

# ■ Predicting smoking among young people: Prospective associations from earlier developmental stages

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## Abstract

Despite the wide body of research conducted on adolescent smoking, most studies have been cross-sectional, which precludes a proper identification of prospective predictors over time. Long-term longitudinal studies aimed to analyze whether distal predictors of smoking behaviors may be identified at early life stages are particularly scarce. This study was completed by collecting data from a wider longitudinal study on child development, analyses predictors of smoking at late adolescence by considering a number of family, peer, school, personality and behavioural/emotional factors measured at early adolescence. It also analyses if a number of temperamental and behavioral variables measured in childhood may be distal predictors of adolescent smoking. Self-reported and parent-reported data was collected from 192 children in 2002; 115 of them could be followed-up in 2009 and 2013. Results indicate that at early adolescence family atmosphere (closeness, support), involvement with antisocial peers, school failure, sensation seeking and externalizing problems predict changes in smoking through the following years. In childhood, externalizing problems, impulsivity/self-control, sensation seeking and limited emotional processing emerge as long-term predictors of adolescent smoking. Children with significant parent-reported externalizing problems show more unfavourable development in smoking patterns during adolescents. These results support theoretical models which underline early externalizing problems, and factors associated to them, as risk indicators for dysfunctional development through time. Results also suggest that the targeted intervention on early-onset externalizing problems might be a useful way to prevent later smoking, among other negative outcomes.

*Keywords: smoking, adolescence, childhood, predictors, longitudinal study, externalizing problems.*

## Resumen

*Predictores del consumo de tabaco en los jóvenes: Relaciones prospectivas desde etapas tempranas del desarrollo.* Aunque se ha desarrollado un amplio cuerpo de investigación en torno al consumo de tabaco en adolescentes, la mayor parte de los estudios han sido transversales, lo cual impide una adecuada identificación de los predictores del hábito de fumar. Son particularmente escasos los estudios a largo plazo, que examinen predictores distales en etapas tempranas de la vida. Este estudio analiza predictores del consumo de tabaco en la adolescencia tardía partiendo de factores evaluados en la adolescencia temprana y en la niñez. En 2002, se recogieron datos en 192 niños, de los cuales 115 pudieron ser evaluados también en 2009 y 2013. Los resultados indican que, en la adolescencia temprana, la atmósfera familiar (cercanía, apoyo), la implicación con iguales antisociales, el fracaso escolar, la búsqueda de sensaciones y los problemas externalizantes predicen cambios en el consumo de tabaco. En la niñez, problemas externalizantes, impulsividad/autocontrol, búsqueda de sensaciones y dificultades en el procesamiento emocional predicen a largo plazo el consumo de tabaco. Además, los niños con problemas externalizantes significativos muestran, durante la adolescencia, un desarrollo más desfavorable en su patrón de consumo. Estos resultados apoyan los modelos teóricos que subrayan la importancia de los problemas externalizantes tempranos, y de los factores asociados a ellos, como indicadores de riesgo para un desarrollo disfuncional. Los resultados también sugieren que la intervención sobre problemas de conducta tempranos puede ser una vía útil para prevenir el posterior consumo de tabaco, entre otras dificultades conductuales.

*Palabras clave: consumo de tabaco, adolescencia, niñez, predictores, estudio longitudinal, problemas externalizantes.*

Tobacco consumption is one of the most important concerns for public health agencies in Western societies. Smoking is known to be a main risk factor for severe health problems, with acknowledged harmful effects not only for the smoker, but also for the surrounding persons.

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It is considered as the leading cause of preventable death in the world, accounting for almost 6 million deaths annually, including more than 600,000 through exposure to second-hand smoke. Despite the decreasing trend in smoking prevalences during the last decade, it is estimated that, in Europe, 16% of all deaths in adults over 30 are due to tobacco, which is supposed to be the highest in the world (WHO, 2016).

Adolescence is known to be a critical stage for understanding the development of tobacco consumption. Most adults smokers had their first cigarette, or were already addicted to nicotine by the age of 18. According to epidemiological studies in Spain (Plan Nacional de Drogas, 2015), among adolescents aged 14-18, 31.4% have smoked sometime in their life, and 25.9% have smoked recently. Apart from the immediate harmful effects of tobacco on young people (higher risk of asthma, impaired lung function and growth, deterioration of physical efforts), exposure to nicotine during adolescence may have long lasting effects on brain development (WHO, 2016), and it is associated to a number of bad outcomes for mental health, like lower life satisfaction, unhealthy eating habits, depression and anxiety (Crone & Reijneveld, 2007; Espada et al., 2011).

