

## Positive Peer Perception, Social Anxiety and Classroom Social Adjustment as Risk Factors in Peer Victimization: A Multilevel Study

Eva M. Romera, Rocío Luque, Rosario Ortega-Ruiz, Olga Gómez-Ortiz, and Antonio Camacho  
Universidad de Córdoba

### Abstract

**Objective:** Individual risks factors of peer victimization have been widely identified in children and adolescents. However, little is known about how the classroom context may increase or decrease the frequency of victimization. The present short-term prospective longitudinal study used a person-by-environment approach to examine whether peer perception and social anxiety, along with class social adjustment levels as a moderator, affect the likelihood of peer victimization over time. **Method:** These effects were modelled using a representative sample of 2,512 Andalusian (Southern Spain) (52% girls) aged 10 to 16 years old ( $M = 12.81$ ;  $SD = 1.69$  at Wave 1). Classroom social adjustment was assessed by within-classroom standard deviation in social adjustment. **Results:** Multilevel modeling indicated a negative relationship between peer perception at W1 and peer victimization at W2, as well as a positive association with social anxiety at W1, after controlling for gender, age and victimization at W1. The direct association between peer perception and peer victimization was intensified by class social adjustment. **Conclusions:** The results provide a more nuanced understanding of the influence of cognitive, emotional, and social variables when trying to address vulnerability to victimization.

**Keywords:** Peer victimization, peer perception, social anxiety, social adjustment, class levels.

### Resumen

*Percepción Positiva de los Iguales, Ansiedad Social y Ajuste Social en el Aula Como Factores de Riesgo de la Victimización Entre Escolares: un Estudio Multinivel.* **Objetivo:** factores individuales de riesgo de la victimización entre iguales han sido ampliamente identificados. Poco es sabido sobre cómo el contexto del aula puede influir en la victimización. El presente estudio longitudinal prospectivo a corto plazo examinó, desde un enfoque individuo-contexto, si la percepción de los iguales, la ansiedad social y los niveles de ajuste social de clase como moderador influyen en la probabilidad de ser víctimas a lo largo del tiempo. **Método:** se contó una muestra representativa andaluza (sur de España) de 2.512 escolares (52% chicas) entre 10 y 16 años ( $M = 12,81$ ;  $DT = 1,69$  en Tiempo 1). El ajuste social en el aula se evaluó mediante la desviación típica de la variable. **Resultados:** la modelización multinivel indicó una relación negativa entre la percepción positiva de los iguales en T1 y la victimización en T2, y positiva con la ansiedad social en T1, controlando el sexo, la edad y la victimización en T1. La asociación directa entre percepción de los iguales y victimización se intensificó por el nivel de ajuste social de la clase. **Conclusiones:** estos resultados proporcionan una comprensión más matizada de la influencia de variables cognitivas, emocionales y sociales para abordar la vulnerabilidad a la victimización.

**Palabras clave:** victimización entre iguales, percepción de los iguales, ansiedad social, ajuste social, niveles de clase.

Peer victimization is a public health concern that affects large numbers of children and adolescents (Chester et al., 2015; Elgar et al., 2015). An individual is victimized if they are intentionally intimidated or harmed physically, verbally, or relationally. Victimization is associated with psychological problems, such as anxiety, symptoms of depression, loneliness, and self-harm behaviors (Casper & Card, 2017; Núñez et al., 2021).

Prevention of peer victimization and its consequences requires a deep knowledge of the associated risk factors. Studies looking into the causes of peer victimization have identified variables

related to cognitive, emotional and social processes (Chen et al., 2018; Troop-Gordon, 2017).

