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Serial mediation analysis of the relationship between uncertainty intolerance and statistical anxiety in university students

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Abstract

The aim of this study was to analyze the effect of intolerance to uncertainty on statistical anxiety, mediating this relationship by negative problem orientation and worry in a sample of university students. A sample of 437 Colombian students (285 females) between 18 and 30 years old (M = 21.28, SD = 2.43) was analyzed using serial mediation models for inhibitory and prospective uncertainty intolerance and three dimensions of statistical anxiety (asking for help anxiety, examination anxiety, and interpretive anxiety). Uncertainty intolerance influences the emergence of statistical anxiety thanks to the mediation of dispositional variables. The findings highlight the mediating role of negative problem orientation on all anxiety symptoms, whereas worry operates as a serial mediator against statistical test anxiety. This study demonstrates that low tolerance for uncertainty leads to the experience of statistical anxiety when students assume problems as a threat.

Keywords

Uncertainty intolerance, statistical anxiety, college student, worry, educational psychology in higher education.

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Anàlisi de mediació serial de la relació entre intolerància a la incertesa i ansietat estadística en estudiants universitaris

Resum

L'objectiu d'aquest estudi és analitzar l'efecte de la intolerància a la incertesa sobre l'ansietat estadística sota la mediació de l'orientació negativa al problema i la preocupació en una mostra d'universitaris. Es van analitzar 437 estudiants colombians (285 dones) d'entre 18 i 30 anys ($M = 21,28$, $DT = 2,43$) mitjançant models de mediació serial entre la intolerància a la incertesa inhibitòria i prospectiva, i tres dimensions d'ansietat estadística (ansietat per demanar ajuda, ansietat davant exàmens, ansietat interpretativa). La intolerància a la incertesa influeix en l'aparició d'ansietat estadística gràcies a la mediació de les variables disposicionals. Els resultats posen en relleu el paper mediador de l'orientació negativa al problema sobre tots els símptomes ansiosos, mentre que la preocupació opera com a mediador serial enfront de l'ansietat davant exàmens estadístics. Aquest estudi demostra que la baixa tolerància a la incertesa condueix a l'experiència d'ansietat estadística quan els estudiants assumeixen els problemes com una amenaça.

Paraules clau

Intolerància a la incertesa, ansietat estadística, estudiant universitari, preocupació, psicologia de l'educació superior.

Análisis de mediación serial de la relación entre intolerancia a la incertidumbre y ansiedad estadística en estudiantes universitarios

Resumen

El objetivo de este estudio es analizar el efecto de la intolerancia a la incertidumbre sobre la ansiedad estadística bajo la mediación de la orientación negativa al problema y la preocupación en una muestra de universitarios. Se analizaron 437 estudiantes colombianos (285 mujeres) de entre 18 y 30 años ($M = 21,28$, $DT = 2,43$) mediante modelos de mediación serial entre la intolerancia a la incertidumbre inhibitoria y prospectiva, y tres dimensiones de ansiedad estadística (ansiedad por pedir ayuda, ansiedad ante exámenes, ansiedad interpretativa). La intolerancia a la incertidumbre influye en la aparición de ansiedad estadística gracias a la mediación de las variables disposicionales. Los resultados ponen de relieve el papel mediador de la orientación negativa al problema sobre todos los síntomas ansiosos, mientras que la preocupación opera como mediador serial frente a la ansiedad ante exámenes estadísticos. Este estudio demuestra que la baja tolerancia a la incertidumbre conduce a la experiencia de ansiedad estadística cuando los estudiantes asumen los problemas como una amenaza.

Palabras clave

Intolerancia a la incertidumbre, ansiedad estadística, estudiante universitario, preocupación, psicología de la educación superior.

INTRODUCTION

For most university students it is a requirement to take statistical courses to complete their undergraduate or graduate education, however, this experience often involves unpleasant subjective experiences that translate into anxiety. Students with statistical anxiety develop a high level of emotional stress when facing statistical problems or situations (Sesé et al., 2015), which affects the learning process, causing negative academic outcomes.

In the last two decades there has been an increased interest in understanding the mechanisms involved in anxiety in the face of statistical content, leading to studies which analyze from skills and knowledge to attributional variables that include affective and cognitive elements of dispositional nature. That is, variables that involve the way individuals cope with problem situations, their handling of ambiguous or unpredictable events or situations, or the concerns surrounding learning. These variables are widely studied in comprehensive models of anxiety as a general experience or from its clinical perspective, but they also promise to offer valuable contributions to the study of statistical anxiety.

Definition and measurement of statistical anxiety

Statistical anxiety is understood as a multidimensional phenomenon (Onwuegbuzie & Wilson, 2003) because, in addition to the emotional responses of tension and distress, it is related to the experiences and attitudes of students towards discipline. In general, students who experience statistical anxiety show nervousness and worry about the results of an exam (Faber et al., 2018). It is possible to observe anxious behaviors that range from nail-biting or feeling angry, to psychological symptoms such as frustration, panic and depression.

The multidimensional measure of statistical anxiety is widely accepted by the scientific community. Cruise et

al. (1985) proposed a model of six factors evaluated using the Statistical Anxiety Rating Scale (STARS), which became the standard measure used in the international literature. From this approach, statistical anxiety is made up of the dimensions: interpretation anxiety, test and class anxiety, fear of asking for help, computational self-concept, worth of statistics, and fear of statistics teachers. However, it has been pointed out that this model not only measures statistical anxiety, but also that the last three dimensions actually correspond to the evaluation of attitudes towards the discipline (Papousek et al., 2012). For this reason, the measure of anxiety should be based on the three initial scales.

