IJEP
International Journal of Educational Psychology

Volume 10, Number 2

Hipatia Press
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Articles

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Finnish Primary School Teachers' Emotional Coping in Student-related Stressful Situations

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Abstract

The current study aimed to explore primary schoolteacher's emotional stress-coping strategy and to examine its possible relationships with stressful situations caused by pupils' misbehaviours in Finland context. A total of 12 items in four subscales with second-order model was the most appropriate structure to understand teachers' emotional coping strategy. In the student-related stressful situations, the most relevant emotional coping strategies were religion/mindfulness, social support from family members, and self-blame. In addition, when teachers use self-blame to acknowledge their stressful emotions, they use another emotional strategy simultaneously, and vice versa. Those results showed significance of future studies on understanding more effective emotional strategies for student-related stress and investigating how teachers use several types of emotional coping strategies coincidently.

Keywords: emotional coping; teacher-student interaction; student-related stress; confirmatory factor analysis.

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El Afrontamiento Emocional de los Maestros de Primaria Finlandeses en Situaciones de Estrés Relacionadas con los Estudiantes

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Resumen

El estudio actual tiene como objetivo explorar la estrategia de afrontamiento del estrés emocional por parte de los maestros y examinar su posible relación con las situaciones estresantes causadas por el mal comportamiento de los alumnos en la Finlandia. La estructura más adecuada para comprender la estrategia de afrontamiento emocional de los profesores fue clasificar un total de doce elementos en cuatro subescalas con un modelo de segundo orden. Las estrategias de afrontamiento emocional más relevantes en las situaciones estresantes relacionadas con los alumnos fueron la religión o conciencia plena, el apoyo social de los familiares y la autoculpabilidad. Además, cuando los profesores usan la autoculpabilidad para reconocer las emociones estresantes, usan otra estrategia emocional simultáneamente y viceversa. Los resultados mostraron la importancia de que los futuros estudios comprendan las estrategias emocionales más eficaces para afrontar el estrés relacionado con los estudiantes e investiguen cómo los profesores utilizan varios tipos de estrategias de afrontamiento emocional de forma coincidente.

Palabras clave: Afrontamiento emocional; interacción profesor-estudiante; estrés relacionado con el estudiante; análisis factorial confirmatorio.

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S tress is a crucial factor affecting the quality of teachers' works (Hartney, 2008; Travers & Cooper, 1996; Greenaway et al., 2014), so understanding specific classroom environments and the optimal ways of coping linked to teachers' psychological and emotional well-being is important (Snyder et al., 2004).

In Finland, the context in which this study was developed, even though a school as a complicate occupational setting that embraces diverse social contexts to interact with many groups such as pupils, colleagues, and administrators, the dynamics has often been overlooked in teacher stress and coping studies (Pietarinen, Pyhältö, Soini, & Samela-Aro, 2013). Recently, Taddei, Contena, Pepe, and Venturini (2017) agree with previous findings that interaction with pupils i.e. teacher stress social-student-related (TSS-Sr) has been the strongest reason causing teacher stress (Van Doogenbroeck, Spruyt, & Vanroelen, 2014; Johnson et al., 2005), and found that it has to be considered differently with other social groups in teacher stress.

With regard to stress coping, the general expectation in Finland is that teachers are rational experts who should manage their own emotions and those of their pupils (Uitto, Kaunisto, Syrjälä, & Estola, 2015). That is, teacher stress-coping or well-being studies might treat emotional issues as a natural part of teachers' roles (Lassila, Jokikokko, Uitto, & Estola, 2017). However, teacher stress covers two crucial concepts related to emotion: one is emotional labour which is an occupational point indicating emotional discrepancies and difficulties of workers who have to interact with others (Ashforth & Humphrey, 1993; Grandney, 2000; Morris & Feldman, 1996). The other is emotional competence which means teachers' emotional control abilities (Lazarus, 2006a; Jennings & Greenberg, 2009; Gross, 2002). Lazarus (2006b) found that, since stress-coping is a comprehensive process of emotional arousal, the three concepts, stress, coping, and emotion form a conceptual unit. Jeter (2013) also stated that using emotion-focused coping more efficiently reduces teachers' work-related stress and burnout.

In sum, by finding the optimal emotional coping strategies, teachers can be helped to accept and cope with student-related stress. Thus, this current study aims to investigate teachers' emotional coping styles connected with student misbehaviours. We developed a scale to clarify the kinds of emotional coping strategies Finnish teachers use, and then examined the interrelationships with types of pupils' misbehaviours.

Necessity of coping scale item reorganization and emotional coping
According to Hobfolls (1988), stress results from an imbalance between
stressful demands and coping resources, both involving an internal
psychological process. Therefore, stress-coping processes cover finding the
best resources and actions to combat the stressor (Blum, Brow, & Silver,
2012). Many researchers have tried to categorize types of those actions and
resources—stress-coping strategies—, including cognitive, emotional, and
problem-solving perspectives.

Table 1
*Summary of coping dimensions evaluated in developed stress-coping
measurements*

Authors (year)	Coping dimensions
Amirkhan (1990)	• Problem-solving / Seeking social support / Avoidance
Billings & Moos (1984)	• Appraisal-focused / Problem-focused / Emotion-focused
Carver et al. (1989)	• Problem-focused / Emotion-focused / Venting of Emotions / Behavioural disengagement / Mental disengagement
Dise-Lewis (1988)	• Aggression / Stress-recognition / Distraction / Self-destruction / Endurance
Endler & Parker (1990a/b)	• Task-oriented / Emotion-oriented / Avoidance-oriented
Epstein & Meier (1989)	• Emotional / Behavioural / Categorical thinking / Superstitious Thinking / Naïve optimism / Negative thinking
Feifel & Strack (1989)	• Problem solving / Emotion-focused
Folkman & Lazarus (1988)	• Confrontive / Distancing / Self-controlling / Seeking social support / Accepting responsibility / Escape-avoidance / Planful problem-solving / Positive reappraisal
Miller (1980, 1987)	• Information-seeking (Monitoring) / Information-distancing
Nowack (1989)	• Intrusive positive thoughts / Intrusive negative thoughts / Avoidance / Problem-focused
Patterson & McCubbin (1987)	• Ventilating feelings / Seeking diversion / Developing self-reliance / Developing social support / Avoiding problems/ Seeking spiritual support / Investing in close friends / Seeking professional support / Engaging in demanding activities / Being humorous / Relaxing

Table 1 displays varied sets of instruments (cited from Parker & Endler,
1992). Some of them contain similar items with different or differently
labelled subscales. For instance, using the Life Events and Coping Inventory
(LECI), Olafsen and Viemerö (2000) researched bullying problems and

coping in primary school kids in Finland. One item, 'get advice from someone' is in the stress-recognition subscale, while the same item is generally in the social support subscale of other measurements (Chinaveh, 2013; Amirkhan, 1990). That is, if researchers use different measurements, we cannot state whether the results are about the same phenomena and constructs. In the perspectives of research communities and practitioners, some findings can cause confusion (Parker & Endler, 1992). Hence, Greenaway and her colleagues (2014), who recently evaluated several established coping strategy measurements, suggested 'subscale item reorganization.'

With regards to items of emotion-focused subscales in several measurements, some of them were also correlated inversely (Scheier, Weintraub, & Carver, 1986), so they are needed reclassification. In detail, denial (in the meaning of avoidance) and seeking social support (in the meaning of facilitating approach toward the stressor) are aggregated under the rubric of emotional coping (Stanton, Danoff-Burg, Cameron, & Ellis, 1994). In addition, Stanton and colleagues (2000) considered most of the established emotional coping strategies as indicators of maladjustment like pessimism, psychopathology, and negative affect and depression. So, they concentrated on a functionalism perspective of emotion, which represents efficient modes of adaptation to changing environmental demands and to nature of emotion and its expression. They reorganized emotion-focused coping items, using only two subscales: emotional processing (four items, e.g. I acknowledge my emotions) and expression (four items, e.g. I allow myself to express emotions).

Even though this scale clarified how emotion is involved in coping processes, those are not enough to describe details of using emotional coping strategies. Moreover, they believed social support strategies more facilitate negative emotion by making people straight focus on stressors (Stanton et al., 2000). However, emotion makes us establish our favourable actions to the stressful environment, pulling us toward certain people, objects, actions, and ideas to process and express it (Levenson, 1999). Therefore, we should know which types of social support group, such as family, colleagues, or friends, people express emotion and get understanding from in coping processes. For this, we consider the broader view of emotional coping to reorganizing, by including more items and subscales from the previous ones.

Student-related Teacher Stress
This kind of teacher stress stems from student misbehaviours (Kyriacou 2001; Tsouloupas et al., 2010) and disrespectful and superficial relationships with pupils (Geiving, 2007). Finnish teachers also have perceived these as primarily causing psychological exhaustion (Hakanen, Bakker, & Schaufeli, 2006; Pietarinen et al., 2013). For example, verbal hostility, and uncooperativeness characterised by playing with personal devices during lectures commonly generate teacher stress (Dalgıç & Bayhan, 2014; Stephens, Kyriacou, & Tønnessen, 2005).

When teachers experience student-related stress in the classroom, they are required to hide negative emotions. This causes job strain from feelings of inconsistency and unfairness (Schaubroeck & Jones, 2000). Furthermore, in teachers' pedagogical thinking, if they have retained internalized pessimistic feelings and schemas of problematic pupils, they are more likely to evaluate those students as posing hardships (Split & Koomen, 2009). O'Connor (2008) stated teachers experience intrinsic compensation from having healthy pupil-related interpersonal relationships; thus, if they have disrespectful and superficial relationships, they easily experience more stress (Spilt, Koomen, & Thijs, 2011). In sum, teachers feel stress not only when they directly experience student misbehaviours and relationships involving mistreatment but when they form a negative impression on their students and their behaviours.

Aims of the study
This study aims to explore teachers' emotional stress-coping strategies in a Finnish context. In addition, the study examines the relation between the teachers' emotional coping strategies and student-related stressful contexts. To respond to the research tasks, the relevant measurements and the items were recategorized to adapt to the Finnish school context. The following questions were tested:

1. What kinds of emotional coping strategies Finnish teachers use?
2. How does emotional coping strategies relate to student-related stressful contexts?

Methods

Procedure and Participants

After getting a permission from a municipality based on the national research integrity or ethics guidelines (TENK, 2012), headmasters of 20 schools located in the central area of Finland were requested to participate data collection via email. Then, four principals replied and asked us to visit their official teacher meetings (10th of Jan, 31st of Jan, 6th of Feb, and 17th of Feb in 2018). Hence, total 85 in-service teachers who are working in four of primary or comprehensive schools—only 1 to 6 grades' teachers—completed the research survey. Most respondents were female teachers (n = 68: 80%) and the minority was men (n = 17; 20%). They have 17.5 years (SD = 10.27) teaching experiences. Total 85 out of 135 teachers participated in the study which is 65.2% response rate.

Measurements

Teacher Social Stress-Student related (TSS-Sr)

TSS-Sr was developed by Taddei and colleagues (2017) inspired by the customer-related social stressor concept (Dorman & Zapf, 2004). Total 18 items in four subscales in this scale: (a) Verbally Aggressive i.e. students' rudeness and inclination to shout out, (b) Dislike i.e. students' unpleasant behaviours like impolite manners, (c) Awkward Reactions i.e. students' incomprehension of teacher work, and (d) Demanding Requests i.e. students' belief to be special, more important, and more experienced than other pupils. The scale presented convergent validity with Maslach Burnout Inventory and reliability with Cronbach's alpha values ranging from .75 to .86. As Kalliopuska (2008) stated that shier and inactive pupils are not considered as a stressor for Finnish teachers, three educational experts discussed items and decided to remove two of them: students who have no sense of humour, and who lack confidence. In summary, the final instrument includes 16 items, rated with six ordered categorical options: *1 = None* to *6 = Too much* Stressful. With the pilot samples, the measurement was highly reliable (α = .82).

Emotional stress-coping strategy

To develop this scale, 254 items in six stress-coping strategy measurements[1] integrated the item pool. With two item selection criteria, if there were explicit emotion-related words and phrases, we chose the items (e.g. I let my feelings out in WCQ). Items also related to religion/meditation (e.g. I pray or meditate in CSES) and substance use (e.g. I try to make myself feel better by eating, drinking alcohol in WCQ) were selected as those items positively influence relieving stress in an emotional way (Goyal et al., 2014; Ferguson, Willemsen, & Castañeto, 2010). Then, a phrase 'to feel better' was added on those items, if needed. After removal of overlapped items, 68 literature reviewed items were narrowed down to 29 items in ten subscales: Venting Emotions, Avoidance, Positive Mind 1-3, Social Support, Substance Use, Professional Support, Religion/Mindfulness Support, and Self-Blame. Thereafter, 23 Finnish Master's degree students at teacher training schools (male: $n = 3$; female: $n = 20$) took part in the pilot study. All participants had teaching experiences and understanding of student-related stress.

In sum, Table 2 indicates pre- and post-pilot items and its reliabilities, respectively. Consequently, five items in PMs and all items in A were eliminated to correct insufficient pre-pilot items' reliability ($\alpha = .65$). In addition, one item related to drinking in SU was divided into drinking alcohol (item 21) and tea (item 22) to differentiate types of stimulants. Hence, we confirmed 22 items in eight subscales ($\alpha = .74$) for the main study rated with self-reported six categorical options: *1 = None* to *6 = Many times*.

Table 2

Emotional coping items and reliability changes between pre- and post-revisions

Factor	Scales	Subscales	Items	Pre α	Post α
VE	WCQ	Confrontive Coping	1. I let my feelings out	.82	.82
	COPE	Venting Emotions	2. I get upset and let my emotions out		
	CRI	Emotional Discharge	3. I cry to let my feelings out		
SB	WCQ	Accepting Responsibility	4. I criticize or lecture myself	.72	.72
	CISS	Emotion Coping	5. I blame at myself for not knowing what to do		
	WCQ	Accepting Responsibility	6. I realize I brought the problem on myself		
PS	WCQ	Seeking Social Support	7. I get professional help	.77	.77
	CRI	Seeking Guidance and Support	8. I talk with a professional person (e.g., doctor, professors)		
	CSI	Seeking Support	9. I go to a professional to help me to feel better		
A	WCQ	Avoidance	[a] I try to keep my feelings from interfering with other things too much	**.43**	-
	CSES	Stop Unpleasant Emotions and Thoughts	[a] I keep from feeling sad		
	CSES	Stop Unpleasant Emotions and Thoughts	[a] I keep myself from feeling lonely		
PM 1	CSES	Get Support from Friends and Family	[a] I do some positive activities for myself to feel better (sports, watching movies)	**.44**	-
	CSES	Use Problem-Focus Coping	10. I talk positively to myself to feel better		**.53**
	WCQ	Self-controlling	11. I tell myself positive things that helped me to feel better		
SS	WCQ	Seeking Social Support	12. I talk about my feelings with co-workers and get accepted sympathy and understanding from co-workers	.45	.45

	CSI	Seeking Support	13. I talk about my feelings with friends and get accepted sympathy and understanding from friends		
	CSES	Get Support from Friends and Family	14. I talk about my feelings with family and relatives and get accepted sympathy and understanding from family and relatives		
PM 2	CSES		[a] I take off my mind with unpleasant thoughts		
	CSES	Stop Unpleasant Emotions and Thoughts	[a] I make unpleasant thoughts go away	.76	-
	CSES		[a] I stop from being upset by unpleasant thoughts		
RMS	WCQ	Positive Reappraisal	15. I pray		
	COPE	Religious Coping	16. I try to find comfort in my religion	.98	.98
	COPE	Religious Coping	17. I seek to God's help		
PM 3	WCQ	Distancing	18. I try to look on the bright side to feel better		.80
	CRI	Positive Reappraisal	19. I try to see the good side of a situation to feel better	.64	
	WCQ	Distancing	[a] I make light of the situation to feel better		-
SU	COPE	Substance Use	20. I use alcohol or drugs to make myself feel better		
	WCQ	Escape-Avoidance	21. I try to make myself feel better by eating, drinking alcohol	.92	.92
			22. I try to make myself feel better by eating, drinking tea		
		Total		**.65**	**.74**

Note: WCQ = Ways of Coping Questionnaire; COPE = COPE Inventory; CISS = Coping Inventory for Stressful Situations - Situation Specific Coping; CSI = Coping Strategy Indicator; CSES = Coping Self-Efficacy Scale; CRI = Coping Responses Inventory; VE = Venting Emotion; SB = Self-Blame; PS = Professional Support; A = Avoidance; PM 1-3 = Positive Mind 1-3; SS = Social Support; RMS = Religion/Mindfulness Support; SU = Substance Use
[a] Items were deleted

