extended version for the analysis of structural equation modelling AMOS (version 22.0; Armonk, NY, USA). Firstly, descriptive statistics (i.e., mean, standard deviation, skewness, kurtosis, and variance) were estimated for each item of BR-ACS. Secondly, to provide validity evidence based on the instrument's internal structure, two confirmatory factor analyses (i.e., multivariant technique to test the number of underlying dimensions and the pattern of item-to-factor relationships, Hair et al., 2010) were performed to test a six-factor correlated structure (i.e., the six different types of motivational regulation) and a three-factor higher-order model (i.e., autonomous motivation, controlled motivation, and amotivation) in accordance with the postulates of SDT (Ryan & Deci, 2017). The maximum likelihood method with the bootstrapping procedure were selected given the lack of multivariate normality (Mardia's coefficient = 213.34, $p < .01$) (Kline, 2015). This bootstrapping procedure allows to solve the violation of multivariate normality assumption through 5000 random replication samples based on the original sample (Kline, 2015). This enables to estimate the standard error and the confidence interval at 95% for each statistical parameter.

Considering the absence of an unequivocal statistical significance test to judge the goodness-of-fit of every hypothesised factor model, research suggests that the assessment of the goodness-of-fit must consider a combination of diverse indices. According to this recommendation, the following fit indices were used: the chi-square and degrees of freedom ratio (χ^2/df), the Comparative Fit Index (CFI), the Incremental Fit Index (IFI), the Tucker-Lewis Index (TLI), the Standardized Root Mean Square Residual (SRMR), the Root Mean Square Error of Approximation (RMSEA) with its confidence interval at 90% (90%CI), and the Bayesian Information Criterion (BIC). The coefficient χ^2/df is adequate with values below 3 (Kline, 2015), the incremental indices (CFI, IFI, and TLI) with values above 0.90, while the error of approximation indices are respectively adequate with values below 0.080 for SRMR and 0.070 for RMSEA (Hair et al., 2010). The BIC is a criterion used to compare rival models, according to which the model with the lowest BIC value would be the most parsimonious and, thus, preferable (Kline, 2015). The standardised regression weights are acceptable with values above 0.40 (Hair et al., 2010). The correlations between factors show an adequate conceptual discrimination with values equal to or less than 0.85 (Kline, 2015).

Thirdly, a multi-group factor analysis of invariance (i.e., multivariant technique to test whether the item characteristics are comparable across manifest groups, Hair et al., 2010) across gender and age was respectively carried out following the methodological approach outlined by Milfont and Fisher (2010). The aim of this analysis was to determine whether the instrument's factor structure was invariant across these variables. The null hypothesis of factor invariance should not be rejected in case of existing differences below 0.010 and 0.015 in CFI and RMSEA values, respectively, among the successive constrained models (Chen, 2007).

Fourthly, to provide reliability evidence, on the one hand, the internal consistency (i.e., degree to which a set of indicators of a latent variable is internally consistent in their measurement, Hair et al., 2010) was examined through the Cronbach's alpha (α) coefficient and the Raykov's composite reliability (ρ) coefficient, both suitable with values above 0.70 (Viladrich, Angulo-Brunet, & Doval, 2017). In addition, to analyse the construct reliability of the higher-order factors, the coefficient *H* by Hancock and Mueller (2001), acceptable with values above 0.70 (Viladrich et al., 2017), was estimated. On the other hand, the instrument's temporal stability (i.e., degree to which an instrument will reflect the same result in different specific measurements evaluating a characteristic psychological trait, Hair et al., 2010) was analysed via intraclass correlation coefficient (ICC) and its confidence interval at 95% (95%CI), which is appropriate with values above 0.70 (Koo & Li, 2016). Fifthly, to show validity evidence based on relations to other variables, a binary logistic regression analysis (i.e., statistical technique to test relationships between independent variables and a dependent variable that is categorised into two dimensions, Hair et al., 2010) was conducted including each motivational regulation as independent variables and the ACS behaviour as a dependent variable. This predictive model was controlled for distance to school.

3. Results

3.1. Descriptive statistics

Table 2 shows a mean score around the mid-point of the measurement scale in the items of the three forms of autonomous motivation, with a standard deviation higher than 1. Nevertheless, the mean score of the items of controlled

motivation and amotivation was low. The items of introjected and external regulation showed higher skewness and kurtosis values than the remaining items.