From a person-by-environment approach, individual characteristics can affect a specific behavior upon the presence of contextual/environmental risk factors (Magnusson, 2015). Literature reviews about bullying have identified the main role of class factors such as social status hierarchies and group norms (Saarento et al., 2015). Compared to the ever-greater attention given to contextual variables associated with bullying, few studies have explored the effect of individual and contextual variables on peer victimization (Méndez et al., 2017; Thornberg et al., 2017; Yun & Juvonen, 2020), and those did pursue this aim were cross-sectional. Only one longitudinal study analyzed individual and contextual risk factors of victimization, but peer group was not considered, and only early adolescence was explored (Karlsson et al., 2014). Individual- and classroom-level predictors of peer victimization need to be investigated in order to improve prevention programs. The current short-term prospective study

will focus on how peer perception, social anxiety and class social adjustment level increase the risk of developing victimization, and more specifically on the cross-level interactions between the predictors. This approach is particularly relevant to identify in which situations some students are more likely to be victimized by others and to identify contextual factors (level of social adjustment in classroom) that can help alleviate the distress experienced by victims. Transition to adolescence is a key stage to explore this aim because the importance of peer relationships increases and there is a higher involvement in antisocial behavior (Nasaescu et al., 2020).

Relational schema approach (e.g., Baldwin, 1992; Holmes, 2000), based on Social Information Processing (SIP) models (Crick & Dodge, 1994) propose that to understand social functioning, representations of peers should be considered. Peer perception is defined as the knowledge structures –social schemas– which children draw from their observations and inferences about the behaviors and attitudes of their peers (Baldwin, 1992; Holmes, 2000). The conclusions they draw from these inferences are stored in long-term memory as relatively stable knowledge structures and are used in new social situations. Children might hold a generalized perception that peers frequently act in a trustworthy and supportive manner, or as unsupportive and uncaring (Ladd & Troop-Gordon, 2003).

Previous theoretical and evidence indicate that peer perception develops from previous social experiences (Crick & Dodge, 1994; Gifford-Smith & Rabiner, 2004). In this line, it was shown that peer adversities, like victimization or rejection, fostered overgeneralized maladaptive perceptions of peers (Ladd et al., 2014; Salmivalli & Isaacs, 2005). But, in line with the social information processing model (Crick & Dodge, 1994), an opposite relationship should be expected: specific socio-cognitive response patterns, including perception of hostile contexts, make peer victimization more likely. Negative peer perceptions can degrade peer relationships because they inhibit trust, affection, and socially receptive behaviors, promoting internalizing symptoms (Gómez-Ortiz et al., 2020; Troop-Gordon et al., 2019) which in turn carries a risk of social rejection (Dawes et al., 2017) and victimization (Hong & Espelage, 2012).

Social anxiety refers to the fear of being negatively evaluated by others (American Psychiatric Association, 2014). It is one of the most common internalizing problems among adolescents (Polanczyk et al., 2015) and its consequences affect to social development. Individuals with social anxiety perceive themselves as being unable to cope effectively with social situations (Blöte et al., 2015), and elicit self-protective behaviors (e.g., withdrawal) (Knappe et al., 2015). In the peer context, victimization has been considered a precursor of social anxiety (Reijntjes et al., 2010; Romera et al., 2016), but a large number of studies recognize social anxiety predicting victimization (Gómez-Ortiz et al., 2018; Pabian & Vandebosch, 2016; Siegel et al., 2009; Tillfors et al., 2012). Adolescents with high levels of social anxiety may evoke irritation in their peers leading to an increase in peer victimization (Tillfors et al., 2012).

Literature suggests that adolescents behave in accordance with specific behaviors that are on average displayed by peers in a given context (Menesini et al., 2015). Recent studies have shown that a class group can reinforce or sanction both bullying and isolation of victims (Coelho & Romão, 2018; Rambaran et al., 2019). Previous studies with a person-by-environment approach, found that the

