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ORIGINAL CONTRIBUTION

Investigating the interplay between parenting dimensions and styles, and the association with adolescent outcomes

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Abstract

Research has indicated that a strictly dimensional or parental style approach does not capture the full complexity of parenting. To better understand this complexity, the current study combined these two approaches using a novel statistical technique, i.e., subspace K-means clustering. Four objectives were addressed. First, the study tried to identify meaningful groups of parents in longitudinal adolescent reports on parenting behaviour. Second, the dimensional structure of every cluster was inspected to uncover differences in parenting between and within clusters. Third, the parenting styles were compared on several adolescent characteristics. Fourth, to examine the impact of change in parenting style over time, we looked at the cluster membership over time. Longitudinal questionnaire data were collected at three annual waves, with 1,116 adolescents (mean age = 13.79 years) at wave 1. Based on five parenting dimensions (support and proactive, punitive, psychological and harsh control), subspace *K*-means clustering, analysed per wave separately, identified two clusters (authoritative and authoritarian parenting) in which parenting dimensions were interrelated differently. Authoritative parenting seemed to be beneficial for adolescent development (less externalising problem behaviour and higher self-concept). Longitudinal data revealed several parenting group trajectories which showed differential relations with adolescent outcomes. Change in membership from the authoritative cluster to the authoritarian cluster was associated with a decrease in self-concept and an increase in externalising problem behaviour, whereas changes from the authoritarian cluster to the authoritative cluster were associated with an increase in self-concept and a decrease in externalising problem behaviour.

Keywords Parenting · Adolescence · Subspace *K*-means clustering · Externalising problems · Self-concept

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Interplay between parenting dimensions and styles

Several authors have pointed out that a strictly variable- or person-centred approach, which is most often used in parenting research, is unable to capture the full complexity of child and family psychology [1, 2]. In parenting research, a variable-centred approach has a focus on parenting dimensions; these are the key concepts and most often studied using (continuous) variables (e.g., what is the association between behavioural control exerted by parents and the wellbeing of the adolescent). Alternatively, the person-centred approach regards parenting as a complex system that is best understood in terms of whole-system properties [2] and categorises parents into parenting styles (e.g., what parenting style is beneficial for adolescent development). The current longitudinal study combined a person-centred and a variable-centred approach.

Parenting practices, dimensions, and styles

Parenting practices

Research literature has distinguished three theoretical approaches in the study of parenting, namely practices, dimensions, and styles. Parenting practices can be described as specific behaviours that are used by parents with the particular aim to socialise their children [3, 4], that is, to assist them to become well-adjusted adults. Examples of parenting practices are comforting an adolescent when he or she is sad or to establish clear but reasonable rules.

Parenting dimensions

Parenting practices often are collapsed into parenting dimensions, broad constructs that do not focus on parent's specific behaviours but more on the general inclination to apply a certain parenting strategy [5]. Parenting dimensions are useful as parsimonious variables in research, because they allow to differentiate between parents and to link this difference with adolescents' social and emotional development. Multiple core parenting dimensions have been proposed in parenting research. For a long time research focused on demandingness, the extent to which parents control their children's behaviour, and responsiveness, the extent to which parents respond to children's emotional and developmental needs [5]. Later on the focus shifted towards three dimensions, namely support (instead of responsiveness), psychological control, and behavioural control (instead of demandingness) [5].

First, the support dimension comprises parental responsiveness, warmth, acceptance, and involvement, which all represent behaviours that contribute to the well-being and nurturance of adolescents [5–9]. The support dimension has been linked to both general well-being (less externalising problems), better school performance [10, 11], and a higher academic self-concept (i.e., how one perceives one's abilities in an academic or learning context).

Second, psychological control describes intrusive parental behaviours towards a child that manipulate the child's thoughts, feelings, and emotions, by using verbal and non-verbal communication (e.g., guilt induction, instilling anxiety, negative verbal interactions) [12–15]. High levels of psychological control are associated with many unfavourable outcomes [12, 16], such as low self-esteem [17], internalising problems [18], externalising problems [19], and lower school performance [20, 21].

Third, behavioural control refers to parental attempts to guide the child's behaviour with the aim of adjusting the behaviour to family and social norms [15]. Behavioural control is a form of control exercised for expected (e.g., rule setting), ongoing (e.g., monitoring and activity awareness), and past behaviour (e.g., punishment and feedback) [21–23]. Both lack of [24] or excessive exertion of behavioural control [8] are associated with a negative impact on adolescent well-being [25]. Research has refined the behavioural control dimension by distinguishing three aspects of behavioural control, namely proactive control, punitive control, and harsh punishment, which is useful because of the differential associations between these three forms of control and adolescent outcome [26]. Punitive punishment and harsh punishment are both reactive in nature, because they follow adolescent behaviour that is considered undesirable by the parent. Both dimensions are punitive in nature, but harsh punishment implies a physical component [26, 27]. Reactive behavioural control has been shown to predict academic underperformance [28] and externalising problems [29]. In contrast, proactive control is a non-invasive form of parental control by which parents establish rules and limitations in order to encourage desired child behaviour [27]. Proactive control is linked to positive school performance and less externalising and internalising problem behaviour [29–31]. In short, contemporary research has identified a Five-Factor model of parenting based on the dimensions: proactive control, harsh punishment, punitive control, psychological control, and support [26] This Five-Factor model will be used in the present study.

Parenting styles

In a third approach employing a variety of statistical procedures, parents are categorised, based upon a number of parenting dimensions into none overlapping parenting styles [29]. Parenting styles are more than the mere composition of underlying dimensions; they form a parenting pattern also referred to as a gestalt [1, 32, 33]. A typology with a strong and long-lasting influence in the field of parenting research was proposed by Baumrind [5, 34, 35]. Based on the dimensions demandingness and responsiveness, three types of parenting styles have been identified: the authoritative, authoritarian, and permissive style. Parents with an authoritarian style score high on the demandingness dimension and low on the responsiveness dimension, whereas parents with an authoritative style score high on responsiveness and high on demandingness. The permissive style was split into indulging parenting (high responsiveness and low demandingness) and neglecting or uninvolved parenting (i.e., low in both responsiveness and demandingness) [36]. By adding a fourth style, Maccoby and Martin were able to describe a broader range of parenting styles. Traditionally, research on parenting styles has focussed on the two dimensions, responsiveness and demandingness. Taking into account a more fine-grained approach in parenting dimensions, including different forms of control, can provide new insights into parenting styles.