Given the relevance of teenage years for the development of tobacco addiction, identification of risk/protection factors for adolescent smoking has been the object of a vast number of studies. Decades of research have delved into the psychosocial variables involved in the onset and maintenance of smoking behaviour among young people (Ogden & Nicoll, 1997). Although most of studies have conducted cross-sectional analyses, the value of follow-up studies, allowing to control for the temporal order of the variables is currently well recognized (Caldeira et al., 2012; Kenford et al., 2005); theoretical models on developmental psychopathology have remarked the plausibility of reciprocal effects between the so-called risk factors and the so-called outcomes (e.g., Dodge et al., 2010), therefore longitudinal studies are a must in order to understand how adolescent smoking emerges and evolves through years.

Developmental models for explanation of adolescent drug use have, in fact, gained popularity in recent years. The so-called “cascading” models (e.g., e.g., Dodge et al., 2010; Haller, Handley, Chasing, & Bountress, 2010) try to step forward in the explanation of adolescent problem behaviours by considering how an interplay of personality, psychosocial and behavioural factors affects child development from early developmental stages. According to these models, early temperamental and family-influenced conduct problems set the starting point for a complex series of processes which lead to an accumulative disadvantage at family and school. At early adolescence, detachment from family, school failure, and association to deviant peers are the consequence of a snowball effect, and act as proximal factors favouring drug involvement. As stated above, reciprocal (“transactional”) effects are a hallmark of developmental models. Thus, behavioural problems and drug use exert effects on psychosocial factors too; this adds complexity to the disentanglement of “determinants” and “consequences”, and contributes to the escalation on behavioural difficulties.

In empirical terms, and in line with the popularity of developmental perspectives within the scientific community, the interest in conducting longitudinal studies has considerably increased through the last years. Among the variables which have been examined from a longitudinal perspective, family factors have been a main focus of interest. Apart from family smoking, which is considered as a good predictor of adolescent smoking, studies have also paid attention to family atmosphere, in terms of conflict, cohesion, closeness, parenting practices and styles, monitoring, support and communication (Gutman, Eccles, Peck, & Malanchuk, 2011). The power of such

family factors as longitudinal predictors of smoking through adolescence has been corroborated by a number of previous studies (e.g., Simons-Morton, 2002).

Peer processes have also been a major centre of research for the prospective studies on adolescent smoking. Developmental, social and clinical psychologists agree in considering peers as main models for attitudes and behaviours during adolescence, in line with the life tasks (i.e., autonomy seeking, identity building) classically linked to the teenage years (Brown, 1990). Although the role played by selection processes (i.e., adolescents tend to choose peers who share their own attitudes and behavioural styles) cannot be dismissed (see Simons-Morton, 2002), there is a good body of evidence from prospective studies supporting the influence of peers on tobacco consumption, i.e., association with peers who smoke, use other drugs and/or involve in antisocial behaviours predicts later tobacco use by adolescents (Kobus, 2003).

Jointly with family and peers, school experiences have been considered as another main source of vulnerability/protection in longitudinal studies; poor commitment to school, low motivation in terms of academic aspirations, school misbehaviour and poor school performance have been found to predict more severe patterns of tobacco use (e.g., Hagger-Johnson, Bewick, Conner, O'Connor, & Shickle, 2012); as it is the case for other psychosocial factors, the relations might well be bidirectional (Pennanen, Haukkala, de Vries, & Vartiainen, 2011) with school experiences influencing the propensity to engage in tobacco use and, reciprocally, tobacco use affecting the involvement with school.

At the more individual side, personality/temperament factors have traditionally been related to substance use at different stages of the life course (Carou, Romero, & Luengo, 2013). In adolescence, personality variables related to disinhibition and high sensitivity to rewards (e.g., impulsivity, sensation seeking) have been prioritized as risk factors for smoking (Luengo, Villar, Sobral, Romero, & Gómez-Fraguela, 2009; Ryan, MacKillop, & Carpenter, 2013), and longitudinal evidence supports, in fact, their role as antecedents of increased involvement in tobacco use (O'Loughlin, Dugas, O'Loughlin, Karp, & Silvestre, 2014). On the other hand, emotional competence (e.g., emotional self-efficacy, empathic skills, and emotional regulation) has been another nucleus of attention by researchers on adolescent smoking, with a number of studies suggesting their relation to onset and continuation of tobacco use (Trinidad & Johnson, 2002; Zullig, Teoli, & Valois, 2014).

Along with personality factors, mental health problems are considered to be predictors of substance use by young people. Externalizing problems (conduct disturbances, aggression, defiant behaviours) have been proposed for decades as problems deeply ingrained in the development of smoking, and longitudinal data supports this relation (e.g., Timmermans, van Lier, & Koot, 2008); internalizing problems in adolescents have also been proposed as predictors involvement in smoking (Becoña & Míguez, 2004), although results in this area are rather inconsistent (Morissette, Tull, Gulliver, Kamholz, & Zimering, 2007). Among the factors related to psychological health, externalizing problems have been the core of a strong branch of research on developmental trajectories (Dodge et al., 2010; Patterson, DeBaryshe, & Ramsey, 1989), which suggest that early-onset conduct problems may be a major indicator for later psychosocial problems, including smoking and use of other substances.