3.2. Confirmatory factor analysis

The confirmatory factor analysis for the six-factor correlated model (i.e., the six motivation regulations) revealed appropriate fit indices: χ^2 (215, $N = 404$) = 550.17, $p < .001$, $\chi^2/df = 2.56$; CFI = 0.93; IFI = 0.93; TLI = 0.92; SRMR = 0.050; RMSEA = 0.062 (90% CI = 0.056, 0.069); BIC = 916.26. As observed in Fig. 1, the standardised regression weights were statistically significant ($p < .001$) and ranged between 0.40 and 0.91. The correlations between factors ranged between −0.51 and 0.85, configuring a *simplex* pattern (Ryan & Connell, 1989) and supporting an acceptable conceptual discrimination between the different latent constructs.

The second confirmatory factor analysis tested a hierarchical three-factor model composed by autonomous motivation (encompassing three primary-order factors: intrinsic motivation, integrated regulation, and identified regulation), controlled motivation (encompassing two primary-order factors: introjected and external regulation), and amotivation. The model estimation obtained an acceptable fit, with values similar to the above-tested model: χ^2 (222, $N = 404$) = 559.16, $p < .001$, $\chi^2/df = 2.52$; CFI = 0.93; IFI = 0.93; TLI = 0.92; SRMR = 0.052; RMSEA = 0.061 (90% CI = 0.055, 0.068); BIC = 883.23. Fig. 2 shows the structural standardised regression weights both for autonomous motivation and for controlled motivation, which were statistically significant ($p < .001$). The correlations among factors ranged between −0.52 and 0.40.

3.3. Invariance analysis

Table 3 reflects differences in CFI and RMSEA values below 0.010 and 0.015, respectively, in each of the successive constrained models for the six-factor correlated structure. Thus, the null hypothesis of factor invariance across both gender and age cannot be respectively rejected.

Table 2
Descriptive statistics of the behavioural regulation in active commuting to and from school questionnaire (N = 404).

Items per factor	*M*	*SD*	γ_1	γ_2	σ^2
Intrinsic motivation	2.49	1.31	−0.53	−0.98	1.72
4. Porque creo que ir andando o en bici al instituto es divertido	2.39	1.47	−0.45	−1.17	2.16
12. Porque disfruto yendo andando o en bici al instituto	2.46	1.50	−0.50	−1.19	2.24
18. Porque encuentro ir andando o en bici al instituto una actividad agradable	2.52	1.46	−0.55	−1.08	2.14
22. Porque me gusta ir al instituto andando o en bici	2.60	1.50	−0.66	−1.03	2.25
Integrated regulation	1.94	1.33	0.07	0.12	1.77
5. Porque ir andando o en bici al instituto está de acuerdo con mi forma de ser	2.42	1.46	−0.43	−1.15	2.12
10. Porque considero que ir andando o en bici al instituto forma parte de mí	1.87	1.56	0.08	−1.51	2.44
15. Porque veo que ir al instituto andando o en bici es como una parte fundamental de lo que soy	1.61	1.52	0.34	−1.37	2.35
20. Porque considero que ir al instituto andando o en bici está de acuerdo con mis valores	1.88	1.53	0.05	−1.45	2.33
Identified regulation	1.99	1.25	−0.05	−1.10	1.57
3. Porque valoro los beneficios que tiene ir al instituto andando o en bici	2.24	1.51	−0.27	−1.34	2.27
9. Porque para mí es importante ir al instituto andando o en bici habitualmente	1.74	1.47	0.24	−1.29	2.15
17. Porque pienso que es importante hacer el esfuerzo de ir al instituto andando o en bici regularmente	1.98	1.53	−0.05	−1.47	2.35
Introjected regulation	0.19	0.44	3.65	8.81	0.19
2. Porque me siento culpable cuando no voy al instituto andando o en bici	0.22	0.65	3.36	1.55	0.43
8. Porque me siento avergonzado si no voy al instituto andando o en bici	0.11	0.47	5.06	8.37	0.22
16. Porque siento que he fallado cuando un día no he ido al instituto andando o en bici	0.19	0.61	3.73	4.76	0.37
21. Porque me pongo nervioso si no voy al instituto andando o en bici regularmente	0.23	0.68	3.44	2.51	0.46
External regulation	0.27	0.53	2.84	10.63	0.29
1. Porque los demás me dicen que debo ir al instituto andando o en bici	0.37	0.89	2.66	2.11	0.79
7. Porque mis amigos/familia/profesor me dicen que debo ir al instituto andando o en bici	0.40	0.93	2.47	5.44	0.86
13. Porque otras personas no estarán contentas conmigo si no voy al instituto andando o en bici	0.16	0.58	2.25	6.53	0.34
19. Porque me siento bajo la presión de mis amigos/familia de ir al instituto andando o en bici	0.16	0.53	2.96	7.12	0.28
Amotivation	0.67	0.84	1.37	1.64	0.71
6. No sé para qué me sirve ir al instituto andando o en bici	0.69	1.15	1.64	1.51	1.70
11. No sé porque tengo que molestarme en ir al instituto andando o en bici	0.96	1.39	1.20	−0.22	0.01
14. No veo el sentido de ir al instituto andando o en bici	0.60	1.09	1.75	1.50	2.08
23. Pienso que ir al instituto andando o en bici es una pérdida de tiempo	0.42	0.97	2.50	3.25	5.56