Vigil-Colet et al. (2008) warn about this situation. They have therefore proposed a shorter and more precise measurement model based on the first three dimensions of the STARS. Their measurement model is based on the identification of three factors called asking for help anxiety, examination anxiety, and interpretation anxiety, which are measured with the Statistical Anxiety Scale (SAS).

The first factor indicates that students feel anxiety when asking other people (teachers, classmates) questions about statistical topics. The second indicates the experience of anxiety when students take statistics exams. The third factor is configured as the anxious response that arises when statistical data must be interpreted and the language used in statistics must be understood (Vigil-Colet et al., 2008).

Dispositional antecendents implicated in statistical anxiety

Currently it is recognized that statistical anxiety is due to the effect of various types of antecedents of a situational, cognitive and dispositional nature (Onwuegbuzie & Wilson, 2003). The situational antecedents are related to the teaching setting, the characteristics of the class, and the role of the statistics teacher. The cognitive background includes reasoning strategies, the role of attention, memory, and metacognitive strategies, among others. Finally, the dispositional antecedents emphasize the role of variables of a psychological nature, individual, behavioral, motivational, and attitudinal differences (Chew & Dillon, 2014; Cui et al., 2019).

Within this last group, topics such as procrastination (Onwuegbuzie, 2004), self-concept (Najmi et al., 2018; Faber & Drexler, 2019) and attitudes towards statistics (MacArthur, 2020) have been widely developed. Meta-analytic reviews show assiduous production on topics such as procrastination, self-efficacy, learning strategies, and self-awareness (Trassi et al., 2022). However, other analytical scenarios, such as the role of intolerance to uncertainty, worry and other associated aspects, still have a long way to go.

Precisely, this type of variable becomes relevant to the extent that the specialized literature has demonstrated its valuable role in the development and maintenance of anxiety symptoms. This has been observed both in studies carried out with a clinical population (Swee et al., 2019), and in comparative studies with non-clinical population groups, including university students (Kertz et al., 2012; Kertz et al., 2014).

Uncertainty intolerance has been described as an important variable involved in anxiety manifestations. Koerner and Dugas (2006) define it as a dispositional characteristic that affects the way of perceiving and interpreting uncertain situations, as well as the way of responding to them. This leads people who do not tolerate uncertainty to feel it as an annoying and stress-generating event. Addiotionally, this experience interferes with the proper functioning of people (Buhr & Dugas, 2002). For his part, Carleton (2016) describes it as a dispositional inability to withstand aversive responses produced by the perceived lack of relevant or sufficient information, which is sustained by the perception of uncertainty.

Originally, uncertainty intolerance was studied within the comprehensive framework of psycho-affective problems. Later it was included as an important phenomenon within generalized anxiety (Krohne, 1993), understanding that high levels of this dispositional characteristic generate cognitive avoidance and negative emotional reactions when individuals are faced with ambiguous and uncertain problem situations. Dugas et al. (1998) delved into this idea, relating uncertainty intolerance with other variables such as poor orientation towards problems, beliefs about worry and cognitive avoidance. They identified particularities in their forms of relationship that differ between patients with generalized anxiety disorder and non-clinical subjects.

Two dimensions of uncertainty intolerance (UI) have been differentiated: the first is prospective UI, which involves elements of a cognitive nature related to fear and anxiety about future events, while the second dimension is inhibitory UI, which encompasses behavioral elements related to action inhibition (Kerz et al., 2014). Some evidence has suggested that each dimension is related to different psychoemotional problems. Thus, prospective UI has been described as being more strongly associated with generalized anxiety and obsessive-compulsive symptoms, while inhibitory UI has been associated with symptoms of panic, social anxiety, and depression (Carleton et al., 2010; McEvoy & Mahoney, 2011). However, subsequent works have not found specific differences in the UI dimensions in different clinical groups. In fact, similar scores have been reported between groups of university students and community groups (Carleton et al., 2012).

Recent evidence has shown that both dimensions of UI are related to symptoms of generalized anxiety. Although the idea that inhibitory UI is more associated with symptoms of social anxiety is reiterated, furthermore, prospective UI has been shown to have a stronger relationship

with tendency to worry than the inhibitory dimension (Kretzmann & Gauer, 2020). These considerations are important in the framework of this study, since the multidimensional evaluation of statistical anxiety involves elements of a social (asking for help anxiety), evaluative (examination anxiety) and cognitive (interpretation anxiety) nature. Therefore, the influence of uncertainty intolerance could vary depending on each dimension.

Uncertainty intolerance has also been related to other dispositional variables, such as negative problem orientation, and worry and its associated consequences, thus constituting analysis models that are relevant in the current study of anxiety. In the case of worry, it is understood as the apprehension manifested in the face of negative events expected by a person, with the capacity to exacerbate emotional distress. Worry implies the intrusion of a set of negative ideas related to the problems a person faces (Wells, 2005), so it is to be expected that individuals with a tendency to worry are more vulnerable to anxiety and unpredictable events.

Indeed, worry is closely linked to uncertainty intolerance, since the abundance of uncertain situations that a person faces on a daily basis can generate numerous worries (Dugas et al., 1994; Koerner & Dugas, 2006). As can be seen, these variables feed back; for example, in people with generalized anxiety there is a tendency not to tolerate uncertainty, which is why they turn to worry as a potential method of coping or preventing the results they fear (Kertz et al., 2014). The close relationship between these variables has also been verified in relation to anxiety as a trait and in relation to manifestations of anxiety before exams. It is generally accepted that worry operates as a subjective mechanism by which uncertainty is sought to be improved (Huntley et al., 2020).