When linking psychosocial development to these styles, research has shown that the authoritative parenting style is associated with a positive influence on the child, such as better mental health and school performance [37, 38], more prosocial behaviour [39], less substance use [40], greater social competence, and less internalising and externalising problems [41, 42]. Authoritarian parents aim to exert control and lack parental warmth [43]. In western societies, authoritarian parenting is linked to more externalising problem behaviour [44], poorer academic achievement [45], and more internalising problems [46].The permissive parenting style is linked with both beneficial and harmful outcomes. Permissive parents aim at maintaining a friendly child–parent bond without exerting control [43]. Although this is positively associated with social confidence and self-esteem, it is negatively associated with academic achievement and school involvement [43, 47], and it increases the risk of externalising problems [48]. In contrast, the neglectful parenting style is only associated with a problematic child development (i.e., lower social and emotional skills) [49, 50]. Often the family context of neglecting parents is stricken by poverty, parental unemployment [45], and depression contributing to problematic child development independent of parenting.

Cultural influence on parenting

In western society, compared to the other three styles (i.e., neglectful, permissive, and authoritarian parenting style), the authoritative parenting style appears to be most beneficial for the child. However, the authoritative parenting style is less normative in non-western cultures and depends on socioeconomic status (SES) [32]. Findings in one culture might not uphold in others and caution is needed to identify ''normative" parenting [51]. For instance, the negative effect of harsh punishment on children seems to be moderated by cultural beliefs, meaning that when studying effects of physical punishment, the cultural context should be taken into account [32, 52].

Strengths and weaknesses of dimensional and style approaches in parenting

Both the dimensional and style approaches in parenting research have strengths and weaknesses [1]. The dimensional approach looks at interactions and correlations between dimensions [53] and is able to deal with questions that concern the relative contributions that predictor variables make to an outcome [54] (e.g., "Is the parenting dimension 'support' related to reported externalising problem behaviour?"). A common criticism against the dimensional approach is that it makes holistic interpretation difficult [2]. In other words the dimensional approach makes abstract of the person: each aspect of the person's behaviour and thinking is regarded in isolation, ignoring the role it might play in the individual's total functioning and interaction with the environment [1].

In contrast, a person-centred approach assesses the common within-person structure of variables, that is, it seeks to classify parents into non overlapping groups or types with similar parenting characteristics (i.e., parenting styles), based on a number of theoretically meaningful variables [53]. A person-centred approach is able to deal with questions that concern group differences in patterns of development [54] (e.g., Is the neglecting parenting style related to negative social and emotional development of the adolescent?).

Different statistical methods to identify parent styles are available: univariate, bivariate, and cluster analysis. So far research on parenting styles has employed a univariate and bivariate approach. An extensive meta-analysis evaluating the associations between parenting dimensions and styles with externalising problems performed by Pinquart [55] included 209 studies. The majority of the studies ($n = 160$) used a univariate approach (e.g., assessing each parenting style as a continuous variable (one score per style), indicating whether a parent is more or less authoritative, authoritarian or permissive [56]), whereas other studies ($n = 49$)

employed a bivariate approach (e.g., classify parents according to the levels of responsiveness and demandingness into the styles defined by Maccoby and Martin [57]).

However, both univariate and bivariate approaches in parenting style research have two major limitations. First, it is often unclear on what basis the groups are differentiated or the group division is arbitrary (e.g., median split). Second, norms are created within a specific cultural and time context. Thus, when the studied parent group has a different cultural background, the found parenting styles may not be representative.

Third, so far identification of parenting styles is founded on a limited number of dimensions (e.g., most often the dimensions responsiveness and demandingness), constraining the possibility to capture the full complexity of parenting, namely the information available in the dimensions withheld [1, 2]. More specifically, the tendency in research on parenting dimensions to distinguish different forms of control has not yet influenced research on parenting styles.

A third statistical method to identify parenting styles, which is cluster analysis, can overcome these limitations in parenting research. Cluster analysis aims at grouping persons in such a way that persons belonging to a cluster are more similar to each other than to those in other groups [58, 59]. As a result, subdividing parents into groups with different parenting styles with cluster analysis is based upon actual similarities and dissimilarities within data. In line with this, the number of identified parenting styles is a direct result of data-analysis and depends upon the underlying data. Moreover, cluster techniques have been pointed out to be useful in cross-cultural research because the technique allows to discern patterns in a sufficiently objective manner to allow replication [60]. As such, cluster analyses can help to refine, redefine, and revalidate previous studies on parenting styles [58]. A wide range of cluster analyses is available.

Subspace *k*-means clustering

In a study by Timmerman et al. [58] several cluster techniques were compared. The study concluded that subspace *k*-means clustering is a reliable procedure to identify parenting styles (i.e., person-centred approach) which allows to look into the dimensional interplay within each cluster separately (dimensional approach). Subspace *k*-means clustering is a unique statistical method that combines the strengths from a person-centred and a dimensional approach because it is able to identify parenting styles based upon a large number of parenting dimensions. Both the number of styles and the cluster size of every style is are data-driven, thus overcoming the limitations of a univariate and bivariate approach.

Timmerman et al. [58] reanalysed data from a previous study that focused on parenting dimensions in a community sample of children aged 7–15 years [61]. The parenting dimensions were based on mother reports of nine parenting subscales measured by the Parental Behavior Scale (PBS) [61]. Two parenting styles were identified: authoritative parenting and authoritarian parenting [58]. The authoritative parenting type was characterised by a balance between support and demandingness, whereas in the authoritarian parenting type, harsh punishment and reactive behavioural control played an important role. Strikingly, the parenting dimensions intercorrelated differently, depending on the parenting type. For example, in the authoritative mothers cluster, monitoring (proactive control) was positively correlated with support but not with behavioural control, whereas in the authoritarian mother group it solely correlated with behavioural control. Furthermore, parenting style was linked to parenting stress, with authoritarian mothers experiencing more stress than the authoritative mothers.