degree to which victimization leads to internalizing problems depends on class characteristics (Gini et al., 2020; Yun & Juvonen, 2020). Furthermore, negative effects experienced by victims, such as psychological distress, were found to be stronger in classrooms with clearly visible unsupportive peers, where children can feel more stressed, anxious, and uncomfortable (Huitsing et al., 2012; Thornberg et al., 2017). Multilevel studies about the precursors of victimization showed that in small classrooms and in classrooms with high level in reinforcing bullying, the association between peer victimization and social anxiety, as risk factor, was stronger (Kärnä et al., 2010; Saarento et al., 2013). Self-perceived social adjustment, that allows a good fit with their immediate social context and school climate (Escalante-Mateos et al., 2020), has been clearly associated with peer victimization (Romera et al., 2020). But to date, no studies have investigated whether and to what extent class social adjustment level can moderate the association between social anxiety and peer victimization. It is expected that in classes with low level of social adjustment there is higher social fear, by the effect of being rejected or isolated, and place students at a higher risk of being bullied.

Empirical studies on adolescents' perceptions of peer behavior and the impact of class level on their own bullying involvement are more inconsistent. Some previous work suggests that children may be more likely to intervene in bullying situations if they perceive that their peers will do so (Barhight et al., 2017). Despite the strong evidence of classroom influence, it is less clear what the moderation effects of class social adjustment levels are on the association between peer perception and victimization. However, according to studies that found that being bullied was exacerbated in classrooms with a climate of inhibition and mistrustfulness (Thornberg et al., 2017) and with a high level of negative social outcome expectations of peer support (Saarento et al., 2013), it is expected that the effect of peer perception on victimization will be stronger in classes with low level of social adjustment.

Researchers have increasingly recognized the importance of social anxiety and peer perception to increase victimization (Hong & Espelage, 2012; Pabian & Vandebosch, 2016). However, previous studies have investigated both factors in relation to peer victimization separately. Therefore, it is important to examine multiple individual characteristics simultaneously to explore how these different psychosocial variables contribute to peer victimization over time. Additionally, it is important to evaluate to what extent classroom characteristics contribute to the prediction of peer victimization beyond what can be explained by other individual characteristics of the adolescents. The aims of the present study were to investigate from a person-by-environment perspective prospective links between individual and contextual characteristics and peer victimization during adolescence. At the individual level, we examined how positive peer perception and social anxiety in wave 1 (W1) were associated with being bullied six months later (W2). At the contextual level, we explored whether class social adjustment (W1) moderates the effect of extent to which adolescents are victimized (W2). In addition to peer victimization W1, gender and age were included as covariates, given victimization has been consistently found more prevalent in girls than in boys (Larrain & Garaigodobil, 2020), as bullying usually peaks around early adolescence (Smith, 2016; Smith et al., 2019).

Consistent with previous studies, we expect that peer perception would be negatively associated with victimization behaviors

in bullying six months later (Hypothesis 1a). In addition, we hypothesize that the more adolescents experience social anxiety, the more likely they are to be victimized by their peers in a subsequent wave (Hypothesis 1b). At the contextual level, we expect that the negative peer perception will be more likely to predict later peer victimization for those adolescents in classes with previous low levels of social adjustment and a positive association between social anxiety (W1) and peer victimization (W2) to be stronger in classes with low levels of social adjustment (W1) (Hypothesis 2).

## Methods

### Participants

We recruited students in the 5<sup>th</sup> to 6<sup>th</sup> year from Primary Education schools and from 1<sup>st</sup> to 4<sup>th</sup> year to Secondary Education in Andalusia (South of Spain), according to the Spanish educational system. The study used stratified, single-stage cluster sampling, with a probability of cluster (center) selection that was proportional to size. Strata were defined by geography (Eastern or Western Andalusia), town population size (small, medium and large size), and by type of educational center (private or public) to create a representative sample of the Andalusian student population. Around 2% refused to participate.

