A Cross-National Comparison of School Motivation Profiles among Canadian and Belgian Adolescents: The Role of Parenting Practices and Youth's Mental Health

Marie-Pier Petit, Ph.D. (submitting author)
Postdoctoral fellow
Département de psychologie
Université du Québec à Montréal
Montréal (Québec)
Canada
petit.marie-pier@courrier.uqam.ca ; petit.mariepier@gmail.com
ORCID 0000-0002-3514-3146

Marie-Hélène Véronneau, Ph.D. (corresponding author)
Associate Professor
Département de psychologie
Université du Québec à Montréal
Montréal (Québec)
Canada
veronneau.marie-helene@uqam.ca
ORCID 0000-0002-2670-735X

Cécile Mathys, Ph.D.
Assistant Professor
Département de criminologie
Université Liège
Liège (Wallonie)
Belgique
cecile.mathys@uliege.be
ORCID: /

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Declarations

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Conflicts of interest
On behalf of all authors, the corresponding author states that there is no conflict of interest.

Availability of data and material
The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Code availability
Not applicable.

Authors' contributions
Marie-Pier Petit conceptualized and conducted the analyses and wrote the manuscript. Marie-Hélène Véronneau directed the conception, design and data collection of the Canadian study. Cécile Mathys directed the conception, design and data collection of the Belgian study. Marie-Hélène Véronneau and Cécile Mathys reviewed and edited the manuscript, and approved the submitted version.

Ethics approval
The Canadian study was approved by the Institutional Review Board of the *Université du Québec à Montréal* (# 259_2020), and the Belgian study was approved by the ethics committee of the faculty of Psychology of the *Université de Liège* (no associated ID at the time of the data collection). The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Consent to participate
Informed consent was obtained from all individual participants included in the study. For the Canadian sample, a signed parental consent form was also required for youth's participation; in the Belgian sample, parents were informed of their child's participation through a letter, and were invited to return a form if they refused to let them participate.

Consent for publication
Not applicable; the manuscript contains no information that can personally identify an individual participant.

Abstract

The pursuit of learning in high school generally draws on multiple sources of motivation that could be affected by learning contexts and cultural values about education. We conducted this study to capture the complex interplay between various motivational regulation strategies across countries. Our goal was threefold: (1) to identify high-schoolers' motivation profiles using the seven types of regulation strategies proposed by the Self-Determination Theory; (2) to investigate the role of parenting practices and youth's mental health in predicting profile membership, and (3) to investigate whether motivation profiles and their associated predictors are replicated across two cross-national samples (435 Canadian and 414 Belgian adolescents), and across two consecutive school years. Participants completed self-report questionnaires at two time points over one year. Latent profile analysis revealed three school motivation profiles that differ on quantity and quality of motivation: *high quantity* (highest intrinsic and extrinsic, lowest amotivation)*, moderately motivated* (moderate intrinsic, high extrinsic, low amotivation) and *poor quality* (lowest intrinsic, moderately high extrinsic, highest amotivation). High levels of positive parenting practices (need support, warmth, monitoring) and low levels of externalizing behaviors predicted increased likelihood of membership in the *high quantity* than in the other two motivation profiles. The structure of the three profiles and the relationships between predictors and profile membership were generally replicated across the two samples and the two school years. The generalizability of our three-profile solution and the importance of a positive family environment and mental health in the development of school motivation in adolescence are discussed.

Keywords: Academic achievement motivation; parenting; mental health; cross cultural psychology; self-determination; high school students

A Cross-National Comparison of School Motivation Profiles among Canadian and Belgian Adolescents: The Role of Parenting Practices and Youth's Mental Health

Motivation pertaining to the school context is central to understanding adolescents' educational success, as motivation enhances the learning process and promotes positive attitudes toward school (Ryan & Deci, 2020). Motivation can be defined as a galvanizing energy, influenced by internal and external factors that arouse, direct, and sustain behavior toward attaining a goal (Greenberg & Baron, 2003). Although motivation was historically conceptualized as a unidimensional construct, theorists from the Self-Determination Theory (SDT) now agree that motivation is a complex, multidimensional and multidetermined phenomenon (Ryan & Deci, 2020).

Despite the multidimensionality of the concept, prior studies have typically examined motivation using unified scores, which may result in the loss of important information (Howard & Hoffman, 2018). Such studies fail to capture how multiple motivational dimensions work together and may present an oversimplification of motivation processes. This is a problem considering that the pursuit of a goal generally draws on multiple and simultaneous sources of motivation (Sheldon & Elliot, 1998). Consequently, Ryan and Deci (2020) encourage the use of more nuanced methods for an accurate assessment of motivation, such as person-centered approaches, instead of traditional variable-centered approaches.

Guided by SDT and using a person-centered approach, the present study aimed to capture the complex interplay between various motivational regulation strategies by mapping distinct school motivation profiles. We also tested two SDT assumptions: first, that humans have a natural and universal inclination toward intrinsic motivation, and second, that one's environment impacts the quality of motivation one develops. To do so, we sought to determine whether Canadian and Belgian high school students shared similar motivation configurations and whether profiles were replicated across school grades, using cross-national and longitudinal data. We also investigated the

role of parental practices and mental health indicators in predicting motivation profile membership.

The Self-Determination Theory

SDT proposes a model of motivation widely used in the fields of education and psychology that operates on along a continuum going from intrinsic motivation, to extrinsic motivation, and last, to amotivation (Howard et al., 2017; Ryan & Deci, 2020). At one end of the continuum, associations between intrinsic motivation and well-being or other positive school outcomes are clearly positive, while a mix of positive and negative associations are found for extrinsic motivation, and only negative associations are found between well-being and amotivation, at the other end of the continuum (Howard et al., 2021). In total, seven types of motivation are hypothesized to exist in youth along the self-determination continuum, as presented next.

In the school context, intrinsic motivation pertains to academic activities undertaken for their inherent interest, enjoyment, and satisfaction. Intrinsically motivated students act out of volition without the aid of external incentives or constraints. It is useful to differentiate between three types of intrinsic motivation, as suggested by Carbonneau et al. (2012) in their Tripartite Model of Instrinsic Motivation. *Intrinsic motivation to know* corresponds to engaging in an activity for the enjoyment derived from learning new things; in *intrinsic motivation to accomplish*, it is for the satisfaction of attempting to surpass oneself or to master a task; and *intrinsic motivation to experience stimulation* refers to the joy of the experiencing intellectual or physical stimulation.

Extrinsic motivation in the school setting refers to engaging in an academic activity as a mean to obtain a specific outcome. For youth, SDT proposes a taxonomy of three extrinsic regulatory styles differing in their levels of relative autonomy. The first type of extrinsic motivation is *identified regulation:* academic activities are fully internalized, they are performed by choice because students judge them to be important; however, they are not as enjoyable as intrinsically motivated actions. *Introjected regulation* refers to academic activities that are somewhat

internalized by the individual, but also partly controlled by the environment, including parent, teacher or peer influence. When motivation is introjected, engagement in an activity is regulated by internal rewards (e.g., ego enhancement) or punishment (e.g., avoidance of guilt, shame, failure). When experiencing *external regulation*, individuals perform academic activities to satisfy external demands (e.g., parental constraints) or to obtain external rewards (e.g., money).

The last type of motivation according to SDT is, *amotivation*, that is, the state of lacking the intention to engage in an academic activity. Amotivation could result from either a lack of self-efficacy, or a lack of value or interest.

Many studies have highlighted that intrinsic motivation is the most beneficial form of motivation, while extrinsic motivation appears to undermine well-being and adjustment (see meta-analysis by Deci et al., 1999). Yet, recent findings provided a more nuanced and complex picture. A meta-analysis (Howard et al., 2021) confirmed that intrinsic motivation was strongly associated with school success and well-being. Rather than being related only to maladaptive outcomes, extrinsic motivation yielded a mix of positive, negative and non-significant results, depending on where each extrinsic regulation fell along the continuum of internalization. Identified regulation was associated with school persistence but unrelated to well-being, while introjected regulation played a dual role due to its positive associations with school persistence and performance but also with indicators of ill-being. External regulation was associated only with decreased well-being; its associations with school persistence and performance were not significant. Last, amotivation was associated with the poorest outcomes in terms of functioning and mental health.

When examining intrinsic and extrinsic motivation in conjunction rather than in isolation, Mujtaba et al. (2018) found that both intrinsic and extrinsic motivation are related to scientific career aspirations among adolescents. Considering that learning occurs in a context involving external pressures that are likely to activate extrinsic mechanisms rather than intrinsic motivation,

such as deadlines, mandated curricula, and grading (Ryan & Deci, 2020), a combination of both intrinsic and extrinsic motivation may promote an adaptive flexibility to various contexts and learning situations. Together, these studies underscore the importance of examining the seven types of motivation simultaneously as each one predicts different mental health and school outcomes, and various motivational orientations appear to work in synergy rather than against each other.

Person-Centered Approach

Research on school motivation has been dominated by variable-centered analyses in the last decades, just like most other domains in the field of psychology. Variable-centered analyses are useful for examining each type of motivation in isolation and for identifying its specific antecedents and outcomes. However, one problem with the variable-centered approach is the assumption that the associations found between school motivation and its antecedents and outcomes apply equally to every student in the general population (Howard & Hoffman, 2018). Composite measures of motivation have been developed as a mean of incorporating various types of motivation into a single score (e.g., relative autonomy index; RAI), but such measures have been subjected to several critiques on theoretical and statistical grounds (Chemolli & Gagné, 2014; Howard, Gagné, Van den Broeck et al., 2020). One of them is that "the multidimensionality of motivation, which is one of SDT's strengths relative to other motivation theories, is sacrificed with the use of the RAI" (Chemolli & Gagné, 2014, p. 578). The authors also argue that individuals with similar RAI scores may engage in different patterns of motivational behaviors.

We thus propose that a person-centered approach would better captures the idiosyncratic variability of students' motivational processes and the multidimensionality of motivation as defined by SDT because it involves a shift in the unit of analysis from the sample to individuals. Person-centered approaches focus on particular combinations of different motivation regulations as they exist within students (Bergman & Magnusson, 1997). These techniques aim to identify clusters of

students who show similar patterns of motivation regulations and assess the adaptive value of various motivation profiles by exploring their relationships with predictors or outcomes (Howard & Hoffman, 2018). Person-centered approaches are anchored in a holistic perspective of human development, which assumes that a proper understanding of individual functioning can only be captured by recognizing that qualitatively different subgroups of individuals presenting similar characteristics exist within the population (Bergman & Magnusson, 1997). Identifying these subgroups might help better capture their specificities, propose ways to improve their achievement and well-being that are tailored to their specific needs and determine groups of students who need to be prioritized in terms of intervention.

Profiles of School Motivation among High School Students

Despite the growing use of person-centered approaches, to the best of our knowledge, no study has yet identified school motivation profiles among high school students by examining concurrently the seven types of motivation postulated by the SDT (Vallerand et al., 1989) through the use of latent profile analysis (LPA). Most studies included only a global score for intrinsic motivation and another one for extrinsic motivation, generally ignored the amotivation dimension, and used cluster analysis, which is a less robust and accurate method for identifying profiles than LPA (e.g., no fit statistics to identify the correct number of profiles, no probability-based classification to account for measurement error when relationships between profiles and external variables are investigated; Vermunt & Magidson, 2002). Findings of such studies generally converge and highlight four school motivation profiles among high school students, often labeled as follows: (1) good quality (high intrinsic motivation / low extrinsic motivation), (2) high quantity (high intrinsic and extrinsic motivation), (3) poor quality (low intrinsic motivation / high extrinsic motivation), and (4) low quantity (low intrinsic and extrinsic motivation; Corpus et al., 2016; Hayenga & Corpus, 2010; Vansteenskiste et al., 2009; Wormington et al., 2012). These profile

labels reflect the assumption that the ratio of intrinsic to extrinsic motivation, which contributes to determining the quality of motivation (Wormington et al., 2012), is at least as crucial as the overall amount of motivation.

Only a few studies examined simultaneously more than two types of motivation. First, Ratelle et al. (2007) conducted mixture modeling on two distinct samples of high school students and one sample of college students using one global score of intrinsic motivation, three types of extrinsic motivation (i.e., identified, introjected, and external regulation), and one score of amotivation. Second, Xie et al. (2020) included in a LPA one global score of intrinsic motivation and three scores of extrinsic motivation to identify school motivation profiles among a large sample of 10,597 high schoolers. Third, Litalien et al. (2019) performed LPA on undergraduates using the seven motivation subscales of the Academic Motivation Scale: three types of intrinsic motivation, three types of extrinsic motivation, and one score of amotivation (Vallerand et al., 1989).