Data Analysis

Model proposal

To check whether this scale has the same second-order structure with the original ones (Heck & Thomas, 2015), we considered first- and second-order models. Based on the results of Exploratory Factor Analysis (EFA) with Principal Axis Factoring (PAF) which is for expected skewed subscales (Muijs, 2011), seven more items in Positive Mind 1, Venting Emotion, and Substance Use were deleted. Although those strategies could mitigate Finnish teachers' negative feelings, but it indicated that teachers do not use them in an emotional way (Westman, Hobfoll, Chen, Davidson, & Laski, 2005; Agabio, Campesi, Pisanu, Gessa, & France, 2016). Therefore, we determined total 15 items with first (M1) and second order (M2) including five factors — Religion/Mindfulness Support, Professional Support, Social Support, Self-blame, and Positive Mind—. Subsequently, six out of nine items in Positive Mind (PM) 1-3 were deleted in this process. Thus, we also considered models without any PM item—12 items in four factors —with both first (M3) and second order (M4) to find the most appropriate 'emotional' coping strategies (See Figure 1).
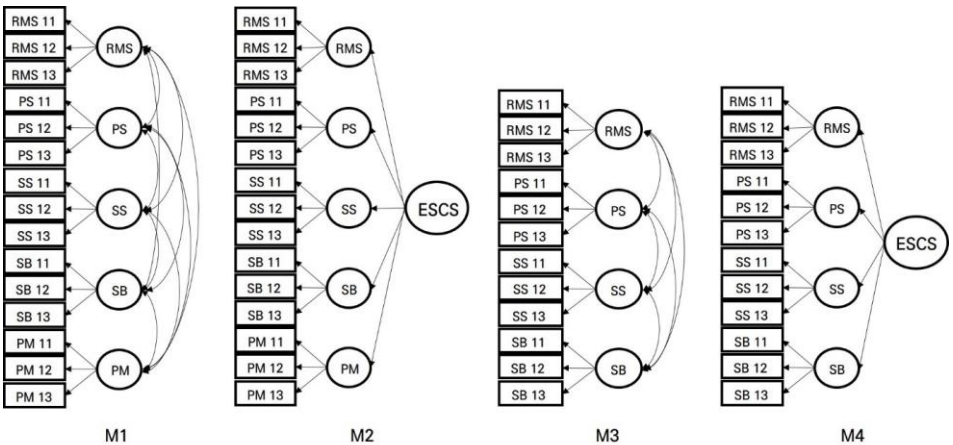

Figure 1. Proposed models illustrate the numbers of factors and orders. M1 is first-order five factors, M2 is second-order five factors, M3 is first-order four factors, and M4 is second-order four factors.

Analytic strategy

Before investigating the correlation between student-related stress and emotional coping, we tested reliability and validity of the selected emotional coping items via Confirmatory Factor Analysis (CFA) which is a method for researchers to specify how latent variables are measured using observed variables (Geiser, 2013). This methodological choice is in agreement with the studies of the original item pools (see Note in Table 1) that provided evidence that ESCS can be understood as a latent construct measured by different but correlated observed variables. So, standardized regression weights of every individual relationship between an item and a factor were described. We also run Full-Information Maximum Likelihood (FIML) with estimate means and intercepts function (Byrne, 2010) for missing values. To reach the model fit, we used indexes, such as Chi-Square test, Comparative Fit Index (CFI > .95), Tucker-Lewin Index (TLI > .95), and Root Mean Square Error of Approximation (RMSEA < .6 or < .8) (Kline, 2013).

Results

Teachers used more social support ($M = 3.84$, $SD = 0.75$; SS) and self-blame ($M = 2.63$, $SD = 0.75$; SB) than other emotional coping strategies. Interestingly, SB subscale had moderate relations with all other subscales (r (RMS) = .45; r (PS) = .45; r (SS) = .40, $p < .001$) (See Table 3). This indicates that those participating teachers might use self-blame strategies with other coping strategies rather than using it alone.

Table 3
Means, standard deviations, reliabilities, and correlations of research variables

Variables		M	SD	1	2	3	4	α
Emotional Coping	1. RMS	1.77	1.14	1.00				.92
	2. PS	1.70	0.76	.67***	1.00			.85
	3. SS	3.84	0.81	.30***	.37***	1.00		.76
	4. SB	2.63	0.75	.45***	.45***	.40***	1.00	.71
Student-related Stress	5. DIS	3.74	0.89	-				.75
	6. VA	3.64	0.86	-	-			.84
	7. DR	3.47	0.95	-	-	-		.83
	8. AR	3.04	0.94	-	-	-	-	.85

Note. 1. RMS = Religion/Mindfulness Support; 2. PS = Professional Support; 3. SS = Social Support; 4. SB = Self-Blame. 5. DIS = Dislike; 6. VA = Verbally Aggressive; 7. DR = Demanding Request; 8. AR = Awkward Reaction
***$p < .001$

In addition, all types of students' misbehaviours made those teachers get stress over the average level. For example, teachers feel stress when students treat them with impolite manners ($M = 3.74$, $SD = .89$; DIS). Moreover, pupils' rudeness and inclination to shout out ($M = 3.64$, $SD = .86$; VA) and their belief to be special and more important than other pupils ($M = 3.47$, $SD = .95$; DR) affect teacher stress. Lastly, students' incomprehension of teachers' work causes teacher stress but it affects lesser than other types of misbehaviours ($M = 3.04$, $SD = .94$; AR). This pupil-related stress scale was highly reliable with the sampled Finnish schoolteacher data ($α = .93$).

As shown in Table 4, regardless of orders, four-factor models (M3 and M4) of emotional coping shows fair or good model fit. However, criteria values suggested that 12 items with second-order model (M4) better explain the whole data [$χ^2(50) = 68.70$, $p > .01$, RMSEA = .06, CFI = .96, TLI = .94].

Table 4
Goodness-of-model-fit indices for four proposed models

	M1	M2	M3	M4
Chi-Square	163.40	170.59	90.17	68.70
df	80	85	49	50
p	< .01	< .01	< .01	> .01
RMSEA	.11	.11	.09	.06
CFI	.88	.87	.92	.96
TLI	.81	.82	.87	.94
Total	-	-	Fair	Good

Notes: M1 = Model 1 (First-order Five-factor); M2 = Model 2 (Second-order Five-factor); M3 = Model 3 (First-order Four-factor); M4 = Model 4 (Second-order Four-factor); RMSEA = Root Mean Square Error Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewin Index

Figure 2 shows the final model with the standardized coefficients of relationships. All the standardized regression weights of the factor items are over .5 ($p < .01$) except for social support (SS) subscale to the emotional coping scale (ESCS) ($\beta = .43$, $p < .01$). Thus, 12 items with second-order model presented to be the most suitable model for further relational investigation with pupil-related stress.
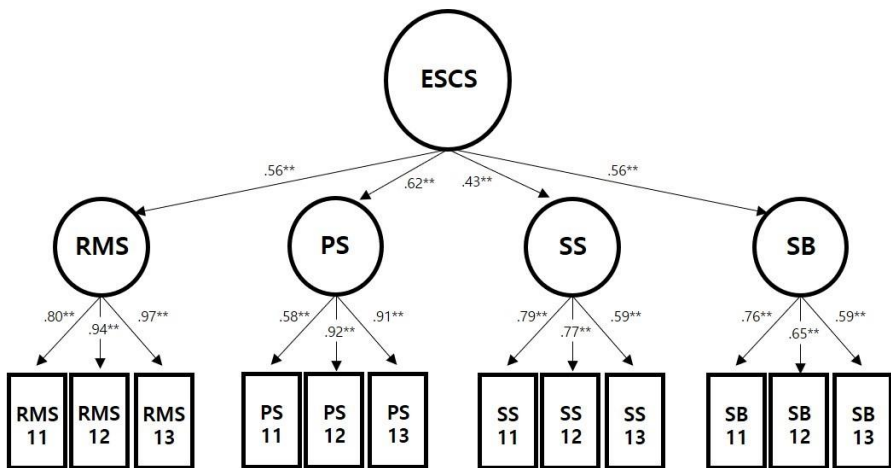
Figure 2. The final coping scale has four-factor and 12 items of second order model (M4). RMS = Religion/Mindfulness Support; PS = Professional Support; SS = Social Support; SB = Self-Blame. All parameters were significant at *p* level < .01

According to the correlation results between emotional coping and student misbehaviours, when students a) attack verbally and non-verbally (*r* = .35 to .38, *p* < .01), b) make teachers feel burden (*r* = .31, *p* < .01), c) make teachers' voice loud (*r* = .29, *p* < .01), d) have critical attitudes toward teachers (*r* = .28 to .42, *p* < .01), e) make teachers angry (*r* = .24, *p* < .05), f) misbehave (*r* = .23, *p* < .05), g) have complains to teachers (*r* = .22, p < .05 and *r* = .30, *p* < .01), and h) ask teachers to do overburden work (*r* = .22, *p* < .05), the participating teachers use the most self-blame strategies which represent accepting and acknowledging the stressful situations. Next, the teachers used religion/mindfulness coping strategies when their pupils make them angry (*r* = .23 to .24, *p* < .05), student complains make their' work more complicated (*r* = .23 to .25, *p* < .01), and when students attack verbally and non-verbally (*r* = .25, *p* < .05). Lastly, when students behave impolitely (*r* = .27, *p* < .05) and attack in several ways (*r* = .22 to .24, *p* < .05), the sampled teachers relied on social support strategies by addressing their feelings to family and relative members more than friends and colleagues.

Discussion

This study aimed at finding the optimal emotional coping strategies to explore associations with student-related stressful contexts. We found three of four emotional coping ways except for professional support were related with stress coming from pupils' misbehaviours. So, we proffer practical suggestions for emotional coping to reduce student-related teacher stress.

Practical spirituality based on chatting with mind

All items in religion/mindfulness support subscale contributed the most in the model, meaning that such support can function as an important emotional coping resource for teachers. The relevant item of this falls under the 'cognitive elements' category in certain previous coping measurements. However, the item reorganization in the emotional coping scale showed its' direct effect on emotional switch from negative to positive ones (Schilderman, 2001; Spezio, Wildman, Sosis, & Bulbulia, 2016). That means these practical-spiritual supports are a sort of conscious living which involves silencing the continuous chatter of the mind in a relaxed playful manner and looking within to connect with what is going inside us (Giri, 2019).

　　　　Additionally, although few participants used this strategy, religion/mindfulness coping connects with specific types of misbehaviours, including when a) students attack them verbally and non-verbally, b) students suddenly get angry at them, and c) students' claims make their work more complicated. Thus, not to ignore but to make teachers recognize using those coping ways is important (Jennings & DeMauro, 2017) by providing places, time, and seminars in school. This does not mean the entire environmental changes. However, it means considering minor parts to make a better working environment for the teachers to be aware of where they are and not overly overwhelmed by what is going on around them (Williams & Kabat-Zinn, 2011). To know clearly how this coping works in an emotional way for individual teachers, this result should be further examined with different types of analyses, such as interviews.

Genuine care and assistance from social networks

Social support strategy has been the most basic and important element to relieve teacher stress (Travers & Cooper, 1996; Botwinik, 2007; Pennebaker, Zech, & Rime, 2001). Montgomery (2017) also stated that relationships

between the external stressors, coping, and burnout are influenced by the degree to which individuals feel socially supported with their boss and colleagues, with their spouse, children—family—, and with friends. Although the sampled Finnish teachers most used social support strategies, they reported talking about 'student-related' concerns mostly only to their family members rather than to friends and colleagues (Thompson & Meyer, 2007). This finding contradicts a Finnish cultural expectation that home is a place free from working stress (Kinnunen et al., 2012). Thus, we should further examine why the other social groups such as colleagues and friends were not pertained to the stressor coming from students' misbehaviours and how talking to family coping strategy influences reducing student-related stress empirically.

In addition, Finnish teachers consider themselves as experts (Pyhältö, Pietarinen, & Soini, 2012), but talking with colleagues was included in socially support, not professional support coping for the participants. This means those two items must be separated from each other and professional support should be understood as a help from people who have a specific qualification(s) such as counsellors, professors, and lawyers. These results indicate that we need to clearly explain and re-consider the specific support groups to which Finnish teachers have recoursed based on cultural features (Rime, 2009).

Acceptance stress as a crucial emotional regulation process
The participating teachers used the self-blame strategy in an attempt to relieve their uncomfortable feelings. According to Stanton and her colleagues' research (2000), this is not about literally blaming themselves but about admitting and acknowledging their emotional status. That is, we found the teachers get emotional support from their own emotional regulation processes. This corresponds with the fact that stress management programmes such as Stress Management Training (SMT; Monroy, Jonas, Mathey, & Murphy, 1997) were designed to build the individual's capacity to cope stress proactively by using self-regulation in the context of stressful situations.

In addition, this strategy was the most frequently presented emotional coping resource against student misbehaviours. When students request many things from, have antagonistic attitudes to, and complain about teachers, teachers' use of this strategy helps them understand where their negative emotions stem from (Chang, 2013). The most interesting finding was when

the teachers use this strategy, they were prone to use other emotional coping resources. According to Cook, Blair, and Buehler (2018), when people communicate with others such as experts or friends, such chances provide an opportunity for them to look back or re-think objectively about behaviours or words. Therefore, when the teachers acknowledge their stressful emotions, they probably use another emotional strategy simultaneously, and vice versa. That is, this result indicated significance of future studies on investigating how teachers use several types of emotional coping strategies coincidently.

Limitations
Analysing self-reported questionnaire should be considered carefully (Carson & Hardy, 1998), because teachers may feel guilty to reflect on the pupils' misbehaviours by thinking its' occupational inappropriateness (Fiorilli, Albanese, Gabola. & Pepe, 2017; Maghan, 2017; Taddei et al., 2017). In addition, the number of participants in the study is not enough to make generalizable conclusions about the entire group of Finnish teachers and we attribute the study findings to the group of participating teachers. However, the study reveals relevant elements which are emerging among teachers and increase our understanding in this context. Also, the quantity of sample alone does not decide the quality of the property's presumption (Zaher, 2007; Boivin & Ng, 2006), but a certain amount—'large'—of data has been emphasized on application feature of factor models (Geiser, 2013; Byrne, 2010). Consequently, the limited sample size of this study should be supplemented for further research to confirm the generalizability of the findings by covering more participants and broader areas of Finland.

Despite of those limitations, this study contributed to investigate stress-coping with the specific stressful situation- and emotion-focused perspectives. We explored previous literatures on teacher stress by probing pre-existing stress-coping scales and distinguishing the best sets of items based on culturally sensitive evidence. Therefore, this trial of item reorganization with emotional perspective can help researchers when they try to identify more effective emotional strategies on student-related stress and apply this into specific stressful school contexts in different cultures.

Disclosure Statement
No potential conflict of interest was reported by the authors.

Notes

[1] a) Ways of Coping Questionnaire (WCQ; α = .61 to 79) (Folkman & Lazarus, 1988 as recited in Greenaway et al., 2014), b) COPE Inventory (COPE; α = .45 to 92) (Carver, Scheier, & Kumari, 1989), c) Coping Inventory for Stressful Situations - Situation Specific Coping (CISS-SSC; α = .70to 93) (Endler & Parker, 1994: as recited in Greenaway et al., 2014), d) Coping Strategy Indicator (CSI; α = .84 to 91) (Amirkhan, 1990), e) Coping Self-Efficacy Scale (CSES; α = .80 to 91) (Chesney, Neilands, Chambers, Taylor, & Folkman. 2006), and f) Coping Responses Inventory (CRI; α = .73 to 75) (Moos, 1993; as recited in Chinaveh, 2013).

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Investigation of the Statistical Anxiety Rating Scale Psychometric Properties with a Sample of Greek Students

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Investigation of the Statistical Anxiety Rating Scale Psychometric Properties with a Sample of Greek Students

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Abstract

The purpose of this study was to adapt the Statistics Anxiety Rating Scale (STARS) for a Greek student population. The STARS was administered to 890 Tertiary Education students in two Greek universities. It was performed a cross-validation study to examine the factorial structure and the psychometric properties with a series of confirmatory factor analyses. Results revealed a correlated six first-order factor model which provided the best fit to the data compared to a six-factor model with one superordinate factor. All six factors of the Greek version of the STARS presented convergent and discriminant validity and were internally consistent. Implications and limitations are discussed.

Keywords: Statistics Anxiety Rating Scale, Greek university students, cross-validation study, confirmatory factor analysis

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Propiedades Psicométricas de la Escala de Calificación de Ansiedad Estadística con una Muestra de Estudiantes Griegos

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Resumen

El propósito de este estudio fue adaptar la Escala de Calificación de Ansiedad Estadística (STARS) para una población de estudiantes griegos. STARS se administró a 890 estudiantes de educación terciaria en dos universidades griegas. Se realizó un estudio de validación cruzada para examinar la estructura factorial y las propiedades psicométricas con una serie de análisis factoriales confirmatorios. Los resultados revelaron un modelo de seis factores de primer orden correlacionados que proporcionó el mejor ajuste a los datos en comparación con un modelo de seis factores con un factor superior. Los seis factores de la versión griega de STARS presentaron validez convergente y discriminante y fueron internamente consistentes. Se discuten las implicaciones y limitaciones.