Note: γ_1 = skewness; γ_2 = kurtosis; σ^2 = variance.

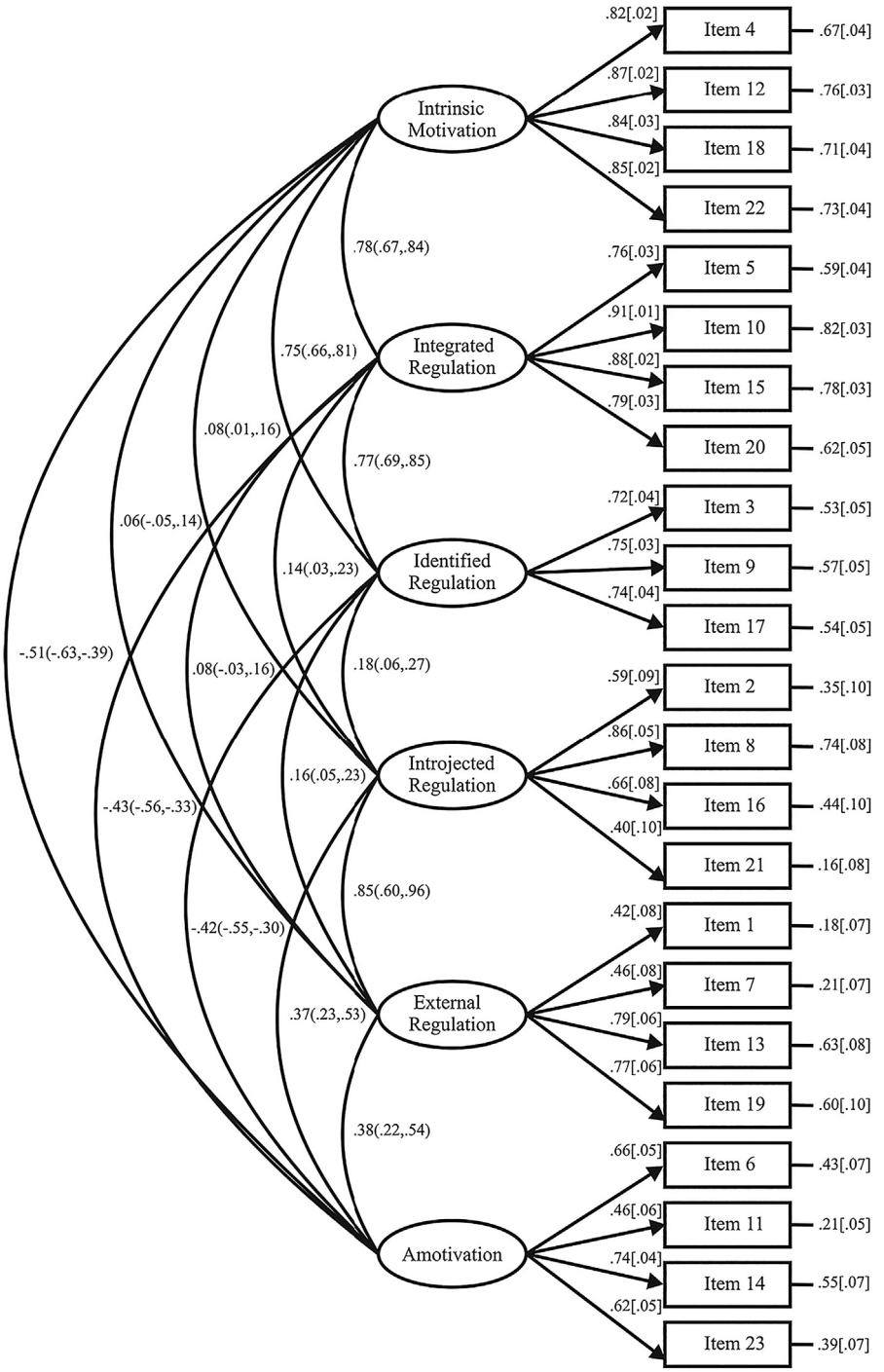

Fig. 1. Confirmatory factor analysis for the six-factor correlated model proposed for the behavioural regulation in active commuting to and from school questionnaire. *Note:* Ellipses represent the latent variables. Rectangles represent the different items. The numbers in parenthesis show the 95% confidence interval, while the numbers in square-brackets reflect the standard error, both estimated by bootstrapping.

3.4. Reliability analysis

The internal consistency analysis revealed acceptable values for intrinsic motivation ($\alpha = 0.91$, $\rho = 0.91$), integrated regulation ($\alpha = 0.90$, $\rho = 0.90$), identified regulation ($\alpha = 0.78$, $\rho = 0.78$), introjected regulation ($\alpha = 0.70$, $\rho = 0.73$), external regulation ($\alpha = 0.71$, $\rho = 0.72$), and amotivation ($\alpha = 0.70$, $\rho = 0.72$). Also, the coefficient H reflected an adequate construct reliability for autonomous motivation ($H = 0.96$) and controlled motivation ($H = 0.89$).