Given that the profile labels used in these three studies are somewhat different from those adopted in previous work, the high/low quantity and the good/poor quality terminology will be used to facilitate the comparison of their results with other studies. In Ratelle et al.'s (2007) findings, three motivation profiles emerged, and they appeared to be similar across the two high school samples, although no formal similarity test of profiles was performed. The first one fitted the description of a "high quantity" profile as described in previous studies (high intrinsic and extrinsic motivation, along with low amotivation)[1]; the second profile was a new profile of moderately motivated students on both intrinsic and extrinsic motivation, along with low amotivation[2]; and the third one fitted the description of a "poor quality" profile (low intrinsic motivation but high

[1] Ratelle et al. (2007) used the label "High autonomous-controlled" for this profile.
[2] Ratelle et al. (2007) used the label "Moderate autonomous-controlled" for this profile.

extrinsic motivation and high amotivation)[3]. In their sample of college students, a "high quantity" profile also emerged, along with two other profiles that they had not found in high school participants: a "low quantity" (low intrinsic and extrinsic motivation but high amotivation) and a "good quality" profile (high intrinsic motivation and low extrinsic motivation and amotivation).

In their large sample of high school students, Xie et al. (2020) found seven motivation profiles. Four of them were similar to those identified by Ratelle et al. (2007). They found a "high quantity"[4] and a "moderately motivated" profiles that had also emerged in Ratelle's high school sample, and a "low quantity"[5] and a "good quality"[6] profiles that had emerged in Ratelle's college sample. Xie et al. (2020) also identified three unique high school motivation profiles: one appears to be a more extreme version of the "low quantity" profile and is characterized by very low levels of intrinsic and extrinsic motivation[7]. A second profile named "externally regulated" is defined by high levels of external regulation and low levels of both intrinsic motivation and other types of extrinsic motivation. Last, a third profile labelled "identified/externally regulated" is delineated by moderately high levels of identified and external regulations and low levels of introjected and intrinsic motivation. Interestingly, Xie et al. (2020) found several distinct patterns of motivation that were driven mostly by extrinsic types of motivation. This raises the question as to whether different profiles would emerge if intrinsic motivation were broken down into subtypes, as postulated by the Tripartite Model of Intrinsic Motivation (Carbonneau et al., 2012).

The study by Litalien et al. (2019) investigated this possibility in a sample of undergraduate students. Among the five motivation profiles found, two were similar to those found by Ratelle et

[3] Ratelle et al. (2007) used the label "Controlled" for this profile.
[4] Xie et al. (2020) used the label "Balanced motivated" for this profile.
[5] Xie et al. (2020) used the label "Balanced demotivated" for this profile.
[6] Xie et al. (2020) used the label "Autonomously motivated" for this profile.
[7] Xie et al. (2020) used the label "Amotivated" for this profile.

al. (2007) and Xie et al. (2020) (the "high quantity profile"[8] and the "poor quality profile"[9]), and one was comparable to the "low quantity"[10] profile found only by Xie et al. (2020). In addition, Litalien et al. (2012) found two new profiles that stood out for their diverging patterns of intrinsic motivation to know, to experience stimulation, and to accomplish. A new profile labelled "knowledge-oriented" was characterized by moderately high intrinsic motivation to know, low amotivation, and average levels on the other types of motivation. Another new profile labelled "hedonist" was characterized by moderate to very high levels of intrinsic motivation for stimulation, amotivation, and identified regulation, combined with average to low levels on the other types of motivation. This results highlights that the desire to acquire knowledge is particularly important for some students, whereas others seem to seek intellectual stimulation without finding such absorbing and stimulating experiences in school, leading them to feel amotivated.

It remains unclear whether the "knowledge-oriented" and "hedonist" profiles found among undergraduates could be extended to high school students if all three types of intrinsic motivation were considered separately (which was not the case in the studies by Ratelle et al., 2007 and by Xie et al., 2020). Undergraduate and high school students evolve in different developmental stages and educational settings, which may result in important differences in motivation profiles. Compared with most high school students, undergraduates have many more opportunities to make choices regarding their academic curriculum, and they do not have the obligation to pursue their studies (Ratelle et al., 2007). Thus, one of the goals of the current study was to test whether the "knowledge-oriented" and "hedonist" groups identified by Litalien et al. (2019) could be replicated on two samples of high school students.

[8] Litalien et al. (2019) used the label "Multifaceted" for this profile.
[9] Litalien et al. (2019) used the label "Controlled" for this profile.
[10] Litalien et al. (2019) used the label "Unmotivated" for this profile.

Universality of Motivation Profiles: Similarities across Countries and School Levels

In addition to the multidimensionality of the motivation construct, another important tenet of SDT is that human beings have an innate, natural propensity to be intrinsically motivated and to learn. SDT is presumed to apply to all individuals, regardless of their cultural background or their age (Ryan & Deci, 2020). The generalizability of SDT assumptions, especially from a cross-cultural perspective, is well supported by a large body of variable-centered studies (see Ryan & Deci, 2020 for a review), but it remains largely untested with a person-centered approach. Consequently, it is not clear whether universal school motivation profiles could be identified, or if motivation profiles are rather cultural- and age-specific.

Also, studies using a person-centered approach found differences in school motivation profiles across high school, college and undergraduate students, but it is not clear whether those changes in motivation profiles start to emerge at the end of high school, or after the transition to college. The increased freedom to choose optional courses toward the end of high school may lead to a change in motivation patterns, but this needs to be tested. Only one study has investigated this issue using a formal test of similarity (Morin et al., 2016), and found similar school motivation profiles across age of in an undergraduate sample. Further research is needed to explore developmental differences at the crucial stage of high school.

Motivation as Context-Dependent: The Role of Parental Practices and Youth's Mental Health

As important as identifying motivation profiles and testing their generalizability may be, it is also crucial to determine the conditions in which the most and the least adaptive profiles evolve. The natural propensity to develop intrinsic motivation and learn posited by SDT could be either enhanced or undermined by social and individual factors (Ryan & Deci, 2020). In line with the holistic perspective (Bergman & Magnusson, 1997), we propose that school motivation needs to be understood by examining multiple aspects of students' lives and their contribution to the formation

of motivation patterns. The current study focuses on two theoretically important areas in adolescents' lives: the parent-child relationship and youth's mental health. Specifically, we selected various parenting practices as well as mental health indicators based on their documented relationships with school motivation, their alignment with SDT, and the ease with which they can be incorporated into parenting and mental health prevention and intervention programs.

Parenting Practices and School Motivation

Parents, as first and primary socializing agents, play a fundamental role in supporting adolescents' school motivation and success. Parenting practices comprise a constellation of dynamically interrelated factors that includes need-supportive parenting as well as parental warmth/rejection and monitoring.

Need-supportive parenting refers to parenting practices that fulfill youth's basic psychological needs (i.e., autonomy, competence and relatedness), and thereby sustain their learning and intrinsic motivation (Ryan & Deci, 2020). Grolnick et al. (1997) proposed a tridimensional conceptualisation of need-supportive parenting. The first dimension is *autonomy support*. It refers to the ability of parents to guide youth's participation in learning activities without using control or pressure. The second dimension is *parental structure.* It encompasses behaviors aiming at increasing youth's competence (e.g., provision of clear expectations, non-critical feedback, and consistent limit setting). The third dimension is *interpersonal involvement*. It refers to the parents' investment of time and resources in the youth's activities, either on the emotional, cognitive or behavioral dimension (Grolnick & Slowiaczek, 1994). Need-supportive parenting practices have been associated with positive outcomes in variable-centered studies, including intrinsic motivation, academic engagement, well-being, social skills, and self-worth (Chen et al., 2019; Chirkov & Ryan, 2001; for a review, see Soenens et al., 2017). So far, partial support for the links between need-supportive parenting practices and school motivation has been found. The

above-described study by Litalien et al. (2019) showed that paternal (but not maternal) autonomy support predicted undergraduate students' membership into the high quantity profile, rather than into the hedonist profile (characterized by high levels of intrinsic motivation for intellectual stimulation but also high levels of amotivation). Surprisingly, paternal involvement was also associated with an increased likelihood of being categorized in the low quantity profile as compared to the knowledge-oriented profile.

In addition to need-supportive parenting, *parental warmth* is another important component to investigate in relation to school motivation. Parental warmth represents the quality of the affective bond between parents and their children, which is characterized by affection, nurturance, acceptance and responsiveness (Rohner et al., 2005). A warm parent-adolescent relationship provides a secure emotional context that facilitates youth's learning by increasing their self-esteem and self-efficacy, and by offering emotional safety enabling the development of their own academic interests (Hill & Wang, 2015). A large body of variable-centered studies found positive associations between parental warmth and various academic outcomes, such as intrinsic motivation, school engagement and academic achievement (Lowe & Dotterer, 2013; for a meta-analysis, see Pinquart, 2016). The above-mentioned study by Litalien et al. (2019) is the only one that has examined parental warmth as a predictor of school motivation profiles from a person-centered perspective. It showed that high levels of parental warmth increased the likelihood of membership into the "high quantity" profile and the "knowledge-oriented" profile in undergraduates.

In contrast, *parental rejection* refers to the absence of affection or the presence of physically and psychologically hurtful behaviors such as hostility, aggressiveness, indifference and neglect (Rohner et al., 2005). These negative parenting practices can have detrimental effects on youth, but little is known about their academic consequences. Extant studies suggest that negative parent-child relationships can induce stress in youth and thwart their basic psychological needs, which, in turn,

can limit students' intrinsic motivation and engagement in academic activities, and elicit several maladaptive outcomes (e.g., externalizing and internalizing behaviors, school dropout, delinquency; Soenens et al., 2017; Vansteenkiste et al., 2020).

One last crucial aspect of parenting to be considered in this study for its high salience during adolescence is *parental monitoring.* It is defined as a set of behaviors that result in parents' knowledge of their youth's activities and whereabouts (Stattin & Kerr, 2000). By structuring, guiding and tracking youth's behaviors, parental monitoring helps reduce adolescents' risky choices (e.g., substance use, affiliation with delinquent friends) that can undermine school motivation and engagement. Parental monitoring has been positively associated with intrinsic motivation and school engagement, and negatively associated with behavioral problems (Lowe & Dotterer, 2013).

To summarize, results from variable-centered studies highlight that need-supportive parenting, parental warmth, and parental monitoring appear to support positive educational outcomes. However, only partial support for these associations came out of person-centered studies conducted with undergraduates. This raises an important question: Does parental influence on adolescents' school motivation vary as a function of students' developmental stage, or else according to the operationalization of the motivation construct?

Mental Health and Motivation

Given the complexity underlying learning processes, mental health is essential for an optimal development and maintenance of school motivation. Youth with externalizing and/or internalizing problems – which are very prevalent during adolescence (Brownlie et al., 2018) – may have difficulty learning because they cannot focus in class and thus limiting their motivation for schoolwork.

Externalizing problems refer to disruptive behaviors that are difficult to reconcile with demands of a classroom and the display of a positive engagement in school. Externalizing behaviors

typically encompass attention problems as well as conduct problems such as aggressive, oppositional and defiance behaviors (Achenbach & Edelbrock, 1978). In contrast, internalizing problems are characterized by emotional or cognitive dysregulation, and generally encompass negative mood problems, including depression, anxiety and social withdrawal (Achenbach & Edelbrock, 1978). Internalizing symptoms such as decreased interest, loss of energy, diminished ability to concentrate, and social isolation (American Psychiatric Association, 2013) theoretically appear incompatible with school motivation.

Accordingly, past studies have indicated that mental health issues impair academic motivation and achievement, with externalizing symptoms generally having a stronger impact than internalizing symptoms (e.g., Olivier et al., 2020). These associations also held true for behavior problems that are closely associated with mental health, such as substance use (Staff et al., 2008).

Very few studies have examined associations between mental health and profiles of school motivation. Ratelle et al. (2007) highlighted that adolescents assigned to the profile with the highest levels of autonomous motivation reported the highest scores on school satisfaction and the lowest scores on anxiety in class. Similarly, Corpus et al. (2016) indicated that membership into their good quality (primarily intrinsic) and their high-quantity profile (high on intrinsic and extrinsic motivation) was associated with high levels of life satisfaction and low scores of sadness. However, youth in the high-quantity profile reported greater feelings of school anxiety than the primarily intrinsic profile.

The present study aims to add to this limited literature by testing whether various externalizing and internalizing behaviors can successfully predict adolescents' membership in different school motivation profiles. As suggested by Olivier et al. (2020), we used specific rather than global measures of externalizing and internalizing behaviors, as specific difficulties are likely to play distinct roles in student motivation (Caci et al., 2015).