In the same way, negative problem orientation is a variable that is related to anxiety and can also predict worry (Dugas et al., 1997; Robichaud & Dugas, 2005). It is also closely related to uncertainty intolerance (Koerner & Dugas, 2006). Negative problem orientation encompasses cognitive and affective experiences. This form of orientation towards problems leads them to be perceived as a threat. Additionally, people experience doubts about their own solving capacities, which leads to feelings of pessimism related to the result that can be obtained (Koerner & Dugas, 2006). This type of experience negatively affects the self-regulation of action in the face of problems, since doubts are generated about their own abilities to face them, and if they are not resolved, they will continue to produce anxiety (Ouellet et al., 2019).

Although initially the study of uncertainty intolerance focused on its role in the etiology of generalized anxiety disorder, it was subsequently recognized as a transdiagnostic characteristic (Carleton et al., 2012; McEvoy et al., 2019). It is currently assumed to be an influential factor in the development and maintenance of anxiety in different groups of people (Carleton et al., 2012; Osman-

agaoglu et al., 2018), even its role in statistical anxiety has been shown (Williams, 2013).

Indeed, the study of statistics implies in itself, handling situations of uncertainty. Chew and Dillon (2014) argue that the probabilistic nature of statistics may imply the emergence of anxiety symptoms in the face of discipline, since students must deal with ambiguous situations in which they find it necessary to make decisions. The authors exemplify their argument by showing that, in the hypothesis test, students must decide if they have enough evidence to reject the null hypothesis or not, counting on a 5% probability of making an error. From their perspective, students may experience discomfort in the face of this type of ambiguity, which would lead to anxiety towards statistical content.

Cui et al. (2019) have supported this idea by pointing out that when studying statistics, students face situations in which the results are uncertain. In this sense, describing an event whose probability of occurrence does not reach 100% translates into an increase in their anxiety levels as a result of experiencing worry and uncertainty.

Although they are few, some studies with university students have addressed the relationship between uncertainty intolerance and statistical anxiety. Williams (2013) analyzed a small sample of 97 graduate students, among whom he assessed statistical anxiety by applying the STARS at the beginning (pretest) and at the end (posttest) of the semester. The results revealed that the anxiety dimensions measured by the test were positively and moderately related to worry and uncertainty intolerance, measuring this as a global factor. Furthermore, although the anxious experience decreased as the semester passed, no changes were observed in the levels of uncertainty intolerance and worry.

Subsequently, Williams (2015) evaluated 103 postgraduate students. She identified that the probability of experiencing elevated symptoms of statistical anxiety was higher among students with a higher tendency to worry, a higher level of negative problem orientation, and positive ideas about the consequences of worrying.

Current study

Although there is copious evidence on the relationship between uncertainty intolerance and anxiety, there are still disagreements in the literature about the specific mechanisms by which these relationships are configured. This discussion is especially relevant in the study of statistical anxiety, in which the role of dispositional elements related to low acceptance of uncertainty and the possible mediating role of worry and negative problem orientation have been little explored. This study proposes a differential analysis of the dimensions of uncertainty intolerance on statistical anxiety in university students. It is understood that the latter is multidimensional, therefore the mechanisms involved in each dimension of anxiety

may vary. The proposed analysis complements and expands previous developments (Williams, 2013, 2015) to the extent that it analyzes specific mediation mechanisms for each dimension of statistical anxiety. It is considered that these include different manifestations that range from the interpretation of statistical information to behaviors of a social order, such as interaction with others through the formulation of questions or doubts.

The objective of this study is to analyze the effect of intolerance to uncertainty on statistical anxiety by mediating this relationship by negative problem orientation and worry in a sample of university students

METHODS

Participants

Through an empirical study with a quantitative approach, a non-probabilistic sample was selected made up of 437 students from three Colombian universities who agreed to participate voluntarily after signing the informed consent. The participants were between 18 and 30 years old (M = 21.28, SD = 2.43) and were divided into 285 women (65.2%) with a mean age of 21.59 years (SD = 2.57), while the number of men was 152 (34.8%) with a mean age of 21.11 years (SD = 2.35). The sample was multidisciplinary; 90 participants (20.6%) were from a basic sciences faculty, 95 (21.7%) from health sciences, 136 (31.1%) from human and social sciences, and 116 (26.5%) from educational sciences.

Measurements

The participants filled out a series of questionnaires whose psychometric properties were reviewed and adjusted to the population to guarantee the validity of the measure. For this, an exploratory factorial analysis (AFE) was carried out with 50% (n = 219) of the sample and a confirmatory factorial analysis (CFA) with the remaining 50% (n = 218). The results of the process are described together with the characterization of each questionnaire.

The statistical anxiety was evaluated with the application of the Statistical Anxiety Scale (SAS; Vigil-Colet et al., 2008), made up of 24 items on a five-point Likert-type scale through which the respondent indicates the level of anxiety that each situation raises (1= "no anxiety", 5= "a lot of anxiety"). The instrument identifies three differentiated factors (8 items each) called asking for help anxiety, examination anxiety, and interpretation anxiety. The AFE retained the factorial structure, but without items 8 and 16 (λ < 0.40) (KMO = .884, x^2(Bartlet) = 4460.5, p < .001, AVE = .624), while the AFC demonstrated an excellent fit (x^2/df = 1.5, CFI = .999, TLI = .999, GFI = .993, NNFI = .999, RMSEA = .001 [90% CI = .000 - .025], SRMR = .060). Internal consistency scores were good for all subscales (asking for help anxiety α = .927, ω = .928; examination anxiety α = .924, ω =

.925; interpretation anxiety α = .844, ω = .844, global α = .947, ω = .947).