The present study

The present study aimed to contribute to the growing literature on adolescent perspectives on parenting. Three main objectives were addressed. First, the study tried to identify meaningful groups of parents (i.e., parenting styles) in longitudinal adolescent reports on parenting behaviour based on the five-dimensional parenting model by Janssens et al. [26]. Previous studies on parenting styles categorised parents based on the parents' levels of responsiveness and demandingness. The present study is in line with these studies but refines the dimension demandingness into the dimensions psychological, behavioural, proactive control, and harsh punishment and operationalises responsiveness as support. This study is, as far as we know, the first to look into the stability and distribution of parenting styles in adolescence based upon data-driven allocation. The study included three data waves, and every wave was clustered separately. Second, the dimensional structure of every cluster was inspected to uncover differences in parenting behaviour between clusters and the dimensional structure of parenting behaviour within clusters. This approach aims to examine whether the dimensions have the same meaning in every style. Third, the identified clusters were compared on several adolescent characteristics (problem behaviour and self-concept), to examine the criterion validity of the parenting typology. These two outcome measures are carefully chosen to highlight the impact of styles upon the development of both adaptive and maladaptive functioning in adolescents given that previous research has indicated that parenting has a long-lasting influence on these characteristics. Fourth, to examine the impact of change in parenting style over time, we looked at the cluster membership over time.

Based on the typology of Maccoby and Martin and the study of Timmerman [34–36, 46, 58] some hypotheses could

be formulated. We expected to find at least two parenting styles, namely authoritative and authoritarian parenting. Based on the study of Timmerman et al. [58] we expected dimensional intercorrelations to differ between styles. More specifically, the dimension proactive control (which is related to monitoring) is hypothesised to play a different role depending on the parenting style. In the authoritative parenting style, adolescent participation and communication about rules and arrangements is encouraged by authoritative parents [62]. As a result, adolescents with authoritative parents may interpret proactive control as a 'positive' form of control, whereas adolescents with authoritarian parents may perceive proactive control as 'restrictive' control. Furthermore, we expected cluster membership to be linked to adolescent self-concept and problem behaviour. Taking into account the results of previous studies, we hypothesised that adolescents within the cluster identified as authoritative to report less externalising problems [41, 42, 63], and to show a higher global and academic self-concept [38], compared to adolescents from other clusters that might emerge.

Method

Participants and procedure

Data were gathered within the longitudinal study STRATEGIES (i.e., Studying Transactions in Adolescence: Testing Genes in Interaction with Environments), which started in 2012 [26]. Participants, students from Grades 7–9, were recruited in nine schools in Flanders, the Dutch-speaking part of Belgium. Adolescent data were collected during school visits or completed within two weeks at home when extra time was needed. In total 2254 participants were invited to participate. At wave 1, a total of 1,116 adolescents (mean age = 13.79 years; $SD = 0.93$, 51% boys) participated in the study (response rate 49.5%). Of the adolescents 97.9% had the Belgian nationality; the most common nationality if not Belgian was Dutch, Moroccan, and Turkish. From the participating families, 79.1% was an intact family (at least one child and both biological parents live together in one household), 7.3% was a one-parent family, 9.8% of the families was a newly blended family. More than half of the families reported a net monthly income above 4300 euro, 15.1% of the families reported an income below 2600 euro (poverty threshold for a family with two children and two adults), which is in line with the poverty risk of families in Belgium [64]. Parents most frequently reported levels of education were high school graduate (28% and 37%, respectively for mothers and fathers), bachelor's degree (53% and 35%), and master's degree (16% and 20%), which is in line with the educational level in the general Flemish population of males and females aged between 25 and 64 years [65]. Family net income influenced dropout (i.e., retention rate was significantly higher when family net income was higher), and family composition and level of education (mothers and fathers) influenced dropout in the third wave (i.e., retention rate was significant higher in intact families and when parents reported a higher educational level).

The present study analysed data from the first three annual waves. From the 1116 adolescents participating in the study, 1095 adolescents completed the parenting measures at wave 1, 989 adolescents at wave 2 (retention rate: 90.32%), and 880 adolescents (retention rate: 80.37%) at wave 3. An active informed consent form was signed by parents and adolescents who assented to take part in a study. Approval for the study was obtained from the Institutional Review Board of the Faculty of Medicine at KU Leuven (ML7972).

Measures

Item examples and Cronbach's alphas as an index for internal consistency are reported for all measures in Table 1.

Parenting measures

Clustering was based on the five-dimensional parenting model proposed by Janssens et al. [26]. Confirmatory factor analyses in this study showed evidence for a five-dimensional parenting model comprising of proactive control, harsh punishment, punitive control, psychological control, and support. We opted to combine different measures of the same construct prior to cluster analysis, based on guidelines in Family psychology research [66]. It is advised to select non-redundant measures of relevant theoretical constructs and to combine different sources of information into higher order measures based on confirmatory factor analysis or another similar method.

Parenting was assessed by 64 items from ten subscales from several questionnaires (for an overview, see Table 1).

Based on the CFA by Janssens et al. [3], who used the same wave 1 data as in the current study, the ten subscales were combined into several dimensions (mean score of the items). The dimension Parental support included 16 items from the subscales Positive Parenting (PPS), Responsivity (LAPPS), and Autonomy Support (PPS). Proactive control included 11 items from the subscales parental expectations for behaviour (PRS) and Monitoring (PRS). Psychological control consisted of 15 items from the subscale psychological control (PCS) and hostility (VHS). The fourth and fifth dimensions, Punitive control and Harsh punishment, respectively, are reflected by the subscales of the same name in the PBS-S questionnaire, five items each. The five-factor model of parenting is in line with tripartite classification of support, behavioural control, and psychological control [7] and refines this classification by distinguishing three aspects