The Current Study

The first objective of this study is to identify distinct school motivation profiles among high school students by simultaneously examining seven types of motivation, including three subtypes of intrinsic motivation and one subscale of amotivation typically ignored in prior studies. LPA was used over cluster analysis because it represents a more accurate and robust method for conducting person-centered analysis (Vermunt & Magidson, 2002). Based on previous findings, we predict three to five distinct school motivation profiles. The second objective aims to test whether various parental practices and mental health indicators identified as key in variable-centered studies of motivation can also predict profile membership. We hypothesize that high levels of need-supportive parental practices, parental warmth and monitoring, and low levels of externalizing and internalizing behaviors will be associated with motivation profiles characterized by high levels of intrinsic motivation and low levels of extrinsic motivation and amotivation. The third objective consists of investigating whether motivation profiles and their associated predictors can be replicated across two cultures (Canadian and Belgian), and across two consecutive school years, using a formal test of similarity (Morin et al., 2016). Profiles are hypothesized to be similar across Canadian and Belgian adolescents and similar across school grades.

Method

Participants

The current study relied on two samples of high school students enrolled in Grades 9 to 11 and recruited approximately during the same period (i.e., between 2012 and 2015). The first sample (blinded) was recruited in Canada (province of Québec) and consisted of 435 adolescents who attended two French-speaking public high schools located in disadvantaged neighborhoods in the suburbs of a large urban area. The Belgian sample consisted of 414 adolescents recruited from one French-speaking public high school located in a small town in the Walloon area. As detailed in

Table 1, Canadian participants were predominantly girls, White, native French speakers, with less than half of the sample living in intact families. About half of the Belgian sample was comprised of girls and the participants were predominantly born in Belgium and mostly lived in intact families. All Canadian participants were enrolled in a general high school program while more than one third of the Belgian sample attended a vocational training high school program.

The two samples were drawn from distinct longitudinal studies using different sampling intervals; however, they both provided two assessments separated by a one-year interval, which were used for the current analyses. In both cases, data were collected in the spring, at the end of each school year. The Canadian study had three yearly waves of data, and most participants had completed two consecutive time points, which were assigned to the first and second waves. For a minority of youth who had completed three yearly waves, two consecutive time points were randomly selected and allocated respectively to the first and second waves. In order to decrease risks of biases that emerge when excluding participants with incomplete data (Enders, 2010), students who participated in one single wave of data collection were retained in the study. In such cases, data from Grade 9 were allocated to the first wave of the study, data from Grade 10 were randomly assigned to either the first or the second wave, and data from Grade 11 were allocated to the second wave. For youth who had completed only Wave 1 and Wave 3, one of these time points was selected randomly. Random allocation was performed so as to obtain an identical number of participants at both waves. Thus, the first wave of data included 303 participants who attended either Grade 9 or 10 (64.4% girls; mean age: 15.82 y.o.), and the second wave of data also consisted of 303 students who attended either Grade 10 or 11 (70.0% girls; mean age: 16.94 y.o.). In total, 171 students provided valid data at both waves – thus, about 56% of the 303 participants included at each wave are the same individuals; the balance represents single-wave participants who differ between the two waves. When compared to single-wave participants, those who had completed two

waves of data were significantly older, t (301) = −2.328, $p < .05$, and they were more likely to report having a father who had attained higher education level, F (1, 231) = 6.045, $p < .05$. The two groups did not differ on gender, race/ethnicity, native language, family structure, and mother's level of education.

The Belgian study consisted of three waves of data collected at six-month intervals from which only data from Waves 1 and 3 were used to match the one-year interval. The first wave of data consisted of 369 students who attended either Grade 9 or Grade 10 (51.8% girls; mean age: 15.19 y.o.), and the second wave of data consisted of 312 participants (51.1% girls; mean age: 16.24 y.o.) who mostly attended either Grade 10 or 11, although it included a minority of students who repeated Grade 9. In total, 269 youth provided valid data at both wave, which represents about 73% of Wave 1 participants, and 86% of Wave 2 participants. Participants who took part in both waves were younger than single-wave participants, t (158.785) = 2.343, $p < .05$, but did not differ on gender, country of birth, and family structure.

Procedure

All students attending the selected grades in the participating schools were invited to take part in the study. Following each institution's ethics review board's requirements, students agreed to participate on a voluntary basis and signed a written consent form. For the Canadian sample, a signed parental consent form was also required for youth's participation; in the Belgian sample, parents were informed of their child's participation through a letter, and were invited to return a form if they refused to let them participate. Participation consisted of a self-reported questionnaire including academic, mental health, and family dimensions. Canadian participants responded to an online questionnaire that took about 75 minutes to complete, and Belgian participants filled a paper-and-pencil questionnaire that took 50 minutes to complete. For both samples and time points, data were collected in the school.

Measures

Table 2 details the measures used in the current study for each sample. All measures were assessed at both time points.

Analytic Strategy

Preliminary analyses. We conducted confirmatory factorial analyses (CFA) using the WLSMV estimator in Mplus to verify whether the seven motivation indicators should all be kept separate when estimating motivation profiles in the main analyses, or if some subscales should rather be combined. Accordingly, we compared the 7-factor model (3 intrinsic motivation [IM] subscales, 3 extrinsic motivation [EM] subscales, 1 amotivation subscale), with the 5-factor model (1 global score of IM, 3 EM subscales, 1 amotivation subscale), and the 3-factor model (1 global score of IM, 1 global score of EM, 1 amotivation subscale). Marsh et al.'s (2005) cutoff values were used to test goodness-of-fit: ≥.90 for Tucker-Lewis Index (TLI) and comparative fit index (CFI), ≤.08 for standardized root mean square residual (SRMR) and root mean square error of approximation (RMSEA), for an adequate fit.

Main analyses. To identify subgroups of high school students with different school motivation profiles, we estimated multiple latent profile analyses (LPA) models with fewer and higher numbers of latent profiles until model could not be replicated or identified. LPAs were performed independently on both Canadian and Belgian samples and on both waves to verify whether similar patterns of profiles emerged across these data sets. The first step was to identify the best fitting profile for each sample and each wave of data based on 5,000 random sets of starting values, 100 iterations per random start, and the 200 best solutions retained for final stage optimization. Then, we conducted two sets of profile comparisons: (1) across waves within a same sample using longitudinal LPAs (Morin & Litalien, 2017); and (2) across countries of a same wave using multiple group LPAs (KNOWNCLASS command in Mplus 8.4; Morin et al., 2016).

To compare similarity of profiles across waves and samples, we followed the procedure developed by Morin and colleagues (2016), consisting of testing four levels of invariance: the number of profiles (*configural similarity*), the within-profile motivation means (*structural similarity*), the within-profile motivation variances (*dispersion similarity*) as well as the relative size of profiles (*distributional similarity*). The procedure consisted in comparing models with equality constraints to previous, less restricted models. The sequence was hierarchical, meaning that the existence of one higher-level invariance implied the existence of lower-level invariances.

The next step of our analytic strategy consisted in examining whether various parenting practices and mental health indicators differed across school motivation profiles within each sample. To do so, we conducted multinomial logistic regression analyses for each of these potential predictors separately, while adjusting for several possible confounding variables (gender, age, race/ethnicity, native language, family situation, and father's and mother's level of education for the Canadian sample; gender, age, country of birth and family situation for the Belgian sample). Predictors were added to the LPA models using the 3-step approach (i.e., R3STEP command in Mplus 8.4). Unlike the traditional single-step approach, the 3-step procedure allows for the inclusion of covariates in the model without changing profile formation (Asparouhov & Muthén, 2014). For mental health indicators, which were common to the Canadian and Belgian samples, we also tested whether the relation between each variable and the school motivation profiles were similar across samples (known as *predictive similarity*). This was tested by constraining multinomial logistic regression coefficients to equality across samples (Morin et al., 2016), while adjusting for common confounding variables (i.e., gender, age, family situation).

Missing data on school motivation indicators were handled with full information maximum likelihood (FIML) implemented in Mplus 8.4, while missing data on potential predictors and confounding variables were handled with multiple imputation. Thirty imputed data sets were

produced for each sample.

Results

Preliminary Analyses

Results from CFAs indicated that as compared with the 3-factors and 5-factor models, the 7-factor model best represented data gathered from the Academic Motivation Scale (Vallerand et al., 1989) for both samples at both waves, meaning that the seven motivational indicators need to be used separately in further LPAs. All fit indices for the 7-factor model were satisfactory in both samples and both waves according to Marsh et al.'s (2005) recommendations (CFI > .948; TLI > .940; RMSEA < .064; SRMR < .065; see supplemental Table S1), and the 7-factor model also had the highest standardized factor loadings on average (see supplemental Table S2). Chi-square difference tests using the DIFFTEST command in Mplus 8.4 also supported the 7-factor structure over the 5-factor structure (Canada-T1: $\Delta \chi^2 (11) = 132.25$, $p < .001$; Canada-T2: $\Delta \chi^2 (11) = 198.21$, $p < .001$; Belgium-T1: $\Delta \chi^2 (11) = 173.56$, $p < .001$; Belgium-T2: $\Delta \chi^2 (11) = 149.55$, $p < .001$). The 3-factor model had the lowest goodness-of-fit indices, as shown in Tables S1 and S2.

Number of School Motivation Profiles

LPAs suggested that school motivation among high school students was optimally represented by a 3-profile solution for each sample at both time points. To reach this conclusion, we compared competing models based on their statistical adequacy, the theoretical meaningfulness and interpretability of profiles, and the sample size of the smallest profile until model nonidentification / nonreplication was achieved (Marsh et al., 2009).

Statistical adequacy was assessed through the examination of five goodness-of-fit indicators: three information criteria (i.e., Bayesian Information Criterion [BIC], Sample-size Adjusted BIC [SABIC], Akaike Information Criterion [AIC]) and two likelihood ratio tests (i.e., adjusted Luo-Mendell-Rubin [aLMR-LRT], Bayesian LRT [BLRT]). All three information criteria, whose lower

values are indicative of better fit and model parsimony, kept on decreasing in both samples and time points without reaching a minimum (see supplemental Tables S3-S4). In such a situation, it is recommended to look for the last relatively large decrease in information criteria values using elbow plots (Nylund et al., 2007), which occurred around the three-profile model in all subsamples for the BIC values while the optimal number of profiles was less clear for the SABIC and AIC values (see supplemental Figures S1-S4). BIC was favored because it is the most commonly used and trusted fit index for model comparison (Nylund et al., 2007).

With respect to likelihood ratio tests, only the aLMR-LRT was used to guide our decision; BLRT was uninformative given that its *p*-values remained significant for all models. Results of the aLMR-LRT indicated that the first nonsignificant *p*-value mostly occurred with the four-profile solution, suggesting no improvement in model fit relative to the three-profile model; consequently, the latter should be favored. We found that the aLMR-LRT pointed to the four-profile model for the first wave of Canadian sample, and to the two-profile model for the second wave of Belgian sample. Yet, these models were discarded because the four-profile model only added a profile not sufficiently different from the three other profiles and was too small ($n = 25$) to conduct post-hoc analyses (as considered by the authors because there is no formal criteria) while the two-profile model did not take into account a well-defined and distinct profile. All of the final 3-profile solutions displayed high entropy values (>.76; Wang et al., 2017) and average class assignment probabilities close to 1 (the highest possible value), indicating great classification accuracy and profile separation. The pairwise correlations between motivation indicators are reported for each sample and each time points in supplemental Tables S5-S6).

Profile Similarity across School Levels and Countries

Profile Similarity across School Levels

Our test of longitudinal profile similarity in the Canadian sample revealed that the 3-profile

models were similar across both time points, in terms of the number of profiles (*configural similarity*), the means of motivational indicators (*structural similarity*), and the relative size of profiles (*distributional similarity*). However, variances differed for one out of the three profiles (*partial dispersion similarity*). In the Belgian sample, similarity was observed between Wave 1 and Wave 2 on all of the four criteria assessed.