A total of 2,512 early adolescents between 10 and 13 and middle adolescents from 14 to 16 years were involved in the study (52% girls,  $M_{Age\ W1} = 12.81$  years;  $SD = 1.69$ ) from a total of 102 classes ( $M_{Size} = 21.73$ ,  $SD = 5.76$ ). Participants completed the questionnaires twice over 6 months: in October 2017 (W1) 2,295 adolescents participated, while in May 2018 (W2) a total of 2,130 students participated. Attrition was caused by moving school or because of absence during data collection. The effect of changes in the very short term was therefore analyzed. A logistic regression found that those adolescents who participated in one wave did not differ from those who participated in both waves regarding the study variables (all  $ps > .05$ ). In the analyses all participants were included regardless of whether they participated once or both times since a multilevel study requires a representative sample of subjects from each class.

### Instruments

Participants' level of peer victimization was assessed with a scale from the *European Bullying Intervention Project Questionnaire (EBIPQ)* (Spanish version: Ortega-Ruiz et al., 2016). The scale is composed of 7 Likert-type items with five options (0 = no to 4 = yes, more than once a week) and refers to victimization behaviors during the last three months (e.g., 'Someone hit, kicked or pushed me'). The internal consistency, measured through McDonald's Omega, was adequate in our sample ( $\omega_{hW1} = .86$  and  $\omega_{hW2} = .86$ ).

Positive peer perception, referring to adolescents' views on their peers, was assessed with the Spanish version of *Generalized Peer Perception* scale (Romera et al., 2017). It is composed of 13 four-point Likert-type items (0 = no, not at all to 3 = totally agree), which describe positive and negative peer classroom qualities during the last three months (e.g., 'My age-mates only think about their own interest'). Answers were transformed in such a way that a higher final score indicates more positive peer perception. The internal consistency of this instrument was adequate in our sample ( $\omega_{hW1} = .87$ ).

Social anxiety was assessed using the Spanish version of *Social Anxiety Scale for Adolescents (SAS-A)* (Olivares et al., 2005). The scale is composed of 18 items answered on a seven-point Likert-type scale (1 = never to 5 = always) ('I get nervous when I talk to peers I don't know very well'). Although the original scale focuses on three factors, other studies have consistently found that items are loaded on a one-factor structure and consequently have used an overall social anxiety score (Wang et al., 2019). The internal consistency of this instrument was adequate in our sample ( $\omega_{hW1} = .91$ ).

Class social adjustment was assessed with the social adjustment subscale from the *Adolescent Multidimensional Social Competence Questionnaire (AMSC-Q)* (Gómez-Ortiz et al., 2020), that incorporates statements about how children be and feel accepted by peers. It is composed of 8 items answered on a seven-point Likert-type scale (1 = totally false to 7 = totally true) ('My classmates help me when I need it'). The internal consistency was adequate in the present sample ( $\omega_{hW1} = .92$ ). Class social adjustment levels were computed as each class' mean score on peer social adjustment, following the procedure used by Krull and MacKinnon (2001).

### Procedure

Ethical approval was obtained from the corresponding author's institution. Permission to administer the questionnaires in schools was granted by the regional government. Written parental consent was required. The students answered the questionnaires during regular school hours. Researchers trained and experienced in psychological research conducted the data collection using standardized instructions. The students completed the surveys anonymously, confidentially, and voluntarily, and they could leave at any time.

### Data analysis

Descriptive statistics, independent *t*-tests and Pearson's correlations were run as preliminary steps. For the differences between groups, dummy variables were created for gender (boy = 1, girl = 2) and age (early adolescence 10-13 years = 1, middle adolescence 14-16 = 2).

The influence of individual- and classroom-level on peer victimization was analyzed using hierarchical linear model software version 8 (HLM) (Raudenbush et al., 2019). HLM provides an analysis of adolescent variance in peer victimization which can be explained by peer perception and social anxiety after controlling for between-classroom variance (Raudenbush & Bryk, 2002). The hierarchical level consisted of individual-level predictors (Level 1) and classroom-level predictor (Level 2). Level 1 involves age, gender, peer victimization W1, peer perception W1 and social anxiety W1. The individual-level predictors were centered at the group mean to provide more accurate intercepts (Raudenbush & Bryk, 2002), while age and gender was centered at the grand mean. Level 2 includes class social adjustment which was centered at the grand mean. The interactions of peer perception and social anxiety  $\times$  class social adjustment were included. Simple slopes were estimated to show the general direction of the moderation effects. The significance level adopted for all analyses was .05.