Table 1 Overview Questionnaires

Parenting Questionnaires	Subscale (item example, *n*, *α W1, α W2, α W3*)
Louvain adolescent perceived parenting scale (LAPPS) [69]	Responsivity (e.g., "My parents like to spend time with me.", seven items, *α W1* = 0.89, *α W2* = 0.89, *α W3* = 0.75)
Parental behaviour scale short (PBS-S) [70]	Positive Parenting (e.g., "If I want to tell something, my parents take their time for listening to me", eight items, *α W1* = 0.82, *α W2* = 0.83, *α W3* = 0.75)
	Rule setting (e.g., "My parents teach me that I have to keep my promises.", five items, *α W1* = 0.83, *α W2* = 0.86, *α W3* = *0.89*)
	Punishment (e.g., "If I object, lie or argue, my parents give me a punishment.", four items, *α W1* = 0.86, *α W2* = 0.88, *α W3* = 0.89)
	Harsh punishment ("e.g., My parents hit me when I have done something I'm not supposed to do.", five items, *α W1* = 0.89, *α W2* = 0.90, *α W3* = 0.89)
Parental regulation scale (PRS) [71]	Parental expectations for behaviour (e.g., "My parents wants to control whatever I do.", six items, *α W1* = 0.78, *α W2* = 0.81, *α W3* = 0.82)
	Parental monitoring of behaviour (e.g., "My parents remind me of the rules they made.", six items, *α W1* = 0.66, *α W2* = 0.65, *α W3* = 0.69)
Perceptions of parents scale (PPS) [72] and research assessment package for schools [73]	Autonomy support (e.g., "My parents take into account my opinion on affairs that concern me.", eight items *α W1* = 0.69, *α W2* = 0.71, *α W3* = 0.73)
Psychological control scale (PCS) [74]	Psychological control (e.g., "My parents do not talk to me when I disappointed them until I please them again", 8 items, *α W1* = *0.70, α W2* = *0.75, α W3* = *0.75*)
Verbal hostility scale (VHS) [28]	Hostility (e.g., "My parents yell or shout when I misbehave.", 6 items, *α W1* = *0.85, α W1* = *0.87, α W3* = *0.87*)
Questionnaire outcomes	Subscale (item example, *n*, *α W1*, *α W2*, *α W3*)
Youth self-report [75, 76]	Rule breaking (e.g., "I disobey my parents.", 14 items, *α W1* = 0.59, *α W2* = 0.66, *α W3* = 0.63)
	Aggressive behaviour (e.g., "I get into many fights.", 17 items, *α W1* = 0.81, *α W2* = 0.80, *α W3* = 0.78)
Self-descriptive questionnaire-II [77]	Global self-concept (e.g. "Overall, I have a lot to be proud of.", 8 items, *α W1* = *0.81, α W2* = *0.84, α W3* = *0.88*)
	Academic self-concept (e.g., "I am too stupid at school to get into a good university.", ten items, *α W1* = 0.86, *α W2* = 0.88, *α W3* = 0.89)

W1 wave 1, *W2* wave 2, *W3* wave 3

of behavioural control, that is, proactive, punitive, and harsh punishment.

All items were rated on a 5-point Likert scale ranging from (1) "(almost) never" to (5) "(almost) always". Adolescents rated parenting behaviour without differentiating between maternal and paternal parenting. Previous research by Van Heel et al. [27] on the same sample, showed full scalar measurement invariance of the five parenting dimensions across the three waves.

Adolescent externalising problems and self-concept

The presence of externalising problem behaviours, including rule breaking and aggressive behaviour, was measured by the Youth Self Report (YSR) [67, 68]. Higher scores indicate more reported Externalising problems. All items were rated on a 3-point Likert scale ranging from (0) "Totally not" to (2) "Clearly or often".

Self-concept, including Global and Academic self-concept, was measured with the Self-Descriptive Questionnaire-II (SDQ-II) [69]. Higher scores indicate a higher Self-concept. All items were rated on a 6-point Likert scale ranging from (1) "False" to (6) "True".

Analyses

Our study used subspace *k*-means cluster analysis, to distinguish clusters based on the five parenting dimensions, in each wave separately. This analysis aims at finding mutually exclusive clusters from subspaces of data (i.e., part of the observed multivariate data) instead of the entire data space (i.e., the observed multivariate data) [70]. This type of analysis simultaneously models the centroids (hence what 'defines' a group of parents based on -a part of- the data or how these groups differ) and the within-cluster residuals in subspaces (known as what differentiates members of a group within its own group). Therefore, a component analysis approach is used, which identifies components to explain variance by grouping the variance within components [58, 71]. The location of each centroid is identified via scores

on a few between-components (which are weighted sums of the observed variables), capturing the main differences between the clusters. The within-cluster variability in the observed variables is represented into a few cluster-specific within-cluster components [58]. As an example, consider Fig. 1 which shows clustering of individuals into two clusters (i.e., 1 between-component and 1 within-component per cluster). The components are computed as weighted sums of the variables. The loadings on the components reflect the weights of the underlying parenting dimensions in these sums. Since the loadings are scaled such that the squared loadings on each component sum up to one, each parenting dimension would have the same influence on a component, if all loadings would equal 0.45. Therefore, we regard loadings as high if they exceed the cut-off of 0.45 [58].

This analysis was performed with the software package Matlab [72]. Each wave was clustered separately. SPSS Multiple imputation was used to replace missing values on the five dimensions, and imputation was based on all parenting items in the three waves. Imputations for 20 adolescents were made for wave 1, 126 imputations for wave 2, and 231 for wave 3. To avoid the clustering to be driven by differences in variance in the five dimensions, all dimensions were standardised. To limit computation time and following previous research [35, 58] the maximum tested number of clusters was four, with a maximum of four within-components. To determine the optimal number of clusters, between and within-components, we made use of the convex hull-based model selection (Chull) procedure [73–75]. The chull procedure is a formal criterion procedure to select a model with an optimal balance between goodness-of-fit measure and the complexity of the model.

All other analyses were carried out in SPSS [76]. Consistency of cluster solutions across time was measured using Cohen's Kappa [77]. All outcome measures (i.e., YSR and SDQ-II) were standardised based upon raw scale scores. One-way ANOVA was used to test group differences in adolescent outcome measures and parenting dimensions. When the assumption of equality of group variances was violated, the Brown-Forsythe *F* test was used.

Results

Configuration selection

The Chull procedure [73–75] suggested to retain the model with two clusters, one between-component and three within-components in all three waves. This configuration explained 92.55, 92.59 and 92.77% of the variance in wave 1, 2, and 3, respectively.

Cluster structure

Cluster between-components

The selected solution in all three waves clearly distinguished two parenting clusters, as indicated by the between-component scores for every cluster, are shown in Table 2.