Supplemental Table S7 reports goodness-of-fit indices of between-wave profile comparisons for both samples. As recommended by Morin and colleagues (2016), lower values on at least two out of the three information criteria (i.e., BIC, SABIC, AIC) suggest that the inclusion of equality constraints improves data fit. First, we ran an unconstrained longitudinal LPA model (i.e. *configural similarity*) separately for each sample. For the Belgian sample, indicators' means and variances were both freely estimated across profiles. For the Canadian sample, however, variance indicators could not be freely estimated across profiles because such models did not converge, which suggests overparameterization and the need to rely on more parsimonious models (Bauer & Curran, 2004). Consequently, we constrained Canada indicators' variance to be equal across each motivational profile for the configural, structural, dispersion, and distributional models. As a second step, indicators' means were constrained to be equal across waves, resulting in a decrease of most indicators' values in both samples, which supported structural similarity. From this model, we added equality constraints for indicators' variances. This resulted in an increase of most indicators' values for the Canadian sample, and a decrease of most indicators' values for the Belgian sample. Thus, dispersion similarity was supported only for the Belgian sample. For the Canadian sample, we tested a model of partial dispersion similarity by constraining indicators' variances for only two out of the three profiles. The adequacy of this model was supported, as indicated by the lower values of all indicators relative to the structural model. Finally, from the partial dispersion similarity model for the Canadian sample, and the dispersion similarity model for the Belgian sample, the size

of the three profiles were constrained to be equal across waves, leading to lower values on all indicators in both samples, which indicated distributional similarity.

Profile Similarity across Countries

Goodness-of-fit indicators resulting from tests of profile similarity between the Canadian and Belgian samples are reported in Table 3. In both waves, indicators' means, but not variances, were freely estimated to ensure model convergence. Results showed that the number of profiles was similar between the Canadian and Belgian samples at both time points, but their indicators' means and variances were partially similar while the relative size of profiles differed. In fact, constraining indicators' mean to be equal across the Canadian and Belgian samples led to higher values on most indicators compared to the unconstrained model, suggesting that the Canadian and Belgian profile structures may not be completely invariant. Then, a model of partial structural similarity with equality constraints imposed on indicators' mean of two out of three profiles was tested. Compared to the unconstrained model, a decrease in most indicator values was observed on first-wave data while on second-wave data, most indicator values increased. This suggests that the structure of two profiles were equivalent at Wave 1 but not at Wave 2. For the second wave of data, a second model of partial structural similarity was estimated with indicators' mean of one profile constrained to be equal between both samples. Lower values on all indicators were observed relative to the unconstrained model, which indicated that the structure of one profile is equivalent across the Canadian and Belgian samples at Wave 2. To the partial structural similarity models, we added equality constraints onto indicators' variances for the two equivalent profiles in Wave 1, and the one equivalent profile in Wave 2. This model resulted in lower values for all fit indices at both time points, which supported the partial dispersion similarity. From the two partial dispersion similarity models, we constrained profile sizes to be equal across the Canadian and Belgian samples. An increase in all indicators' values was observed, indicating that profile sizes differed across samples

at both waves. Consequently, the partial dispersion similarity models were used for further profile interpretation and tests of predictive similarity.

Description of School Motivation Profiles

Results from the partial dispersion similarity models comparing Canadian and Belgian profiles at each wave are depicted in Figure 1. Even though differences were observed in one profile at Wave 1 and in two profiles at Wave 2, variations were negligible and did not affect profile interpretation. Thus, we consider that the three profiles described below are applicable to both samples and waves. Profiles were named according to the quantity and quality of motivation displayed across subscales, based on the ratio of intrinsic to extrinsic motivation. The first profile, named *poor quality*, had the lowest levels on each intrinsic motivation indicators as well as the highest level of amotivation among the three profiles. Like the two other profiles, levels of identified extrinsic motivation and external regulation were relatively high among the *poor quality* profile—although these levels were still lower than it was in the other two profiles. It is noteworthy, however, that levels of introjected extrinsic motivation were clearly lower compared to the other profiles. The *poor quality* profile represented the smallest profile in the Canadian sample at Waves 1 and 2 (17.0% and 18.6% of the sample, respectively). In contrast, it was the second largest profile at Wave 1 (32.9%) and the largest profile at Wave 2 (37.9%) among the Belgian sample—although its size at Wave 2 was nearly equivalent to the *moderately motivated* profile (37.2%), which is discussed next.

The second profile, named *moderately motivated*, exhibited higher levels of intrinsic and extrinsic motivation compared to the *poor quality* profile on each of their respective indicators, as well as a lower level of amotivation. Participants assigned to the *moderately motivated* profile formed the largest group in both samples and waves (45.3-53.9%), with some nuance for the second wave of data in the Belgian sample, wherein this group was equivalent in size to the *poor quality*

profile (as mentioned above). The third profile, named *high quantity*, presented the highest levels on all intrinsic and extrinsic indicators as well as the lowest level of amotivation. The *high quantity* profile formed the second highest proportion of the Canadian participants (29.5-37.7%) and the lowest proportion of the Belgian participants (13.7-25.0%), at both waves. Across all profiles, extrinsic motivation tended to be higher than intrinsic motivation, while amotivation was the lowest, except for the *poor quality* profile whose level of amotivation was similar to, or even higher than intrinsic motivation.

Parenting Practices and Mental Health Indicators as Predictors of Profile Membership

Table 4 reports regression coefficients of concurrent profile membership predictors in both samples and waves. Results revealed that most parenting practices and mental health indicators predicted concurrent profile membership, even after adjusting for several sociodemographic variables. In fact, parental monitoring, parental warmth / affection, rule-breaking and aggressive behaviors, and attention problems were associated with Canadian participants' profile membership at both waves. In addition, withdrawal was associated with Canadian participants' profile membership, but only at the first wave.

Similarly, in the Belgian sample, all three need-supportive parenting practices as well as rule-breaking behaviors, aggressive behaviors, and attention problems were associated with concurrent profile membership in both waves.

Globally, higher levels of psychological adjustment and family functioning increased the likelihood of being assigned to the *high quantity* profile compared to at least one of the two other profiles. Conversely, youth reporting lower levels of need-supportive practices and monitoring behavior from their parents, and those who presented higher levels of psychological maladjustment and risk factors (i.e., rule-breaking and aggressive behaviors, attention problems, withdrawal) were more likely to belong to the *poor quality* profile compared to at least one of the two other profiles.

Predictive Similarity of Mental Health Indicators across Countries

For mental health indicators, which were measured in both across samples, tests of predictive similarity were performed for each wave of data. Goodness-of-fit indicators resulting from these tests are detailed in Table 5. Starting from the model of partial dispersion similarity specific to each wave (see Table 3, bolded lines), we first tested a model in which the relation between each predictor and profile membership was estimated freely across the Canadian and Belgian samples, controlling for common sociodemographic variables (i.e., gender, age, family structure). Then, this model was compared to one in which the associations of predictors and control variables with profile membership was constrained to be equal across samples. Results showed that associations between profile membership and aggressive behavior, attention problems, anxiety / depression, and withdrawal were similar for the Canadian and Belgian samples at both waves, as evidenced by lower values on at least two information criteria indicators found for the invariant model. Similarly, the relation between profile membership and rule-breaking behavior differed across samples but only for the first wave.

Discussion

Our study is unique for several reasons. To our knowledge, this is the first time that latent school motivation profiles were investigated in high school students using all seven types of motivation from the Academic Motivation Scale (Vallerand et al., 1989). Second, we identified reliable predictors of motivation profiles in two important areas of adolescents' lives—parent-child relationship and mental health using several complementary. Last, we were able to replicate the motivation profiles and their associated predictors across a Canadian and a Belgian sample of high-schoolers, and across two consecutive school years.

Patterns of School Motivation Profiles

In line with other person-centered studies, the current study highlights that high school

students are simultaneously motivated by several types of intrinsic and extrinsic regulations (Ratelle et al., 2007; Litalien et al., 2019; Vansteenkiste et al., 2009; Wormington et al., 2012; Xie et al., 2020). In our findings, patterns of school motivation could be captured by three profiles. Two of them differ mostly quantitatively: the *high quantity* profile, which displays high levels of both intrinsic and extrinsic motivation along with the lowest amotivation, and the *moderately motivated* profile, which is characterized by moderate levels of intrinsic motivation along with relatively high extrinsic regulation and relatively low amotivation. The third profile differs mostly qualitatively. The *poor quality* profile is an unbalanced pattern of low intrinsic and introjected motivation, and moderately high identified and external regulations as well as amotivation.

It is noteworthy that the three profiles we found were consistent with those reported by Ratelle et al. (2007) whose study was conducted among a similar population (two other Canadian high school student samples), used the same analytical strategy (LPA) and the same motivation measure (Academic Motivation Scale [AMS], Vallerand et al., 1989), but only a global score of intrinsic motivation instead of three subtypes like us. On one hand, the present study enables us to show the robustness of this three-profile solution across contexts and populations. Our study extends prior findings by showing that, within each profile, acquiring new knowledge and surpassing oneself was more important in the pursuit of high school studies than being stimulated at school (see Figure 1). On the other hand, the similarity of the profile structure between the 7- and the 5-indicators models indicates that the use of only one global score of intrinsic motivation seems sufficient to delineate correctly high school motivation profiles.

A *high quantity* profile (high on all intrinsic and extrinsic motivations) has been identified in all person-oriented studies we found on school motivation, regardless of the school level (high school, college, undergraduate), the analytical strategy used (cluster analysis, traditional LPA, bifactor modelling), the number of motivation indicators included (from 2 to 7), and the motivation

measure used (AMS, Academic Self-Regulation Scale). Consequently, this could be considered a "core" students' profile that occurs in a plethora of contexts and populations (Howard et al., 2016). In contrast, the *moderately motivated* and the *poor quality* profiles can be considered "peripheral" profiles (Howard et al., 2016), meaning that they occur in more limited contexts. These two profiles have only been identified in studies conducted among high school students, using traditional LPA and the AMS as the motivation measure (Ratelle et al., 2007; Xie et al., 2020). Although motivation profiles similar to the *poor quality* profile we found have been previously identified in both high school and undergraduate students (Litalien et al., 2019; Vansteenkiste et al., 2009; Wormington et al., 2012), the *poor quality* profile from the current study has the particularity of having high levels of identified and external regulation but low levels of introjected regulation. This may reflect a developmental particularity: high school students may have not the ability to pressure themselves toward learning when they are not intrinsically motivated. This could also be a methodological artifact due to the use of different motivation measures: all of the studies which have found the *poor quality* profile have used the AMS measure (Vallerand et al., 1989). It has been argued that the introjected items from the AMS represent more intrinsic than extrinsic motivations (Wormington et al., 2012), which may partly explain this distinctive profile.

Contrary to what could be expected based on prior person-centered analyses, we did not find a profile high on intrinsic motivation and low on extrinsic motivation, generally referred to as good-quality motivation (Corpus et al., 2016; Hayenga & Corpus, 2010; Vansteenskiste et al., 2009; Wormington et al., 2012). We did not find any profile with a dominance of one specific type of intrinsic motivation either (e.g., knowledge-oriented profile; Litalien et al., 2019). Given that such profiles emerged among college or undergraduate students (Ratelle et al., 2007; Litalien et al., 2019), differences in profiles may again reflect the fact that the learning process of high school and post-secondary students occurs in very different contexts. A large proportion of the academic

curriculum in high school is compulsory, as opposed to college and university wherein students not only pick their program of studies, but also many elective classes. Thus, most high school students must complete coursework that has nothing to do with their intrinsic interests or their career plans, in contrast with older students included in past studies. Post-secondary and high school students are also going through different developmental stages. This is an important distinction given that motivation is an age-sensitive process, and it should be examined in future studies by integrating diverse samples of students.

Alternatively, the non-emergence of the good-quality and the knowledge-oriented profiles in our study may reflect methodological differences. Studies which have identified the good-quality profile among high school students have used only a global score of intrinsic motivation and a global score of extrinsic motivation (Corpus et al., 2016; Hayenga & Corpus, 2010). This strategy may have limited the number of possible profiles. In contrast, the knowledge-oriented profile found by Litalien et al. (2019) in undergraduate students was identified by conducting bifactor modelling along with factor mixture analysis (Morin & Marsh, 2015; 2016). This is a recently developed person-oriented method that helps to disentangle the qualitative differences (i.e. shapes) with the quantitative differences (i.e., level) between profiles. Although our approach enabled us to find some qualitative differences between profiles, researchers who are particularly interested in studying the different shapes of motivation profiles and to use the holistic perspective of motivation (Bergman & Magnusson, 1997) to guide their research are encouraged to consider this innovative analytical avenue.

Replication of Profiles across School Levels and Countries

Another major contribution of this study was to test the generalizability of our three-profile solution using a formal test of similarity (Morin et al., 2016). For the first time, to our knowledge, cross-national comparisons of SDT school motivation profiles have been performed. Besides minor

differences between profiles, our results highlight the similarity of the profile structure between Canadian and Belgian high school students. This finding appears to lend support to the SDT assumption about the universality of the processes underlying intrinsic motivation (Ryan & Deci, 2020). However, additional cross-countries comparative studies using a person-centered approach are needed to confirm this hypothesis, especially between countries that differ more dramatically regarding their cultural values about education and their pedagogical practices (e.g., individualist vs collectivist societies). For instance, Areepattamannil (2012) found in their descriptive discriminant analysis that Indian immigrants in Canada had higher levels of intrinsic motivation than Indians living in India.