Palabras clave: Escala de calificación de ansiedad estadística, estudiantes universitarios Griegos, estudio de validación cruzada, análisis factorial confirmatorio

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I n Greek universities, like in many other universities worldwide, most students are required to enroll in at least one compulsory statistics course in many faculties such as Education and Social Sciences (Lavidas et al., 2020). Many scholars mention that the statistics course is a fundamental module in tertiary education, aiming not only to provide the necessary knowledge of statistics needed for effectively conducting quantitative research but also to further develop critical and analytic thinking skills (Ben-Zvi & Makar, 2016; Koh & Zawi, 2014; Lavidas et al., 2020; Ruggeri, Dempster & Hanna, 2011). Nevertheless, most students in social sciences do not realize the potential value of statistics in their field of studies or their future careers. Hence, attending a statistics course is often a negative and anxious experience, mainly because of the difficulties of grasping statistical concepts (Chiesi & Primi, 2010).

Statistics anxiety has been defined as the feelings of anxiety students encounter when attending a statistics course or implementing statistical methodology (Cruise, Cash & Bolton, 1985). Those feelings could include intensive worry, tension, mental disorganization, intrusive thoughts, and symptoms of stress when students enrolled in statistics courses as an integral part of their curriculum (Papousek et al., 2012; Zeidner, 1991). Literature support that the percentage of graduate students in social and behavioral sciences, psychology, and business, experiencing uncomfortable levels of statistics anxiety is between 66% and 80% (Mji & Onwuegbuzie, 2004). As a result, statistics anxiety may provoke several problems over the statistics course in college, and many times, statistics anxiety considered as a major barrier to achieving satisfactory academic performance across several academic disciplines, such as education (Nasser, 2004; Onwuegbuzie, 2004), psychology (Chiesi & Primi, 2010; Macher et al., 2012; Shah Abd Hamid & Karimi Sulaiman, 2014), and business (Bell, 2008). In this frame, it is clear that university lecturers must take into account students' statistic anxiety before lecturing. Hence, statistics teachers could measure the level of statistics anxiety of students and revise their teaching utilizing approaches that decrease the students' statistic anxiety and increase the students' engagement in the learning procedure (Lavidas et al., 2020; Williams, 2014).

A further review of the statistics and math anxiety and instruments for their measurement revealed the existence of several instruments for measuring

statistics anxiety, such as the STARS (Cruise et al., 1985), the Statistics Anxiety Measure (Earp, 2007), the Statistics Anxiety Scale (Pretorius & Norman, 1992), the Statistical Anxiety Scale (Virgil-Colet, Lorenzo-Seva & Condon, 2008), and the Statistics Anxiety Inventory (Zeidner, 1991), and for measuring math anxiety, the Scale for Assessing Math Anxiety in Secondary education (SAMAS) (Yáñez-Marquina & Villardón-Gallego, 2017). However, the STARS (Cruise et al., 1985) has been used extensively worldwide by researchers due to the superiority of its validity and reliability data as compared with other measures (Chew & Dillon, 2014). For example, Virgil-Colet et al. (2008) developed a scale to assess the anxiety of students taking a statistics course, the "Statistical Anxiety Scale" (SAS). SAS was a three dimensional instrument that assessed three different aspects of anxiety. These aspects were: examination anxiety, asking for help anxiety, and interpretation anxiety. Nevertheless, at least half of the items of SAS were derived from STARS, and the analysis of the validity of the measure was insufficient. Also, another instrument was developed by Earp (2007), the "Statistics Anxiety Measure" (SAM), to measure statistics anxiety and identify students who confronted statistics anxiety in statistics courses. SAM consisted of six subscales: anxiety, fearful behavior, attitude, expectation, history, self-concept, and performance. The analysis of the factorial structure of SAM resulted in a four-factor structure (anxiety, class, math, and performance) comprised of 23 items and with a poorer internal consistency compared to STARS.

Taking into account the superiority of STARS as we mentioned before, as well as no previous attempt has been reported in Greece aiming to validate STARS for the Greek student population so far, it is very important to be carried out in this research. Therefore, this study aims to investigate the factorial structure and the psychometric properties of the STARS for a Greek student population.

Literature review

Many studies have compared the levels of statistics anxiety among several groups of students (Chew & Dillon, 2014; Rodarte-Luna & Sherry, 2008). Furthermore, Bell (2008), in a series of studies, used the Statistics Anxiety Rating Scale (STARS) (Cruise, et al., 1985) and found differences based on course length and type of student.

Additionally to statistics anxiety, several studies have investigated tertiary students' attitudes towards statistics. Statistics anxiety and attitudes toward statistics have statistically significant negative relationships (Baloglu Kocak & Zelhart., 2007; Chew & Dillon, 2015; Finney & Schraw, 2003; Perepiczka Channdler & Becerra, 2011). Student attitudes toward statistics tend to be negative, especially in social and behavioral sciences (Mills, 2004; Sarikaya et al., 2018; van Appel & Durandt, 2018; Vanhoof et al., 2011). Due to their negative attitude, students often experience a statistics course as an intimidating component that inhibits effective conceptual learning, resulting in high levels of statistics anxiety (Baloglu et al., 2007; Onwuegbuzie & Wilson, 2003; Vanhoof et al., 2011).

Factors contributing to the statistics anxiety are broad and usually are focused on three major categories of factors: dispositional, situational, and environmental (Baloglu et al., 2007; Onwuegbuzie & Wilson, 2003). Dispositional antecedents are intrapersonal factors, which include students' emotional and psychological characteristics (Baloglu et al., 2007). Dispositional factors include topics such as attitudes toward statistics, learning styles, perceived abilities at developmental stages in life, perfectionism, evaluation concern, and fear of failure (Onwuegbuzie & Wilson, 2003; Walsh & Ugumba-Agwunobi, 2002). Situational antecedents are immediate factors arising from attending a statistics course. Situational antecedents of statistics anxiety surround students and include previous and present experiences such as minimal previous statistics and math experience, delayed introduction to quantitative research methods, mental disorientation from the value of quantitative analysis, course selection conditions (e.g. required or optional), and nature of statistics courses (Baloglu et al., 2007). Environmental antecedents are interpersonal factors mainly linked to the classroom experience, which can include student's experiences with the professor, such as lack of feedback from statistics instructors (Onwuegbuzie & Wilson, 2003).

Statistics anxiety is usually linked to mathematics self-concept (Macher et al., 2011; Williams, 2014). A person's mathematics self-concept refers to the perception (perceived competence at mathematics) about his or her ability to do well in mathematics, and may also include preferences for math, confidence in learning, and using efficiently mathematics (Ma and Kishor 1997). Students with poorer mathematics self-concept, experience high levels

of statistics anxiety. This, in turn, is directly related to attitudes and performance. Many studies support that mathematics self-concept and statistics anxiety are direct predictors of attitudes toward statistics, with a positive and negative relationship respectively expected (Chamberlain et al., 2015; Chiesi & Primi, 2010; Lavidas et al., 2020; Macher et al., 2012; Sesé et al., 2015; Williams, 2014). Several math-related variables have been studied connected to statistics anxiety, but math self-concept is considered as the most common attitudinal variable (Williams, 2014).

Statistics Anxiety Rating Scale

One of the most popular instruments for measuring statistical anxiety is Statistics Anxiety Rating Scale, commonly known as STARS. STARS was developed by Cruise, et al. (1985). Even though many years have passed since STARS' first publication, it retains its popularity and has been used extensively by researchers mainly due to its satisfactory psychometric properties, and the multitude of its items (Chew et al., 2018). Initially, an 89-item pilot instrument was completed by 1150 participants in the US. A PCA (Principal Component Analysis) with varimax rotation was conducted. Results indicated that the rotation of 51 items on six factors yielded a more interpretable structure. The six components of statistics anxiety are (a) Interpretation Anxiety, (b) Test and Class Anxiety, (c) Fear of Asking for Help, (d) Worth of Statistics, (e) Computation Self-Concept, and (f) Fear of Statistics Teachers. 'Interpretation Anxiety' refers to the feelings of anxiety experienced when interpreting statistical data. The 'Test and Class Anxiety' subscale indicates the anxiety involved during a statistics course or when taking a statistics test. 'Fear of Asking for Help' is defined as the anxiety experienced when seeking help, either from the professor or a fellow student, to comprehend the material covered in class, or any kind of statistical data, or an outcome. 'Worth of Statistics' reflects students' perceptions of the relevance and utility of statistics in their studies, their personal lives, and their future careers. 'Computation Self-Concept' refers to a student's perceived self-efficacy of his or her ability to understand and calculate statistics. Finally, `Fear of Statistics Teachers' relates to the student's perception of the statistics instructor.

The 51-item STARS includes two parts. The first part consists of 23 items aiming to measure statistics anxiety related to situations where students deal

with statistics. This part includes the following factors: (a) Interpretation Anxiety, (b) Test and Class Anxiety, (c) Fear of Asking for Help. The assessment was based on a 5-point Likert-type scale ranging from 1 (no anxiety) to 5 (a great deal of anxiety). The second part consists of 28 items dealing with or related to statistics and statistics teachers. This part includes the following factors: (d) Worth of Statistics, (e) Computation Self-Concept, and (f) Fear of Statistics Teachers. The participants were required to rate how much they agree with each of a list of statements on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). STARS is intercultural and has been used successfully internationally. In addition to English, it has been translated and used in German (Papousek et al., 2012), Chinese (Liu et al., 2011), and Arabic (Nasser, 2004).

Several studies revealed and supported the original six-factor structure of the STARS with the use of student samples in certain countries: the UK (Hanna, Shevlin & Dempster, 2008), the USA (DeVaney, 2016), Austria (Papousek et al., 2012), China (Liu et al., 2011), and South Africa (Mji & Onwuegbuzie, 2004). The six factors showed satisfactory internal consistency in these studies: Cronbach's Alpha coefficient ranged from .72 to .95. Given that the high internal consistency of the overall scale (Baloglu, 2002; Chew & Dillon, 2014; Mji & Onwuegbuzie, 2004; Watson et al., 2003), and the high intercorrelations between the initial STARS subfactors (Baloglu, 2002, 2003; Chew et al., 2018; Hanna et al., 2008; Mij & Onwuegbuzie, 2004; Papousek et al., 2012; Watson et al., 2003), may indicate unidimensionality of the STARS, six-factor models with one superordinate factor were also tested (Chew, Dillon & Swinbourne, 2018; Hanna et al., 2008; Papousek et al., 2012). Also, a six-factor model with two correlated superordinate factors (statistics anxiety and attitudes toward statistics) was limited investigated (Chew et al., 2018; DeVaney, 2016; Papousek et al., 2012). We considered that the specific factorial structure is not testable, because the second superordinate factor "attitudes toward statistics" indicates not only attitudes but also statistics anxiety, as it includes the factor "fear of statistics teachers".

The objectives of the Study
Considering that previous studies have mainly explored the six first order factor model and the six-factor model with one superordinate factor (Chew et al., 2018; Hanna et al., 2008), the main aims of this study were: 1). To

investigate the factorial structure and the psychometric properties of the Greek version of STARS. 2). To compare the two aforementioned models in terms of goodness of fit to our data, derived from Greek social sciences students.

Methodology

The Sample

This web survey was conducted in three academic periods, during the first month of the winter semester of 2017, 2018, and 2019. All students enrolled in the introductory statistics course were asked to participate voluntarily and they had to consent for the use of their data according to the new General Data Protection Regulation (GDPR). Moreover, the students were informed that the questionnaire is anonymous, and the data collected will be used solely for research purposes. The sample consisted of 890 students of the third year of study from two departments educational science and childhood in the education of two Greek Universities, the University of Patras (33.1%), and the National and Kapodistrian University of Athens (66.9%). The huge majority of participants were women (97.9%) and this fits with gender's distribution in the total Greek population of students in the departments of early childhood education where approximately 96% of the students are female.

The Research Instruments

Data were collected utilizing a questionnaire, which consisted of two sections of 55 closed-ended questions. Section A included questions regarding students' general characteristics (gender, department of studies) and two items about perceived competence at mathematics (based on a 7-point Likert type scale, 1 = Not good at all .through to 7 = Excellent): a) how good were you in high school mathematics and b) how good are you in mathematics (Lavidas et al, 2020). We used this scale as a validity criterion of STARS. Since we have mentioned that students' perceived competence at mathematics is linked with their statics anxiety (Macher et al., 2011; Williams, 2014). The second section consisted of 51 items of the statistics anxiety rating scale (STARS) (Cruise, et al., 1985). The first 23 "anxiety" items were measured using a five-point scale ranging from 1. no anxiety to 5. very strong anxiety. The other 28 "attitudes" items were measured using a Likert rating scale from 1. Strongly

disagree to 5. Strongly agree. The specific direction of responses indicates that the higher scores represent higher anxiety and more negative attitudes toward statistics.

For the adaption of the 51 statements of STARS, we followed a forward and backward translation procedure. Two statisticians with great teaching experience and fluent in both English and Greek translated the items of the STARS. The first researcher translated the items from English to Greek, and the second researcher translated vice versa. The two researchers worked independently and the two English versions, final and authentic were compared. Modifications were made to the Greek versions because of the issues raised from the back-translated items and the fact that the instrument is designed and tested on different groups in different countries.

Finally, to investigate the response bias to the above 51 questions, the Greek version of the social desirability scale (Lavidas & Gialamas, 2019) was administrated to a sample of 35 students, along with the standard questionnaire. No significant correlations support the absence of bias (Lavidas & Gialamas, 2019).

Data Analysis Strategy

Throughout all stages of the factorial analysis, the R environment (R Core Team, 2018) was employed. The final factorial structure was obtained after a series of factor analyses that employed the "lavaan" package (Rosseel, 2012) and the package "semTools" (Jorgensen et al., 2018). Fit indices used to test the factorial structure were the ratio of chi-square to degrees of freedom (χ^2/df), Comparative Fit Index (CFI), Tucker Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). Carmines and McIver (1981) suggested that ratios (χ^2/df) in the range of 2 to 3 are indicative of an acceptable fit. Moreover, values of CFI and TLI close to 0.95 and RMSEA close to 0.06 (Byrne, 2010; Hu and Bentler, 1999) imply an acceptable fit. As an estimator in Exploratory and Confirmatory Factor Analysis, we used a robust WLSMV estimator that does not assume normally distributed variables and can be used for ordered data (Muthén, 1993). This choice was since there were asymmetries in the distributions of the STARS items. Mardia's (1970) estimate of multivariate skewness and kurtosis with the "psych" package (Revelle, 2018), was found very large and statistically significant (p<.001).

The data file was divided into two random subsets, "training" sample (N1=442, University of Patras: 35.5% and the Kapodistrian University of Athens: 64.5%, Female: 98.19%) and "validation" sample (N2=448, University of Patras: 30.8% and the Kapodistrian University of Athens: 69.2%, Female: 97.54%) respectively. To validate the six factors (dimensions) of the STARS cross-validation was used in two stages. In the first stage, the factorial structure of STARS was explored with the "training" sample. In the second stage, the derived structure with the remainder independent "validation" sample was confirmed. In both samples factor analysis, the loss of fit was studied, when the second-order factor model fitted. The first-order six-factors model indicates the existence of six correlated factors (subscales of STARS). A second-order factor model suggests that the correlations among the six first-order factors of STARS are explained by one superordinate factor. Finally, the construct validity and reliability for the "training" and "validation" sample were established.

Results

The results of the exploratory factor analysis of the six-factor measurement model with all 51 items (see Table 1) showed an acceptable fit of the model with the data. However, two items (item No. 9: Reading an advertisement for a car which includes figures on miles per gallon, depreciation, etc., and item No. 24: I am a subjective person, so the objectivity of statistics is inappropriate for me) from this factorial structure presented very low loadings ($\lambda<0.4$) and were excluded from the analysis. This decision was based on the fact that the exclusion of these items does not affect the STARS content validity, and simultaneously the remaining items will enhance the convergent validity (Hair et al., 2017). Additionally, the model with remaining items without correlated errors, presented an acceptable fit with the data, in all fit indices (see Table 1), and most loadings were above .7 in all six constructs (see Table 4). Similarly, this factorial structure was confirmed for the "validation" sample too (see Table 1). Finally, in both samples, all fit indices revealed not acceptable fit for the second-order factor model with one superordinate factor.