The loadings of the five parenting dimensions on the single between-component (Table 3) specified the two identified parenting clusters. This between-component showed a

Table 2 Between-component score

	Cluster 1	Cluster 2
Wave 1	0.464	− 1.804
Wave 2	0.407	− 1.841
Wave 3	0.402	− 0.749

Cluster 1: authoritative parenting, cluster 2: authoritarian parenting

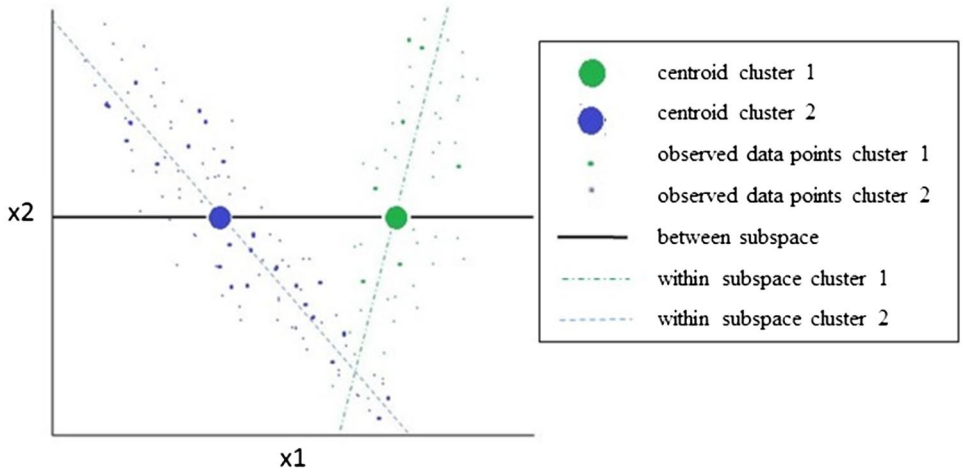

Fig. 1 Example subspace *K*-means clustering

Table 3 Between-component Loadings on the five parenting dimensions

	Proactive Control	Harsh punishment	Punitive control	Psychological control	Support
Wave1	−0.08	**−0.74**	−0.27	**−0.53**	0.29
Wave2	−0.07	**−0.76**	−0.23	**−0.51**	0.33
Wave3	−0.05	**−0.73**	−0.07	−0.38	**0.56**

Loadings > |0.45| are indicated in boldface

Table 4 Consistency in ratings over time

	Kappa value	Asymptotic standard error	Approximate (*T*)
Clustering wave 1 × wave 2	0.404	0.034	13.497***
Clustering wave 1 × wave 3	0.241	0.030	8.554***
Clustering wave 2 × wave 3	0.281	0.029	10.280***

*$p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.001$, $N = 1109$

high negative loading (> |0.45|) [58] in harsh punishment in all three waves. In both wave 1 and wave 2 psychological control had a high negative loading, whereas in wave 3 it had a moderate negative loading. Support showed a positive loading in all waves, with a high loading in wave 3. Based on the loading of the clusters on the between-component, we labelled the two obtained clusters as 'authoritative parenting' and 'authoritarian parenting' types.

Although between-component loadings show some changes over time, loadings never change substantially and any change follows a trend (i.e., differences in between-component loadings on psychological control decline between waves and differences in support increase). Thus, we conclude that the interpretation of the clusters does not change over time.

Cohen's kappa was used to measure cluster membership consistency between two time points (Table 4). All Cohen's kappa coefficients were significantly different from zero, meaning that overlapping cluster membership in the different waves is not merely the result of random chance. However, cluster membership consistency between two time points ranged from minimum to weak according to standards by McHugh [77]. Kappa values were larger when waves were closer in time (e.g., Kappa values wave 1 versus wave 2 was larger than Kappa values wave 1 versus wave 3).

Depending on membership per wave, eight different 'change' patterns were possible (hereafter called membership trajectories): two patterns were 'stable' (in all three waves being member of the same cluster, in total 60.60% of the sample, so either member of cluster 1 in all waves or member of cluster 2 in all waves), whereas six patterns could be marked as 'unstable' (membership shifting across waves) (Table 5).

Cluster within-components

The within-cluster components were varimax rotated to allow a more easy interpretation of the within-component structure. The structure differed between the two clusters. The structure in the authoritative cluster was consistent across the three waves (Table 6). The first component primarily showed a positive loading on the dimension proactive control, the second component indicated a positive loading on support and a negative loading on psychological control, and punitive control loaded positively on the third component. The structure in the authoritarian cluster was not completely consistent over time (Table 6). The first

Table 5 Wave membership

Wave 1	Membership	*N* (%)	Wave 1-2	Membership	*N* (%)	Wave 1-2-3	Membership	*N* (%)
1	882	79.53	1-1	792	71.42	1-1-1	586	52.84
						1-1-2	206	18.58
			1-2	90	8.12	1-2-1	43	3.88
						1-2-2	47	4.24
2	227	20.47	2-2	111	10.01	2-2-2	86	7.75
						2-2-1	25	2.25
			2-1	116	10.46	2-1-1	68	6.13
						2-1-2	48	4.33

Membership can either be 1 = cluster 1 or 2 = cluster 2, e.g., 1-2-1 equals cluster 1 in wave 1, cluster 2 in wave 2, cluster 1 in wave 3, cluster 1: authoritative parenting, cluster 2: authoritarian parenting

Table 6 Within-cluster Components Authoritative and Authoritarian cluster

Wave 1	Authoritative type			Authoritarian type		
	Component 1	Component 2	Component 3	Component 1	Component 2	Component 3
Proactive Control	**0.95**	−0.06	0.01	0.00	0.03	**0.62**
Harsh Punishment	0.02	−0.08	0.02	**0.99**	0.02	0.03
Punitive Control	0.01	−0.05	**1.00**	0.08	−0.27	**0.56**
Psychological Control	0.19	**−0.65**	−0.08	−0.07	**−0.79**	0.20
Support	0.25	**0.75**	0.00	−0.11	**0.52**	0.55
Wave 2	Component 1	Component 2	Component 3	Component 1	Component 2	Component 3
Proactive Control	**0.96**	−0.08	0.00	−0.04	**0.44**	**0.53**
Harsh Punishment	0.02	−0.09	0.00	**1.00**	0.00	0.01
Punitive Control	0.00	−0.01	**1.00**	0.03	0.06	**0.55**
Psychological Control	0.14	**−0.68**	0.02	−0.02	−0.38	0.64
Support	0.24	**0.72**	0.00	0.00	**0.81**	−0.03
Wave 3	Component 1	Component 2	Component 3	Component 1	Component 2	Component 3
Proactive Control	**0.97**	0.00	0.00	−0.11	**0.55**	0.37
Harsh Punishment	0.00	−0.09	0.05	**1.00**	0.00	0.03
Punitive Control	0.00	−0.04	**1.00**	0.02	0.16	**0.58**
Psychological Control	0.16	**−0.74**	−0.08	0.02	−0.21	0.70
Support	0.18	**0.67**	−0.01	0.07	0.79	−0.19

Loadings > |0.45| are indicated in boldface

component was consistent across the three waves, with harsh punishment loading highly on this component. The second and third components were not consistent across the three waves. In wave 1, Psychological control loaded negatively and support positively on the second component, proactive, punitive control and support all loaded highly on the third component. In wave 2 and wave 3, proactive control and support loaded highly on the second component. Proactive control, punitive control, and psychological control loaded highly on the third component.