Even though all these lines of research have been fructiferous, most of the longitudinal studies carried out in this area have spanned for a short or medium period of time. With the growth of develop-

mental psychopathology (Cicchetti & Cohen, 2006), the need of long-term longitudinal studies has been reinforced. Although proximal factors are relevant to understand the mechanisms involved in smoking, the need to investigate on the distal factors is increasingly underlined (Otten, Wanner, Vitaro, & Engels, 2009). Later smoking might be part of a chain of events starting in childhood, and these early factors have yet to be well delineated. In addition, long-term prospective studies are particularly scarce beyond the Anglo-Saxon geographical circles. Researchers have previously been encouraged to go deeper into the determinants of smoking behaviour across different sociocultural settings (Galérra et al., 2010), so that the generalizability of the etiological mechanisms identified in other cultures may be proved.

On the basis of these considerations, this study intends to contribute to the knowledge on prospective predictors of adolescent smoking behaviours. As part of a wider longitudinal project which started out in 2002, this study analyses a set of psychosocial and personality factors as predictors of tobacco use among adolescents. Predictors in two developmental stages are analysed: First, we examine how psychosocial, personality and behavioural variables, measured in early adolescence, are able to predict changes in smoking during the following years. Second, we go even backwards through the developmental course; long-term predictors of adolescent tobacco use are analysed, by examining whether a number of behavioural and personality/temperamental variables measured in childhood are related to smoking in adolescence.

## Method

### Participants

This study analyzes data collected from the UDIPRE longitudinal project, a prospective research devoted to analyze behavioural, emotional, personality and psychosocial development from childhood to early adulthood. The UDIPRE project started in the 2002-03 academic year (T1 wave) with an initial sample of 192 children aged 6-11 ( $M = 8.05$ ;  $SD = 1.49$ ) evaluated in 34 schools in Galicia, NW Spain. Schools were located in urban and rural areas and in predominantly working-class communities. This initial sample was followed-up through a number of new data collections across adolescence and early adulthood (more information about UDIPRE study can be found in several previous papers; López-Romero, Romero, & Andershed, 2015; López-Romero, Romero, & Gómez-Fraguela, 2015; Romero and Alonso, 2015; Romero, Kapralos, & Gómez-Fraguela, 2016). For the specific aims of the present study, apart from data gathered in T1, data collections carried out in 2009 (T2 for the present study; mean age = 13.82) and 2013 (T3 for the present study; mean age = 17.27) were considered. Thus, data collected in childhood, early adolescence and late adolescence were included in the study, so that predictors of smoking change through adolescence may be analysed. The sample participating in these three waves of UDIPRE was composed of 115 children (41 females); thus, attrition rate for this ten-year follow up was 40%. Comparison of attrited and non-attrited participants revealed no differences either in the socio-demographic descriptors or in levels of T1 conduct problems.

### Measures

According to the objectives of this study, we considered measures of tobacco use both in T2 (early adolescence) and T3 (late adolescence). In order to study predictors of changes in smoking

through adolescence, we considered a set of potential psychosocial, behavioural and personality predictors measured in T2. In order to study more distal (childhood) predictors, we also considered a cluster of behavioural and personality/temperament variables measured in T1; both in T1 and T2 measures taken from parents' and children's reports were used.

### Tobacco use (T2 and T3)

As a parsimonious indicator of recent tobacco use we considered a single item about monthly cigarette use: "How many days have you smoked cigarettes during the last month?" This item is part of the Drug Use Questionnaire, widely used in previous studies (Luengo, Romero, Gómez-Fraguela, Garra, & Lence, 1999; Romero, Rodríguez, Villar, & Gómez-Fraguela, 2016). This specific monthly smoking item is answered with a six-point scale, scored 0-5: "None", "1-2 days", "3-5 days", "6-10 days", "11-20 days", "more than 20 days".

### Psychosocial, personality and behavioural variables at T2

#### Family processes

Measurement of perceived parenting practices was carried out through the Adolescent Family Process Measure (AFP; Vazsonyi, Hibbert, & Snider, 2003). The AFP has been widely used across different cultures and its psychometric goodness has also been proved in Spain (Torrente & Vazsonyi, 2012). The questionnaire asks the adolescents about several dimensions of interaction with parents: closeness (e.g., "My mother/father gives me the right amount of affection"), support ("My mother/father sometimes put me down in front of other people"), monitoring (e.g., "My mother/father wants to know who I am with when I go out with friends or on a date"), communication (e.g., "How often do you talk with your mother/father about problems you have at school?"), conflict (e.g., "How often do you have disagreements or arguments with your mother?") and peer approval (i.e., parent's approval of adolescent's peers; "How often does your mother/father approve of your friends?"). Adolescent rated the relations with both father (alpha reliabilities ranging between .65 for peer approval and .78 for communication) and mother (alphas ranging between .72 for conflict and .86 for communication); when both scores were provided, they were averaged for a more parsimonious global indicator.