Uncertainty intolerance was measured with the Intolerance of Uncertainty Scale, short form (IUS-12; Carleton et al., 2007). This is the shortened version of the original 27-item IUS scale (Freeston et al., 1994) created to identify reactions to uncertainty, the future, and ambiguous situations. The psychometric properties of the IUS-12 are comparable to the original version, but it has the advantage of being a short questionnaire; additionally, it is useful for evaluating diverse populations, while the extended version has more clinical applications (Carleton et al., 2012). The instrument identifies two dimensions called prospective UI (seven items) and inhibitory UI (five items) (McEvoy & Mahoney, 2011). Our AFE corroborated the dimensional structure with all the items (KMO = .842, x^2(Bartlet) = 1129.2, p < .001, AVE = .466) and the AFC reported good indicators (x^2/df = 1.5, CFI = .989, TLI = .986, GFI = .996, NNFI = .986, RMSEA = .049 [90% CI = .036 - .062], SRMR = .057). The internal consistency was very good for prospective UI (α = .872, ω = .873), for inhibitory UI (α = .819, ω = .822) and for the global scale (α = .887, ω = .886).

The Negative Problem Orientation Questionnaire (NPOQ; Gosselin et al., 2001) was also applied, which identifies the tendency of people to focus on negative aspects of situations that represent social problems. We used the revised version (Robichaud & Dugas, 2005) made up of 12 Likert-type items (1 = "not at all true of me", 5 = "extremely true of me") that offer a one-dimensional result. Our AFE (KMO = .882, x^2(Bartlet) = 1053.3, p < .001, AVE = .631) led to the elimination of items 5 to 9 due to their low factor loading (λ < 0.40), while the AFC with the seven-item version showed an excellent fit (x^2/df = 1.2, CFI = .999, TLI = .998, GFI = .997, NNFI = .998, RMSEA = .031 [90%CI = .000 - .076], SRMR = .053) as well as high internal consistency (α = .912, ω = .912).

Finally, concern was assessed with the Penn State Worry Questionnaire (PSWQ, Meyer et al., 1990), originally made up of 16 Likert-type items (1 = "not at all typical of me", 5 = "very typical of me") that measure a single factor. Our AFE reduced the number of items to nine (KMO = .922, x^2(Bartlet) = 1304.5, p < .001, AVE = .533) and this shorter version showed excellent fit to the AFC results (x^2/df = 1.5, CFI = .999, TLI = .998, GFI = .997, NNFI = .998, RMSEA = .067 [CI90% = .049 - .087], SRMR = .042), as well as high internal consistency (α = .937, ω = .938).

Procedure

To access the participants, institutional authorizations were requested, informed consent was obtained from those evaluated, and the instruments were applied in a self-administered and collective manner. The data were loaded

into an SPSS for Windows database (version 25) with which the statistical analyzes were performed. The applied research protocol received the approval of the institutional authorities and conforms to compliance with international ethical guidelines and the provisions of Law 1090 for psychological research with human beings in Colombia.

Statistical analysis

The purpose of this study was to test two main hypotheses. The first (H1) states that *the relationship between inhibitory UI and statistical anxiety is mediated by negative problem orientation and worry*. Nine hypotheses are derived from this, corresponding to three for each dimension of statistical anxiety. The first set of hypotheses proposes that negative problem orientation (NPO) mediates the relationship between inhibitory UI (INH) and the three dimensions of anxiety: asking for help anxiety, AHA (H1$_a$); examination anxiety, EXA (H1$_d$); and interpretation anxiety, ANI (H1$_g$). The second set hypothesizes that worry (WOR) mediates the relationship between INH and AHA (H1$_b$), EXA (H1$_e$), and ANI (H1h), and the third set hypothesizes that NPO and WOR mediate in causal sequence the relationship of INH with AHA (H1$_c$), EXA (H1$_f$), and ANI (H1$_i$).

The second main hypothesis (H2) maintains that *the relationship between prospective UI and statistical anxiety is mediated by negative problem orientation and worry*. Three sets of hypotheses similar to those described regarding the relationship between INH and anxiety dimensions are generated from it, but using prospective UI (PRP) as an independent variable. The complete list of hypotheses and the decision regarding each of them is presented at the end of the results.

A descriptive analysis of the data was carried out and the relationships between the variables were tested with the Pearson correlation coefficient. Subsequently, to test the serial mediation models, the macro PROCESS v4.2 (Hayes, 2018) for SPSS was used. This procedure uses confidence intervals through the bootstrapping technique that support the results obtained in mediation analysis. This type of analysis makes it possible to explain the influence of a predictor variable X on a response variable Y thanks to the decomposition of direct and indirect effects generated by the independent variable on an intervening mediator Z, and from this on the dependent variable (X→Z→Y) (MacKinnon, 2008).

In this study we have carried out serial mediation models (SMM) with two mediators (X→M1→M2→Y) generating a total of six SMM corresponding to three for each dimension of uncertainty intolerance. In the first three SMM the response variables were AHA, EXA and ANI, while the independent variable was INH and the mediators were NPO and WOR. This procedure was similar for the three remaining models, but using PRP as the independent variable. The SMMs were calculated with PROCESS model 6 with 5000 bootstrapping samples with 95% confidence interval (CI); thus, an indirect effect exists when the interval does not include the value 0. A consistent heteroscedasticity estimator (HC3) was also calculated to avoid its effect on the results (Mérida-López et al., 2022). Age and gender were controlled to avoid their effect on the results.