Table 4 in the appendix shows the six-factor factorial structure for both "training" and "validation" samples. Item loadings were significant, and their standardized values ranged from .518 to .948 with a mean = .780.

Table 1

Fit Indices of the STARS' item, six-factor model, and second-order factor of "training" and "validation" samples.

	x2	df	x2/df	TLI	CFI	RMSEA	90%CI (RMSEA)
"Training" Sample (51 items) six factors	2,851.52	1209	2.36	.945	.942	.057	.053-.060
"Training" Sample (49 items) six factors	2,699.37	1112	2.43	.946	.949	.057	.054-.060
"Training" Sample (49 items) second order one factor	4,660.79	1121	4.16	.880	.886	.085	.082-.087
"Validation" Sample (49 items) six factors	3,052.26	1112	2.74	.939	.942	.062	.060-.065
"Validation" Sample (49 items) second order one factor	4,823.23	1121	4.30	.885	.890	.086	.083-.088

Aiming to establish the construct validity of the derived factorial structure, convergent, and discriminant validity were also investigated (Table 2). Average Variance Extracted (AVE) index with a value at least .50 (Raykov, 2001) and Heterotrait-Monotrait (HTMT) ratio did not exceed the .85 (Henseler, Ringle & Sarstedt, 2014), establishing the convergent and discriminant validity, respectively. For the reliability of the derived factorial structure, Cronbach's a and Composite Reliability (CR) were calculated. Indices' values of at least .70 are considered satisfactory (Raykov, 2001). As shown in Table 2 the values of Cronbach's exceeded the cut off value for both the "training" and the "validation" samples. Finally, the reliability coefficient

was excellent (Cronbach's alpha=.933) for the perceived competence at the mathematics scale.

Table 2
Reliability and validity indices for "training" and "validation" samples.

Six Factors	Cronbach's Alpha	Composite Reliability (CR)	AVE	HTMT ratios					
				1	2	3	4	5	6
1	.901(.915)	.905(.918)	.491(.531)	1	(.838)	(.704)	(.500)	(.596)	(.433)
2	.927(.930)	.939(.940)	.660(.665)	.808	1	(.737)	(.485)	(.654)	(.450)
3	.867(.899)	.894(.924)	.680(.765)	.693	.719	1	(.397)	(.427)	(.387)
4	.964(.964)	.968(.968)	.669(.670)	.466	.455	.297	1	(.776)	(.726)
5	.885(.887)	.892(.894)	.551(.555)	.575	.574	.406	.785	1	(.659)
6	.872(.874)	.879(.880)	.595(.596)	.371	.464	.368	.722	.594	1

Notes: 1. Interpretation anxiety, 2. Test and class anxiety, 3. Fear of asking for help, 4. worth of statistics, 5. Computational self-concept, and 6. Fear of statistics teachers.
HTMT. Heterotrait-Monotrait Ratio of Correlations. The indices of the "validation" sample are displayed in parentheses.

Table 3 shows, for the total sample, that students stated declared moderate anxiety (the majority of means ranged from 2 to 3) about statistics. Moreover, all subscales are satisfactory intercorrelated (ranged .301 to .707). Finally, all subscales are negatively correlated with perceived competence at mathematics (Cronbach's Alpha=.933), indicating satisfactory criterion validity of STARS. The less perceived competence at mathematics the higher was the anxiety about statistics.

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Table 3
Six factors, descriptive statistics and product-moment correlation coefficient (N=890)

	Mean	SD	1	2	3	4	5	6
1. Interpretation anxiety	2.37	.70	1					
2. Test and class anxiety	3.11	.89	.736**	1				
3. Fear of asking for help	2.14	.87	.593**	.621**	1			
4. worth of statistics	2.13	.77	.448**	.441**	.299**	1		
5. Computational self-concept	2.38	.82	.518**	.546**	.344**	.707**	1	
6. Fear of statistics teachers	2.04	.72	.349**	.400**	.301**	.623**	.522**	1
Perceived competence at mathematics	4.16	1.41	-.408**	-.436**	-.248**	-.481**	-.636**	-.338**

Note: The stars factors and Perceived competence at mathematics are based on 5-points (1 to 5) and 7 points (1 to 7) scale respectively. All correlation is significant at the 0.01 level (2-tailed).

Discussion

The purpose of the study was to validate an adapted Greek version of the STARS. The factorial structure of the STARS was investigated through EFA and CFA. The standardized factor loadings were all positive and statistically significant, ranged from 0.52 to 0.95. Moreover, this factorial structure had satisfactory convergent and discriminant validity. Acceptable internal consistency reliabilities were found in each of the six subscales of the Greek

version of the STARS, ranged from .87 to .96. This is in agreement with previous research (Chew et al., 2018; Cruise et al., 1985; DeVaney, 2016; Hanna et al., 2008; Liu et al., 2011; Mij & Onwuegbuzie, 2004; Papousek et al., 2012). For example, Chew et al. (2018) reported internal consistency which ranged from .81 to .94.

This study also contributes to the existing body of the literature by adding evidence of the current status of the factorial structure of the STARS. The results supported that a correlated six first-order factor model provided the best fit to the data compared to a six-factor model with one superordinate factor. Hence, this study also indicates that statistics anxiety is a multidimensional construct, yet useful that expresses much further than a general disposition to anxiety. The results are in agreement with other studies (Chew et al., 2018; DeVaney, 2016; Hanna et al., 2008), which also reported that the six first-order factor model was the best explanation of the data. Thus, it seems that specific items and subscales are unable to measure statistical anxiety directly. On the contrary, many items measure other concepts such as the worth of statistics and computation self-concept. If the STARS measures exclusively statistics anxiety, then the model with one superordinate factor, in which all first-order factors load on a single second-order factor, would make a better fit to the data compared to the original six first-order factor model. Hence, also the Greek version of STARS measures anxiety and attitudes toward statistics.

Also, taking into account the heterogeneity of the items, and the finding that the six factors of the instrument do not measure statistics anxiety exclusively, we consider that factors "Interpretation Anxiety", "Test and Class Anxiety", "Fear of Asking for Help", and "Fear of Statistics Teachers" could be used in order to measure statistics anxiety, whereas factors "Worth of Statistics" and "Computation Self-Concept" probably represent attitudes toward statistics. In light of this conclusion, statistics teachers could influence the situational factors which contribute to statistics anxiety. For example, teachers may remind their students of the importance of previous knowledge and skills that will be needed later, such as solving simple mathematical equations, and in any case minimizing mathematical formalities in teaching statistics (Baloglu et al., 2007; Lavidas et al, 2020). Similarly, teachers could influence the factors that are linked to attitudes toward statistics, such as the dispositional environmental factors. For example, teachers must pay attention

to students' learning styles (Onwuegbuzie & Wilson, 2003; Walsh & Ugumba-Agwunobi, 2002), and enhance the feedback which comes from students' intellectual ability and perceived creativity (Onwuegbuzie & Wilson, 2003).

Limitations of this study include the origin of the sample exclusively from early childhood education students, the sample consists of students in three consecutive academic years and the use of a quantitative inquiry only. Another limitation of this research was the fact that in Early Childhood Education, the huge majority of students are females. We suggest that this gender bias has no important effect on the factorial structure and the validity of this study, as reported in the other studies with similar instruments (Bechrakis et al., 2011). However, there is a significant gender difference in mean levels of statistics anxiety, as reported in other studies using STARS (Zeidner, 1991; Onwuegbuzie, 1995; Rodarte-Luna and Sherry, 2008; Bechrakis et al., 2011). Statistics anxiety can be further explored in Greece, with more diverse samples (e.g., other disciplines). Moreover, this study could be enriched by using a mixed method (e.g., quantitative, and qualitative approaches) to obtain a better and clear understanding of the characteristics of statistics anxiety. For example, conducting face to face interviews with the students presenting high levels of statistics anxiety could be a useful step for gaining further insight into the deeper feelings of the students, and exploring the causes of statistics anxiety.

Finally, future studies may focus on investigating other aspects of statistics anxiety such as the role of statistics teacher and his/her didactic methods in reducing anxiety, and the influence of students' social status/cultural background on anxiety during a statistics lesson.

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Appendix

Table 4
Six-factors factorial structure for "training" and "validation" samples (49-item version)

Factor	"Training" Sample Mean (sd)	Loadings	"Validation" Sample Mean (sd)	Loadings
<u>1. Interpretation anxiety</u>				
2. Interpreting the meaning of a table in a journal article	2.56 (1.01)	.700	2.42 (1.04)	.665
5. Making an objective decision based on empirical data	2.46 (0.93)	.649	2.42 (1.02)	.674
6. Reading a journal article that includes some statistical analyses	2.06 (1.01)	.683	1.99 (0.99)	.734
7. Trying to decide which analysis is appropriate for my research project	2.90 (1.00)	.728	2.94 (0.99)	.729
9. Reading an advertisement for a car which includes figures on miles per gallon, depreciation, etc.	1.79 (0.94)	----	1.72 (0.91)	----
11. Interpreting the meaning of a probability value once I have found it	2.71 (0.98)	.864	2.66 (0.99)	.810
12. Arranging to have a body of data put into the computer	2.24 (1.06)	.701	2.24 (1.03)	.680
14. Determining whether to reject or retain the null hypothesis	2.83 (0.95)	.720	2.86 (1.04)	.828

17. Trying to understand the odds in a lottery	2.03 (0.94)	.590	2.03 (0.97)	.632
18. Watching a student search through a load of computer printouts from his/her research	1.89 (0.97)	.631	2.00 (1.03)	.730
20. Trying to understand the statistical analyses described in the abstract of a journal article	2.06 (0.92)	.709	2.10 (0.98)	.774
2. Test and class anxiety				
1. Studying for an examination in a statistics course	3.15 (1.03)	.815	3.12 (1.07)	.816
4. Doing the coursework for a statistics course	2.83 (1.10)	.795	2.81 (1.18)	.836
8. Doing an examination in a statistics course	3.85 (1.08)	.910	3.83 (1.07)	.893
10. Walking into the room to take a statistics test	3.64 (1.10)	.919	3.63 (1.10)	.925
13. Finding that another student in class got a different answer than I did to a statistical problem	2.97 (1.09)	.675	3.01 (1.15)	.693
15. Waking up in the morning on the day of a statistics test	3.41 (1.19)	.869	3.40 (1.20)	.823
21. Enrolling in a statistics course	2.19 (1.11)	.790	2.25 (1.22)	.829
22. Going over a final examination in statistics after it has been marked	2.79 (1.21)	.695	2.96 (1.21)	.680
3. Fear of asking for help				
3. Going to ask my statistics teacher for individual help with	2.51 (1.11)	.831	2.48 (1.16)	.877

material I am having difficulty understanding				
16. Asking one of your lecturers for help in understanding a printout	2.35 (1.09)	.888	2.34 (1.15)	.919
19. Asking someone in the computer lab for help in understanding a printout	1.97 (0.96)	.837	2.03 (1.06)	.885
23. Asking a fellow student for help in understanding a printout	1.74 (0.86)	.736	1.73 (0.97)	.789
4. Worth of statistics				
24. I am a subjective person, so the objectivity of statistics is inappropriate for me	2.07 (0.98)	----	2.03 (0.92)	----
26. I wonder why I have to do all these things in statistics when in actual life I will never use them	2.20 (1.02)	.853	2.16 (1.07)	.819
27. Statistics is worthless to me since it is empirical and my area of specialization is abstract	2.02 (0.94)	.832	1.96 (0.94)	.832
28. Statistics takes more time than it is worth	2.11 (0.90)	.775	2.10 (0.93)	.765
29. I feel statistics is a waste	1.78 (0.85)	.815	1.71 (0.83)	.803
33. I lived this long without knowing statistics, why should I learn it now?	1.97 (1.00)	.878	1.99 (1.02)	.864
35. I do not want to learn to like statistics	1.83 (0.96)	.796	1.78 (0.95)	.808
36. Statistics is for people who have a natural leaning toward maths	2.37 (1.14)	.662	2.49 (1.27)	.764

37. Statistics is a pain I could do without	2.27 (1.06)	.873	2.23 (1.09)	.857
40. I wish the statistics requirement would be removed from my academic program	2.73 (1.19)	.836	2.72 (1.26)	.848
41. I do not understand why someone in my field needs statistics	2.11 (0.96)	.858	2.10 (0.96)	.861
42. I do not see why I have to fill my head with statistics. It will have no use in my career	2.02 (0.90)	.889	1.97 (0.90)	.882
45. I cannot tell you why, but I just do not like statistics	2.47 (1.15)	.847	2.51 (1.15)	.840
47. Statistical figures are not fit for human consumption	1.98 (0.83)	.692	1.99 (0.82)	.723
49. Affective skills are so important in my (future) profession that I do not want to clutter my thinking with something as cognitive as statistics	2.14 (0.95)	.770	2.12 (0.90)	.739
50. I am never going to use statistics so why should I have to take it?	2.03 (0.91)	.863	2.03 (0.92)	.857
5. Computational self-concept				
25. I have not done maths for a long time. I know I will have problems getting through statistics	2.92 (1.29)	.765	2.87 (1.28)	.766
31. I cannot even understand secondary	2.07 (1.12)	.745	2.11 (1.15)	.773

school maths; how can I possibly do statistics?

34. Since I have never enjoyed maths I do not see how I can enjoy statistics	2.21 (1.19)	.948	2.26 (1.23)	.912
38. I do not have enough brains to get through statistics	1.74 (0.88)	.661	1.77 (0.93)	.672
39. I could enjoy statistics if it were not so mathematical	2.56 (1.20)	.852	2.59 (1.17)	.848
48. Statistics is not really bad. It is just too mathematical	3.09 (1.08)	.518	3.15 (1.03)	.558
51. I am too slow in my thinking to get through statistics	1.97 (1.01)	.626	2.04 (1.07)	.620
6. Fear of statistics teachers				
30. Statistics teachers are so abstract they seem inhuman	1.85 (0.86)	.705	1.87 (0.88)	.675
32. Most statistics teachers are not human	1.87 (0.83)	.769	1.92 (0.92)	.766
43. Statistics teachers speak a different language	2.23 (0.98)	.876	2.26 (1.07)	.917
44. Statisticians are more number oriented than they are people oriented	1.90 (0.86)	.782	1.99 (0.92)	.767
46. Statistics teachers talk so fast you cannot logically follow them	2.26 (1.01)	.715	2.30 (1.03)	.714

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Why Some Adolescents Engage in Risk-Taking Behavior

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Why Some Adolescents Engage in Risk-Taking Behavior

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Abstract

This study explored adolescents' reasons for involving themselves, or not, in risk-taking behavior, in two vulnerable areas of North Jakarta. The sample was purposively selected among households with adolescents ranging from 12 to 18 years old living in the two areas. The study involved 401 parents (8% female; 92% male; mean age 45.3 years) and 414 adolescents (57.49% female; 42.51% male; mean age 14.9 years). Parents' demographic data included educational level, employment status, family income, and expenditure. Adolescents were asked about their perceptions of their relationships with their parents, whether they had been involved in eight risky behaviors (smoking, consuming alcohol, substance use, brawling, crime, physical fighting, heavy petting, and premarital sex), and reasons for engaging in risky behaviors or not. The comparison of proportions of eight risky behavior was tested by different test procedures, namely Z test, Chi-Square and Marascuillo multiple comparison. Results revealed that older adolescents were more likely to be involved in risk-taking, and boys were more likely to engage in risky behaviors than girls. The study also indicated that curiosity and peer pressure were the main reasons adolescents engaged in risky behaviors. Advice from family members, fear of God, and fear of being sinful were reasons adolescents did not engage in risky behaviors.

Keywords: adolescents, risk-taking behavior, urban poor.

Porqué Algunos Adolescentes se Implican en Conductas de Riesgo

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Resumen

Este estudio exploró las razones de los adolescentes para involucrarse, o no, en el comportamiento de riesgo, en dos áreas vulnerables del norte de Jakarta. La muestra se seleccionó a propósito entre los hogares con adolescentes de 12 a 18 años que vivían en las dos áreas. En el estudio participaron 401 padres (8% mujeres; 92% hombres; edad promedio 45,3 años) y 414 adolescentes (57,49% mujeres; 42,51% hombres; edad promedio 14,9 años). Los datos demográficos de los padres incluían el nivel educativo, la situación laboral, el ingreso familiar y los gastos. Se les preguntó a los adolescentes acerca de sus percepciones de sus relaciones con sus padres, si habían estado involucrados en ocho conductas de riesgo (fumar, consumir alcohol, consumir sustancias, pelearse, cometer delitos, peleas físicas, caricias y relaciones sexuales prematrimoniales) y las razones para participar En conductas de riesgo o no. Los resultados revelaron que los adolescentes mayores tenían más probabilidades de participar en la toma de riesgos, y los niños tenían más probabilidades de participar en conductas de riesgo que las niñas. El estudio también indicó que la curiosidad y la presión de los compañeros eran las razones principales por las que los adolescentes tenían conductas de riesgo. El consejo de los miembros de la familia, el temor a Dios y el temor de ser pecadores fueron razones por las cuales los adolescentes no se involucraron en conductas de riesgo.