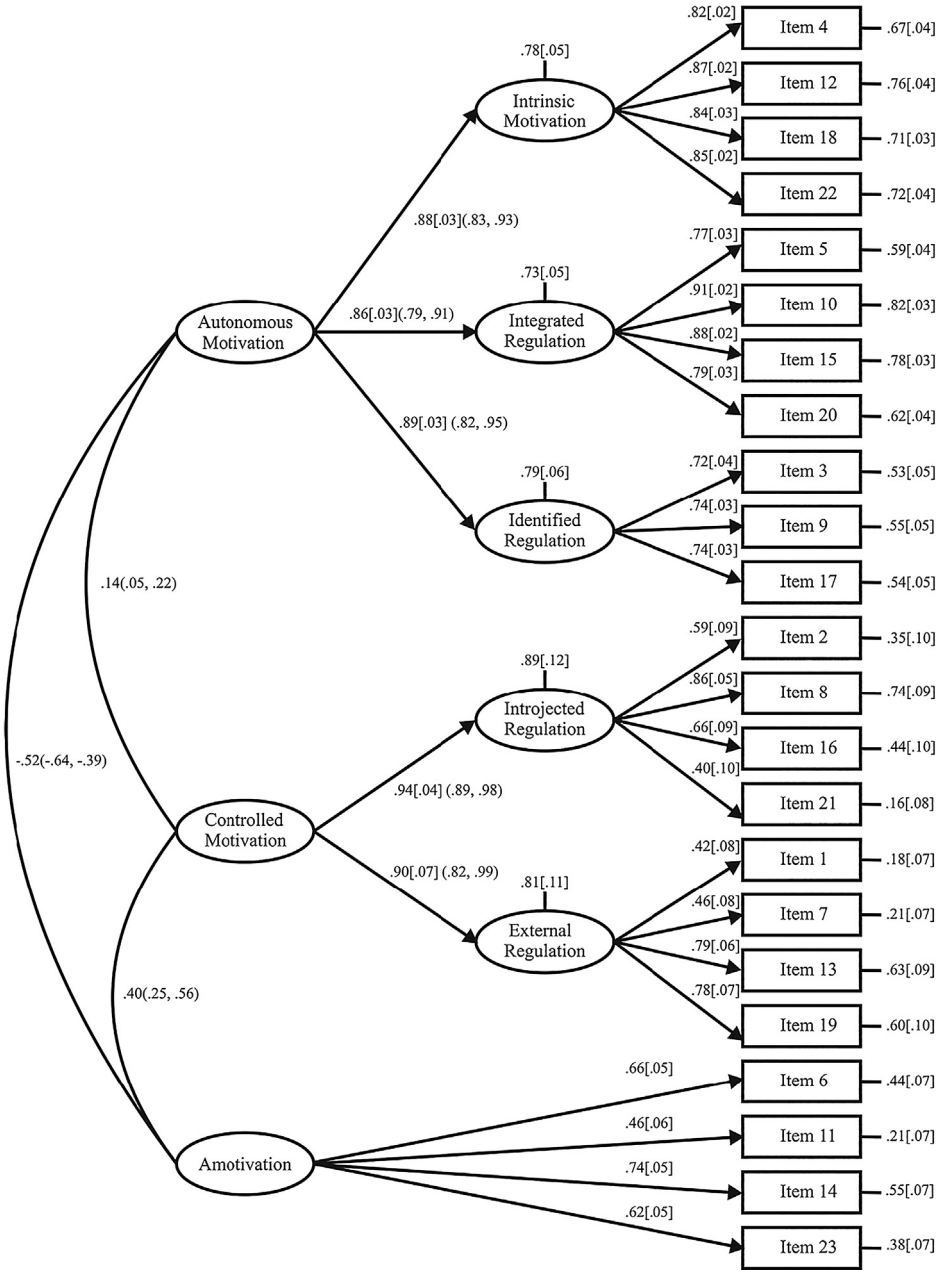

Fig. 2. Confirmatory factor analysis for the hierarchical three-factor model proposed for the behavioural regulation in active commuting to and from school questionnaire. *Note:* Ellipses represent the latent variables. Rectangles represent the different items. The numbers in parenthesis show the 95% confidence interval, while the numbers in square-brackets reflect the standard error, both estimated by bootstrapping.

The instrument's temporal stability analysis reflected an ICC value of 0.74 (95%CI = 0.60, 0.82) for intrinsic motivation, 0.71 (95%CI = 0.55, 0.81) for integrated regulation, 0.76 (95%CI = 0.61, 0.84) for identified regulation, 0.73 (95%CI = 0.57, 0.83) for introjected regulation, 0.75 (95%CI = 0.60, 0.85) for external regulation, and 0.70 (95%CI = 0.54, 0.81) for amotivation.

3.5. Binary logistic regression analysis

After controlling for distance to school, intrinsic motivation (Wald = 2.96, $p = .017$), integrated regulation (Wald = 11.08, $p = .001$), and identified regulation (Wald = 9.29, $p = .002$) positively and significantly predicted ACS behaviour (Table 4).

Table 3