Differences in externalising behaviours and self-concept between clusters

The authoritative and authoritarian cluster were compared on self-reported externalising problems (i.e., aggressive and rule breaking behaviour), and global and academic self-concept using a one-way ANOVA. To test whether cluster membership is linked to these variables cross-sectionally and longitudinally, cluster membership in wave 1 was used to test differences in variables at waves 1, 2, and 3, cluster membership in wave 2 for variables at waves 2 and 3, and cluster membership in wave 3 for variables at wave 3. Adolescents with parents in the authoritarian cluster reported significantly more externalising problems compared to adolescents in the authoritative parents cluster and for both the subscales, Rule breaking and Aggressive behaviour (Table 7) at the same wave and subsequent waves.

Adolescents with parents in the authoritative cluster reported significantly higher levels of global self-concept compared to adolescents in the authoritarian parents cluster (Table 7) at the same wave and the subsequent waves. Adolescents with parents in the authoritative cluster reported significantly higher levels on academic self-concept compared to adolescents in the authoritarian parent cluster (Table 6) in the same wave.

Longitudinal associations between cluster membership and adolescent outcome

Change in cluster identity is associated with change in adolescents' social and emotional development. Looking into membership trajectories showed that a change in membership from the authoritative cluster to the authoritarian cluster is associated with problematic child development (lower self-concept and more externalising problem behaviour, Fig. 2).

Discussion

In the current study, grouping of parents was data-driven, as such subdividing parents is based upon actual similarities and dissimilarities within data. Following the approach

Table 7 Externalizing problems subscales and self-descriptive questionnaires subscales

Cluster membership	Timepoint measurement	Outcome variable		Mean	*N*	SD	*Df*	*F*	B–F	Cohen's *d*
Wave 1	Wave 1	YSR rule breaking behavior	Authoritative	−0.121	873	0.897	1271.699		46.709	0.616
			Authoritarian	0.477	221	1.221			***	
		YSR aggressive behavior	Authoritative	−0.138	872	0.855	1269.841		54.415	0.708
			Authoritarian	0.543	221	1.303			***	
	Wave 2	YSR rule breaking behavior	Authoritative	−0.105	790	0.895	1249.390		30.802	0.538
			Authoritarian	0.421	198	1.256			***	
		YSR aggressive behavior	Authoritative	−0.102	790	0.889	1246,711		27.757	0.534
			Authoritarian	0.421	198	1.279			***	
	Wave 3	YSR rule breaking behavior	Authoritative	−0.084	714	0.918	1207.663		19.403	0.457
			Authoritarian	0.366	165	1.236			***	
		YSR Aggressive behavior	Authoritative	−0.079	714	0.917	1206.976)		16.892	0.428
			Authoritarian	0.343	165	1.245			***	
Wave 2	Wave 2	YSR rule breaking behavior	Authoritative	−0.117	830	0.871	1182.540		42.669	0.757
			Authoritarian	0.613	158	1.353			***	
		YSR aggressive behavior	Authoritative	−0.107	830	0.869	1181.160		34.101	0.689
			Authoritarian	0.561	158	1.387			***	
Wave 3	Wave 3	YSR rule breaking behavior	Authoritative	−0.100	611	0.906	1416.524		17.069	0.333
			Authoritarian	0.229	268	1.157			***	
		YSR aggressive behavior	Authoritative	−0.061	611	0.944	1445.031		6.712	0.202
			Authoritarian	0.140	268	1.106			**	
Wave 1	Wave 1	SDQ global	Authoritative	0.053	871	0.990	1,1092	12.125		−0.261
			Authoritarian	−0.207	223	1.012		***		
		SDQ school	Authoritative	0.057	868	0.993	1,1089	13.957		−0.281
			Authoritarian	−0.222	223	1.000		***		
	Wave 2	SDQ global	Authoritative	0.032	789	1.005	1985	4.048		−0.159
			Authoritarian	−0.127	198	0.971		*		
		SDQ school	Authoritative	0.037	789	1.007	1985	5.527		−0.187
			Authoritarian	−0.149	198	0.957		*		
Wave 2	Wave 2	SDQ global	Authoritative	0.058	830	0.946	1194.139		12.864	−0.367
			Authoritarian	−0.306	157	1.203			***	
		SDQ school	Authoritative	0.046	830	0.976	1206.169		9.896	−0.295
			Authoritarian	−0.247	157	1.088			**	
	Wave 3	SDQ global	Authoritative	0.039	752	0.960	1156.589		5.934	−0.270
			Authoritarian	−0.230	128	1.186			*	
		SDQ school	Authoritative	0.016	752	0.992	1878	1.321		−0.110
			Authoritarian	−0.094	128	1.045		***		
Wave 3	Wave 3	SDQ global	Authoritative	0.082	612	0.943	1878	13.681		−0.272
			Authoritarian	−0.188	268	1.099		***		
		SDQ school	Authoritative	0.057	612	0.989	1878	6.629		−0.189
			Authoritarian	−0.131	268	1.014		**		

Cluster 1: authoritative parenting, cluster 2: authoritarian parenting

B-F Brown-Forsythe *F* test

*$p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.00$

suggested by Gorman-Smith et al. [66] clustering was based on previous confirmatory factor analysis. As such, clustering was based on the five-dimensional parenting model proposed by Janssens et al. [26], comprising proactive control, harsh punishment, punitive control, psychological control, and support. This method allowed to refine the underlying