Palabras clave: adolescentes, comportamiento de riesgo, pobres urbanos.

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Adolescence is often considered a period of turmoil and behavioral problems for both adolescents and their parents, at least partly because that period of life is characterized by high curiosity and the desire to experiment. It is a time of changes and transformation (Uzaina & Srivastava, 2016) and a time to develop identity, opinions, and values (Rolison & Scherman, 2002; Saranya & Nigesh, 2017) as consequences of coping with developmental tasks of individuating from parents and gaining autonomy (Leather, 2009).

Another specific characteristic of adolescence is strong peer pressure, that is, orientation shifts from parents to peers (Baumgartner, Valkenburg, & Peter, 2010), and peers have a more powerful influence on adolescents' beliefs, attitudes, and behaviors (Brakefield et al., 2014). Indeed, risk-taking behaviors among adolescents tend to happen in the presence of peers; some examples are substance use (Allen, Chango, Szwedo, Schad, & Marston, 2012; Mason, Mennis, Linker, Bares, Zaharakis, 2014; Marotta, 2017), gambling (Van Hoorn, Crone, & Van Leijenhors, 2016), sexual behavior (Ajilore, 2015; Baumgartner et al., 2010), and aggressive behavior (Low, Polanin, & Espelage, 2013; Vitaro et al., 2015).

Adolescents often engage in risky behaviors - defined as an individual acting in a dangerous way and possibly suffering particular, potentially harmful and dangerous conditions, social problems or illness, disability, and death (Mohd et al., 2015) - as a form of rebellion against forceful adult influence. In addition, adolescents' high curiosity motivates them to experiment with varied, novel, and complex activities and to be willing to take physical and social risks that provide sensation (Rolison & Scherman, 2002). Thus, engagement in one risky behavior likely leads to engagement in others (Leather, 2009). This appears to explain why risk-taking behavior reaches its peak during adolescence (Baumgartner et al., 2010). Of course, adolescents' risky behaviors have both short- and long-term implications for psychological and physical health, for instance, social problems in adulthood or physical illness, impairment, disability, and even death (Hale & Viner, 2016). Also, the frequency and intensity of individual risk behavioral patterns lead to augmented risk of sickness and impairment (Steptoe & Wardle, 2004; Baban & Craciun, 2007).

Parents, Peers, and Environment Influence Adolescents' Risk-Taking Behavior

According to Bronfenbrenner's ecological theory of human development, interactive dynamics among all family members—parents, children, and extended families—have a role in shaping each family member's behavior. The quality of parent–adolescent relationships also influences adolescents' social and emotional development (Cavendish, Montague, Enders, & Dietz, 2014). Parental variables such as parenting practices, religiosity, monitoring, and attachment to mother and father significantly influence whether adolescents become involved in smoking cigarettes or using drugs and alcohol (Bahr, Hoffman, & Yang, 2005; Chuang, Ennett, Bauman, & Foshee, 2009; Jang & Johnson, 2010; Miller et al., 2011), risky sexual behavior (Baumgartner et al., 2010; Landor, Simons, Simons, Brody, & Gibbons, 2011; Sylvester, 2014; Ofole, 2015; Ajilore, 2015), aggressive behavior (Arım, Dahinten, Marshall, & Shapka, 2011; Batool, 2013), and antisocial behavior (Cook, Buehler, & Henson, 2009).

Authoritative parenting, which is typified by warmth and responsive communication, as well as by protective and strong control toward risky behavior, can prevent adolescents' engagement in it (Chuang et al., 2009; Miller et al., 2011). Authoritative parenting also affects adolescents' selection of their peers (Landor et al., 2011). In family life, parents introduce social norms and religious values that children adopt, later internalize, and, as adolescents, use as references not to engage in risky behaviors (Jang & Johnson, 2010; Landor et al., 2011). Research of Omoponle and Olanrewaju (2020) reported that there was a significant correlation between family background, child rearing practices, self-regulation and adolescents' tendencies to criminal acts. Of these variables, self-regulation gives the most significant contribution which is then followed by parenting pattern and family background. Harris-McKoy and Cui (2013) reported that lack of parental control was significantly associated with adolescent delinquency. According to Liu, Wang and Tian (2019) a good relationship between parents and adolescents, which is indicated by less conflict is very important in decreasing risky behavior among adolescents. Esiri (2016) reported that criminal behavior is learned through association with people who often commit crimes. This statement was supported by the study of Augustyn, Ward and Krohn (in Howell, 2019) that the probability of children involve in

criminal gangs were influenced by parents' membership in criminal gang. The study of Augustyn et.al. showed that parents are role models of behavior for adolescents. The above explanation indicates the important of good relationship between parents and adolescents.

Previous research on adolescents' risk-taking behavior reported that peer groups have both positive and negative impacts. Maxwell (2002) found that peers might influence adolescents to begin smoking cigarettes and marijuana. However, peers can also influence adolescents to stop consuming alcohol and chewing tobacco. Mason et al. (2014) showed that close friends' attitudes impact adolescents' substance use. Having unresponsive close friends who pay little attention to or do not care what adolescents do might lead to increased substance use. Conversely, close friends who show concern about and disapproval of substance use can affect its decrease.

A study on the relationship between religion, religiosity, and risky behavior reported that religion and religiosity play an important role in protecting adolescents from engaging in risky behavior, such as smoking and alcohol consumptions (Sinha, Cnaan, & Gelles., 2007; Marsiglia, Ayers, & Hoffman, 2012; Brown, et.al., 2014; Charro Baena, Meneses, Caperos, Preitos, & Uroz, 2018); premarital sex and HIV risks behavior (Gyimah, Kodzi, Emina, & Cofie, 2013; Cerqueira-Santos & Koller, 2016; Hasnain, Sinacore, Mensah, & Levy, 2005), fighting and violence (Salas-Wright, Vaughn, & Maynard, 2014).

Marsiglia, et.al. (2012) conducted a study with adolescents aged 14-17 in central Mexico and reported that adolescents who have high scores in both intrinsic religiosity and extrinsic religiosity were less likely to take risks by cigarette and alcohol use. Intrinsic religiosity referred to the importance of religion in personal behavior, while extrinsic religiosity referred to individual's involvement in religious activities such as church attendance. The Arli et al.'s study (2016) with Indonesian youth aged 18-24 showed that intrinsic religiosity influenced youth's perception of risky behavior, such as gambling, health and safety, and ethics. Youth with high scores in intrinsic religiosity were less likely to engage in risky behavior. Additionally, Ameri, Mirzakhani, Nabipour, Khanjani, & Sullman (2017) conducted a study with Iranian university students and found that students who engaged more often in religious activities and had stronger intrinsic religiosity were less likely to engage in risky behavior, such as sexual risk-taking, careless driving,

violence, smoking, alcohol, and substance use. According to Sinha, et al. (2007) and Mojahed (2014) religion has a very positive role in decreasing risk-taking behavior both directly and indirectly. Religious rules and prohibitions are a direct way in which risky behavior is inhibited, while religious activities and communities are indirect ways in which religion inhibits risky behavior. Religious teachings thus serve as a basis for preventing adolescents from engaging in risk-taking behaviors, for instance, premarital sex, alcohol and substance use, and violence.

Poverty is also regarded as predictor of criminal behaviors among adolescents (Sariaslan, Larsson, D'Onofrio, Långström, & Lichtenstein, 2014; Shah, Soomro & Mirjat, 2019). According to Shah et.al (2019) lack of resources to fulfill the needs lead adolescents to engage in criminal acts. Shong, Bakar and Islam (2018) stated that poor and unhappy family conditions as well as school failure are two factors associated with children's criminal behavior. The study of Madise, Zulu and Ciera (2007) reported that poverty is the driving factor for female adolescents to involve in early sexual activity and having sexual activity with multiple partners. These sexual activities are intended to get gifts or money. The explanation above shows that family life is essentials for adolescents to engage in risky behavior. Therefore, this study focuses on the risk-taking behavior of adolescents from vulnerable neighborhood. This study is also interested in identifying adolescents' perception on their connection with their parents. Another study on adolescents' risk-taking behavior also reported that family financial pressure, disadvantaged neighborhoods, unstable life, and lack of hope and certainty are likely to affect adolescents' risky behaviors (Caldwell, Wiebe, & Cleveland, 2006). Unfavorable and uncertain conditions leading to hopelessness indirectly impact adolescents' maladaptive school and coping behaviors (Bolland et al., 2007). McKelvey et al. (2011) reported that community violence negatively impacts children's psychosocial development, including risk-taking behavior. However, families with low conflict can protect children from community violence's negative effect. Thus, McKelvey et al.'s study (2011) showed that good family life and good parenting play important roles in decreasing adolescents' risk-taking behavior.

Referring to the above explanation on the risk-taking behavior among adolescents, this study is intended to provide an overview of eight risk-taking behaviors namely smoking, consuming alcohol, substance use, brawling,

crime, physical fighting, heavy petting, and premarital sex of adolescents in two vulnerable areas in North Jakarta Indonesia. The study also provides information on parent-adolescents relationship as perceived by adolescents which regarded as important factor that influence adolescents' engagement in risky behaviors. In this study adolescents' reasons for engaging in or not in risky behavior is also presented. Knowledge of the reasons for adolescents' involvement in risky behavior will provide information for designing future youth behavior change programs (Buckley & Sheehan, 2016) health promotion programs (Dey, Gmel, Studer, & Mohler-Kuo, 2014), and other prevention programs (Oman, Vesely, Kegler, McLeroy, & Aspy, 2003; Morales-Alema, 2011; Hale & Viner, 2016).

This study provides an overview of eight risk-taking behaviors (smoking, consuming alcohol, substance use, brawling, crime, physical fighting, heavy petting, and premarital sex) of adolescents in two vulnerable areas in North Jakarta, Indonesia. The study provides information on parent–adolescent relationships as perceived by adolescents. In addition, the study provides information on adolescents' reasons for engaging in or not in risky behaviors. Knowledge of the reasons for adolescents' involvement in risky behaviors will provide important information for designing future youth behavior change programs (Buckley & Sheehan, 2010), health promotion programs (Dey, Gmel, Studer, & Mohler-Kuo, 2014), and other prevention programs (Oman, Vesely, Kegler, McLeroy, & Aspy, 2003; Morales-Alema, 2011; Hale & Viner, 2016).

Method

Using a nonrandom sampling method, this study was initially conducted as a household survey in two vulnerable neighborhoods in North Jakarta. The neighborhoods are located in two slum areas with poor quality and high-density housing, poor sanitation, inadequate access to clean water and other infrastructure. Although some household heads in these two neighborhoods have low-level permanent jobs, most work as temporary informal workers, fishermen, motorbike taxi drivers, truck drivers, port workers, or are unemployed. Therefore, these two neighborhoods are considered unsafe and vulnerable. Households with adolescents of 12 to 18 years old were purposively selected. The research defines "parents" as fathers, mothers, or

any adults living in the same house with adolescents and available to participate in interviews. Adolescents are identified as boys and girls of 12 to 18 years of age who are still in school, have dropped out of school, have already worked, or are unemployed. Informed consents were obtained from all participants involved.

The sample included 401 parents (female n = 32; 8% and male n = 369; 92%). As many as 91.5% (n = 367) were married, and 8.4% (n = 34) were widows, widowers, or not married. Parents' mean age was 45.3 years (SD = 7.4; min = 22.8 and max = 70.0). The survey also involved 414 adolescents, 57.49% (n = 238) female and 42.51% (n = 176) male. Adolescents' mean age was 14.92 years (SD = 1.65). As many as 91.3% (n = 378) of adolescents involved were still in school, 2.4% (n = 10) had finished high school, and 6.3% (n = 26) had dropped out. Of those still in school, 90.3% were male and 92% female.

Parents and adolescents were interviewed in separate places, using a questionnaire developed by the researcher by referring to the previous report conducted by Kusumawardani and Suhardi (2011) on behavioral health risk among adolescents in West Java, Indonesia including smoking, unhealthy behavior, and physical activities. The parental questionnaire obtained information related to educational background, employment, income, and household expenditure. The questionnaire for adolescents related to eight potentially risky behaviors (smoking, consuming alcohol, substance use, brawling, criminal activity, physical fighting, heavy petting, and premarital sex). Expected responses were "yes" or "no." In the adolescent questionnaire, 20 items addressed adolescents' perception of their relationship with their parents. Respondents chose from three alternative answers, that is, "often," "sometimes," and "never." The questionnaire also included items on reasons for taking or not taking risky behaviors.

Two hypotheses were tested in this study. First, whether there is different proportion between boys and girls in related to eight potential risky behaviors (smoking, consuming alcohol, substance use, brawling, criminal activity, physical fighting, heavy petting and premarital sex) (H_0: $p_{girls}=p_{boys}$ against the alternative hypotheses H_a: $p_{girls}\neq p_{boys}$.). Were boys more likely to be involved in eight potential risky behaviors than girls? The second hypotheses was whether there is different proportion between adolescents age 13-15.9 years and adolescents age 16.18 years in their involvement to eight potential risky

behaviors (H_o:$p_{13-15.9y}$=p_{16-18y} against the alternative hypotheses H_a:p_{13-15y}≠p_{16-18y}). Were older adolescents i.e. age 16-18 years more likely to be engaged in eight potential risky behaviors than younger adolescents i.e. age 13-15 years old?

Results

Parents' Characteristics

Parents' educational backgrounds were as follows: More than half (63.4%) had a low level of education (35.7% elementary; 27.7% junior high), from elementary school, grade 1 to junior high school, grade 9. One-third of parents (33.4%) had graduated from senior high school and 2.7% from institutions of higher learning (0.5% did not answer). More than half of parents had been able to fulfill the basic requirement of 9 y compulsory education.

Work and family life were closely related to educational level. The higher the education, the better the jobs and quality of life or well-being. With regard to parents' employment, Table 1 indicates that most parents were informal workers in various sectors (40.6%; n = 163) (e.g., motorbike taxi driver, truck driver, fishing laborers, building construction workers), and some were unemployed (6%; n = 24). Data on parents' employment relates to data on their educational background: Lack of knowledge and skills needed for high levels of employment might have been the reason most parents worked in informal sectors with low wages.

Data indicated that parents were categorized at low socioeconomic levels (Table 1). In previous studies, Ponnett (2014) and Crandall, Magnusson, Novilla, Novilla, and Dyer (2017) reported that family financial problems influence adolescents' behavior and often lead to parental conflict because parents cannot meet the family's needs. Previous studies also reported that serious criminal cases often occur in low-income and low-resource communities, and these circumstances influence adolescents' antisocial behavior (Cook et al., 2009; Tjora, Hetland, Aarø, & Øverland, 2011; Elliott, Avery, Fishman, & Hoshiko, 2002; Djerboua, Chen, & Davison, 2016).

Table 1
Parents' Educational and Employment Background

Parents' educational and employment background	f = 401	%
Education		
No answer	2	.5
Elementary school	143	35.7
Junior high school	111	27.7
Senior high school	134	33.4
University/tertiary education	11	2.7
Employment		
Unemployed	24	6.0
Self-employed	83	20.7
Employee	86	21.5
Factory workers	45	11.2
Temporary informal workers in various sectors	163	40.6

Adolescents' Perception of Their Connection with Their Parents
Table 2 characterizes relationships of adolescents and their parents as perceived by the adolescents. Even though numbers are small, some adolescents perceived their relationship with their parents as not strong. Some felt that their parents never supported or motivated them, never paid attention or listened to them, and never praised them. Some mentioned that their parents never fulfilled their needs, never spent time with them, and never provided advice they needed. Table 2 also shows that some adolescents reported that they were scolded with abusive words, often hit or beaten with or without tools, or abused by their parents.

Contreras and Cano (2014) stated that communication among family members is the essential dynamic of family relations, and lack of communication is associated with antisocial behaviors. Open communication relates to a democratic parenting style that shows warmth and relates positively to affection. In contrast, problematic communications are related to the authoritarian parenting style and positively related to criticism and rigid manners of setting rules.