RESULTS

The descriptive data and the correlations of the study variables are described in Table 1, where correlations are observed between all the variables. PRP shows moderate relationships with the cognitive variables, and correlations between weak ($0.10 \leq |rxy| < 0.30$) and moderate ($0.30 \leq |rxy| < 0.50$) with the dimensions of statistical anxiety. In the case of INH, the relationships with the dimensions of statistical anxiety AHA and EXA are mod-

Table 1. Descriptive statistics and correlations between study variables

Variable	Mean (SD)	PRP	INH	WOR	NPO	AHA	EXA
1. PRP	24.75 (5.24)	—					
2. INH	15.61 (4.64)	.569	—				
3. WOR	30.69 (8.30)	.495	.554	—			
4. NPO	20.22 (6.93)	.449	.592	.649	—		
5. AHA	19.11 (8.18)	.222	.322	.329	.391	—	
6. EXA	26.99 (8.04)	.401	.301	.406	.339	.562	—
7. INA	13.54 (5.22)	.198	.299	.276	.354	.645	.514

Note: All correlations have associated p-values < .001. PRP = prospective UI, INH = inhibitory UI, WOR = worry, NPO = negative problem orientation, AHA = asking for help anxiety, EXA = examination anxiety, INA = interpretation anxiety.

erate, while with INA they are weak according to Cohen's (1988) interpretation criteria.

In the mediation analysis, three models were built for each dimension of uncertainty intolerance; the first three correspond to INH as an independent variable (Table 2), and the last three to PRP. In SMM1, no direct effects were recorded, however, after considering the role of mediating variables, total effects were observed. The results show that of the three indirect mediation effects, only the one corresponding to the INH→NPO→AHA pathway is relevant. Given the initial lack of effect of INH on AHA, the model identifies full mediation.

Total mediation is also present in SMM2, since it did not show any direct effects. In this model, all indirect effects are relevant (Table 2), both due to the mediation of NPO, as well as the mediation of WOR, and due to the joint effect of both mediating variables (NPO + WOR). Finally, in SMM3 both the direct and total effects were relevant, so the mediation of the model is partial. In this case, the relationship between INH and EXA is mediated by NPO, while the indirect effects obtained in the WOR-mediated pathway are ruled out. The final model with all the identified effects is presented in Figure 1.
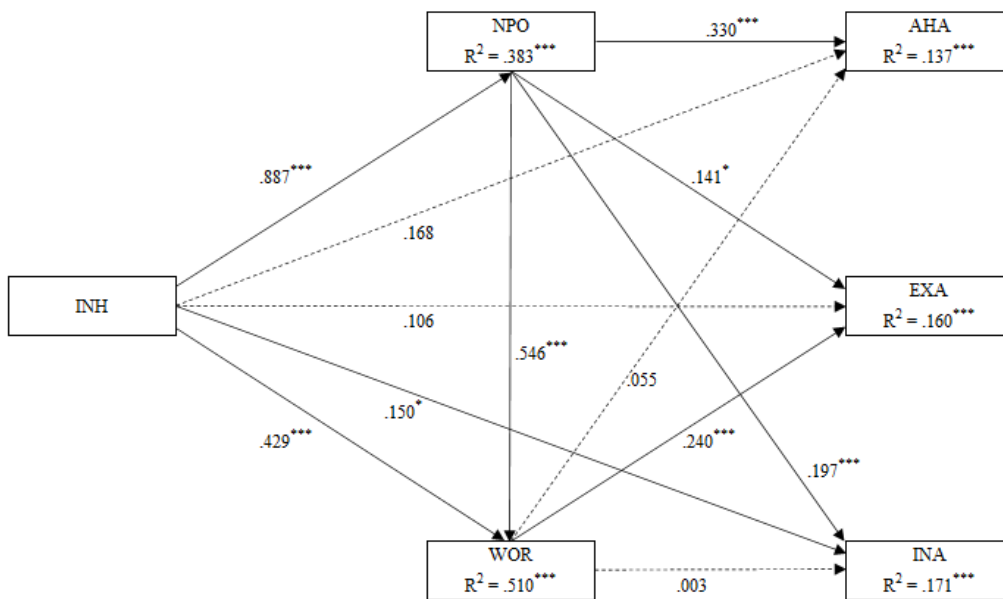
The SMM of the relationship between PRP and the dimensions of statistical anxiety showed similar results to the models where INH operated as an independent variable. At first, SMM4 identified full mediation through the indirect effect of NPO between the study variables.

Table 2. Indirect effects obtained in the Serial Mediation Model (SMM) of the relationship between inhibitory UI and statistical anxiety dimensions from the mediating variables worry and negative problem orientation.