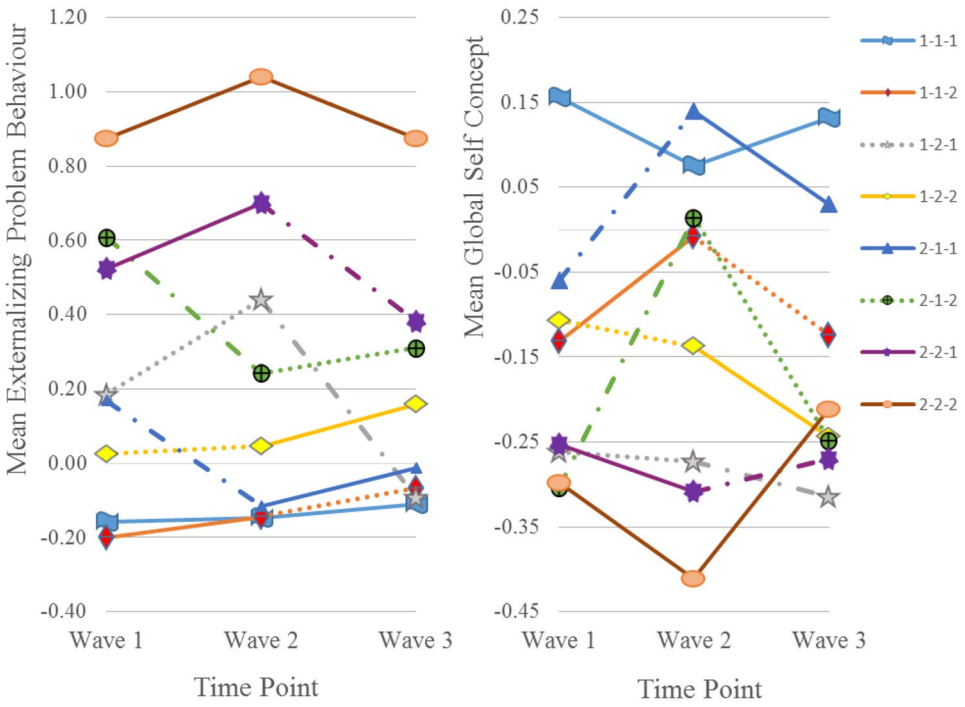

Fig. 2 Trajectory based upon membership in every wave. Authoritative cluster is identified as cluster 1; authoritarian cluster is identified as cluster 2. If membership changed from cluster 1 to cluster 2, the line between time Points is dotted; if membership changed from cluster 2 tot cluster 1, the line between time points is dash dotted; if membership did not change between time points the line is solid

parenting dimensions previously used in the research of parenting styles. In line with Timmerman et al. [58], we found two distinct parenting groups in each wave. The optimal model complexity was identical in all three waves, including two clusters, one between-component and three within-components. Furthermore, an in-depth interpretation of the identified groups was possible, both by looking into group differences and differences between individuals within groups on the one hand and the dimensional interplay on the other hand, combining the strengths of both dimensional and style approaches. Although subspace *k*-means clustering has been used to report on data from one study on parenting before [58], the current study is, to our knowledge the first to use this method on longitudinal data.

Defining the two parenting groups

The single between-component allows researchers to clarify the distinction between the two groups. Interestingly, although cluster identification was performed for each wave separately, the between-component was largely stable over time. In the first two waves, the between-component mainly contrasted harsh punishment and psychological control, which implies that the two parenting types mainly differ in the extent to which adolescents report psychologically and physically controlling behaviour by their parents. Over time the contrast between psychological control decreased between the two groups, whereas the contrast between support increased. In the third wave, the parenting types are also distinguished by the amount of support. Because previous parenting typologies have proposed similar styles based on levels of control (a concept related to 'demandingness') and support (related to 'responsiveness') [57], we labelled the two groups as authoritative parenting and authoritarian parenting. One group of adolescents clearly experienced the behaviour of their parents as more positive, with lower loadings on harsh punishment and psychological control and a higher loading on support in the third wave. We did not consider this group as 'permissive'. Permissive parents are reluctant to enforce standards of conduct [46]. Differentiation between the clusters was less based upon the dimensions proactive control and punitive control (e.g., lower loadings on the between-factor). In case of permissive parenting, we would expect differentiation between the clusters based on all control dimensions (e.g., high loadings on punitive control, harsh control, psychological control, and proactive control), but we did not see this pattern occur.

In prior literature regarding parenting styles, authoritative and authoritarian groups have been distinguished by the presence or absence of support (i.e., responsiveness) whereas both are high on demandingness. However, our results indicate that specific types of control (i.e., harsh punishment and psychological control) are also important in defining authoritarian and authoritative parenting styles.

Research about the distribution of parenting styles in a community sample is lacking. As a consequence, it is difficult to draw strong conclusions about finding two instead of four distinct styles as proposed by Maccoby and Martin [57]. This might result from the statistical method used, namely variance is not only explained by adding clusters (in this

case identifying styles), but also explained by the within-component that allows variance within the clusters (reported parent behaviour can vary within a style). Or it might be that finding two styles is the result of sampling: data were collected in a general population sample with active consent, probably making the group of adolescents with parents with serious parenting issues or who exhibit low levels of all forms of control small or underrepresented [4]. A third possible explanation relates to a more theoretical level: the used parenting questionnaires might not assess all necessary parenting dimensions to capture all possible parenting styles. For example we might have found a permissive style by directly measuring the dimensions lax discipline (e.g., not being able to say no to an adolescent) and nonenforcement (e.g., not paying much attention to adolescent misbehaviour [78]).

Differentiation within parenting groups

To gain insight into the differences within each separate cluster, we examined the within-components structure in more detail, which summarised the within-cluster variability in the observed dimensions [58]. Within-cluster variability in the authoritative parenting group was stable over time; hence differentiation within the authoritative parenting group was based upon the same three components. The parenting dimensions proactive control and punitive control loaded positively on two separate components, whereas a third component showed a high negative loading on psychological control and a high positive loading on support. This implies that in the authoritative cluster proactive control was clearly distinguished from punitive control and that parents who are perceived as supportive tend to be seen as using low levels of psychological control. This result is not completely in line with the finding from Timmerman et al. [58] that monitoring (conceptualised as asking about the activities of the child to prevent unwanted behaviour) in the authoritative cluster is related to support and can be considered as a way of showing interest in children. However, the proactive control dimension in the current study included not only parenting behaviours related to monitoring, but also parenting practices that refer to setting rules and clarifying parental expectations about adolescent behaviour.

The within-component structure for the authoritarian parenting group was wave-dependent. This might imply that the perceptions of adolescents in the authoritarian parenting group change when they grow older (the same parenting behaviour is differently interpreted). Only harsh punishment loaded highly on a first component, independent of wave. In other words, harsh punishment was not correlated to the other parenting dimensions. The other two components are more challenging to interpret because for some components loadings changed across waves. Nevertheless, a general trend is present in the three waves. The second component included a contrast between support and psychological control, which is comparable to the second component in the authoritative cluster. The third component mainly pertains to aspects of control, and included all control dimensions (i.e., proactive, punitive, and psychological control), except for harsh punishment. Thus, according to the adolescents in this authoritarian parenting group, when parents apply one form of control, they probably use the other forms of control as well. In the first wave, but not in the subsequent waves, support also was positively correlated with these forms of control. This might imply that adolescents in the authoritarian parenting group on a younger age perceive control also partly as support. Hence parental rules may function in this case as helping guidelines, but when adolescents grew older they might perceive expression of control as a lack of trust and not as an expression of support.