Table 2

Adolescents' Perception of Connection with Parents

No	Parent–adolescent connections	often/ never	Age			
			12–12.9 (n = 29)	13–15.9 (n = 218)	16–18 (n = 167)	Total (n = 414)
			Count	Count	Count	Count
1	Supports and motivates me	often	20	154	117	291
		never	2	5	4	11
2	Gives me attention and listens to me	often	23	151	126	300
		never	1	1	2	4
3	Hits me (with or without tools)	often	2	8	6	16
		never	20	148	125	293
4	Shows me affection	often	25	175	121	321
		never	0	4	4	8
5	Praises me	often	18	109	85	212
		never	2	5	7	14
6	Cheers me up	often	20	118	85	223
		never	2	2	9	13
7	Respects my freedom	often	13	84	56	153
		never	5	24	10	39
8	Scolds me with abusive words	often	1	11	10	22
		never	21	152	119	292
9	Understands me	often	21	128	99	248
		never	0	5	2	7
10	Trusts me	often	22	130	108	260
		never	1	0	2	3
11	Provides advice and guidance	often	23	170	129	322
		never	0	2	4	6
12	Provides my needs	often	26	158	101	285
		never	0	2	2	4
13	Harasses me	often	1	3	3	7
		never	28	200	155	383
14	Gives me money	often	28	184	125	337

		never	1	6	7	14
15	Buys things for me	often	12	110	76	198
		never	3	8	8	19
16	Has open communication with me	often	19	127	100	246
		never	1	8	5	14
17	Forces me to work for a living making me unable to learn, attend school, and play	often	0	4	6	10
		never	29	195	145	369
18	Spends time with me	often	13	78	68	159
		never	3	13	8	24
19	Touches parts of my body, making me uncomfortable	often	0	5	2	7
		never	28	198	153	379
20	Supports my schoolwork (only answered if attending school)	often	24	136	112	272
		never	3	21	11	35

Adolescents' Engagement in Risky Behaviors

Table 3 indicates that age correlates with adolescents' risky behaviors. Risky behaviors were performed mostly by older adolescents from 13 to 18 years. Alarmingly, some children aged 13 to 15 already smoked (6%), drank alcohol (1.4%), and engaged in brawls (2.8%), in physical fights (5.5%), and in heavy petting (0.5%). Table 3 also shows that smoking (5.6%), physical fights (4.6%), and brawling (2.2%) were the riskiest behaviors in which adolescents were involved. Although in relatively small numbers, some adolescents also engaged in consuming alcohol (1%), substance use (0.2%), heavy petting (0.5%), and premarital sex (0.2%).

Table 3
Adolescents' Risky Behaviors by Age

No.	Risky behaviors	No/Yes	Age 12–12.9 (n = 100) %	13–15.9 (n = 218) %	16–18 (n = 167) %	Total (n = 414) %	Z-value	p-value
1	Smoking	no	100	94.0	94.0	94.4		
		yes	0	6.0	6.0	5.6	0,000	1.,000
2	Drinking alcohol	no	100	98.6	99.4	99.0		
		yes	0	1.4	0.6	1.0	0,782	0.434
3	Substance use	no	100	100	99.4	99.8		
		yes	0	0	0.6	0.2	1.306	0.192
4	Brawling	no	100	97.2	98.2	97.8		
		yes	0	2.8	1.8	2.2	0.663	0.507
5	Criminal activity	no	100	100	100	100		
		yes	0	0	0	0	na	na
6	Physical fights	no	100	94.5	95.8	95.4		
		yes	0	5.5	4.2	4.6	0.603	0.546
7	Heavy petting	no	100	99.5	99.4	99.5		
		yes	0	0.5	0.6	0.5	0.138	0.890
8	Premarital sex	no	100	100	99.4	99.8		
		yes	0	0	0.6	0.2	1.306	0.192

Table 4 shows adolescents' risk-taking behaviors across genders. Boys were more likely than girls to be involved in risky behaviors (e.g., smoking, drinking alcohol, brawling, and physical fighting). However, even though the number is small, some female participants were also involved in drinking alcohol (0.4%), substance use (0.4%), physical fighting (0.8%), and heavy petting (0.4%).

Table 4
Adolescents' Risky Behaviors by Gender

No.	Risky behaviors	Yes/No	Boys (n = 176) %	Girls (n = 238) %	Total (n = 414) %	Z-value	p-value
1	Smoking	no	87.5	99.6	94.4		
		yes	12.5	.4	5.6	5.294	0.000
2	Drinking alcohol	no	98.3	99.6	99.0		
		yes	1.7	.4	1.0	1.314	0.189
3	Substance use	no	100	99.6	99.8		
		yes	.0	.4	.2	0.901	0.368
4	Brawling	no	94.9	100	97.8		
		yes	5.1	.0	2.2	3.497	0.000
5	Criminal activity	no	100	100	100		
		yes	.0	.0	.0	na	na
6	Physical fights	no	90.3	99.2	95.4		
		yes	9.7	.8	4.6	4.273	0.000
7	Heavy petting	no	99.4	99.6	99.5		
		yes	.6	.4	.5	0.285	0.775
8	Premarital sex	no	99.4	100	99.8		
		yes	.6	.0	.2	1.351	0.177

According to Idemudia and Sekano (2015), gender and age are important factors that determine probability of risk-taking behaviors. Erol and Orth (in Idemudia & Sekano, 2015) reported that adolescent boys showed higher levels of risk-taking behaviors than girls. Djerboua et al. (2016) also stated that physical fighting related to injury was more frequent in males than in females. However, Idemudia and Sekano (2015) found no significant gender differences in risk-taking behavior. Meanwhile, Schulte, Ramo, and Brown (2009) identified factors that influenced alcohol-drinking behavior in adolescence and continued into adulthood. Their study's result indicated that certain biological and psychosocial factors appear to impact boys and girls similarly. However, as adolescents shifted into adulthood, biological and psychosocial impact appeared to differ between males and females.

Sabri et al. (2017) assessed gender differences regarding two factors of HIV transmission, multiple sexual partners and sharing needles. Results indicated that more men than women had recent multiple sex partners and shared needles. For physical fighting, Djerboua et al. (2016) reported that males were more often involved than females.

In this study the comparison of proportions of eight risky behavior, namely smoking, drinking alcohol, drug use, fighting, criminal acts, physical fights, heavy petting, and premarital sex engaged by adolescents was tested by different test procedures. A Z test was used to measure the equality of proportions among the population, a Chi-Square test was performed for testing the independence of risky behavior, and Marascuillo procedure was applied to provide the magnitude of variation in the pairs of proportions.

The two hypotheses, comparison of proportions of eight risky behaviors between girls and boys population as well as between adolescents age 13-15.9 and 16-18 years population were tested by Z test. For the gender population the hypotheses tested was H_0: $p_{girls}=p_{boys}$ against the alternative hypotheses H_a: $p_{girls}\neq p_{boys}$. The Z test was applied to test the hypotheses of each risky behavior between girls and boys. For the age population the hypotheses tested was H_o:$p_{13-15.9y}=p_{16-18y}$ against the alternative hypotheses Ha: $p_{13-15.9y}\neq p_{16-18y}$. The Z test was applied to test the hypotheses of each risky behavior between adolescents' age 13-15.9 years and 16-18 years. This study did not include the population of age 12-12.9 y since they did not engage in risky behavior. The hypotheses tested in the Z test was performed with the following formula.

$$z = \frac{(\bar{p}_1 - \bar{p}_2)}{\sqrt{\bar{p}(1 - \bar{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

Based on gender population, the result of Z test showed for smoking Z= 5.294 with p value = 0.00, brawling Z = 3.497 with p value = 0.00, and physical fight Z= 4.273 with p value = 0.00. Small Z value showed for other five risky behaviors, namely drinking alcohol, substance use, criminal activity, heavy petting and premarital sex. The result of this Z test indicated that the proportions of three risky behaviors, namely smoking, brawling and physical fight are not equal between girls and boys population. Meanwhile, based on

age population, the result of Z test showed that all Z-values are small, less than 1.96 and all p values are more than 0.05. This study used $\alpha = 0.05$ level of significant which means that the proportions of eight risky behaviors between age 13-15.9 and age 16-18 years are equal. There was no difference between adolescents age 13-15.9 and 16-18 years in engaging with eight risky behaviors (see table 3)

The Chi-Square test was performed to test the hypotheses H_o:$p_1=p_2=$....$p_7=p_8$ against the alternative hypotheses that not all eight risky behaviors proportions are equal, H_a=not all p_i are equal (i=1, 2,3....8). The result of Chi-Square test was $\chi^2 = 77.016$ with the p value = 0.00. This study choose α 0.05 level of significant ($\chi^2 = 77.016$; p<0.05), which can be concluded that not all proportions of eight risky behaviors engaged by adolescents are equal.

In order to identify the equality of the proportion of risky behaviors, a multiple comparisons procedures known as Marascuillo procedure was performed. The result showed that there is difference on the proportion of risky behaviors that adolescents engaged in, namely between smoking vs substance use, smoking vs criminal activity, smoking vs heavy petting, smoking vs premarital sex, substance use vs physical fights, criminal activity vs physical fights, physical fights vs heavy petting, and physical fights vs premarital sex (see table 5)

Table 5
Result of Multiple Comparison using Marascuillo procedures

Pairwise Comparison	$\lvert p_i\text{-}p_j \rvert$	CV_{ij}	Significant if $\lvert p_i\text{-}p_j \rvert > CV_{ij}$
Smoking - Drinking alcohol	0.046	0.046	Not Significant
Smoking - Substance use	0.053	0.043	Significant
Smoking - Brawling	0.034	0.050	Not Significant
Smoking - Criminal activity	0.056	0.042	Significant
Smoking - Physical fights	0.010	0.057	Not Significant
Smoking - Heavy petting	0.051	0.044	Significant
Smoking - Premarital sex	0.053	0.043	Significant

Drinking alcohol - Substance use	0.007	0.020	Not Significant
Drinking alcohol - Brawling	0.012	0.032	Not Significant
Drinking alcohol - Criminal activity	0.010	0.018	Not Significant
Drinking alcohol - Physical fights	0.036	0.043	Not Significant
Drinking alcohol - Heavy petting	0.005	0.022	Not Significant
Drinking alcohol - Premarital sex	0.007	0.020	Not Significant
Substance use - Brawling	0.019	0.028	Not Significant
Substance use - Criminal activity	0.002	0.009	Not Significant
Substance use - Physical fights	0.043	0.040	Significant
Substance use - Heavy petting	0.002	0.016	Not Significant
Substance use - Premarital sex	0.000	0.013	Not Significant
Brawling - Criminal activity	0.022	0.027	Not Significant
Brawling - Physical fights	0.024	0.047	Not Significant
Brawling - Heavy petting	0.017	0.030	Not Significant
Brawling - Premarital sex	0.019	0.028	Not Significant
Criminal activity - Physical fights	0.046	0.039	Significant
Criminal activity -Heavy petting	0.005	0.013	Not Significant
Criminal activity - Premarital sex	0.002	0.009	Not Significant
Physical fights - Heavy petting	0.041	0.041	Significant
Physical fights - Premarital sex	0.043	0.040	Significant
Heavy petting vs Premarital sex	0.002	0.016	Not Significant

Reasons to Engage in Risky Behaviors

Knowledge about reasons for risky behaviors is very important. In this study, seven factors influenced adolescents to engage in risky behaviors: (1) pressure from friends and (2) family, (3) desire after watching a film, (4) after viewing the Internet, (5) after reading a book or magazine, and (6) after seeing something directly, and (7) wanting to try something or wanting to know more about something. Table 6 indicates that wanting to try or wanting to know (n = 21; 50%) and pressure from friends (n = 17; 40.5%) were the most frequent reasons adolescents engage in risky behaviors.

Table 6
Reasons to Engage in Risky Behaviors

Reasons to engage in risky behaviors	No/Yes	Boys (n = 37)	Girls (n = 5)	Total (n = 42)
		%	%	%
Peer pressure	no	56.8	80.0	59.5
	yes	43.2	20.0	40.5
Family pressure	no	97.3	100.0	97.6
	yes	2.7	.0	2.4
Encouraged by viewing movies	no	97.3	80.0	95.2
	yes	2.7	20.0	4.8
Encouraged by viewing the Internet	no	89.2	80.0	88.1
	yes	10.8	20.0	11.9
Encouraged by books and/or magazines	no	94.6	100.0	95.2
	yes	5.4	.0	4.8
See directly	no	81.1	100.0	83.3
	yes	18.9	.0	16.7
Try/want to know	no	48.6	60.0	50.0
	yes	51.4	40.0	50.0
Others	no	97.3	100.0	97.6
	yes	2.7	.0	2.4

Reasons Not to Engage in Risky Behaviors

Adolescents reported eight reasons not to engage in risky behaviors: (1) being advised by family; (2) by religious leaders; (3) by other adults, such as teachers, community leaders, etc.; or 4) by friends or peer groups; 5) fear of God for committing sins; 6) of being scolded by parents; 7) of destroying the future; and 8) of harm; and (9) others. Table 7 indicates that being advised by family (68%) was higher than being advised by teachers and community leaders (23.9%), religious leaders (20.7%), and friends or peers (14.5%). Data suggests that families play an important role in influencing adolescents not to engage in risky behaviors. This follows Morales-Alema (2011) who indicated that parental involvement is a significant buffer for high-risk sexual behavior.

Table 7
Reasons Not to Engage in Risky Behaviors

No	Reasons not to engage in risky behaviors	No/ Yes	Boys (n = 139)	Girls (n = 233)	Total (n = 372)
			%	%	%
1	Advised by family	no	33.8	30.9	32.0
		yes	66.2	69.1	68.0
2	Advised by religious leaders	no	79.9	79.0	79.3
		yes	20.1	21.0	20.7
3	Advised by other adults (teachers)	no	80.6	73.4	76.1
		yes	19.4	26.6	23.9
4	Advised by peers	no	87.8	84.1	85.5
		yes	12.2	15.9	14.5
5	Fear of God/of committing sins	no	54.7	42.1	46.8
		yes	45.3	57.9	53.2
6	Fear of parents	no	51.8	48.5	49.7
		yes	48.2	51.5	50.3
7	Fear of ruining the future	no	58.3	43.8	49.2
		yes	41.7	56.2	50.8
8	Fear of dangerous impact	no	58.3	51.1	53.8
		yes	41.7	48.9	46.2
9	Others	no	97.8	97.0	97.3
		yes	2.2	3.0	2.7

Discussion and Conclusion

This study was conducted in vulnerable areas of North Jakarta, where more parents have low educational and employment backgrounds as well as low-income and expenditure levels.

Previous studies reported that family income influences development of adolescents' behavior, that is, financial problems lead to adolescents' maladaptive coping due to the family's inability to meet their basic needs (Ponett, 2014; Crandall et al., 2017). Adolescents from low-income families take risky behaviors as a form of maladaptive coping with family financial

stress. Besides that, most low-income families live in communities with high crime rates, high poverty, and few resources; antisocial behaviors are perceived as normative (Cook et al., 2009). Djerboua et al. (2016) reported that family prosperity influences adolescents' risk-taking behavior. Adolescents from families with low socioeconomic levels have higher risk of being involved in physical fights and having related injuries. Tjora et al. (2011) reported that parents' socioeconomic status was significantly associated, directly and indirectly, with adolescents' initiation and development of smoking behavior. Conversely, high socioeconomic status had direct negative association with adolescents' smoking behavior.

A study conducted by Jang & Johnson (2010) showed that adolescents imitate the behavior of those around them, especially their parents when they see their parents smoke and use drugs. Parents directly show their adolescents that smoking and using drugs is part of an acceptable lifestyle. Additionally, Elliott et al. (2002) reported that experiencing and witnessing family violence contributed to risky sexual behavior among young female adolescents. Meanwhile, the study of Herrera & McCloskey (2003) indicated that childhood sexual abuse appeared to be the powerful predictor of girls' criminal behavior. Study by Iverson, Jimenez, Harrington, & Resick (2011) reported that exposure to family violence during childhood, including childhood physical abuse, childhood sexual abuse, and witnessing parental violence contribute to the risk for victimization of intimate partner violence for both male and female. Ccommunities at lower socioeconomic levels have low level of education and do not have enough knowledge about parenting and childcare. Therefore, children in poor communities are often exposed to family violence.

The present study also showed that fear of God for committing sins, fear of parents, and fear of damaging the future were reasons adolescents did not engage in risky behaviors. This study supports Landor et al. (2011) in that a negative relationship exists between religious beliefs and risky sexual behavior; parental religiosity affects authoritative parenting and youth religiosity. The present study also supports the findings of previous studies (Marsiglia, et.al., 2012; Arli et.al., 2016; Ameri, et.al., 2017) that religion and religiosity can directly and indirectly influence adolescents' perceptions of risky behavior and the eagerness to engage in risky behavior. Thus, it is very

important to integrate religious aspects while developing intervention programs for adolescents to prevent them from engaging in risky behavior. Despite peers' influence on sexual behavior, the parental role was found strong enough to facilitate adolescents in deciding not to engage in risky sexual behavior. Parents play an important role in protecting their adolescents from risky activities. They play a role in preparing their adolescents to be responsible for the various decisions that they make, including in their sexual behavior. Communication with and supervision of adolescents by their parents greatly helps adolescents to not feel alone in facing challenges in their development.