Although the profile structure was similar, the proportion of adolescents in each profile differed across Canadian and Belgian adolescents. While the *moderately motivated* profile tended to include a larger proportion of youth in both samples, we found that the *high quantity* profile was relatively more prevalent in the Canadian sample, and the *poor quality* profile was relatively more prevalent in the Belgian sample. This discrepancy may partly be explained by the fact that the Belgian study followed the grade repeaters throughout both waves of data collection while they were included only at one time point in the Canadian study.

We also examined whether the three profiles were replicated across high school levels. Our findings support the similarity of motivation patterns in the last years of high school. This is an important finding in a context where different patterns of motivation between high school and college students have been previously highlighted (Ratelle et al., 2007). Our results add to this literature by suggesting that the diversification of motivation profiles occurs later on.

Predictors of Motivation Profiles

Another significant contribution of the current study is to identify the conditions in which the most and the least adaptive motivation profiles occur by examining two aspects of adolescents'

lives: parenting practices and youth's mental health.

Parenting Practices

As hypothesized, need-supportive parenting practices (in the Belgian sample) as well as parental warmth and monitoring (in the Canadian sample) predicted membership to a profile with higher ratio of intrinsic to extrinsic motivation. Our findings are in line with variable-centered studies and with SDT tenets, both suggesting that parents who adopt positive behaviors toward their children create a favourable learning environment that proves beneficial for adolescent intrinsic motivation (Ratelle & Duchesne, 2017; Soenens et al., 2017). At the same time, our findings show that positive parenting practices could also elicit extrinsic motivation, considering that the profile with the highest level of intrinsic motivation also exhibit the highest level of extrinsic motivation. The use of a person-centered approach brings light to the fact that positive parenting practices may foster various types of motivation regulations, which may help students adapt to a variety of learning situations.

Contrary to our expectations, negative parenting practices did not predict school motivation in our study. The lack of associations between negative parental behaviors and motivation can be related to the low scores of parental rejection, hostility and neglect found in our sample. Levels of parental maltreatment faced by our participants were possibly too weak to impact significantly their school motivation. Further research will be needed to explore these associations in more vulnerable adolescent populations.

Youth's Mental Health

The current study also emphasized the importance of youth's mental health in predicting school motivation profiles. Overall, we found that students experiencing behavioral or cognitive difficulties are disadvantaged with regards to school motivation, and these observations tend to be replicated in both samples and time points. More specifically, adolescents reporting higher levels of

rule-breaking and aggressive behavior were less likely to belong to the high quantity or the moderately motivated profiles. Such findings are consistent with variable-centered studies indicating that externalizing behaviors are associated with lower school engagement (Olivier et al., 2020). A potential mechanism linking externalizing behaviors with lower school motivation might be that deviant adolescents generally tend to devalue academic activities, which may lead to further disengagement from school (Li & Lerner, 2011).

The current findings also revealed that youth reporting higher levels of attention problems were more likely to belong to profiles with lower levels of intrinsic motivation. This is in line with studies showing that adolescents with ADHD tend to have a motivational deficit compared to peers without ADHD (Smith et al., 2020). Adolescents experiencing attention problems often report difficulty focusing and self-regulating their motivation in long, slow-paced, and physically inactive tasks, such as studying and doing schoolwork (APA, 2013).

Interestingly, we found limited support for a link between internalizing difficulties and a problematic motivation profile. The only significant association found was for students in the *poor quality* profile who were more withdrawn than others in the Canadian sample at Time 1. In contrast, our measure of anxiety / depression did not predict school motivation profiles in our study, which is consistent with a growing body of research suggesting that symptoms of anxiety may partly reflect school performance anxiety. Unlike disengaged students, highly motivated adolescents may experience anxiety because they want to perform well academically (Elmelid et al., 2015). These findings suggest that future work needs to use clearly distinct and more complete measures of both depressive and anxious symptomatology to get a clearer picture of their respective associations with motivation profiles.

Strengths, Limitations and Future Research

This study presents many strengths, like the use of seven types of motivation to identify motivation profiles, the inclusion of two samples from different countries, the use of a model-based clustering approach, and the examination of a wide range of specific predictors. Yet, this study also has some limitations.

First, students came from a limited number of high schools. Although the school motivation profiles have been replicated in our Canadian and Belgian samples and were similar to previous studies (Ratelle et al., 2007), our findings should be reproduced using representative samples of high school students in both countries.

Second, although we used longitudinal data to corroborate the profiles at different ages, predictors of motivation profiles were measured at the same wave of data collection as motivation itself. This strategy was used because students' motivation profile and the school environment may change significantly as students move up to the next school grade. Thus, concurrent measures of predictors and motivation appeared more appropriate for our analyses. Yet, this analytic strategy makes the temporality and the causal pathway difficult to determine. In order to better address temporality issues, we are currently planning to use latent transition analysis (LTA) with this dataset as the next step of our inquiry to identify predictors of change in motivation profiles over time. Unfortunately, applying LTA would go beyond the purpose of the current paper, which aimed at identifying motivation profiles.

A third limitation is that a number of students did not complete both waves of data collection and could not be followed over one year. Although part of the missing data is probably random (e.g., students being sick on the day data were collected), others may have decided to drop out of the study for reasons that are related to our main variables (e.g., amotivation, dropout). To overcome this limitation, the Belgian data collection was spread out over several days to maximize the number of respondents. Differences in data collection may partly explained differences in the

distribution across motivation profiles distribution between the Canadian and the Belgian samples, as dropouts and grade repeaters may potentially have different profiles of motivation.

Fourth, the current study relied entirely on self-reported data. For instance, we looked at anxiety, depression, attention problems and other externalizing behavior as reported by participants rather than based on a clinical diagnosis. Contrary to a diagnosis, self-reported symptoms do not necessarily take into account the degree of functional impairment caused by the symptoms in the adolescent's life. However, mental health based on self-assessment may more closely match the difficulties a person is going through than an assessment done by a third party.

Fifth, the Likert scale used for motivational indicators differed between the Canadian and Belgian samples. School motivation profiles could have been even more similar between the two samples if identical scales were used, notably the dispersion similarity which test differences in profile variances across samples.

Theoretical and Clinical Implications

From a theoretical standpoint, our findings highlight the multidetermined process of learning among high school students that involves various types of intrinsic and extrinsic motivation. Furthermore, our findings suggest that using the "intrinsic" and "extrinsic" motivational orientations is necessary for correctly identifying motivation profiles in high school students. In fact, we found that levels of identified regulation and external regulation were quite similar within each profile, even though the former is a form of "autonomous" regulation and the latter is "controlled". Thus, using the more global "autonomous" and "controlled" categories may hide important differences across profiles. This finding is important because the distinction between autonomous and controlled motivation is commonly used nowadays (Lawman & Wilson, 2013). It is noteworthy that our findings go against the SDT assumption which postulates higher correlations between more theoretically proximal regulations and weaker correlations between more distal

regulations (known as the simplex structure; Howard, Gagné & Morin, 2020). In line with prior research (Fairchild et al., 2005), we found that within profiles, introjected regulation (rather than identified regulation) more closely follows the levels of intrinsic motivation. This result suggests that introjected regulation may be more self-determined than previously hypothesized by SDT, at least for the domain of education. It is possible that among high school students, internal pressure to study that characterizes introjected regulation may be closely related to intrinsic motivation toward accomplishment and surpassing oneself, and such a subtle difference may be difficult to capture with existing questionnaire measures.

From a methodological standpoint, the diversification of the person-oriented analytical strategies used, the number of motivation indicators included, the different motivation measures and the type of scores used (e.g. raw, standardized) complicate the comparison of profiles across studies. This situation has certainly contributed to the diversity of the profile labels proposed in different studies, in which an identical profile label sometimes have a different profile structure and meaning across studies. As a result, it is difficult to determine the extent to which profile differences across studies truly reflect developmental and school-context differences, or simply methodological differences. One way to disentangle the relative contribution of these methodological differences would be to replicate the profiles across different contexts and populations using the same method. In addition, the identification of "core" profiles across studies, as suggested by Howard et al., (2016), could be helpful to develop a better understanding of the profiles' motivation that are generalized across studies. If one advantage of person-centered approach is to maximize the variability of students' motivational processes and the multidimensionality of motivation, too many profiles would increase confusion among researchers and clinicians.

From a clinical standpoint, our findings stress the importance of understanding the context

in which the learning and motivational processes occur by taking into account the cultural values around education as well as proximal spheres of adolescents' lives. The high levels of extrinsic motivation that our three profiles exhibited are consistent with the fact that education systems in most Western countries such as Canada and Belgium define school success in large part through extrinsic incentives including grades and diplomas rather than internal incentives such as the development of competences. In this context, relying on both intrinsic and extrinsic motives appear as the most adaptive strategy to achieve academic success. This conclusion parallels the one drawn by other scholars stating that intrinsic motivation may have a buffering effect on the negative consequences that are associated with some types of extrinsic motivation, such as ill-being (Howard et al., 2021; Ratelle et al., 2007). Also, parents should be supported in building a positive relationship with their children that can act as a catalyzer of adolescent's motivation to learn. To help parents achieve this goal, intervention programs should be developed to promote caring parenting and monitoring skills, and to teach parents how to be responsive to their child's needs by supporting their autonomy, providing structure and being emotionally involved (Joussemet et al., 2014). Schools should also promote positive mental health, develop monitoring systems to screen and detect emotional, psychosocial, cognitive, and behavioral issues at an early age, and provide the appropriate and needed support throughout the individual's educational path. Finally, schools should be creative in developing alternative ways of evaluating student learning. Such method should focus more on the mastery of competence and knowledge, which enhance intrinsic motivation, rather than performance and grading, generally associated with extrinsic motivation (Ryan & Deci, 2020).

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Table 1

Sociodemographic Characteristics of Canadian and Belgian Samples at Wave 1 and Wave 2

	Canadian sample		Belgian sample	
	Wave 1 (*n* = 303)	Wave 2 (*n* = 303)	Wave 1 (*n* = 369)	Wave 2 (*n* = 311)
	% / mean (*SD*)	% / mean (*SD*)	% / mean (*SD*)	% / mean (*SD*)
Gender[a]				
Boy	35.6	30.0	48.0	45.7
Girl	64.4	70.0	51.8	51.1
Age (mean [*SD*])	15.85 (.84)	16.94 (.63)	15.19 (.96)	16.24 (.94)
High school level[a]				
Grade 9	64.0		54.7	5.5[b]
Grade 10	36.0	37.6	45.3	55.0
Grade 11		62.4		36.3
High school program[a]				
General training	100.0	100.0	61.0	56.6
Vocational training	0.0	0.0	39.0	39.9
Race[a]				
White	64.0	62.0		
Other	32.0	36.0		
Country of birth[a]				
Belgium			92.4	92.3
Other			7.0	4.2
Native language[a]				
French	80.5	78.2		
Other	18.2	20.8		
Family structure[a]				
Parents still together (CND)	46.5	46.2		
Living with both parents (BLG)			64.2	57.9
Other	52.5	52.8	35.2	37.3
Mother's level of education[a]				
High school or less	29.4	25.7		
College	17.8	30.0		
University	26.4	34.0		
Don't know	18.5	8.9		
Father's level of education[a]				
High school or less	31.0	28.4		
College	15.8	17.8		
University	29.4	35.6		
Don't know	22.4	16.5		

Note. [a.] Sum of categories may be lower than 100% due to missing values. [b] This percentage reflects grade repeaters in the Belgian sample. Grade repeaters in the Canadian sample were lost in the second wave. CND = Canada. BLG = Belgium