| Indirect effect | Completely standardized indirect effects | | | |
| | | | 95% CI | |
	Effect	BootSE	Lower Limit	Upper Limit
Indirect effect SMM1				
Total	.195 (.039)	.039	.118	.272
INH→NPO→AHA+	.166 (.038)	.038	.093	.241
INH→WOR→AHA	.013 (.015)	.015	-.016	.043
INH→NPO→WOR→AHA	.015 (.017)	.017	-.018	.048
Direct effects	β = .168 [95%CI = -.050, .387], SE(HC3) = .111, t = 1.514			
Total effects	β = .511 [95%CI = .335, .688], SE(HC3) = .090, t = 5.693***			
Indirect effect SMM2				
Total	.043	.043	.117	.285
INH→NPO→EXA+	.036	.036	.001	.146
INH→WOR→EXA+	.021	.021	.022	.105
INH→NPO→WOR→EXA+	.021	.021	.028	.109
Direct effects	β = .106 [95%CI = -.111, .323], SE(HC3) = .110, t = .957			
Total effects	β = .449 [95%CI = .283, .616], SE(HC3) = .085, t = 5.315***			
Indirect effect SMM3				
Total	.158	.037	.086	.234
INH→NPO→INA+	.156	.036	.086	.228
INH→WOR→INA	.001	.015	-.030	.032
INH→NPO→WOR→INA	.001	.017	-.033	.035
Direct effects	β = .150 [95%CI = .025, .276], SE(HC3) = .064, t = 2.359*			
Total effects	β = .329 [95%CI = .220, .437], SE(HC3) = .055, t = 5.964***			

Note: * p < .05, *** p < .001, INH = inhibitory UI, NPO = negative problem orientation, WOR = worry, AHA = asking for help anxiety, EXA = examination anxiety, INA = interpretation anxiety, BootSE = standard error with bootstrapping, CI = confidence interval, HC3 = heteroscedasticity consistent standard error. + Paths with statistically relevant indirect effects.

Figure 1. Final model illustrating the mediating role of negative problem orientation and worry in the relationship between inhibitory UI and statistical anxiety dimensions.
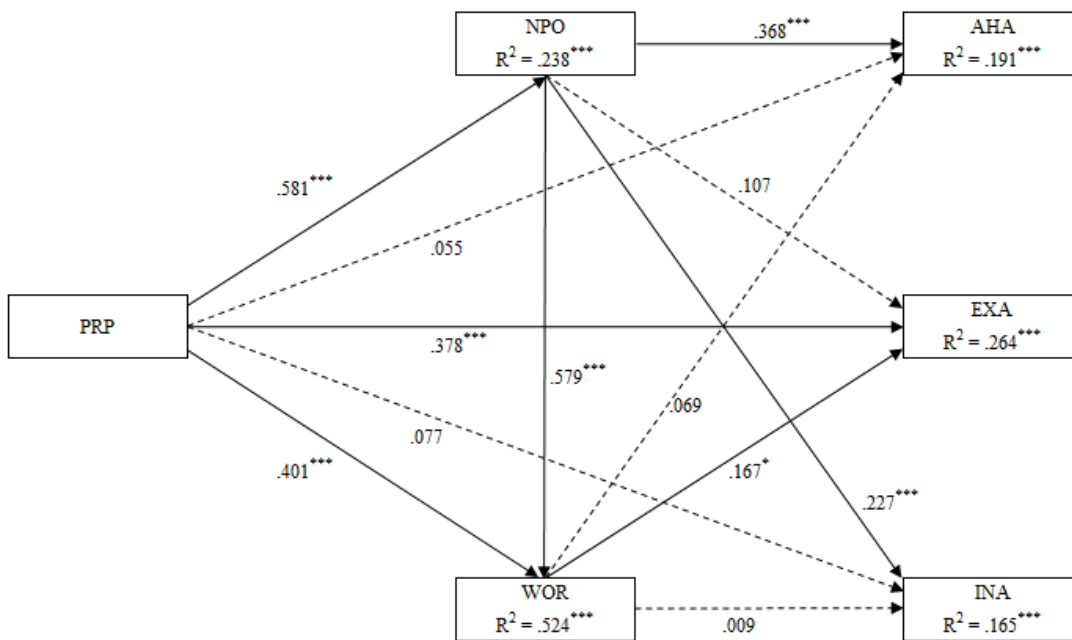

Note: * $p < .05$. *** $p < .001$.

Table 3. Indirect effects obtained in the Serial Mediation Model (SMM) of the relationship between prospective UI and statistical anxiety dimensions from the mediating variables worry and negative problem orientation.

| | Completely standardized indirect effects | | | |
| | | | 95% CI | |
Indirect effect	Effect	BootSE	Lower Limit	Upper Limit
Indirect effect SMM4				
Total	.169	.031	.233	.233
PRP→NPO→AHA+	.137	.028	.196	.196
PRP→WOR→AHA	.018	.016	.051	.051
PRP→NPO→WOR→AHA	.015	.013	.041	.041
Direct effects	$\beta = .055$ [95%CI = -.112, .222], SE(HC3) = .085, $t = .647$			
Total effects	$\beta = .319$ [95%CI = .166, .473], SE(HC3) = .078, $t = 4.088$***			
Indirect effect SMM5				
Total	.121	.031	.064	.184
PRP→NPO→EXA	.040	.025	-.008	.090
PRP→WOR→EXA+	.044	.020	.008	.085
PRP→NPO→WOR→EXA+	.037	.015	.007	.068
Direct effects	$\beta = .378$ [95%CI = .214, .542], SE(HC3) = .083, $t = 4.538$***			
Total effects	$\beta = .563$ [95%CI = .429, .697], SE(HC3) = .068, $t = 8.257$***			
Indirect effect SMM6				
Total	.139	.031	.081	.201
PRP→NPO→INA+	.132	.028	.080	.192
PRP→WOR→INA	.004	.016	-.028	.035
PRP→NPO→WOR→INA	.003	.013	-.024	.029
Direct effects	$\beta = .077$ [95%CI = -.020, .174], SE(HC3) = .049, $t = 1.552$			
Total effects	$\beta = .215$ [95%CI = .123, .307], SE(HC3) = .047, $t = 4.588$***			

Note: *** $p < .001$, PRP = prospective UI, NPO = negative problem orientation, WOR = worry, AHA = asking for help anxiety, EXA = examination anxiety, INA = interpretation anxiety, BootSE = standard error with bootstrapping, CI = confidence interval, HC3 = heteroscedasticity consistent standard error. + Paths with statistically relevants indirect effects.