The present study indicated that even though the percentage is small, less than 10% of adolescents living in two vulnerable areas of North Jakarta engage in risky behaviors, namely, smoking, consuming alcohol, substance use, brawling, crime, physical fighting, heavy petting, and premarital sex. However, this study showed that there is difference on the proportion of risky behaviors that adolescents engaged in.

The study also revealed that some parent–adolescent relationships are not strong, thus likely influencing adolescents' engagement in risky behaviors. Fear of God because of sins, fear of parents, and fear of damaging the future were the most common reasons for adolescents not to involve themselves in risky behaviors. Intervention programs intended for young people, therefore, will also be relevant for communities at a lower socioeconomic level.

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Two Interventions to Improve Knowledge of Scientific and Dissemination Articles in First-Year University Students

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Abstract

The Representations of science in mass media have shown a significant increase in the last years. However, mass media dissemination activities can extend to pseudoscience due to the fact that not all scientific news are published with the same rigour. Thus, we aimed to develop two theoretical-practical interventions among first-year university students with the purpose of improving their knowledge about scientific studies and original scientific sources, as well as to critically analyze dissemination of scientific research in media. The interventions had a positive impact on knowledge about scientific information sources, particularly Pubmed, in addition to reducing the number of incorrect features linked to both scientific and dissemination articles, suggesting the importance of interventions focused on misconceptions. However, students showed knowledge of correct features of scientific articles, independently of our intervention, and they made more mistakes when attributing incorrect features to scientific articles when compared to dissemination ones.

Keywords: scientific sources; dissemination; Pubmed; neuroscience; university students.

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Dos Intervenciones para mejorar el Conocimiento sobre Artículos Científicos y de Divulgación en Estudiantes Universitarios de Primer Año

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Resumen

La representación científica en los medios de comunicación ha mostrado un aumento significativo en los últimos años. Sin embargo, debido a la falta de rigor científico, dicha divulgación por parte de los medios de comunicación podría considerarse pseudociencia. Por ello, el objetivo del presente estudio fue el desarrollo e implementación de dos intervenciones teórico-prácticas en estudiantes de primer año de universidad con el objetivo de mejorar su conocimiento sobre los estudios científicos y sobre las fuentes científicas originales, además de analizar de manera crítica la difusión científica en los medios de comunicación. Las intervenciones mostraron un impacto positivo en el conocimiento de las fuentes de información científica, destacando entre estas Pubmed, además de una reducción en las características incorrectas de artículos científicos y divulgativos, resaltando entonces, la importancia de intervenciones centradas en conceptos erróneos. Sin embargo, los estudiantes mostraron un conocimiento adecuado de las características correctas de los artículos científicos, independientemente de nuestra intervención, y cometieron más errores a la hora de atribuir características incorrectas a los artículos científicos en comparación con los divulgativos.

Palabras clave: Fuentes científicas; divulgación; Pubmed; neurociencia; estudiantes universitarios.

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Representations of science in mass media, including printed and/or broadcasting media, have shown a significant increase in the last years, particularly in the field of natural sciences (O'Connor & Joffe, 2014; Schäfer, 2012). The popularization of science, that is, to disseminate research, can lead to an interesting dialogue between civil society and scientists, and in consequence, it can generate multiple benefits in both directions (Blanco López, 2004; Jensen et al., 2008; Klar et al., 2020). For example, some of the misconceptions that certain part of the society assumes can be corrected (Blanco López, 2004; Illingworth & Prokop, 2017), and citizens distance from science and technology can be shortened (Howard-Jones, 2014; Vasconcelos, 2016). This can lead to a better understanding of science, critical thinking (Eagleman, 2013), and also, promotion of certain social values (Rull, 2014). Moreover, dissemination activities may give rise to higher involvement of population in scientific research (Alamri et al., 2019). This engagement between science and society is not only necessary from a cultural, social and utilitarian perspective (Blanco López, 2004), but it is also an ethical obligation that the scientific community should conduct, taking into account that much research is funded by public resources (Eagleman, 2013; Jucan & Jucan, 2014).

As mentioned above, divulgation of science can provide multiple advantages to society. However, it is important to outline that citizens can take advantage of it depending on the quality of dissemination (Saguy & Almeling, 2008). Unfortunately, not all scientific news are published with the same rigour, some mass media tend to exaggerate results (Saguy & Almeling, 2008), or may not be transparent or accurate enough (Guenther et al., 2017a). Nevertheless, dissemination activities should share not only striking results but also the negative ones or the necessary process to carry out the studies (Resnick, 2014). Some of the reasons behind these problems are that scientific journalism is focused on the most alarmistic findings in order to attract public attention (Saguy & Almeling, 2008) and difficulties encountered when understanding scientific language and processes (Guenther et al., 2017a).

As a result, sometimes, mass media dissemination activities can extend to pseudoscience, that is, a false knowledge masked as science and characterized by a lack of a valid scientific method and reliable evidence (Majima, 2015). It has been suggested that pseudoscience can be assumed as inoffensive based

on the premise that society is capable enough to distinguish science from pseudoscience (Cortiñas-Rovira et al., 2015). However, several authors point out that pseudoscientific beliefs and practices are common in nowadays societies (Afonso & Gilbert, 2010; Majima, 2015; Tsai et al., 2015), and some outline the need to discredit these theories not supported with facts or evidence (Majima, 2015).

In recent years, there is a significant enhancement of mass media interest in neuroscience (O'Connor et al., 2012; O'Connor & Joffe, 2014; Racine et al., 2010). There is a tendency to show an excessive optimism about advantages of experimental results (Racine et al., 2010) and/or to over-extrapolate them, reaching conclusions far from the original ones (O'Connor et al., 2012). Likewise, part of the scientific journalism does not usually provide relevant or accurate data about the study they are informing about and around 35% of the news does not include the original source of information (Racine et al., 2010). Particularly in the neuroscience's field, myths about the brain have dangerously increased (Davidson, 2017; Howard-Jones, 2014), being extended also across primary and secondary education, where a significant number of teachers presents false beliefs and myths about the human brain (Dekker et al., 2012; Düvel et al., 2017; Ferrero et al., 2016). It is very alarming that, although neuromyths seem to be more common in people without exposition to neuroscience education –suggesting that specific courses in neuroscience help to reduce these false beliefs– even experts in the field sometimes endorse them (Macdonald et al., 2017a).

Regarding university students, pseudoscience beliefs are less prevalent in this population than in citizens with lower educational status (Macdonald et al., 2017a). However, university students also believe in pseudoscientific claims (Afonso & Gilbert, 2010; Peña & Paco, 2004; Tsai et al., 2015; Tseng et al., 2014). Furthermore, university students misinterpret the data presented in media reports of science, overestimating its analytic ability (Norris et al., 2003). Interestingly, an analytic style of thinking can be a protective factor against pseudoscience, as it negatively contributes to unfounded beliefs (Ståhl & van Prooijen, 2018; van Elk, 2019). Therefore, it may be interesting to encourage critical and analytic thinking among university students. Critical thinking can be developed, for example, by allowing students an autonomous discovery of information (Snyder & Snyder, 2008), promoting class discussion (Hemming, 2000) or instigating intellectual conflicts which can

lead to constructive controversies (Johnson & Johnson, 2009). Some efforts to do this can be found in elementary school, where improvements in critical thinking occur as a result of grade transition (Koerber et al., 2015). In higher educational levels, such as university, interventions focused on raising student's critical thinking are reported across different fields of knowledge (Cone et al., 2016; Foster & Lemus, 2015; Holmes et al., 2015; Ngai, 2007; Yazici, 2004). In particular, practical applications of "learning by doing" results positive, leading to higher critical thinking skills (Ngai, 2007; Yazici, 2004). In science, recent findings report that practise in making decisions based on data (Holmes et al., 2015) or introduction of practical exercises (Foster & Lemus, 2015) triggers to significant improvements in undergraduates' critical thinking competence (Foster & Lemus, 2015; Holmes et al., 2015). Regarding health sciences, it is reported that a laboratory curriculum course, which consists of providing formative feedback and clinical reasoning, can also be beneficial in terms of development of critical thinking (Cone et al., 2016). However, the studies mentioned above do not specifically aim to assess the improvement of critical thinking in order to differentiate between pseudoscience and science. Interestingly, the development of an interdisciplinary course on science, in which knowledge about the differences between science and pseudoscience is included, can not only facilitate critical thinking, but also promote engagement in science (Rowe et al., 2015). However, it is interesting to note that despite the alarming neuro-pseudoscientific claims (Davidson, 2017; Dekker et al., 2012; Düvel et al., 2017; Howard-Jones, 2014), as far as we know, there are no theoretical-practical interventions focused on encouraging university students to think critically about the importance of reliable dissemination of neuroscience. Thus, our main objective has been to improve knowledge about scientific studies and its dissemination. For this reason, we have developed two studies among first-year university students with the purpose of improving their knowledge about scientific studies and original scientific sources, as well as to critically analyze dissemination of scientific research in the media. In Study 1, we aimed to know whether students would be able to differentiate between scientific sources and channels used for the dissemination of science news after a theoretical-practical intervention. In Study 2, we aimed to know whether students would be able to understand an original scientific source and

to rewrite a research article for its dissemination as a science news after a theoretical-practical intervention.

Materials and methods

Sample and Data Collection

In Study 1, the initial sample was composed of 123 first-year students of Degree in Psychology, average age of 18.62 (range 18-26) (27 men and 96 women). Of this total sample, 108 subjects (87.80%) answered pre-intervention questionnaire, 104 completed the intervention (84.55%) and 73 (59.34%) answered post-intervention questionnaire. From these 73 students, 6 (8.22%) did not participate in the intervention, while the remaining 67 subjects (91.78%) did complete the intervention.

In this first study, our research team developed a pre-post questionnaire (*Questionnaire on reliable sources of scientific information*). This questionnaire was designed for the purpose of this study. It included 19 items in which students should rank different types of sources of scientific information (articles, scientific conferences, books, dissemination Youtube channels, TED talks, podcast, news, TV programs and web pages with non-rigorous information) according to a Likert scale (1 -unreliable source- to 5 -totally reliable source-). They were asked about the reliability of each type of source of information and whether the source of information was familiar to them. The sources of scientific information were previously selected according to the subjective criteria of 5 researchers in the field of neuroscience and behavioural science. These experts classified into low, medium and high reliability each of the items (Table 1).

Table 1
Classification, sources, and examples provided on the Questionnaire on reliable sources of scientific information.

Classification	Sources	Examples
High scientific reliability	Original scientific sources	Pubmed articles Conferences in scientific congress Books from faculty library
Medium scientific reliability	Dissemination by scientists on the Internet or mass media	Dissemination YouTube channels Dissemination podcasts TED talks
Low scientific reliability	Dissemination by non-experts (for example, journalist), not scientific rigorous, and/or pseudoscientific	Science section of news TV programs about paranormal events Web pages with non-rigorous information

In order to conduct Study 1, we administered the *Questionnaire on reliable sources of scientific information* to students. Once they had responded, they were given indications and theoretical information about reliable sources of information and they were explained the activity they need to carry out. Thus, professors involved in this project explained that they need to work in pairs in order to find a dissemination article, news, podcast, YouTube video etc. about a research finding in neuroscience and its original scientific source. At this point, professors explained how to look for some key information related to the original article in the dissemination source (such as the name of the main author, workplace, scientific journal) and how to use this information to look for in scientific databases. In this study, we emphasized the use of Pubmed, a biomedical and life sciences powerful database. Once they find the original article and both sources of information have been read, students were asked to make an oral presentation in which they should summarize the information presented in the article and they should compare both sources, scientific and dissemination, trying to answer questions about what kind of language (generalized, specialized, formal, informal...) does each source use, how are they structured, which one provides more information, do they include

references to other authors who have previously been working in the same field, do the documents present similar results and findings and which document is using generalizations, exaggerations or categorical statements. The students not only presented their own work, but they also had to attend presentations of their peers and participate in a final debate promoted by professors, in which they discussed about scientific dissemination and rigorous interpretation of the original scientific source. Study 1 ended with the administration of post questionnaire (*Questionnaire on reliable sources of scientific information*). This post questionnaire included also questions about their participation in the project and their level of satisfaction (score: lowest satisfaction 0 to highest satisfaction 10).

In Study 2, the initial sample was composed of 120 first-year students of Psychology. Average age of the students was 19 (range 18-44) (26 men and 104 women). Ninety-one students (75.83%) answered the pre-intervention questionnaire, 84 (70.00%) participated and completed the intervention and 86 (71.66%) answered the post-intervention questionnaire. From these 86 subjects, 67 (77.90%) completed intervention, while 19 students (22.10%) did not.

In this second study, our research team designed a pre-post questionnaire for the purpose of the study. The questionnaire is named Questionnaire on knowledge of scientific and dissemination articles. This questionnaire was designed to analyse the importance of different features of neuroscience scientific articles and dissemination articles. The students were asked about how they could describe neuroscience scientific articles and dissemination articles according to a Likert scale (from 1 - not important - to 5 - very important -). The questionnaire included a total of 15 items: 5 items that describe scientific articles, 5 items that describe dissemination articles and 5 items that describe both types of articles (Table 2). The items were selected according to the subjective criteria of 5 researchers in the field of neuroscience and behavioural science.

Table 2
Items of the Questionnaire on knowledge of scientific and dissemination article.

Item	*Type of article*
1. An attractive and striking title	Dissemination
2. A structure divided into different sections, such as introduction, method, results and conclusions	Scientific
3. Graphic material that helps to better understand the written text	Both
4. A specialized and technical language	Scientific
5. An everyday and accessible language	Dissemination
6. A general structure, divided into a title, general body and conclusions	Dissemination
7. Possible applications of the study and future lines	Both
8. An informative and descriptive title for the content of the article	Scientific
9. The intention to inform and entertain at the same time	Dissemination
10. Mention of the researchers of the article and their workplaces	Both
11. Citations and scientific references of previous works	Both
12. A detailed description of the methodology, allowing others to replicate the study	Scientific
13. Use of examples to make the objectives and results of the research understandable	Dissemination
14. Before publication, it is subjected to a process of expert review	Scientific
15. Reported results are obtained in research approved by an ethics committee	Both

In Study 2, we administered *Questionnaire on knowledge of scientific and dissemination articles* in the first place. Then, the students were explained the activity they had to do. In groups of 3 to 4, they had to read a scientific article from the field of neuroscience. This article was provided by professors. The students were asked to write a journalistic article with the aim of disseminating research findings of the article. The document would be concise, readable, and intended to reach a broad audience. The articles selected were in English and with a level of complexity adjusted for first-year students. The students received theoretical information and examples about differences between a scientific article and a dissemination one. They were also instructed to make rigorous science content, providing truthful data and citing the original publication, and using everyday language. Students were asked to make an oral presentation in which they should present a sketch of their dissemination article. Professors would correct and/or guide their work. After corrections, students should present the final project, a template that reproduces the structure of a newspaper article: title, entry, body of the article and photograph, which could be taken from the original publication. Study 2 ended with the administration of post questionnaire, which included also questions about their participation in the project and their level of satisfaction (score: lowest satisfaction 0 to highest satisfaction 10).

Data analysis

Data were analyzed using SigmaPlot 12.5. In Study 1 we analyzed data using a two-way repeated measures ANOVA. Intervention measure (two levels: pre/post) and reliability (three levels: low/medium/high) were considered as within-subjects and between-subjects factors, respectively. Post hoc comparisons were done when significant differences were found using the Holm-Sidak method.

In Study 2 we performed repeated measures ANOVA to examine knowledge of the features of each article across pre and post-intervention measures. Average score on each questionnaire (pre/post) was the main factor. When statistical differences were found, Holm-Sidak method was used as a multiple comparison procedure. Student's *t*-tests were used to assess differences between articles in the score obtained by the students in each intervention measure (pre/post). We used Mann-Whitney Rank Sum Test

when normality test failed. Results were considered statistically significant when p<0.05.