In line with the recommendations of Raudenbush and Bryk (2002) our model involves three steps. Step 1 estimated an

unconditional model without predictors to yield the variation between classrooms (intraclass correlation, ICC) of peer victimization. When individuals are nested, the ICC reports the degree of required setting to provide consistent standard errors. Later, Step 2 aimed at estimating a random intercept model composed by individual-level predictors (Level 1) with the aim of exploring whether the variability between classrooms is retained once the individual factors have been controlled. This step comprises: a) covariates (age, gender and peer victimization W1); and b) predictors (peer perception W1 and social anxiety W1). Finally, in Step 3 the Level 2 predictors were added to address if class social adjustment would influence the effects of individual-level predictors on peer victimization. This step comprises: a) classroom-level predictor (class social adjustment W1); and b) cross-level interactions (class social adjustment W1 × peer perception W1 and class social adjustment W1 × social anxiety W1). HLM were estimated by restricted maximum likelihood estimation (REML). The results reported are based on robust standard error due to the non-normality of the distribution of peer victimization (see Table 1). The Little’s MCAR test reveals that the data was not completely missing at random, but the low value of normed  $\chi^2$  ( $\chi^2/df = 1.35$ ) (Bollen, 1989) indicates that the data was missing at random.

Results

Preliminary results

The descriptive statistics and correlations for all variables are presented in Table 1. The independent *t* tests indicated significantly higher peer victimization for boys than girls at W2 ( $t = 2.32, p < .05, d = .10$ ). Girls scored significantly higher on social anxiety ( $t = -4.92, p < .001, d = .22$ ). Girls and boys did not differ in positive peer perception ( $p > .05$ ). Early adolescents scored significantly higher than middle adolescents on peer victimization ( $t_{w1} = 3.06, p < .01, d = .13; t_{w2} = 3.50, p < .001, d = .16$ ), social anxiety ( $t = 2.41, p < .05, d = .11$ ) and positive peer perception ( $t = 9.54, p < .001, d = .43$ ). The correlation analysis showed that positive peer perception was negatively associated with social anxiety and peer victimization, while social anxiety and peer victimization were positively associated.

Table 1  
Correlations and Descriptive Statistics

Variables	1	2	3	4	5
1. Peer perception W1	–				
2. Social anxiety W1	-.27***	–			
3. Peer victimization W1	-.44***	.37***	–		
4. Class social adjustment W1	.27***	.02	-.08***	–	
5. Peer victimization W2	-.27***	.25***	.46***	-.10***	–
Theoretical range	0-3	1-5	0-4	1-7	0-4
<i>M</i>	2.06	2.22	.55	5.45	.58
<i>SD</i>	.49	.79	.69	.37	.68
<i>S</i>	-.60	.71	2.03	-.31	1.76
<i>K</i>	-.03	.14	4.60	.62	3.51

Note: *S* = Skewness; *K* = Kurtosis.  
\*\*\*  $p < .001$

Hierarchical linear model

Step 1: The unconditional model

After estimating the unconditional model without predictors, the ICC of peer victimization was .09, indicating that 9% of the variance was attributed to the differences between classrooms. The between classroom variances were significant ( $\chi^2/df = 1.99, p < .001$ ), which means the alternative hypothesis was accepted regarding differences in peer victimization W2 between classrooms. These results suggest that it was convenient to test HLM to provide how the variance was accounted by Level 1 and Level 2 variables.