#### Deviant peers

A measure of involvement with antisocial peers was included in the UDIPRE project, and was used for this specific research. The scale, adapted from Thornberry, Lizotte, Krohn, Farnworth and Jang (1994) is composed of five items tapping the contact with rule-breaking peers (e.g., peers who "Steal things or keep for oneself things belonging to others", "Threaten or attack other persons", "Use illegal drugs"). Even if a specific measure of tobacco use by peers was not available, this measure was used as a marker of the involvement with more generally deviant peers. Cronbach's alpha for this scale was .77.

#### School experiences

Three indicators were taken for adjustment to school. A 6-item scale taken from the School Adaptation Scale by Berry, Phinney, Sarn and Vedder (2006) was administered to measure school involvement (e.g., "In the mornings I dislike having to go to school";  $\alpha = .76$ ). In addition, two single items were used to measure, respectively, school absenteeism ("Did you miss some classes without justified reason during the last month?") and school failure ("How many subjects did you fail the last year?").

### Personality

Taking into account the previous research on individual characteristics related to tobacco and other substance use, three personality variables were considered at early adolescence: impulsivity, sensation seeking and empathy. Impulsivity was assessed through a reduced version of the Impulsivity subscale from the I.6 (Eysenck, Easting, & Pearson, 1984; adaptation from Silva, Martorell, & Clemente, 1986); the scale consisted of 12 items (e.g., "Do you say or do things without thinking?";  $\alpha=0.76$ ). Sensation seeking was assessed through the Emotion and Adventure Seeking Sub-scale (Sensation Seeking Scale for Children; Russo et al., 1993) This scale is composed by 26 items with a forced-choice format (e.g. "I would like to climb a mountain/I think that people who do dangerous things like climb a mountain is crazy";  $\alpha = .82$ ). As a result, a global score of sensation seeking was created ( $\alpha = .82$ ). For measurement of empathy a short version of the Empathy Scale for Children (Del Barrio, Aluja, & García, 2004) was used. It includes 10 self-reported items (e.g., "I get sad when I see another child being hurt";  $\alpha = .63$ ).

### Behavioural and emotional problems

As a measure of behavioural and emotional problems at early adolescence, the Child Behaviour Checklist (Achenbach, 1991) was used. The CBCL is a widely known instrument which relies on parent ratings for assessment of psychological difficulties in children and adolescents; the global scales of externalizing ( $\alpha = .83$ ) and internalizing problems ( $\alpha = .79$ ) were used for this study.

### Behavioural and personality variables at T1

For identification of potential distal predictors of tobacco use, the CBCL was also administered in T1 including both externalizing ( $\alpha$  in T1 = .87) and internalizing ( $\alpha$  in T1=.76) scales. We also included as candidates for distal predictors the above mentioned measures of impulsivity ( $\alpha$  in T1 = .77), sensation seeking ( $\alpha$  in T1=.67) and empathy ( $\alpha$  in T1 = .50). Finally, parent-reported temperamental measures of emotional and self-control dysregulation were taken through the Child Psychopathic Traits Scale (mCPS; Lynam & Gudonis, 2005), consisting of 55 items which may be grouped in two global factors: Factor 1 (F1;  $\alpha = .80$ ) encompassing affective difficulties such as lack of empathy and poor affective response, and Factor 2 (F2;  $\alpha = .81$ ) including traits related to lack of self-control, such as susceptibility to boredom and lack of planning.

### Procedures

For the first wave of data collection (T1), schools were contacted and consent was asked from parents. Then, a screening process took place through a brief teacher-reported scale of disruptive problems (see López-Romero, Romero, & Andershed, 2015), in order to guarantee that children with high and low levels of behavioural problems were represented in the sample. Out of the families selected for the longitudinal study, 87% agreed to participate. Trained staff administered the questionnaires individually to parents and youths, with confidentiality strictly guaranteed. For the follow-ups, the contact was established again with the families through telephone and/or mailed post. After parents and children agreed to participate again, appointments were scheduled for the new assessment meetings, which usually took place at the schools the children were now attending. As regards parents' reports, questionnaires were completed by the person who attended the assessment meeting (usually youths' mothers). When both parents were present, they jointly filled in the questionnaires

by reaching a mutual agreement in their answers. More details about the procedures for the UDIPRE project have been reported in previous studies (e.g., López-Romero, Romero, & Gómez-Fraguela, 2015; Romero et al., 2016).