Multi-group analysis of factor invariance across gender and age.

	χ^2	*df*	χ^2/df	CFI	IFI	TLI	SRMR	RMSEA (90%CI)	MC	$\Delta\chi^2$	Δdf	ΔCFI	ΔRMSEA
Invariance across gender (N = 404)													
1. Configural invariance	797.83	430	1.85	0.922	0.922	0.909	0.066	0.046 (0.041, 0.051)	–	–	–	–	–
2. Metric invariance	844.95	447	1.89	0.916	0.916	0.905	0.072	0.047 (0.042, 0.052)	2 vs. 1	47.11***	17	−0.006	0.001
3. Scalar invariance	874.65	470	1.86	0.915	0.915	0.908	0.073	0.046 (0.041, 0.051)	3 vs. 2	29.71	23	−0.001	−0.001
4. Error variance invariance	926.07	493	1.87	0.908	0.908	0.905	0.076	0.050 (0.046, 0.055)	4 vs. 3	51.42**	23	−0.007	0.004
Invariance across age (N = 404)													
1. Configural invariance	935.45	430	2.18	0.907	0.909	0.891	0.055	0.048 (0.044, 0.052)	–	–	–	–	–
2. Metric invariance	973.67	447	2.18	0.904	0.905	0.891	0.058	0.048 (0.044, 0.052)	2 vs. 1	38.23**	17	−0.003	0.000
3. Scalar invariance	1016.38	470	2.16	0.900	0.901	0.892	0.058	0.049 (0.045, 0.052)	3 vs. 2	42.71**	23	−0.004	0.001
4. Error variance invariance	1145.44	493	2.32	0.892	0.893	0.888	0.061	0.051 (0.047, 0.055)	4 vs. 3	129.06***	23	−0.008	0.002

Note: MC = Model Comparison.
* $p < .05$.
*** $p < .001$.
** $p < .01$.