A comparison of the two parenting types showed that the parenting dimensions correlated in a different way within each type. This is particularly striking for proactive control. In the authoritative parenting group this dimension was uncorrelated with the other parenting dimensions and thus seems to function as a non-invasive form of parental control, used to prevent unwanted child behaviour. In contrast, in the authoritarian parenting group, proactive control was linked to other forms of control, leading to the conclusion that rule setting occurs in a different, and maybe a less constructive climate. For instance, the sentence: "I want you home at 2AM.", might be perceived completely different by the adolescent depending upon the parenting style. Some adolescents might feel that their parents care about them, while others might have the feeling that their parents try to restrict them. This is an interesting finding because it stresses the importance to explore new methods (e.g., subspace *k*-means clustering) to refine previous findings based solely on either a dimensional or a parenting style-approach.

Associations between parenting groups and adolescent externalising problem behaviour and self-concept

A further validation effort of the two parenting types was performed by comparing self-reported problem behaviour and self-concept across the two parenting clusters. Adolescents within the authoritative parenting cluster reported less externalising problems than adolescents within the authoritarian parenting cluster, for both subscales, namely rule breaking and aggressive behaviour. Cluster membership (i.e., parenting style) significantly predicted self-reported externalising problems in subsequent waves, with adolescents belonging to the authoritative parenting cluster reporting less externalising problems in later waves. In addition, adolescents within the authoritative cluster reported a higher

self-concept (both global and academic) compared to adolescents from the authoritarian cluster.

The study showed that around 20–30% of the samples in wave 1 and wave 2 were allocated to the authoritarian cluster. In wave 3 the authoritarian group was larger (35%); however, developmental changes in adolescence can explain these findings. An important developmental task in adolescence is an increase in autonomy [78], and more conflict may occur between parents and adolescents as a result [79–82]. Adolescence is a period of fast social-cognitive development, especially in late adolescence [83], and disagreement between parent and adolescent might promote typical youth individuation processes [84–87]. This may influence both the perception of the adolescents on parenting and the interaction with their parents (e.g., parents trying to exert control), thus affecting the clustering.

Clinical relevance

Our findings highlight the importance of identifying parenting styles based on adolescents' perspectives on parenting. Identification of parenting styles in adolescence may prevent the risk to develop social and emotional problems such as low self-esteem and externalising problem behaviour [88]. In this study we identified a group of parents that was categorised as authoritarian in all waves (7.75%). These adolescents and their families might benefit from professional guidance on parent-adolescent relationships (e.g., in family therapy) [89] that influence the patterns of family functioning [90]. Differentiated parenting advice (e.g., psycho-education) depending on cluster trajectories might increase intervention effectiveness [88].

Additionally, harsh punishment and psychological control might influence adolescents' perception of their relationships with their parents [19]. Parents need to be advised that in an attempt to exert control, the adolescent might misinterpret their behaviour as intrusive control. Thus, unintentionally, their attempt might impact negatively on the parent–adolescent relationship. However, rule setting might work in a positive adolescent–parent environment (i.e., supportive parents who show genuine interest in their adolescents' lives and try to monitor adolescent behaviour in a constructive manner) [26].

Our findings also highlighted that parents need to take the adolescents' age into consideration and adjust their parenting accordingly [91, 92]. For example, the authoritative style was mostly used in this community sample (52.84% of the sample was categorised as authoritative in all three waves). Furthermore, some parents seemed to change their parenting style in a positive way across adolescence (8.38% of the sample was first categorised as authoritarian but later on, either in wave 2 or wave 3, parents in this group changed towards an authoritative style). Thus our findings are similar to the research of Branje [91, 93]; namely that age plays a significant role in the perception of parenting styles. Younger adolescents might perceive parents' controlling behaviour as supportive. However, as the adolescents grow older, parental control might be perceived as invasive and no longer perceived as a sign of support.

Strengths and limitations

Although the study has many strengths, including its reliance on a large dataset, its use of a longitudinal design, and the use of an empirically valid parenting dimensions model, a number of limitations should be noted. First, although drop-out is inherent to a longitudinal study, drop-out in our study is associated with demographic variables which might have influenced the results. More specific because we see important changes depending on age, more research is needed to replicate these findings to ensure that found effects are the direct result of developmental changes. Second, the study was conducted in Flanders; thus the sample was limited to predominantly Caucasian families. Because parenting is culture-specific [32], findings from this study may not generalise to other cultural contexts. Future cross-cultural research based on the five-dimensional parenting model using subspace *k*-means clustering would allow to identify culture-specific clusters and distributions. Third, as mentioned, no reliable estimations are available from a general population about the allocation of parenting styles. We proposed some ideas (e.g., on a theoretical level, sample level, methodological level) that can explain these findings; however, more research is needed to test these ideas. Moreover, future research would benefit from observational measures to capture parents' levels of the five dimensions. Adolescent report and behavioural observation scores could be compared, and the association between adolescent outcomes and parenting groups based on observational measures could be explored.

Last, adolescents reported on both parents simultaneously and only the perception of the adolescent was taken in account, limiting the scope of the findings to the viewpoint of adolescents on their parents. In the future, research could benefit from a differentiation between maternal and paternal parenting, because differences between parents may have different implications for adolescent outcomes. For example, it could be examined whether an adolescent with two authoritarian parents develops more externalising problem behaviours than an adolescent with only one authoritarian parent.

Conclusion

To conclude, based upon adolescents' reports, two parenting styles were identified, an authoritative and an authoritarian cluster. Adolescents from the authoritative cluster

reported a higher self-concept and less externalising problem behaviours. Independent of style, psychological control and support correlated negatively; hence if adolescents report more psychological control, they report less support. In the authoritarian cluster the dimension proactive control correlated highly with other control dimensions, whereas in the authoritative cluster proactive control is uncorrelated to other dimensions. This might indicate that adolescents' perceptions of rule setting depend upon the parenting style. The results of our study suggest that it is possible to capture the complex interplay of group membership (parenting styles) and dimensional information by combining the information from multiple dimensions into non-arbitrary groups.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Informed consent Written informed consent was obtained from all individual participants included in the study, as well as from a parent or legal guardian of each participating child.

Ethical approval All procedures involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Approval for the study was obtained from the Institutional Review Board of the Faculty of Medicine at KU Leuven (ML7972).

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