### Statistical analyses

First, with the aim of analysing how the different clusters of potential predictors could in fact predict changes in smoking through adolescence (from T2 to T3), a set of hierarchical regression analyses was carried out, taking T3 smoking as the criterion variable, with a lagged design. After controlling for age and gender (first step), T2 smoking was entered in the equation (second step) and, finally, the different sets of psychosocial, personality and behavioural predictors were entered (third step). Thus, controlling for the effect of T2 smoking, these analyses would allow identification of significant predictors of change from T2 to T3.

Second, correlations between T1 (childhood) variables and T3 (late adolescence) smoking were computed, so that the associations between adolescent smoking and distal past variables may be depicted; T3 smoking was considered for this analysis in order to maximize the variance in smoking, as smoking rates in T2 (early adolescence) were still low.

Finally, given that the relevance of externalizing behavioural problems for T3 smoking was proved, we analysed whether the progression of smoking through adolescence was different in children with and without significant T1 externalizing problems. Thus, considering  $T = 70$  in T1 CBCL-Externalizing as the cut-off point, the sample was split into two groups: individuals who were in the clinical range of externalizing problems when they were children, and individuals low in externalizing problems. The evolution of smoking from T2 to T3 was then compared through General Linear Model with two factors: one between subjects (group) and another one within-subjects (time). By examining whether there is a significant interaction between group and time, the differential progression of both groups is analysed. All the statistical analyses were run with the software IBM SPSS 20.0

## Results

### Identification of T2 predictors of change in smoking from T2 to T3

At T2 (early adolescence), 91.4% of participants had not smoked for the last month. At T3 (late adolescence), this percentage was reduced to 65%. When the most severe consumption pattern (i.e., more than 20 times in a month) was considered, it was found that 1.7% exhibited this pattern at T2 and 18.9% in T3, thus corroborating the change which takes place in smoking involvement through adolescence. In order to analyse possible predictors for the changes in smoking from T2 to T3, hierarchical regression analyses as described above were conducted. The final models, after all the steps, are shown in Table 1.

As can be observed in the table, all the sets of predictors added explained variance to T3 smoking after controlling for sociodemographic variables and, more importantly, after controlling for T2 smoking. Thus, family, school, peer, personality and behavioural variables, measured in early adolescence, seem to effectively (albeit moderately) predict changes in smoking from early to late adolescence. From the family variables which were considered, closeness and support emerge as the significant predictors, with negative

betas, i.e., low levels predict increases in smoking through years. The involvement with antisocial peers at early adolescence is also a significant predictor of increases in smoking through years. As for school experiences, school failure is significantly linked to increases in smoking. At the personality side, sensation seeking is selected by the regression analysis as the significant predictor. Finally, externalizing problems reported by parents also contribute to explain changes in smoking pattern.

Table 1. Hierarchical regression analyses for prediction of changes in smoking between T2 and T3 considering the psychosocial, personality and behavioural variables measured in T2.

	Beta	Change in R2 after each step	F for change in R2	Total R2
<b>FAMILY INTERACTIONS</b>				
Age	.09			
Gender	-.07	.06	2.78	
T2 Smoking	.26*	.10	10.35**	
Closeness	-.32*			
Monitoring	-.07			
Communication	-.00			
Conflict	-.05			
Support	-.27*			
Peer Approval	-.05	.12	7.23*	.28
<b>ANTISOCIAL PEERS</b>				
Age	.13			
Gender	-.06	.06	3.43*	
T2 Smoking	.24*	.11	12.82**	
Involvement with antisocial peers	.29*	.07	9.04**	.25
<b>SCHOOL EXPERIENCES</b>				
Age	.19*			
Gender	.01	.01	2.75	
T2 Smoking	.44***	.09	9.88**	
School involvement	-.01			
Absenteeism	-.17			
School failure	.41***	.17	7.48***	.33
<b>PERSONALITY</b>				
Age	.07			
Gender	-.05	.06	3.43*	
T2 Smoking	.23*	.11	12.85**	
Impulsivity	.01			
Sensation seeking	.26*			
Empathy	-.13	.08	3.38*	.26

	Beta	Change in R2 after each step	F for change in R2	Total R2
<b>BEHAVIOURAL PROBLEMS</b>				
Age	.18			
Gender	.06	.05	2.80	
T2 Smoking	.29**	.10	11.89**	
Externalizing	.31**			
Internalizing	-.18	.04	2.47	.21

T1 = Time 1; T2 = Time 2; T3 = Time 3; \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ .

From the clusters included in this study, school and family were the sets of variables which a stronger contribution for explaining change, with increases in explained variance of .17 and .12, respectively.