Table 2

List of Study Measures

Measure	Sample	# items	ω	Description / Example of item	Item response categories
Variables of interest					
Profile indicators					
School motivation	Canada Belgium			Students' motivation toward high school, as assessed by the validated French version of the Academic Motivation Scale (AMS; Vallerand et al., 1989)	Canada From 0 (strongly disagree) to 3 (strongly agree)
Subscales:					
Intrinsic motivation				*I attend high school…*	Belgium From 0 (strongly disagree) to 4 (strongly agree) Scores were recoded the following way to obtain the same range of values than in the Canadian sample: 0 = 0; 1 = .75; 2 = 1.5; 3 = 2.25; 4 = 3. Items of each subscale were averaged.
To know		4	.85–.89	*… because I experience pleasure and satisfaction while learning new things.*	
To accomplish		4	.80–.88	*… for the pleasure I experience while surpassing myself in my studies.*	
To experience stimulation		4	.75–.84	*… for the high feeling that I experience while reading about various interesting subjects.*	
Extrinsic motivation					
Identified regulation		4	.75–.83	*… because eventually it will allow me to enter the job market in a field that I like.*	
Introjected regulation		4	.83–.89	*… to prove to myself that I can do better than just a high school degree.*	
External regulation		4	.59–.83	*… in order to get a more prestigious job later on.*	
Amotivation		4	.82–.85	*Honestly, I don't know; I really feel that I'm wasting my time in school.*	
Potential predictors of motivation profile membership					
Family sphere					
Need-supportive parenting practices	Belgium			Students' perceptions of how their parents' behaviors support their basic psychological needs using the French version of the Interpersonal Behavior Scale (Otis & Pelletier, 2000)	From 1 (never) to 7 (always)
Subscales:					Items of each subscale were summed.
Interpersonal involvement		5	.81–.88	*My parents spend a lot of time and energy to help me in what I do.*	
Autonomy support		6	.71–.84	*My parents give me opportunities to make my own decisions.*	
Parental structure		10	.76–.87	*The feedback I receive from my parents is constructive and helps me do better.*	
Parental acceptance / rejection	Canada			Students' perceptions of the quality of their affectional bond with their primary caregiver. We used the validated French version of the Parental Acceptance-Rejection Questionnaire – Short Form (PARQ-SF; Rohner, 2005)	From 1 (always false) to 4 (always true)
Subscales:					Two scores were created by summing respective items: one positive score of parental warmth and affection, and one negative score of parental hostility, neglect and rejection.
Warmth/Affection		8	.87	*Says nice things about me.*	
Hostility / Aggression / Indifference / Neglect / Rejection		6	.92	*Punishes me severely when he/she is angry.* *Pays no attention to me.* *Sees me as a big nuisance.*	
Parental monitoring	Canada	17	.85	Parents' knowledge of their adolescent's activities and whereabouts. (The French version of the parental monitoring scale (Keijsers & Poulin, 2013; Stattin & Kerr, 2000) was used. *How often do your parents ask you about what happened during your free time?*	From 1 (never) to 4 (always) All items were summed.

Measure	Sample	# items	ω	Description / Example of item	Item response categories
Mental health sphere					
Psychosocial adjustment	Canada Belgium			Participants' self-report of various externalizing and internalizing behaviors, as measured by the French version of the validated Child Behavior Checklist – Youth Self-Report (CBCL-YSR; Achenbach & Rescorla, 2001).	From 0 (does not apply/not true) to 2 (very true or often true).
Subscales:					Items of each subscale were summed.
Externalizing behaviors					
Rule-breaking behavior		15	.77–.81	*I drink alcohol without parents' approval.*	
Aggressive behavior		17	.78–.83	*I get in many fights.*	
Attention problems		9	.71–.80	*I am inattentive or easily distracted.*	
Internalizing behaviors					
Anxiety and depression		12	.80–.85	*I am afraid of going to school.*	
Withdrawal		8	.65–.76	*I prefer being alone than with others.*	
Control variables					
Demographics	Canada Belgium			Canada & Belgium: Participant's gender (0 = boy; 1 = girl), age (Canada: exact age calculated with date of birth; Belgium: self-reported age), and family situation (Canada: 0 = both parents living together, 1 = parents divorced/separated/other; Belgium: 0 = living with both parents, 1 = living with one parent/other). Canada only: Participant's race/ethnicity (0 = White, 1 = Other), native language (0 = French, 1 = other), and mother's and father's level of education. Belgium only: Participant's country of birth (0 = Belgium, 1 = other).	

Table 3

Tests of Profile Similarity between the Canadian and Belgian Samples at Wave 1 and Wave 2

	Wave 1			Wave 2		
	BIC	SABIC	AIC	BIC	SABIC	AIC
Profile similarity						
Configural (unconstrained)	9157.19	8963.51	8882.07	8738.57	8544.91	8468.95
Structural (mean invariance)	9108.35	8981.34	8927.94	8695.31	8568.32	8518.51
Structural (partial mean invar. – 2 equivalent profiles)	9098.22	8948.99	8886.24	8708.38	8559.17	8500.64
Structural (partial mean invar. – 1 equivalent profile)				8713.08	8541.64	8474.40
Dispersion (partial variance invar. – 2 equivalent profiles)	**8962.75**	**8813.52**	**8750.77**			
Dispersion (partial variance invar. – 1 equivalent profile)				**8605.58**	**8434.14**	**8366.90**
Distributional (size invariance)	8995.91	8853.03	8792.95	8614.19	8449.10	8384.35

Note. Lines in bold reflect best-fitting solutions for profile comparisons between samples at each wave. BIC = Bayesian Information Criterion. SABIC = Sample-size Adjusted Bayesian Information Criterion. AIC = Akaike Information Criterion.

Table 4

Concurrent Predictors Associated with School Motivation Profiles in the Canadian and Belgian Samples at Wave 1 and Wave 2

	Canadian sample						Belgian sample					
	Wave 1			Wave 2			Wave 1			Wave 2		
	Poor vs.		Mod. vs.	Poor vs.		Mod. vs.	Poor vs.		Mod. vs.	Poor vs.		Mod. vs.
	Moderate	High	High	Moderate	High	High	Moderate	High	High	Moderate	High	High
	β [95% CI]	β [95% CI]	β [95% CI]	β [95% CI]	β [95% CI]	β [95% CI]	β [95% CI]	β [95% CI]	β [95% CI]	β [95% CI]	β [95% CI]	β [95% CI]
Parental variables												
Need-supportive parenting												
Interpersonal involvement							.09*** [.05, .14]	.17*** [.10, .25]	.08* [.01, .15]	.03 [-.03, .08]	.13*** [.06, .19]	.10*** [.05, .16]
Parental structure							.08*** [.05, .11]	.14*** [.10, .19]	.06** [.02, .10]	.04* [.00, .07]	.10*** [.05, .14]	.06** [.02, .10]
Autonomy support							.11*** [.06, .15]	.16*** [.10, .22]	.05 [-.00, .11]	.04 [-.00, .09]	.14*** [.08, .20]	.10** [.04, .15]
Parental acceptance / rejection												
Warmth / affection	.05 [–.02, .11]	.10* [.02, .18]	.05 [–.02, .12]	.04 [–.03, .10]	.19** [.08, .30]	.15** [.04, .25]						
Rejection / hostility / neglect	–.03 [–.07, .01]	–.02 [–.07, .02]	.01 [–.03, .05]	–.02 [–.05, .02]	–.05 [–.10, .01]	–.03 [–.09, .02]						
Parental monitoring	.05* [.01, .10]	.11*** [.05, .17]	.06* [.01, .11]	.05* [.01, .09]	.13*** [.07, .20]	.09** [.03, .14]						
Youth's mental health indicators												
Rule-breaking behavior	–.08 [–.17, .00]	–.15** [–.25, –.04]	–.06 [–.16, .03]	–.08 [–.18, .01]	–.22*** [–.34, –.11]	–.14** [–.24, –.05]	–.12*** [–.19, –.06]	–.25*** [–.35, –.15]	–.13* [–.23, –.02]	–.11** [–.19, –.03]	–.23*** [–.33, –.12]	–.12* [–.21, –.02]
Aggressive behavior	–.09* [–.16, –.01]	–.08 [–.17, .01]	.01 [–.07, .08]	–.08 [–.16, .01]	–.16** [–.27, –.06]	–.08 [–.18; .02]	–.08** [–.14, –.02]	–.17*** [–.25, –.09]	–.09* [–.17, –.02]	–.06 [–.13, .01]	–.10** [–.17, –.03]	–.04 [–.10, .02]
Attention problems	–.22*** [–.34, –.10]	–.26*** [–.38, –.13]	–.03 [–.13, .07]	–.06 [–.17, .05]	–.15* [–.27, –.04]	–.10 [–.20, .01]	–.14*** [–.22, –.07]	–.37*** [–.49, –.25]	–.23*** [–.34, –.11]	–.10* [–.19, –.01]	–.20*** [–.30, –.10]	–.10* [–.18, –.01]
Anxiety/depression	–.03 [–.11, .05]	–.02 [–.11, .06]	.01 [–.06; .08]	.08 [–.01, .16]	.02 [–.07, .11]	–.06 [–.13, .02]	.07 [–.01, .14]	.07 [–.02, .15]	.01 [–.07, .08]	.01 [–.10, .11]	–.02 [–.12, .09]	–.02 [–.10, .05]
Withdrawal	–.19** [–.31, –.07]	–.17** [–.30, –.05]	.01 [–.10, .12]	.05 [–.08, .18]	–.06 [–.21, .10]	–.11 [–.23, .02]	.02 [–.08, .12]	–.06 [–.20, .08]	–.08 [–.21, .04]	–.08 [–.20, .05]	–.10 [–.23, .03]	–.02 [–.12, .08]

Note. All models were adjusted for the following confounding variables: gender, age, race/ethnicity, native language, family situation, and father's and mother's highest level of education for the Canadian sample, and gender, age, country of birth and family situation for the Belgian sample. Poor = poor quality profile. Moderate = Moderately motivated profile. High = high quantity profile. β = regression coefficients. CI = confidence intervals. * p <.05. ** p <.01. *** p <.001.

Table 5

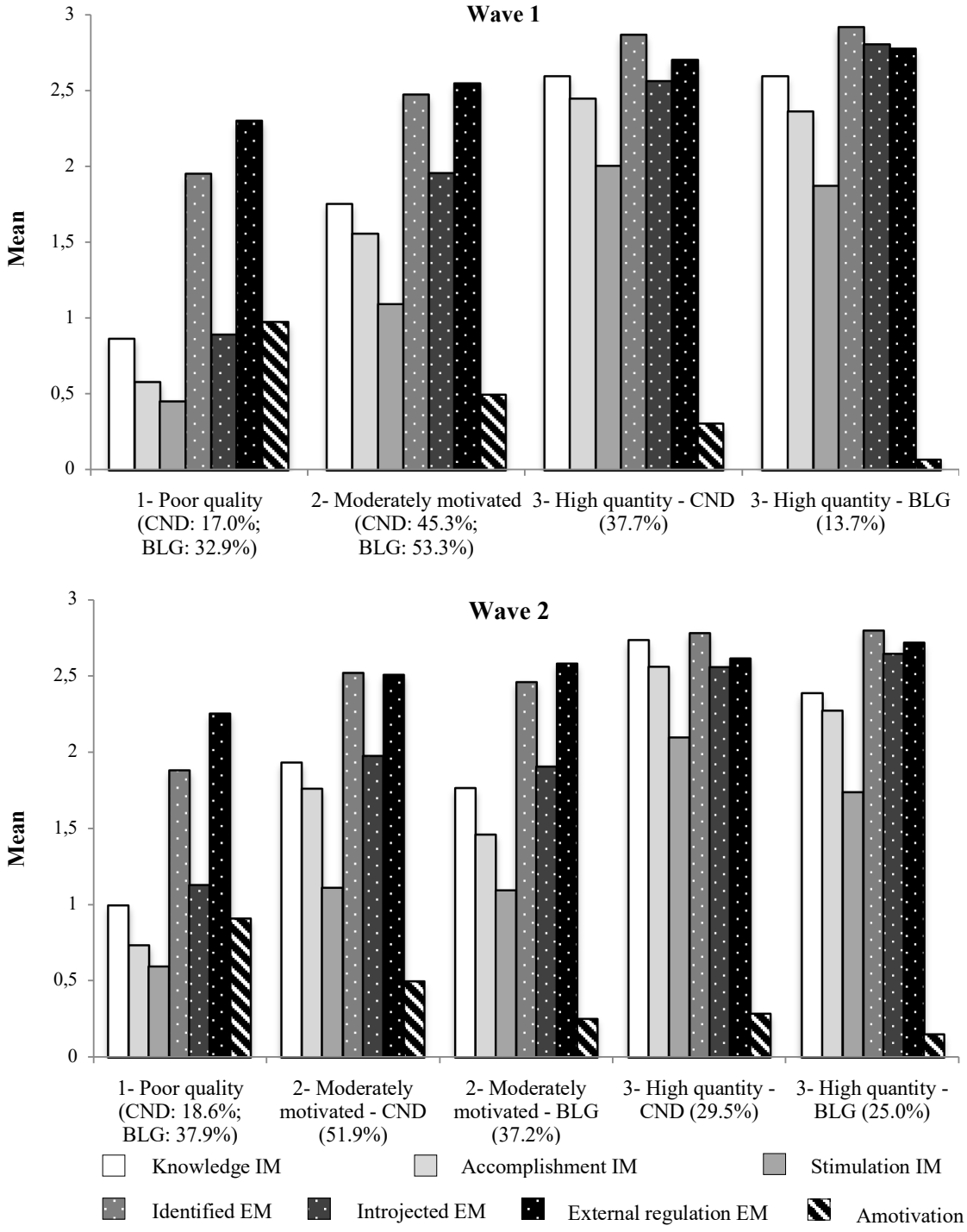
Tests of Predictive Similarity between the Canadian and Belgian Samples at Wave 1 and Wave 2