Figure 2. Final model illustrating the mediating role of negative problem orientation and worry in the relationship between prospective UI and statistical anxiety dimensions.

Note: $^{*} p < .05.$ $^{***} p < .001.$

While in SMM5 two indirect effects were identified, the first is given by the mediation of WOR between PRP and EXA, and the second by the chain mediation of NPO and WOR. In the third model (SMM6), the mediating effect of NPO between the study variables is recorded. The data for the effects of SMM 4, 5 and 6 are described in Table 3, while Figure 2 illustrates all calculated effects.

Based on the data obtained, five of the nine hypotheses related to the indirect effects of INH and the dimensions of statistical anxiety are supported, as well as four of the hypotheses related to the mediating effects between PRP and said dimensions. The definitive summary of the response to the hypotheses is shown in Table 4.

DISCUSSION

This study has been carried out with the objective of analyzing the effect of intolerance to uncertainty on statistical anxiety, by means of mediating this relationship by negative problem orientation and worry in a sample of university students. The findings reinforce the evidence of the crucial role that uncertainty intolerance plays in the emergence and maintenance of anxiety symptoms. In particular, they offer new information about how relationship mechanisms are interwoven between dispositional variables and anxiety when faced with statistics. Although the literature has been extensive in the study of these relationships against generalized anxiety disorder or trait anxiety in the non-clinical population, its application to the particular phenomenon of statistical anxiety

has seen little development. So, the results of this study add to the evidence that until now was known in post-graduate students (Williams, 2013, 2015).

Within the hypotheses proposed, it was expected that both negative problem orientation and worry would mediate the relationship between the two dimensions of uncertainty intolerance and the three dimensions of statistical anxiety. Additionally, it was proposed that the first two variables constitute a serial mediation sequence of the type X→M1→M2→Y. However, this last result can only be partially supported, since examination anxiety was the only dimension of statistical anxiety against which serial mediation was recorded.

The findings in relation to both dimensions of uncertainty intolerance were similar. In the mediation models only two essential differences are identified. The first is that in the inhibitory UI models, complete or total mediation is observed compared to asking for help anxiety and examination anxiety. This means that no initial influence of the independent variable was identified on these dimensions of statistical anxiety. On the other hand, in the prospective UI models, in addition to total mediation with asking for help anxiety, this type of mediation was identified with interpretation anxiety. The second difference is that negative problem orientation mediates the relationship between inhibitory UI and examination anxiety. In contrast, in the analysis related to prospective UI, this mediation only occurs in the serial chain with worry.

Two results stand out among what has been described. As a first measure, it is important to point out that except for the serial mediation of test anxiety, there were

Table 4. Decision on the measurement hypotheses formulated in the study.

H1: The relationship between inhibitory UI and statistical anxiety is mediated by negative problem orientation and worry.			H2: The relationship between prospective UI and statistical anxiety is mediated by negative problem orientation and worry.		
Hp	SMM1	Evidence	Hp	SMM4	Evidence
H1a	INH→NPO→AHA	Supported	H2a	PRP→NPO→AHA	Supported
H1b	INH→WOR→AHA	Unsupported	H2b	PRP→WOR→AHA	Unsupported
H1c	INH→NPO→WOR→AHA	Unsupported	H2c	PRP→NPO→WOR→AHA	Unsupported
Hp	SMM2	Evidence	Hp	SMM5	Evidence
H1d	INH→NPO→EXA	Supported	H2d	PRP→NPO→EXA	Unsupported
H1e	INH→WOR→EXA	Supported	H2e	PRP→WOR→EXA	Supported
H1f	INH→NPO→WOR→EXA	Supported	H2f	PRP→NPO→WOR→EXA	Supported
Hp	SMM3	Evidence	Hp	SMM6	Evidence
H1g	INH→NPO→INA	Supported	H2g	PRP→NPO→INA	Supported
H1h	INH→WOR→INA	Unsupported	H2h	PRP→WOR→INA	Unsupported
H1i	INH→NPO→WOR→INA	Unsupported	H2i	PRP→NPO→WOR→INA	Unsupported

Note: Hp = hypothesis, INH = inhibitory UI, PRP = prospective UI, NPO = negative problem orientation, WOR = worry, AHA = asking for help anxiety, EXA = examination anxiety, INA = interpretation anxiety, SMM = Serial Mediation Model.

no other mediations in which worry participated; a result that goes back to those reported by Williams (2013), who identified that worry in postgraduate students was moderately related to test anxiety, but did not show relationships with interpretative anxiety or fear of asking statistical questions. This evidence indicates that the tendency to worry does not appear clearly related to all the manifestations of statistical anxiety, requiring its decomposition, hence the multidimensional analysis addressed can be considered a success.