### Identification of T1 predictors of smoking in adolescence

In a second step, we went backwards in the life-course, and examined the relations of T3 smoking to personality/temperamental and behavioural/emotional problems measured in T1. The results are presented in Table 2.

Table 2. Correlations between T1 measures and T3 smoking.

	T3 smoking
Impulsivity	.22*
Sensation seeking	.21*
Empathy	-.19
mCPS-Affective deficit	.23*
mCPS-Self-control deficit	.22*
Externalizing problems	.35**
Internalizing problems	.07

\*  $p < .05$ ; \*\*  $p < .01$ .

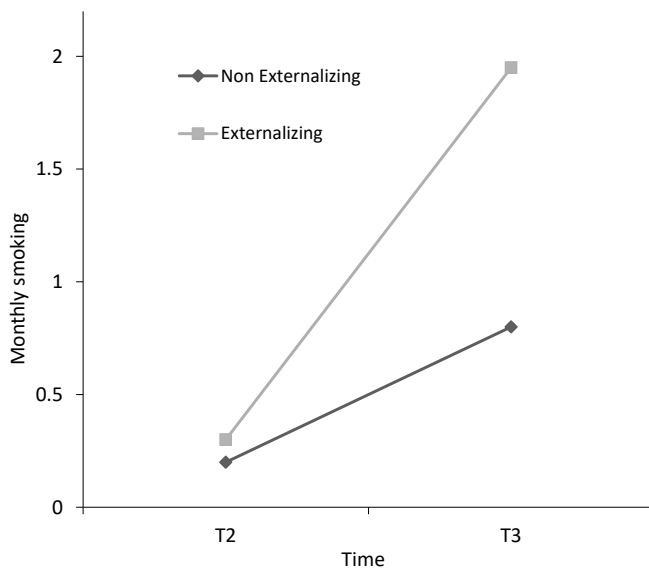
Table 2 shows that, despite 10 years lagging between T1 and T3, one may find significant associations between the variables measured in T1 and smoking frequency in T3. Smoking in late adolescence is related to impulsivity, sensation seeking, affective and self-control deficits, and, especially, externalizing problems ( $r=.35$ ). Thus, indicators of a disinhibited style of behaviour seem to be consistently associated (either self-reported or parent-reported) with the risk of future smoking.

After corroborating the relevance of this disinhibited/externalizing childhood pattern, we analysed whether children with clinical elevations in externalizing problems might have a differential progression in smoking patterns years later, through adolescence.

With the  $T=70$  cut-off point, two groups were identified in the sample: 56 children with externalizing problems and 59 without them. The analysis of variance 2 (Group) x 2 (Time) showed significant effects for group ( $F=5.77$ , 1/96  $df$ ,  $p < .05$ ), Time ( $F=43.83$ , 1/96  $df$ ,  $p < .001$ ) and, interestingly, interaction Group x Time ( $F=6.57$ , 1/96  $df$ ,  $p < .05$ ). Figure 1 clarifies the meaning of the interaction by illustrating the slopes in marginal estimated means from T1 to T2.

As Figure 1 shows, even if there is an increase in tobacco use through adolescence for both groups, externalizing children show a sharper increase when compared with non-externalizing. Differences in smoking cannot be observed in early adolescence, but they sprout over the teenage years, with a more severe pattern for the externalizing children.

Figure 1. Differential progression in monthly smoking through adolescence by T1 Externalizing and Non Externalizing individuals.



## Discussion

The determinants of tobacco smoking have been the object of a huge amount of research by social and health sciences. The damages of tobacco on health have been recognized for long (WHO, 2016), and the search for psychosocial mechanisms leading to tobacco addiction by youths has been a priority. Nevertheless a vast majority of these studies have been cross-sectional or have been conducted during short periods of time, overlooking the need to explore more distal factors, which might provide insights about how the vulnerability/protection processes develop through time. As the possibility of reciprocal effects between smoking and its risk factors is increasingly acknowledged (Simons-Morton, 2002), the need of longitudinal studies is even stronger, in order to identify which factors are actually prospective predictors (and not outcomes or just correlates) of smoking. This study goes beyond the more common short-term longitudinal studies, and, in contrast with most studies in this field, which usually focus on a limited set of predictors, involves multiple clusters of variables proposed by the contemporary theoretical models. This allows comparison of the predictive power of various sets of factors, helping to elucidate which ones are the strongest in different developmental stages. In addition, this study provides long-term longitudinal data on smoking based on a Spanish sample; the need to involve diverse cultures in longitudinal studies has been specifically stated in previous literature (Galérea et al., 2010), as a way of clarifying whether the results and principles arisen from studies in the US and Northern Europe, may be extended to a wider context.