Step 2: Individual-level predictors

As shown in Table 2, age and gender were not associated with greater later involvement in peer victimization. Positive peer perception and social anxiety were negatively and positively associated with subsequent peer victimization respectively, even after controlling for the effects of prior victimization. The results provide an ICC of .15, suggesting that 15% of the variability in peer victimization was attributed by the individual-level predictors introduced in this step.

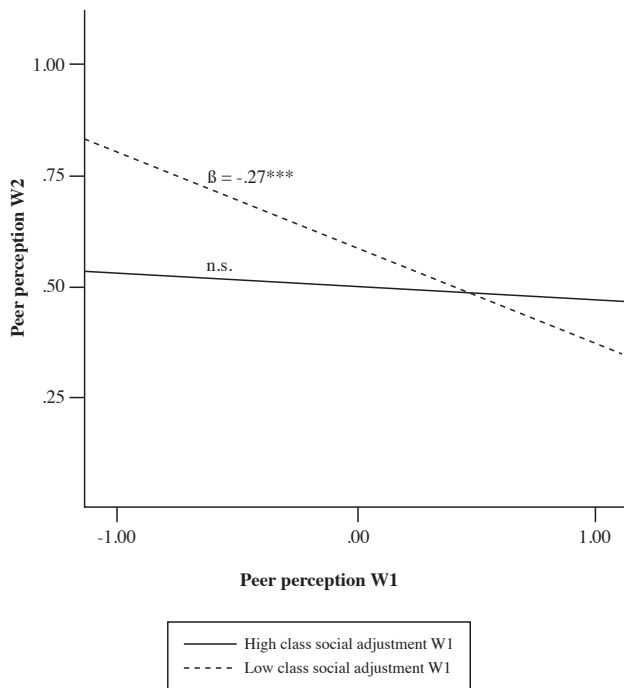
Step 3: Cross-level interaction predictors

After controlling for the effects of all individual-level predictors and class social adjustment, as classroom-level predictor, the results suggest that class social adjustment was not found to moderate the association between social anxiety and peer victimization ( $p > .05$ ). However, class social adjustment had a significant cross-level interaction with positive peer perception to predict peer victimization (see Table 2). The simple slopes test indicated that the association between peer victimization was significant for adolescents in classes with low social adjustment levels, but not for those from high levels (see Figure 1). The results provide an ICC of .23, suggesting that 23% of the variability in peer victimization between classrooms was attributed to class social adjustment.

Table 2  
Summary of the Hierarchical Linear Model Predicting Peer Victimization W2

Variable	Individual-level model		Classroom-level model	
	b	SE	b	SE
Individual-level predictors				
Gender	-.07***	.05	-.07	.05
Age	-.02***	.02	-.02	.02
Victimization W1	.28***	.07	.25**	.08
Peer perception W1	-.14*	.07	-.10	.07
Social anxiety W1	.13**	.04	.14**	.04
Classroom-level predictors				
Class social adjustment W1			-.17*	.09
Cross-level interactions				
Class social adjustment W1 x Peer perception W1			.47**	.17
Class social adjustment W1 x Social anxiety W1			.14	.04

Note: Gender were dummy coded (1 = Boy and 2 = Girl)  
\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$



**Figure 1.** Simple Slopes Showing the Moderating Effect of Class Social Adjustment Levels (W1) on the Association Between Peer Perception (W1) and Peer Victimization (W2)

### Discussion

In this study we used a person-by-environment model (Magnusson, 2015) to examine the effects of positive peer perception and social anxiety and the moderating effects of class social adjustment levels on peer victimization.