Instead, neither the controlled forms of motivation (i.e., introjected and external regulation) nor amotivation significantly predicted ACS. The total variance explained was 57%.

4. Discussion

The objective of this study was to adapt the Spanish version (González-Cutre et al., 2010) of BREQ-3 (Markland & Tobin, 2004; Wilson et al., 2006) to the ACS context and to analyse its psychometric properties. The results supported the use of the Behavioural Regulation in Active Commuting to and from School (BR-ACS) questionnaire as a valid and reliable instrument to measure the six motivational regulations outlined by SDT in the ACS context with Spanish adolescents.

The results of the confirmatory factor analysis showed adequate fit indices for the 23-item six-factor correlated structure. Overall, the obtained correlations reflected a *simplex* pattern (Ryan & Connell, 1989), providing psychometric support for the presence of the self-determination *continuum* hypothesised by SDT (Ryan & Deci, 2017). This *simplex* pattern is characterised by high and positive correlations between the adjacent motivational regulations in this *continuum* and a negative correlation between the two ends. These results are in line with those obtained both in the original version of BREQ-3 (Markland & Tobin, 2004; Wilson et al., 2006) and in the Spanish version (González-Cutre et al., 2010) in an exercise setting. However, some results differ, most likely because of the peculiar features of the ACS context. Higher correlations than usual were found for the three autonomous and for the two controlled forms of motivation in this instrument. The high correlations among the forms of autonomous motivation have been found with adolescents in other instruments that measure motivation based on SDT in a physical education context (e.g., Ferriz, González-Cutre, & Sicilia, 2015; Lonsdale, Sabiston, Taylor, & Ntoumanis, 2011). These studies have already shown the difficulty of adolescents to distinguish between the activities carried out because they are important (i.e., identified regulation) and the activities carried out because they are enjoyable (i.e., intrinsic motivation). Therefore, the most noteworthy result in relation to the ACS context was the high correlation between the two

Table 4
Binary logistic regression analysis predicting active commuting to and from school from the different types of motivational regulation.

	Active commuting to and from school (N = 404)				
	B (SE)	Wald	p-value	Exp (B)	R^2
(constant)	3.82 (0.73)	27.59	<0.001	45.77	0.57
Distance to school	−1.15 (0.12)	96.43	<0.001	0.32	
Intrinsic motivation	0.57 (0.36)	2.96	0.017	1.78	
Integrated regulation	1.39 (0.42)	11.08	0.001	0.25	
Identified regulation	0.58 (0.19)	9.29	0.002	1.79	
Introjected regulation	−0.23 (0.20)	1.37	0.242	0.79	
External regulation	−0.08 (0.20)	0.13	0.723	1.07	
Amotivation	−0.12 (0.22)	0.27	0.602	0.89	

forms of controlled motivation. A possible explanation may lie in that both motivational forms obtained a very low mean score, reflecting that they are not generally present in this Spanish adolescent sample. Thus, adolescents interpret that this behaviour would be undertaken for autonomous reasons such as fun or for valuing its importance, and they do not find much difference between undertaking it for internal (introjected regulation) or external (external regulation) pressures.

Given these correlations, it is not surprising that a hierarchical three-factor structure (i.e., autonomous motivation, controlled motivation, and amotivation) was also underpinned by the results obtained in the confirmatory factor analysis, in line with the instrument developed by White et al. (2018) for ACS. Methodologically, this result could be useful when autonomous motivation, controlled motivation, and amotivation want to be considered inside a complex structural model in association with other variables. Theoretically, these results give empirical support to the three general types of motivation proposed by SDT (Ryan & Deci, 2017) taking into account their quality.