This study first analysed predictors of smoking in late adolescence, on the basis of psychosocial, personality and behavioural variables measured four years before. Results showed that for every cluster of factors which were examined (family, peers, school, personality, behavioural/emotional problems), significant predictors of smoking may be identified, even after controlling for the previous level of tobacco use.

For the family relational context, the factors related with affective involvement (closeness, support) arose as significant predictors. The relevance of variables related with emotional bonds between parents and children has previously been highlighted by cross-sectional (Muñoz-Rivas & Graña, 2001) and prospective studies (Simons-Mor-

ton, 2002). In fact, family relations, attachment and commitment occupy a remarkable role in well-known theories on adolescent drug use (Elliott, Huizinga, & Ageton, 1985; Hawkins, Catalano, & Miller, 1992). Our results underline the relevance of the family emotional atmosphere for protection of smoking; some other previous studies (Mehabee-Gittens, Xiao, Gordon, & Khour, 2013) have also found that emotional bonds may be particularly important as protection mechanisms for behavioural problems at early stages of adolescence. In order to delineate the processes by which family involvement influences health-risk behaviours, some studies and models have proposed that bonding to family could exert its effects through indirect pathways, i.e., protecting children from association with problematic peers, or promoting involvement with school (e.g., Chassin, Curran, Hussong, & Colder, 1996; Elliott et al., 1985).

In fact, the peer group has traditionally been considered as one of the strongest sources of influence on the development of adolescent smoking. Following the principles inspired on major theoretical models like social learning theory (Akers, 1977; Bandura, 1977), youths are supposed to develop norms, attitudes and behaviours according to the type of peers they are socialized with. Accordingly, involvement with problematic peers has found to be of the most consistent correlates of problem behaviour in adolescence (Kobus, 2003; Lloret, Gázquez, Botella, & Feri, 2013). This result has often been interpreted as a reflection of the influence of peers on adolescent behaviours. Nevertheless, the selection of similar peers (captured by the popular sentence “birds of a feather flock together”) has been claimed as a plausible process too (Romero, Luengo, & Gómez-Fraguela, 2000); longitudinal studies are thus essential to ascertain to what extent involvement with problematic peers is actually a predictor or merely a correlate of problematic behaviour. In this study, we found that a higher involvement with antisocial peers predicts increases in smoking through time, thus providing evidence to the role of peers as reinforcers of involvement in substance use. It is noteworthy that in our research we did not use a specific measure of peer smoking (which was not available in the wider longitudinal study), but a measure of general antisocial behaviour. Although more specific measures of peers’ drug use are usually considered in this field of research, an association between general antisocial behaviour by peers and tobacco use has also been shown by some other studies (e.g., Bigan, Duncan, Ary, & Smolkowski, 1995). This pattern of results suggests that involvement in rule-breaking groups seems to promote assumption of non-conventional norms, and within this context, tobacco use is also shaped. This finding calls for a wider understanding of peer influences, and may be aligned with a broad conception of “problem behaviour” (e.g., Donovan & Jessor, 1985) as a behavioural constellation which emerges from a common root of determinants. Generally deviant attitudes seem to be modelled at the peer group and, this way, the antisocial peer group may foster a variety of norm-breaking acts, including substance use.

As for school, we found that school failure is, among the school factors which were analyzed, the one which predicts further tobacco consumption through adolescence. The relationships between school achievement and smoking had been reported by previous studies (e.g., Hover & Gaffney, 1988), but, again, the interpretation of this relation is not straightforward: low school achievement may be a risk factor for involvement in smoking, but involvement in smoking, and in the smoking peer group, might also influence educational outcomes through the fostering of negative attitudes towards school. In fact, evidence for both processes has been provided (e.g., Pennanen et al., 2011). Our results support that school failure predicts an increase in smoking through adolescence, and consequently supports

the importance of promoting adaptation to school as a preventive measure at early adolescence. In fact, school and family emerge as the most powerful source for prediction at early adolescence. These results support the relevance of conventional psychosocial settings as insulators of drug use patterns, in line with the classical postulates of social control models (e.g., Elliott et al., 1985); these results also endorse the proposal of intervention strategies aimed to strengthen bonds with family and school at early adolescence in order to develop healthy psychosocial lifestyles.

This study also considered a cluster of personality factors which have previously been identified as vulnerability/protection factors for tobacco's and other substance's use. Our data provides evidence supporting the capacity of sensation seeking to predict increases in smoking through time. The need for strong, novel and exciting experiences has been related to smoking and other adolescent problem behaviours by numerous previous studies (see Del Barrio & Alonso, 1994; Wellman et al., 2016). In our study, sensation seeking also stands out, among other personality variables, as a prospective factor associated to smoking.