At the individual level, the current study confirmed hypothesis about how children's negative peer perception and social anxiety would influence their involvement in victimization situations. Regarding our first hypothesis, results were consistent with social information processing model (Crick & Dodge, 1994): perception of hostile contexts made peer victimization more likely. Although prior studies suggest that peer adversities may be more likely to influence in perception about the group (Ladd et al., 2014; Salmivalli & Isaacs, 2005), our study indicate an inverse effect. These results suggest that children with negative peer perception may feel mistrust towards their group and have a reduced sense of motivation to interact with them. If they believe that their classmates are untrustworthy, children may inhibit from social interaction, promoting social rejection (Dawes et al., 2017) and victimization (Hong & Espelage, 2012). With regard to our second hypothesis, we found a significant effect over time of social anxiety. This highlights the main role that emotions linked to social anxiety, such as fear or worry, play in explaining why students may end up being victimized (Gómez-Ortiz et al., 2018; Pabian & Vandebosch, 2016; Tillfors et al., 2012). According to the interpersonal models of social anxiety and peer victimization (Siegel et al., 2009), a higher use of self-protective behaviors, characteristic of social anxious people, may increase peer victimization, perhaps because they reduce tolerance to interpersonal stress (Knappe et al., 2015) and favor a possible irritation in their peers (Tillfors et al., 2012).

At the class level, our results showed that the association between peer perception and being bullied was stronger in classes with lower level of social adjustment, so our third hypothesis about moderation effects was confirmed. This is in line with previous studies which have shown that climate classroom and peer support expectative affect victimization (Saarento et al., 2013; Thornberg et al., 2017). Over time, adolescents in groups with untrusted and unsupportive groups may become aware of the climate of hostility and isolation in their classrooms, that exacerbate the negative perception of classmates and the involvement in peer victimization. In this sense, low level of social adjustment in classrooms could intensify fear and insecurity and weakens interpersonal relationships by decreasing confidence among students (Pan et al., 2020), thereby increasing the prevalence of victimization. These results highlight the psychological and social cost of poor quality in peer relationships (Huitsing et al., 2012). These novel findings concerning the moderating effects of class social adjustment justify further this study. However, as unexpected, the second part of third hypothesis was not confirmed. Social anxiety did not significantly affect victimization anywhere within the range of class levels, so no moderation effect was found on this relationship. Further studies are necessary to allow more definitive conclusions about the effects of class social adjustment levels on the interconnections between social anxiety and peer victimization.

This study complements the extensive area of research that explores the mechanisms that may precede bullying victimization, exploring multiple individual characteristics simultaneously. The current prospective study indicates that adolescents' peer perception and social anxiety contribute over time to being bullied. In parallel, it demonstrates how descriptive class norms may influence such association. Our research thereby emphasize that it is essential to include cognitive, emotional, and social variables in prevention models for victimization, as well as highlighting that such models should incorporate a person-by-environment perspective.

Limitations of the study include the use of self-reports, which may give rise to certain biases, but the instruments employed have been used widely in previous research. Also, data were collected at two points in time, six months apart, while a longer study horizon with more waves of data collection might explain more of the variation in the variables, and provide better insight into the interconnections between the variables, including the reciprocal nature of some of these relationships. Although our study includes data from a large Spanish adolescent sample that was selected randomly, the results should be taken with precaution because the sample consisted of schools from a single region. Future studies need to consider such analyses to integrate adolescents from different cultural background (Pistella et al., 2020) and specific disorders (Murray et al., 2020) for a more adequate generalization. Our suggestion for future research, also, is to adopt such an approach, which would further extend our knowledge about the causes of victimization among peers and other contextual factors, like family (Gómez-Ortiz et al., 2019). Future multi-level perspective studies might consider the inclusion of reports from others (i.e., peers and teachers) and other techniques (i.e., peer nomination).

From a practical perspective, this study has implications for bullying policies and prevention and intervention programmes in schools at individual and classroom level. This study adds to practitioners' knowledge about the relevance to promote more supportive peer groups. Educational programmes applied in schools should place more emphasis on social anxiety and also

extend the intervention strategies to teach and foster abilities to face difficult and unpleasant situations instead of avoiding them repeatedly. Prevention initiatives should also promote awareness of the influence of perception in relationships to learn to self-regulate and assume responsibility for their thoughts, reactions, and behaviors in social interactions.

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