Results

Study 1

Regarding the percentage of students who show knowledge of each source of information (dissemination article or scientific article), the two-way RM ANOVA revealed significant effect of the intervention ($F_{(1,16)}$ = 8.549, p=0.010). The reliability ($F_{(2,16)}$ = 3.439, p=0.057) and the interaction between both factors (Reliability x Intervention) were not significant ($F_{(2,16)}$ = 1.606, p=0.231). The post hoc Holm-Sidak method revealed that there were differences between pre and post-intervention measures in the sources assigned to high reliability (t= 2.741, p=0.015) but not in the sources assigned to medium (t= 3.957, p=0.432) and low reliability (t= 1.214, p=0.242). Furthermore, in post-intervention measures, we found differences in students' knowledge of the sources assigned to high and medium reliability (t= 2.950, p=0.025). No differences were found in students' knowledge of the high and low reliability sources (t= 2.218, p=0.078), neither of the medium and low (t= 0.948, p=0.356) (Fig. 1)
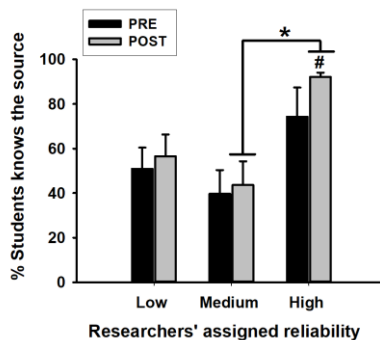

Figure 1. Percentage of students who knows the information source (Mean ± S.E.M). The *x*-axis shows the three levels of reliability assigned by researchers to each

source. Students showed higher knowledge of the sources classified as high reliability in the post-intervention measure compared to the pre-intervention measure (# p =0.015). In the post-intervention, we found differences in students' knowledge of the sources assigned to high and medium reliability (* p=0.025).

Regarding perceived reliability of sources of information (average score), the two-way RM ANOVA revealed significant effect of the assigned reliability ($F_{(2,16)}$ = 14. 198, $p<0.001$) and intervention ($F_{(1,16)}$ = 8.052, p=0.012). The interaction between both factors (Assigned reliability x Intervention measures) was not significant ($F_{(2,16)}$ = 0.443, p=0.650). Pairwise comparisons with Holm-Sidak method showed that students perceived as with higher reliability the high reliability sources compared with medium (t= 4.634, $p<0.001$) and low (t= 5.015, $p<0.001$). There were no differences in the perceived reliability between medium and low reliability sources (t= 0.322, p=0.752), neither between pre and post-intervention measure of each reliability: low (t= 1.233, p=0.236); medium (t= 1.575, p=0.135) and high (t= 2.022, p=0.060) (Fig. 2)
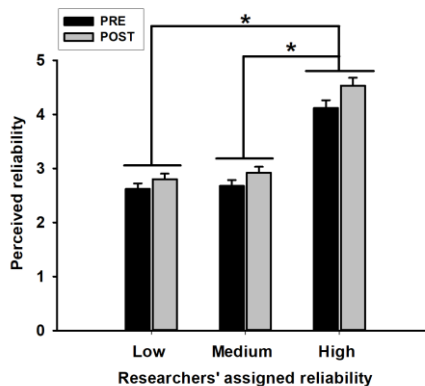

Figure 2. Perceived reliability mean score of sources of information (Mean ± S.E.M). The *x*-axis shows the three levels of reliability assigned by researchers to each source. Students perceived as with higher reliability sources classified as high reliability (* p <0.001).

We decided to look more deeply into the effects of our intervention and explore students' knowledge about a high-reliability source on which we have focused our intervention, Pubmed, and also on one source with low reliability, a TV program. Pre-intervention, 35.185% of our students knew Pubmed while 90.740% of our students knew the TV program. Post-intervention, 87.671% of the students showed knowledge of Pubmed, while the TV program maintained its popularity (93.150%).

Finally, we examined student's level of satisfaction with the intervention. From a total of 67 students who received the intervention, their satisfaction mean was 8.636 with a standard deviation of 1.076 and a standard error of 0.131 (Fig. 3)
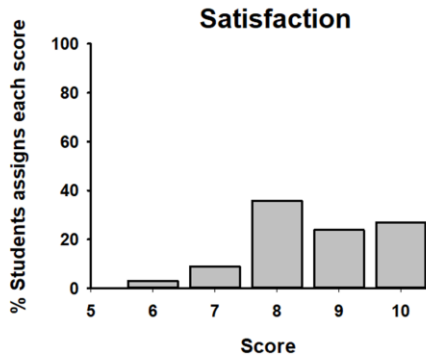

Figure 3. Percentage of students by level of satisfaction with the intervention (score 0: lowest satisfaction, score 10: highest satisfaction). Students showed scores above 6 in their level of satisfaction with the intervention.

Study 2

We examined knowledge of the features of each article across pre and post-intervention measures. Regarding the percentage of correct scores given by the students to the features of scientific and dissemination articles, we found statistically significant differences between the two types of articles in the pre-intervention ($t_{179}= 2.343$, $p=0.020$) and in the post-intervention measure ($U= 958.500$, $n_1=67$, $n_2=67$, $p< 0.001$). Comparisons between pre and post-

intervention measures revealed differences in percentage of correct scores for dissemination articles ($F_{(1,65)}=19.470$, $p<0.001$), but not for scientific articles ($F_{(1,66)} = 2.593$, $p=0.112$) (Fig. 4a). When we analysed percentage of incorrect scores given by the students to the features of the questionnaire, we also found differences between the two types of articles in the pre-intervention ($U= 2475.000$, $n_1=90$, $n_2 =91$, $p< 0.001$) and in the post-intervention ($U= 1524.500$, $n_1=67$, $n_2=67$ $p=0.001$). Comparisons between pre and post-intervention measures revealed lower percentage of incorrect scores given by the students for scientific articles ($F_{(1,66)} = 31.416$, $p<0.001$) and dissemination articles ($F_{(1,65)} = 84.368$, $p<0.001$) after intervention (Fig. 4b)
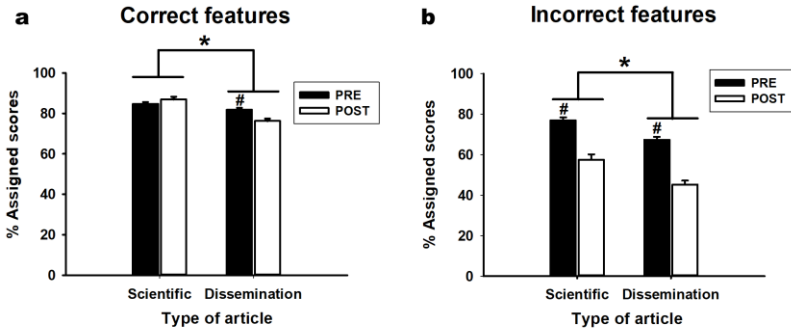

Figure 4. Percentage of scores classified as correct and incorrect given by the students to each type of article in the pre and post-intervention (Mean ± S.E.M). The *x*-axis shows the two types of articles: scientific and dissemination articles. **a.** Percentage of scores given to the correct features of each article. Comparing pre- and post-intervention, there were differences between the two types of articles (* *p*<0.05). Correct scores for the dissemination articles were lower in the post-intervention than in the pre-intervention (# *p*<0.001). **b.** Percentage of scores given to the incorrect features of each article. There were differences between the two types of articles in the pre-intervention and the post-intervention measure (* *p*<0.05). Comparisons between pre and post-intervention measures revealed lower percentage of incorrect scores given by the students for scientific and dissemination articles (# *p*<0.001).

Finally, we examined student's level of satisfaction with the intervention. From a total of 67 students who received intervention, their satisfaction mean was 8.014 with a standard deviation of 1.638 and a standard error of 0.200. 97 % of the students presented a level of satisfaction greater than 6 (Fig. 5)
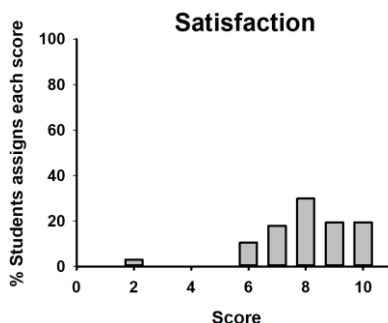

Figure 5. Percentage of students by level of satisfaction with the intervention (score 0: lowest satisfaction, score 10: highest satisfaction).

Discussion

The aim of the present study was to improve first-year university student's knowledge about scientific studies and its dissemination. Our intervention aimed to enhance their knowledge about original scientific sources, in addition, to encourage critical analysis of scientific research portrayed in the mass media.

In Study 1, we developed a theoretical-practical intervention targeted to first-year university students in which we provided theoretical information about reliable sources of information and how to use scientific database, i.e., Pubmed. Then, first-year university students had to apply the theoretical content to perform the work. In particular, they were asked to select a dissemination article. Then, they needed to find its original scientific source. They should compare information and language used by dissemination and scientific articles. Finally, they participated in a final debate over rigor of scientific dissemination. Moreover, first-year university students were asked

to make an oral presentation, in which they had to summarize their work and answer the questions.

The results from Study 1 reveal that our theoretical-practical intervention resulted in enhanced knowledge of high reliable sources of information. We did not find any difference in medium and low reliability sources. Indeed, first-year university students present similar knowledge about these information sources, regardless the degree of reliability, without any specific formation about the scientific and non-scientific sources of information (pre-intervention). Post-intervention, students display a higher knowledge about high reliability sources than medium reliability sources. Moreover, we explored the student's perceived reliability of different sources of information, scientific and dissemination. Our results show that students perceive as higher reliability those sources derived from original scientific resources and consequently classified by researches as "high scientific reliability", such as Pubmed articles or conference in scientific congresses, in comparison with "medium scientific reliability" sources, such as dissemination made by scientists on the Internet or podcasts, and "low scientific reliability" sources, web pages with non-rigorous information or TV programs. These differences in their perception were obtained before and after intervention. In consequence, our theoretical-practise intervention had a positive impact on knowledge about scientific sources of information, but we do not reach an enhancement of the perceived reliability of high reliable sources of information, probably because our sample already presented accurate perceived reliability of scientific and dissemination field.

Some studies address to examine and/or promote accurate discern about reliable and unreliable sources of information, focusing on an accurate use of internet resources (Julien & Barker, 2009; Sanchez et al., 2006). Specifically, it has been reported that secondary schoolers are confused when selecting and using information from internet-based sources in order to solve academic tasks (Julien & Barker, 2009). Indeed, they seem to be unaware of how search sources work and they give low importance to the process of finding information (Julien & Barker, 2009). However, as far as we know, there is no literature that collects precise information about student's knowledge of scientific and non-scientific sources of information in response to specific related training.

University students show high rates of recognition of high reliability sources of information, as some of them use scientific sources for academic purposes (Romanov & Aarnio, 2006). Specifically, in health science university education, searching information from MEDLINE is common at least twice a month for study purposes (Romanov & Aarnio, 2006). Therefore, an accurate perceived reliability of high scientific sources is an academic skill developed during university studies. However, it is important to outline that the knowledge of those scientific sources of information does not guarantee its accurate use (Romanov & Aarnio, 2006). The development of searching skills across high reliability sources has a positive impact not only on the student's scientist career but also in his/her daily life, leading to a better understanding of science (Julien & Barker, 2009). For this reason, it is necessary to include these seeking skills in the student's academic curriculum (Barranoik, 2001; Julien & Barker, 2009; Romanov & Aarnio, 2006). The objective might be not only to inform about the availability of certain high reliability sources of information but also to promote their accurate management. This could be done by including particular training in recognizing and using scientific sources of information, which could also have a positive impact on the student's learning abilities (Sanchez et al., 2006).

Moreover, in Study 1, we aimed to examine two sources of information, one with high reliability, PubMed, and another with low reliability, a Spanish TV program. After the intervention, Pubmed was known better by the students, meanwhile, the Spanish TV program was similarly known. Thus, we can assume that our theoretical-practise intervention resulted in increased knowledge about Pubmed scientific database, which use is highly recommended for future academic and professional purposes. From our point of view, there are several reasons to encourage the development of specific scientific seeking skills through academic studies: there is a large extent of pseudoscientific beliefs related to neuroscience in nowadays societies (Davidson, 2017; Dekker et al., 2012; Düvel et al., 2017; Ferrero et al., 2016; Howard-Jones, 2014); scientific dissemination sources are not accurate and rigorous enough, showing, for example, excessive optimistic conclusions (O'Connor et al., 2012; Racine et al., 2010) or not scientific-based results explanation (O'Connor & Joffe, 2014); and university students are not able to accurately interpret scientific data from mass media (Norris et al., 2003). We

are in accordance with several authors that also suggest the need for improving student's abilities of seeking information (Barranoik, 2001; Julien & Barker, 2009; Romanov & Aarnio, 2006). This could have a positive impact on discrediting false beliefs, which is extremely necessary (Majima, 2015), and generating a better understanding of science (Julien & Barker, 2009).

In our intervention, first-year university students were subjected to carry out practical activities –select the dissemination source, find the original source, compare both and elaborate an oral presentation–, being this type of learning known to be positive across a wide range of areas of knowledge, as it is able to encourage student's critical thinking (Cone et al., 2016; Foster & Lemus, 2015; Holmes et al., 2015; Ngai, 2007; Yazici, 2004). As students were asked to perform an oral presentation, they worked on their oral language expression, and more specifically, formal language (Aguilar-tablada, 2001; Villagrán & Harris, 2009). Moreover, as the oral presentation was time-limited, students improved their synthesis abilities, focusing on relevant points, an intrinsic desirable characteristic of scientist communication (Aguilar-tablada, 2001; Villagrán & Harris, 2009). Likewise, as all original scientific articles were written in English, students need to face with this language (Di Bitetti & Ferreras, 2017). Finally, except for the theoretical content teaches gave at the beginning of the project and the clarification of specific doubts, performance of work was autonomous. As a consequence, the intervention could have improved not only their ability to know, locate, understand, synthesize and use information from reliable scientific sources, but also to enhance their understanding of science and to develop their group work skills and autonomous work. However, we cannot ensure these specific effects because we did not include an assessment of the above-mentioned skills.

In Study 2, we also developed a theoretical-practical intervention targeted to first-year university students, but, as a difference, we focused on the development of accurate scientific dissemination abilities. For this purpose, after providing theoretical information about discrimination between scientific and dissemination content, in addition to empathizing on how to maintain rigor and accuracy when transforming scientific information into disseminative, students had to read a neuroscientist article written in English and generate an accurate and rigorous journalistic article.

Our results showed that first-year university students recognize correct features of scientific articles independently of our intervention. However, they made more mistakes when attributing incorrect features to scientific articles when compared to dissemination ones. Therefore, first-year university students recognize better those features that are essential within scientific articles, but they show greater trouble when identifying incorrect features linked to scientific articles in comparison with dissemination content. Similarly, it has been shown that university students may show from average to moderate levels of knowledge, meanwhile, they do not display a lack of misconceptions, that is, wrong ideas about science (Fraim, 2012). Moreover, teachers present false beliefs (Dekker et al., 2012; Düvel et al., 2017; Ferrero et al., 2016; Kaltakçi & Didiç, 2007; Macdonald et al., 2017b), and high rates of scientific knowledge can be also accompanied by misconceptions (Kaltakçi & Didiç, 2007).

Our theoretical-practical intervention did succeed in reducing the number of incorrect features linked to both scientific and dissemination articles post-intervention. This suggests that any academic intervention should pay attention to misconceptions. It has been shown that students may achieve a correct understanding about science but also misconceptions in the same field of knowledge (Nehm & Reilly, 2007). Thus, interventions focused on decreasing misconceptions seem to be essential. Some of them, taken on neurosciences courses, have shown to be beneficial in dispelling brain misunderstandings (Macdonald et al., 2017b). Others have improved neuroscience literacy but have not reduced belief in neuromyths (Im et al., 2018). In accordance with our results, it has been reported that there are not only misunderstandings about how to disseminate science (Guenther et al., 2017b; O'Connor et al., 2012; Racine et al., 2010; Saguy & Almeling, 2008), but also in writing some scientist articles. Thus, it can be interesting to improve students' incorrect understanding of writing science (Downs & Wardle, 2007).

First-year university students were asked to perform a time-limited oral presentation after transforming a scientific article into a dissemination one, with the final aim of writing an accurate and rigorous journalistic article. Thus, our intervention could have improved student's oral and written language abilities and competence in reading manuscripts written in English. In addition, our intervention might have developed group work skills and

autonomous work. However, as in study 1, the lack of specific assessment of these skills make impossible to probe their real improvement.

Finally, 84.55% and 70.00% of the students participated in study 1 and study 2, respectively. Students' satisfaction with both activities was very high. Hence, considering that these activities were not mandatory, we achieved high student's engagement. This could result in an enhanced engagement in scientific research, as it was already demonstrated in previous studies after application of courses linked to science (Rowe et al., 2015).

Conclusion

In the first theoretical-practical intervention, focused on scientific and non-scientific sources of information, our results showed improvement of students' knowledge of high reliable sources of information. Our intervention had a positive impact on knowledge about scientific information sources, particularly Pubmed. In the second theoretical-practical intervention, aimed to generate better discrimination between scientific and dissemination articles, students showed knowledge of correct features of scientific articles, independently of our intervention. However, they made more mistakes when attributing incorrect features to scientific articles when compared to dissemination ones. The intervention did succeed in reducing the number of incorrect features linked to both scientific and dissemination articles. This suggests the importance of interventions focused on misconceptions. Participation and satisfaction of first-year university students were very high, which lead us to be positive about further interventions.

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