When behavioural and emotional problems are analysed, the prominence of externalizing problems (aggression, disruptive conducts, and defiant behaviours) in comparison with internalizing (anxiety, mood disturbances) is also evidenced. It has widely been discussed about the role of externalizing problems for drug use in adolescents (see Espada & Méndez, 2000), and about the directionality of the relations between both kinds of behaviours. Our study evidences that, at early adolescence, externalizing problems are antecedents of increases in smoking behaviour throughout the following years.

The significance of externalizing problems is also evidenced when we search for childhood predictors of adolescent smoking. When the distal factors are examined, externalizing difficulties show a moderately high association with later smoking. Neither in childhood or in early adolescence we found evidence that internalizing problems predict later involvement in tobacco use. As we stated in the introduction of this paper, the possible role of internalizing problems is not well known, and in fact, some authors have suggested that early anxiety or other internalizing symptoms in the absence of disruptive behaviour might actually protect a child from later tobacco use (e.g., Costello et al., 1999), perhaps because internalizing difficulties may prevent a child from interaction with a peer group that exposes him/her to substance use.

Beyond studying how externalizing problems, as a dimensional construct, are linked to later tobacco use, this study advanced into the analysis of clinically significant externalizing patterns. When we specifically study children with significant early externalizing problems we found that, in fact, externalizing children have a higher increase in their frequency of smoking from early to later adolescence. Thus, the pertinence of intensifying prevention efforts for children with clinically significant externalizing problems is reinforced; even though differences in smoking cannot be detected in early adolescence, early externalizing youths will show a significantly sharper progression in smoking patterns through the teenage years.

Along with externalizing problems, a set of childhood temperamental factors, both self- and parent-reported, were also associated to later smoking. Indicators of disinhibited, under controlled temperamental patterns (i.e., impulsivity, sensation seeking, self-control deficit), as well as emotional difficulties, seem to be also markers of a higher risk of tobacco smoking in the long run.

These results may be explained under the light of modern developmental models, which make a strong emphasis on disruptive

problems to understand substance abuse as part of a wider array of symptoms beginning in early life stages. Particularly, as stated in the introduction, the "cascading" models (e.g., Dodge et al., 2010) propose that early externalizing problems are in the centre of a chain of cumulative processes (school failure, limited skills for self-control and emotional processing, social rejection, family dysfunctions), which, as a snowball effect, progressively limit the opportunities for a healthy development. In this scenario, behavioural problems show a high risk of chronification, and substance misuse may emerge as part of broader psychosocial difficulties; involvement with problematic peers would be a proximal factor which ultimately strengthens the antisocial tendencies for children in this developmental trajectory.

In this vein, it has been proposed that intervention on early-onset externalizing children may be an efficient way of indicated prevention. Intervention on disruptive children, and on their associated difficulties (e.g., family interactions, emotional and social skills, adaptation to school) has shown to be an effective way of preventing not only future antisocial behaviours, but also involvement in substance use (Romero et al., 2016; Zonneville-Bender, Matthys, Van De Wiel, & Lochman, 2007). In fact, the relation of early externalizing problems with multiple unfavourable life outcomes (including substance misuse) has led some researchers to consider that conduct disorders might be the greatest opportunity for prevention in the mental health context (Harley, Murtagh, & Cannon, 2008).

This study does not lack limitations. As a long-term longitudinal study, attrition was an expectable limitation, thus reducing the final sample size. In fact, the need to advance in this field with bigger samples needs to be highlighted. Although costly, wider samples, followed up closely for long periods of time, would allow investigation on mediating, moderating, and transactional effects among factors through time. Theoretical frameworks propose that a complex dynamic interplay among behavioural, temperamental, family, school and peer factors takes place, and large samples with repeated data collections through time are required for a full, statistically powerful, modelling of such relations. In addition, large studies would allow profiling different developmental trajectories through time; on one hand, although early externalizing problems show a high risk of negative outcomes, recent research suggests that there is not just one pathway for early-onset conduct problems (López-Romero, Romero, & Andershed, 2015). On the other hand, a variety of developmental trajectories are likely to be identified in smoking patterns (Yang & Netemeyer, 2014); research on their predictors, correlates and consequences should be systematically examined. It must be also borne in mind that in our study we could just consider a number of factors theoretically involved in smoking development, yet some important variables (e.g., parental or peer smoking) were not available.

In conclusion, although the study of precursors of smoking needs further refinement, this long-term study, using data from different informants, indicates that a number of personality, behavioural and psychosocial factors may be meaningful pieces for prediction of future smoking patterns. Predictors can be identified not only from early adolescence, but distal predictors, both parent- and self-reported, could also be drawn from childhood, with disruptive problems as a principal risk focus. These results support the utility of intervention on externalizing problems, and on factors known to be related with them, as a way for prevention of future problems, including adolescent smoking.

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## Conflict of interests

The authors declare that they have no competing interests.

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