	Wave 1			Wave 2		
	BIC	SABIC	AIC	BIC	SABIC	AIC
Predictive similarity						
Rule-breaking behavior						
Unconstrained	**8867.36**	**8705.43**	**8637.72**	8275.20	8091.06	8020.46
Invariant	8862.43	8706.85	8641.79	**8267.52**	**8089.73**	**8021.57**
Aggressive behavior						
Unconstrained	8919.88	8757.95	8690.16	8300.81	8116.68	8046.08
Invariant	**8908.44**	**8752.86**	**8687.73**	**8288.32**	**8110.54**	**8042.38**
Attention problems						
Unconstrained	8900.23	8738.30	8670.43	8361.70	8177.57	8106.68
Invariant	**8889.30**	**8733.72**	**8658.51**	**8352.33**	**8174.55**	**8106.10**
Anxiety/depression						
Unconstrained	8952.33	8790.40	8722.54	8343.44	8159.30	8088.61
Invariant	**8943.11**	**8787.53**	**8722.32**	**8331.15**	**8153.36**	**8085.11**
Withdrawal						
Unconstrained	8899.87	8737.94	8670.30	8311.97	8127.84	8057.34
Invariant	**8890.21**	**8734.63**	**8669.65**	**8301.28**	**8123.28**	**8055.21**

Note. Lines in bold reflect best-fitting solutions for comparisons of relations between profile and outcomes, at each wave. BIC = Bayesian Information Criterion. SABIC = Sample-size Adjusted Bayesian Information Criterion. AIC = Akaike Information Criterion.

Figure 1

Profiles of Academic Motivation in Canadian and Belgian Samples at Wave 1 and Wave 2



Note. IM = Intrinsic motivation. EM = Extrinsic motivation. CND = Canada. BLG = Belgium.

Table S1

Comparisons of Fit Indices for Confirmatory Factor Analysis of the Academic Motivation Scale ─ Canadian and Belgian Samples at Wave 1 and Wave 2

	Canadian sample		Belgian sample	
	Wave 1	Wave 2	Wave 1	Wave 2
7-factor model				
X^2 (329)	672.35***	694.73***	830.99***	697.90***
X^2/df	2.04	2.12	2.53	2.12
CFI	.968	.958	.948	.963
TLI	.963	.952	.940	.958
RMSEA	.059 [.052-.065]	.061 [.054-.067]	.064 [.059-.070]	.060 [.054-.066]
SRMR	.065	.064	.054	.050
5-factor model				
X^2 (340)	832.86***	1010.44***	1056.00***	956.11***
X^2/df	2.45	2.97	3.11	2.81
CFI	.954	.923	.926	.939
TLI	.949	.914	.917	.932
RMSEA	.069 [.063-.075]	.081 [.075-.086]	.075 [.070-.081]	.076 [.071-.082]
SRMR	.070	.103	.065	.061
3-factor model				
X^2 (347)	1327.65***	1475.34***	1738.52***	1998.28***
X^2/df	3.83	4.25	5.01	5.76
CFI	.909	.870	.859	.836
TLI	.901	.858	.843	.822
RMSEA	.097 [.091-.102]	.104 [.098-.109]	.104 [.099-.109]	.124 [.118-.129]
SRMR	.099	.103	.088	.107

Note. df = degree of freedom. CFI = comparative fit index. TLI = Tucker-Lewis index. RMSEA = root mean squared error of approximation. SRMR = standardized root mean squared residual.

Table S2

Standardized Factor Loadings of the Academic Motivation Scale on the Canadian and Belgian Samples at Wave 1 and Wave 2

	Canadian sample		Belgian sample	
	Wave 1	Wave 2	Wave 1	Wave 2
	Factor loadings range (mean)	Factor loadings range (mean)	Factor loadings range (mean)	Factor loadings range (mean)
7-factor model				
IM to know	.842-.891 (.864)	.785-.887 (.852)	.759-.836 (.810)	.754-.872 (.826)
IM to accomplish	.801-.908 (.845)	.768-.871 (.841)	.686-.798 (.743)	.812-.851 (.831)
IM to experience stimulation	.759-.853 (.810)	.694-.849 (.794)	.464-.803 (.688)	.507-.820 (.685)
Identified EM	.762-.834 (.788)	.734-.847 (.778)	.698-.780 (.745)	.780-.839 (.812)
Introjected EM	.778-.901 (.833)	.701-.880 (.804)	.728-.820 (.787)	.818-.869 (.854)
External regulation EM	.340-.763 (.620)	.342-.913 (.677)	.641-.947 (.738)	.718-.937 (.821)
Amotivation	.617-.904 (.820)	.673-.897 (.807)	.691-.872 (.814)	.649-.933 (.833)
Global	.340-.908 (.797)	.342-.913 (.793)	.464-.947 (.761)	.507-.937 (.809)
5-factor model				
IM (merged score)	.706-.890 (.806)	.621-.850 (.771)	.422-.806 (.715)	.443-.835 (.734)
Identified EM	.762-.834 (.788)	.734-.847 (.750)	.698-.780 (.745)	.782-.839 (.812)
Introjected EM	.775-.907 (.833)	.699-.891 (.814)	.729-.818 (.787)	.816-.872 (.854)
External regulation EM	.340-.764 (.620)	.339-.910 (.653)	.642-.949 (.737)	.719-.936 (.821)
Amotivation	.617-.905 (.820)	.672-.892 (.834)	.690-.872 (.814)	.648-.933 (.833)
Global	.340-.907 (.783)	.339-.910 (.766)	.422-.949 (.747)	.443-.936 (.789)
3-factor model				
IM (merged score)	.705-.893 (.806)	.618-.852 (.771)	.416-.807 (.715)	.436-.841 (.733)
EM (merged score)	.127-.902 (.546)	.122-.893 (.551)	.404-.811 (.646)	.507-.851 (.727)
Amotivation	.606-.909 (.819)	.664-.896 (.833)	.690-.873 (.814)	.646-.935 (.834)
Global	.127-.909 (.696)	.122-.896 (.686)	.404-.873 (.699)	.436-.935 (.745)

Note. IM = intrinsic motivation. EM = extrinsic motivation.

Table S3

Comparisons of Fit Indices for Iterative Latent Profile Models in the Canadian Sample at Wave 1 (N = 303) and Wave 2 (N = 303)

	AIC	BIC	SABIC	aLMR-LRT (*p*)	BLRT (*p*)	Entropy	*n* per profile	Profiles classification probabilities
Wave 1								
2 profiles	3735.08	3816.78	3747.01	.000	.000	.869	108; 195	.958; .965
3 profiles	**3522.47**	**3633.89**	**3538.74**	**.047**	**.000**	**.857**	**50; 160; 93**	**.931; .944; .927**
4 profiles	3388.97	3530.09	3409.57	.010	.000	.884	134; 90; 25; 54	.931; .947; .957; .929
5 profiles	3296.57	3467.40	3321.52	.612	.000	.887	25; 42; 135; 61; 40	.991; .859; .943; .940; .899
6 profiles	3245.20	3445.74	3274.48	.268	.000	.902	20; 5; 40; 45; 132; 61	.967; .989; .912; .873; .937; .945
7 profiles	Model not identified							
Wave 2								
2 profiles	3981.86	4063.56	3993.78	.002	.000	.812	113; 190	.933; .953
3 profiles	**3771.85**	**3883.26**	**37.88.11**	**.000**	**.000**	**.862**	**52; 92; 159**	**.948; .923; .939**
4 profiles	3680.42	3821.54	3701.03	.344	.000	.885	160; 20; 30; .93	.954; .922; .895; .920
5 profiles	3608.66	3779.72	3633.83	.382	.002	.865	12; 31; 43; 85; 132	.964; .952; .846; .924; .919
6 profiles	Model not identified							

Note. Lines in bold reflect the best-fitting solution at each wave. AIC = Akaike information criteria; BIC = Bayesian information criteria; SABIC = sample-size adjusted Bayesian information criteria; aLMR-LRT = adjusted Lo-Mendell-Rubin likelihood ratio test; *p* = p-value; BLRT = bootstrapped likelihood ratio test.

Figure S1

Elbow Plot of Information Criteria on the Canadian Sample at Wave 1

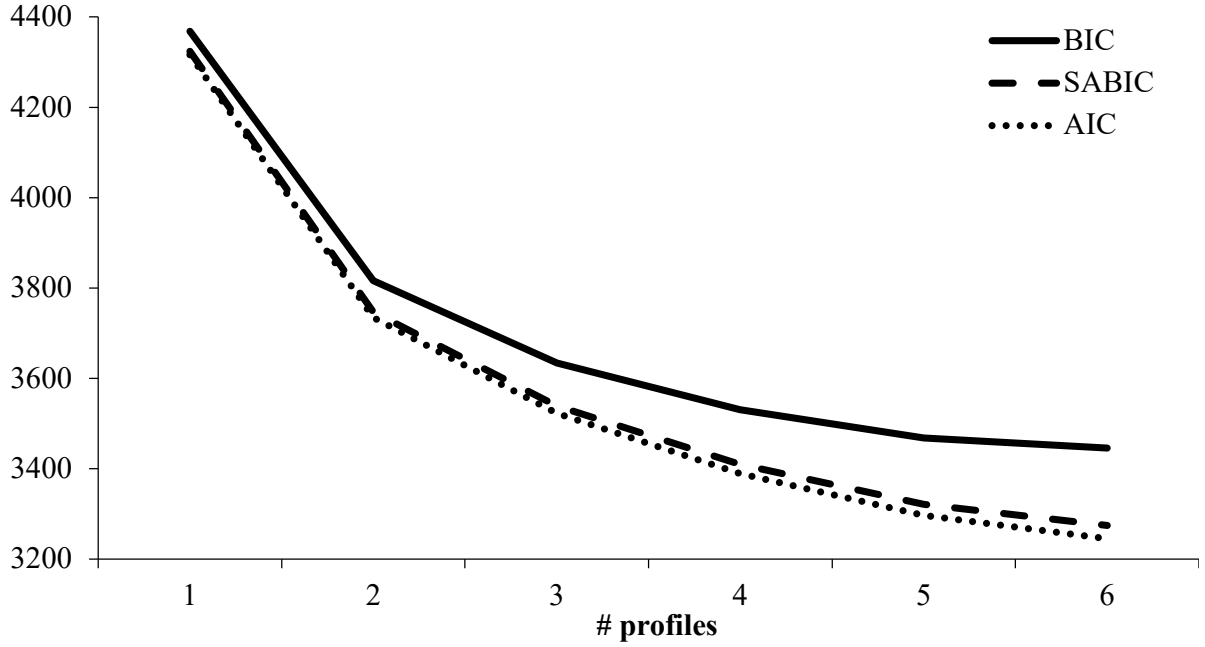
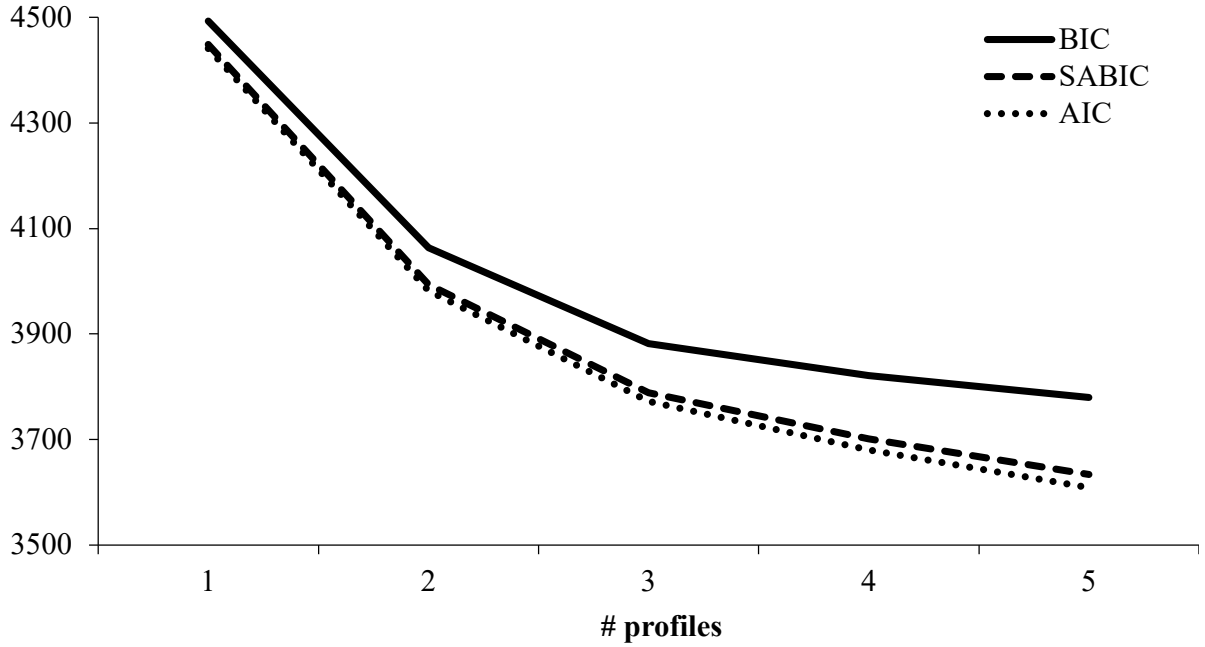


Figure S2

Elbow Plot of Information Criteria on the Canadian Sample at Wave 2



Note. BIC = Bayesian Information Criterion. SABIC = Sample-size Adjusted Bayesian Information Criterion. AIC = Akaike Information Criterion.