The role of worry as a mediator in the experience of anxiety linked to evaluation through exams or academic tests coincides with previous reports. It has been indicated that the intense fear towards this type of evaluation entails a high level of uncertainty intolerance (Huntley et al., 2020). In this sense, students who have little tolerance for uncertainty may perceive failure as threatening and intolerable. This logic follows what has been suggested by previous studies (Dugas et al., 1998; Ladouceur et al., 1997), which suggest that people use worry as a way of coping with the uncertainty that not knowing implies (Kertz et al., 2014). Vigil-Colet et al. (2008), have also pointed out that the responses of statistical anxiety have undergone changes in the student body. It is currently infrequent that manifestations of anxiety are given to the statistics class itself; on the other hand, the role of the exams is decisive in this process, since it is common for students to experience it as a very distressing event (Vigil-Colet et al., 2008). Concerns are commonly focused on the individual and social consequences implied by failure (Chin et al., 2017).

The second result to which we draw attention consists of the important role that negative problem orientation plays in showing relationships in all the analyses carried out, except for the fact that it does not operate as a simple mediator in the relationship between prospective UI and examination anxiety. Instead, it operates in chain with worry. Specifically, in the analysis models proposed that negative problem orientation precedes worry in a serial chain that mediates the hypothesized relationships. Our evidence supports this hypothesis in relation to examination anxiety, but not with the other forms of anxiety. Generally, it is noteworthy, as suggested by the literature (Dugas et al., 1997; Kertz & Woodruff-Borden, 2012; Robichaud & Dugas, 2005), that worry is notably predicted by negative problem orientation.

The functional interactions of this variable with inhibitory UI predict 51% of worry (R^2 = .510, $p < .001$), while the interaction with prospective UI predicts 52.4% (R^2 = .524, $p < .001$) (see Figure 1 and 2). Additionally, negative problem orientation appears in all total mediations between the three dimensions of statistical anxiety and inhibitory UI, in addition to the already described mediations in relation to prospective UI. All of this supports what was stated by Koerner and Dugas (2006), who described this dispositional variable as closely related to uncertainty intolerance to the extent that a negative approach to problems implies that they are assumed as a threat with reduced solving capacities. This lack of perceived resources deregulates the actions of the individual (Ouellet et al., 2019) to face the challenges posed by statistical situations, which can lead to the development of the forms of anxiety studied.

Limitations

It is important to specify that in this study, we have evaluated the effects of uncertainty intolerance by breaking it down into the two dimensions that consider both fear of future events and action inhibition. However, there is controversy in the literature about the effects of this differentiation. While some studies have suggested that inhibitory UI is related to social anxiety and prospective UI is related to generalized anxiety or obsessive traits (Carleton et al., 2010; McEvoy & Mahoney, 2011), others have not found these particularities (Carleton et al., 2012). The truth is that our data identifies that both dimensions are related to manifestations of anxiety of a social or cognitive nature when mediated by dispositional variables, instead of registering specific relationships according to each dimension of uncertainty intolerance. This seems to support the idea that both forms of intolerance affect the anxiety experience without distinction.

In this regard, it is important to mention that in some empirical works with clinical and non-clinical samples (Shihata et al., 2018; Wilson et al., 2020) and in meta-analytic reviews (McEvoy et al., 2019), it has been suggested that the measurement of uncertainty intolerance using IUS-12 is better represented by a one-dimensional solution. However, it is true that other recent studies (Kretzmann et al., 2020) with the Latin American population recommend the bifactorial measurement based on prospective UI and inhibitory UI.

These antecedents, plus the very nature of the data reported in this study, encourage us to continue testing different analysis proposals that help to clarify the effective model of influence of the dispositional variables studied on statistical anxiety. Given the similarity of the models obtained using a bifactorial uncertainty intolerance structure, subsequent work should analyze the effects of a one-dimensional measure of intolerance on statistical anxiety.

Indeed, new studies are necessary to broaden the understanding of these processes in the experience of statistical anxiety, and it is important to also consider the role of other variables, such as the consequences associated with the tendency to worry, which have shown a relevant effect in diverse populations (Ryum et al., 2017, Williams, 2013). Additionally, attributive processes and the way students self-assess in relation to statistics (self-concept) (Faber & Drexler, 2019) may have an effect on their assessment of their disposition towards the discipline and towards the associated academic activities. It has previously been described that negative problem orientation has a greater effect in clinical populations than in university students (Kertz et al., 2014). However, in our sample these results differ, so it is also important to formulate studies that broaden the discussion from a comparative, and even cross-cultural approach.

Implications for Theory and Practice

Even though it has been recognized that studying statistics itself entails the inherent approach to situations of uncertainty (Chew & Dillon, 2014; Cui et al., 2019), the inability to tolerate it does not necessarily lead directly to university students developing anxiety about statistics. Except for the direct relationship between inhibitory UI and interpretation anxiety, and the relationship between prospective and examination anxiety, the effects of uncertainty intolerance occur on other forms of anxiety due to the crucial role of negative problem orientation.

This evidence serves as support for the development of comprehensive training plans that consider the interference of the phenomenon described in the expression of anxiety towards statistical content. Hence its consideration is necessary when proposing didactic and pedagogical strategies that guarantee accessibility to content by the student. Teaching practice is called to promote contextualized activities to teach statistics, as well as problems and study situations in which the student believes favorable conceptions about the contents, so that these are not assumed as a threat but as educational challenges loaded with meaning.

Conclusion

The manifestations of statistical anxiety continues to be a highly penetrating problem among university students. This experience is not exclusively due to the nature of the discipline, but involves the participation of dispositional elements that seem crucial in the emotional tension and behavioral inhibition that anxiety implies. Previous research (Williams 2013, 2015) has found evidence on the relationship between these dispositional variables and statistical anxiety, while the current findings that we present reveal that a threatening perception of statistics and the demands that their learning represents seems to be a decisive mechanism that weaves the connection between uncertainty intolerance and statistic anxiety.

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