Additionally, the findings of this study provide evidence of invariance across gender and age for the six-factor correlated structure. Specifically, the results are useful since they support the use of this instrument to explore the possible differences concerning motivational regulation between boys and girls with different age in ACS. On the other hand, the internal consistency and temporal stability analyses showed acceptable values for each of the factors constituting the BR-ACS questionnaire, which is in line with those obtained in the Spanish version of BREQ-3 in the general exercise context (González-Cutre et al., 2010). It should be noted that evidence supporting the instrument's composite reliability and the construct reliability for the higher-order factors were also provided in the present study.

The results from the binary logistic regression analysis were in accordance with SDT (Ryan & Deci, 2017) and, therefore, supported validity evidence based on relations to other variables of the BR-ACS questionnaire. As expected, the autonomous forms of motivation (i.e., intrinsic motivation, integrated regulation, and identified regulation) were positively associated with ACS behaviour. These findings are consistent with a previous systematic review in adolescents which showed the positive relationship between the three autonomous forms of motivation for leisure-time physical activity and physical activity levels (Owen et al., 2014). Furthermore, the results suggest that intrinsic motivation may not be the most important predictor of ACS, indicating that it is unlikely for adolescents to commute actively to and from school just for enjoyment. Rather, developing autonomous reasons to engage adolescents in ACS behaviour seems to be a promising strategy to improve the rates of ACS. The results also showed no association of the controlled forms of motivation and amotivation with ACS. These findings are in line with previous research in adolescents, showing a weak or null prediction of these motivational regulations on physical activity behaviour (McDavid et al., 2014; Owen et al., 2014; Taylor et al., 2010). This might suggest that controlled forms of motivation do not underpin meaningful behavioural engagement of adolescents when they commute actively to and from school.

These results reflect that adolescents' motivation plays a role to consider when explaining ACS, and its measurement through this instrument should be considered together other variables that traditionally have been used to explain ACS behaviour (e.g., distance from home to school, perception of road safety, barriers to active commuting, parents' mode of commuting to their workplace). It would be fundamental to develop multicomponent school-based interventions grounded in SDT tenets, adopting a whole school approach (e.g., family, school community), to increase autonomous motivation for ACS.

Despite the results obtained, it is necessary to acknowledge that the participant sample was of convenience, preventing us from generalising our findings to the adolescents as a whole. Therefore, future studies should consider more heterogeneous samples with respect to the educational level (i.e., Primary Education or Higher Education) or cultural context in order to determine whether the factor structure of this instrument would remain invariant for such sociodemographic variables.

As a conclusion, the adaptation of BREQ-3 to the ACS context provides a new measurement instrument (i.e., the BR-ACS questionnaire) to assess the different types of motivational regulation in this context, which supposes a series of methodological, theoretical, and practical implications. With respect to methodological implications, the BR-ACS questionnaire represents the first valid and reliable instrument to measure the six different types of motivational regulation in ACS from the SDT perspective. In relation to theoretical implications, the results support the assumptions raised by SDT in ACS; the adolescents experienced adaptive behavioural outcomes when their motivation was autonomous rather than controlled or amotivated. Consequently, the assessment of the quality of motivation from an SDT perspective might help to provide a deeper understanding of the motivational processes implied in ACS behaviour in adolescents. In relation to practical implications, these findings open the way for developing potentially effective interventions, suggesting that the increase of autonomous motivation (i.e., intrinsic motivation, integrated, and identified regulation) in adolescents may improve the ACS behaviour. In this regard, the BR-ACS questionnaire could also be used to assess the effectiveness of school-active commuting interventions by monitoring possible fluctuations in the types of motivational regulation. Moreover, the BR-ACS questionnaire will also allow to analyse the predictive role of contextual factors (e.g., autonomy support for active commuting from different social agents of the school community) on motivational regulations for ACS, which the aim to adopt a whole-of-school approach to improve ACS behaviour.

Acknowledgments

This study was supported by the Spanish Ministry of Economy, Industry and Competitiveness and the European Regional Development Fund (DEP2016-75598-R, MINECO/FEDER, UE). Additionally, this study takes place thanks to funding from the University of Granada, Plan Propio de Investigación 2016, Excellence actions: Units of Excellence; Unit of Excellence on