Table S4

Comparisons of Fit Indices for Iterative Latent Profile Models in the Belgian Sample at Wave 1 (N = 369) and Wave 2 (N = 311)

	AIC	BIC	SABIC	aLMR-LRT (*p*)	BLRT (*p*)	Entropy	*n* per profile	Profile classification probabilities
Wave 1								
2 profiles	4654.14	4740.18	4670.38	.000	.000	.829	171; 198	.943; .955
3 profiles	**4432.49**	**4549.82**	**44.54.64**	**.001**	**.000**	**.854**	**119; 57; 193**	.952; .892; .942
4 profiles	4322.88	4471.49	4350.93	.392	.000	.840	127; 49; 35; 158	.906; .921; .873. .918
5 profiles	4245.28	4425.17	4279.23	.227	.000	.843	71; 29; 49; 167; 53	.834; .916; .911; .943; .844
6 profiles	4178.47	4389.66	4218.33	.246	.000	.876	78; 55; 160; 12; 49; 15	.885; .889; .939; .826; .907; .923
7 profiles	4124.86	4367.33	4170.62	.347	.000	.836	10; 42; 14; 69; 78; 108; 48	.968; .854; .927; .887; .804; .884; .943
8 profiles	4099.23	4372.98	4150.90	.492	.000	.870	21; 6; 81; 128; 40; 15; 32; 46	.844; .982; .903; .911; .829; .988; .856; .930
9 profiles	Model not replicated							
Wave 2								
2 profiles	4031.14	4113.42	4043.64	.000	.000	.823	139; 172	.943; .955
3 profiles	**3844.02**	**3956.22**	**3861.07**	**.070**	**.000**	**.842**	**54; 151; 106**	**.928; .932; .928**
4 profiles	3735.11	3877.22	3756.70	.162	.000	.861	41; 138; 25; 107	.905; .923; .917; .936
5 profiles	3664.16	3836.19	3690.29	.431	.000	.872	42; 10; 123; 28; 108	.927; .936; .913; .858; .938
6 profiles	3591.35	3793.30	3622.03	.671	.000	.858	27; 77; 38; 10; 115; 44	916; .912; .905; .947; .894; .855
7 profiles	3544.99	3776.85	3580.21	.239	.000	.857	29; 64; 115; 5; 26; 14; 58	.907; .879; .894; .990; .876; .940; .871
8 profiles	Model not identified							

Note. Lines in bold reflect the best-fitting solution. AIC = Akaike information criteria; BIC = Bayesian information criteria; SABIC = sample-size adjusted Bayesian information criteria; aLMR-LRT = Adjusted Lo-Mendell-Rubin likelihood ratio test; *p* = p-value; BLRT = bootstrapped likelihood ratio test.

Figure S3

Elbow Plot of Information Criteria on the Belgian Sample at Wave 1

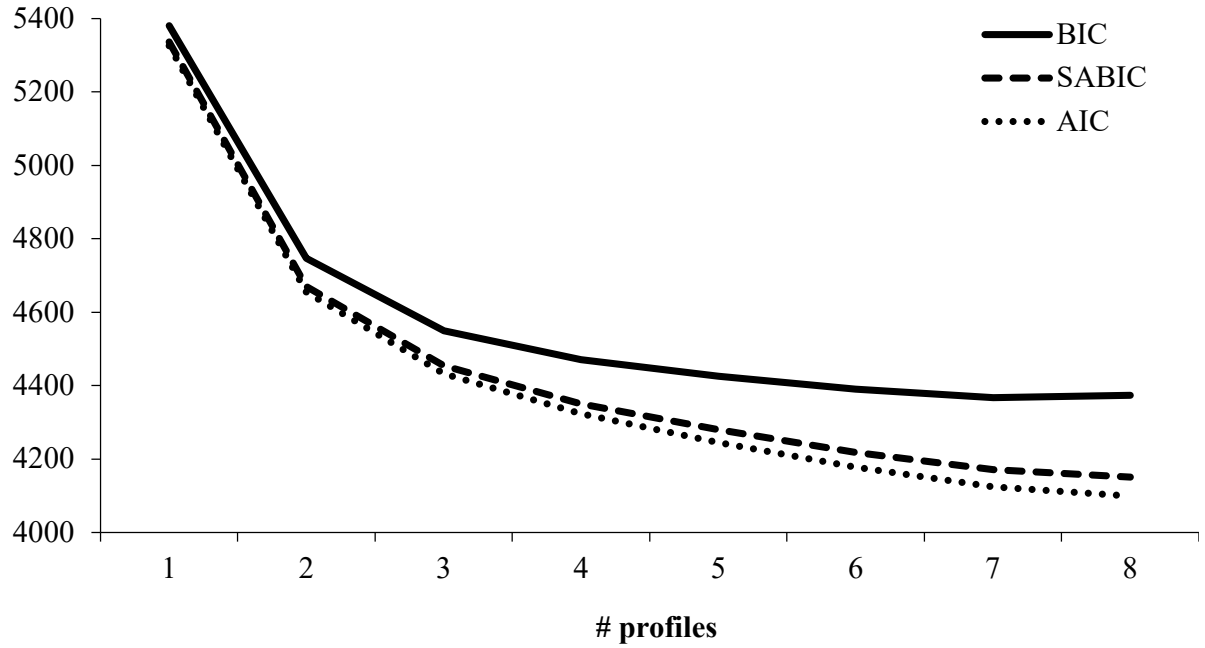
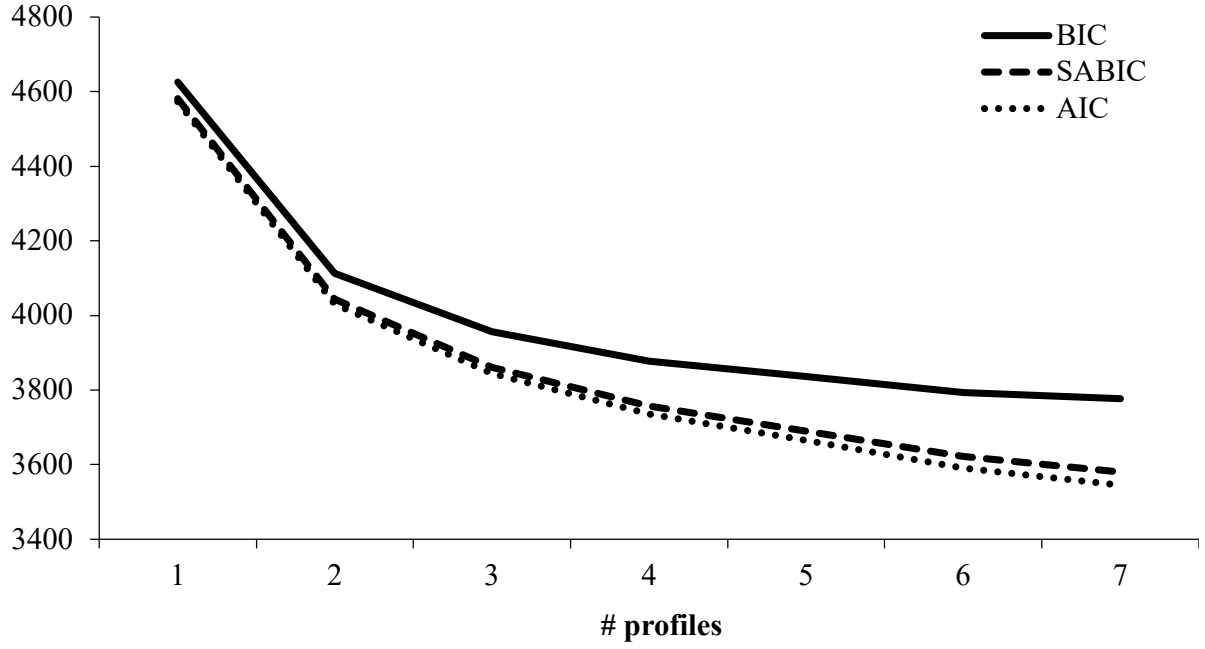


Figure S4

Elbow Plot of Information Criteria on the Belgian Sample at Wave 2



Note. BIC = Bayesian Information Criterion. SABIC = Sample-size Adjusted Bayesian Information Criterion. AIC = Akaike Information Criterion.

Table S5

Pairwise Correlations between Motivation Indicators from the Measurement Model in the Canadian Sample

Variables	IM to know	IM to accomp.	IM for stimul.	Identified EM	Introj. EM	Ext. reg. EM	Amotivation
IM - know	–	.691	.739	.358	.510	.154	–.347
IM – accomp.	.771	–	.641	.392	.723	.110	–.306
IM – stimul.	.758	.718	–	.289	.441	.048	–.250
Identified EM	.478	.417	.362	–	.415	.444	–.300
Introj. EM	.618	.770	.601	.409	–	.301	–.149
Ext. reg. EM	.128	.165	.185	.441	.244	–	–.087
Amotivation	–.320	–.238	–.218	–.439	–.223	–.072	–

Note. Pairwise correlations for the first time point are below the diagonal whereas pairwise correlations for the second time point are above the diagonal.

Table S6

Pairwise Correlations between Motivation Indicators from the Measurement Model in the Belgian Sample

Variables	IM to know	IM to accomp.	IM for stimul.	Identified EM	Introj. EM	Ext. reg. EM	Amotivation
IM to know	–	.705	.686	.463	.580	.230	–.426
IM to accomp.	.697	–	.650	.452	.747	.185	–.294
IM for stimul.	.716	.623	–	.294	.464	.065	–.254
Identified EM	.496	.490	.319	–	.459	.618	–.438
Introj. EM	.594	.750	.512	.549	–	.321	–.279
Ext. reg. EM	.174	.278	.088	.545	.353	–	–.321
Amotivation	–.410	–.364	–.367	–.414	–.311	–.200	–

Note. Pairwise correlations for the first time point are below the diagonal whereas pairwise correlations for the second time point are above the diagonal.

Table S7

Tests of Profile Similarity across Wave 1 and Wave 2 on the Canadian and Belgian Samples

	BIC	SABIC	AIC
Profile similarity – Canadian sample			
Configural (unconstrained)	7538.84	7348.42	7294.32
Structural (mean invariant)	7443.46	7319.69	7284.52
Dispersion (variance invariant)	7433.97	7332.42	7303.56
Partial dispersion (variance invariant – 2 equivalent profiles)	7352.75	7228.99	7193.81
Distributional (size invariant)	**7340.14**	**7222.72**	**7189.35**
Profile similarity – Belgian sample			
Configural (unconstrained)	8078.10	7798.86	7723.82
Structural (mean invariant)	8000.90	7788.29	7731.17
Dispersion (variance invariant)	7917.74	7771.77	7732.55
Distributional (size invariant)	**7908.04**	**7768.42**	**7730.90**

Note. Lines in bold reflect best-fitting solutions for each sample. BIC = Bayesian Information Criterion. SABIC = Sample-size adjusted Bayesian Information Criterion. AIC = Akaike Information Criterion.