

PSYCHOLOGICAL FACTORS ASSOCIATED WITH ACADEMIC PERFORMANCE IN STATISTICS

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The importance of statistical thinking is recognized in most professions, and at least one course in statistics is considered in the curricula in order to develop skills in statistical analysis; however, many students - especially those of humanities - study statistics unwillingly and even with fear. In this context, the present study analyzes how the performance of a sample of psychology students in a statistics course is related to the attitudes toward statistics, statistics anxiety and the type of motivation to study it. Likewise, the research is complemented by a qualitative analysis through drawings and stories about the representations that students have about statistics. Knowing the importance of these psychological factors related to learning statistics provides elements to implement better strategies for improving its teaching.

INTRODUCTION

In recent years, statistical knowledge has come to prominence and played an increasingly important role in society mainly for its multiple uses to explain facts from everyday life and the scientific world. In this way, the relationship between the statistical culture of a country and its development is getting closer, considering that information management and its quantitative analysis are vital to make better decisions in different professional fields.

Statistics is a discipline included in the curricula of most majors mainly because of its direct relationship with scientific research. However, though its usefulness is recognized, it is known that a significant number of university students develop a barrier or an inadequate attitude towards it (Vendramini & Brito, 2001). It has been observed that humanities students in general avoid taking statistics courses and have a negative perception of them (Zehra & Iqbal, 2012).

In my experience teaching a statistics course in a faculty of psychology, I perceived a "rejection of statistics" from the first class. Faced with this situation, I decided to start a collective "catharsis" immediately, which would also provide elements to diagnose the perceptions and attitudes towards statistics. Thus, I proposed students to imagine that statistics was a person. Then, I asked questions like, "Would it be a man or a woman? How old would he/she be? What would he/she wear? Who would he/she live with? What would he/she do on a Saturday night?" In several occasions, the collective representation of statistics turned out to be a bit antisocial, elderly woman wearing plaid who lived with her cats and spent a lot of time on her computer, even on Saturday nights. This activity helped break the ice the first day of class, it lowered the tension in the group, and it prompted conversations about the ideas and prejudice that students have about statistics.

THEORETICAL BACKGROUND

Attitudes towards statistics are formed throughout time as a consequence of the emotions experienced in learning mathematics and statistics (Gal, Ginsburg, & Schau, 1997), and there are several studies on the attitudes towards statistics and their relationship with the performance in this subject, which consistently demonstrate the existence of a significant, positive correlation between both variables (Sesé, Jiménez, Montaña, & Palmer, 2015).

Another psychological factor related to academic performance is anxiety. Statistics courses are among those that cause anxiety the most among students during their education (Onwuegbuzie & Wilson, 2003). This situation has caught the attention of researchers and has led to the creation of a specific, singular construct called statistical anxiety. A greater anxiety of this type has also been linked to a lower performance in this course (Sesé et al., 2015).

On the other hand, it has been found that students' type of motivation is one of the factors that could be taking part in their performance, attitudes and anxiety towards statistics. Currently, it is known that cognitive and motivational factors interact and take part in the quality of student learning and, consequently, in their performance. Thus, in order to learn, it is necessary to have the

ideal motivational components to trigger and set in motion the relevant cognitive components (Valle, Gonzáles, Barca, & Núñez, 1996).

Within the previous framework, this study aims to show the relationships between academic performance in statistics and three psychological factors: the type of motivation to study, the attitudes towards statistics and statistical anxiety.

METHOD

For this quantitative study, the design is correlational in nature. The sample consisted of 156 psychology students from a private university in the metropolitan area of Lima, who had already passed a statistics course before and who, at the time of the study, were studying a statistics course for psychology in their third year of education. The average age was 20.7 years old ($SD = 3.5$), and 77% were women.

To measure the psychological variables, the following tools – adapted to Spanish – were used. They were applied during the fifth week of classes and appropriate characteristics were recorded in reliability and validity:

- Survey of Attitudes Toward Statistics (SATS-28) (Schau, Stevens, Dauphinee, & Del Vecchio, 1995): It has 28 items with Likert scale from 1 to 7 and it consists of 4 dimensions: Affect (related to positive and negative feelings towards statistics); Cognitive Competence (attitudes towards knowledge and intellectual skills involved in statistics); Value (attitudes towards usefulness, relevance and the value of statistics in personal and academic life); and Difficulty (attitudes towards the difficulty of the course).
- Statistical Anxiety Scale (SAS) (Vigil-Colet, Lorenzo-Seva, & Condon, 2008): It measures the level of anxiety of university students towards statistics through 24 items with Likert scale from 1 to 5. This scale has a latent structure of three dimensions: Examination Anxiety, Asking for Help Anxiety, and Interpretation Anxiety.
- Academic Self-Regulation Scale (Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009): Composed of 16 items with a Likert scale from 1 to 5 that indicate the reasons for studying the course (in this particular case, it was adapted for statistics), it measures the motivational profiles, which can be: Controlled Motivation, composed of the external regulation (they do activities to obtain an external result) and introjected regulation (they do activities due to internal pressures); and Autonomous Motivation, composed of the identified regulation (they do activities considering that they are relevant or significant for him/her) and the intrinsic motivation (they do activities for enjoyment or interest in themselves).

The grades of the course evaluations were used (graded tests taken throughout the course, exam 1 taken at midsemester and exam 2 taken at the end of the course) to obtain the indicator of academic performance in statistics.

A didactic experience and its corresponding qualitative analysis were also carried out with a subsample of 41 participants from the quantitative study. In this experience, having the activity described in the introduction as motivation, a slide was shown with the following sentence: "Imagine that STATISTICS is a person (you choose if it is a woman or a man). Draw STATISTICS as detailed as you can and, on the other side of the sheet, write a brief story of her/him". After delivering the drawings with their stories, we discussed about the interpretation of some of the drawings and the emotional charge present.

RESULTS AND DISCUSSION

At the descriptive level, the highest scores of attitudes towards statistics were the dimensions of Value ($M = 5.70$, $SD = 0.85$) and Cognitive Competence ($M = 5.35$, $SD = 0.91$), followed by Affect ($M = 4.51$, $SD = 1.28$) and Difficulty ($M = 3.82$, $SD = 0.77$). Regarding statistical anxiety, the highest scores were from Anxiety Examination ($M = 3.68$, $SD = 0.85$), followed by Asking for Help Anxiety ($M = 2.28$, $SD = 0.89$) and Interpretation Anxiety ($M = 2.23$, $SD = 0.73$) with similar scores. Regarding the type of motivation, the scores are not high, but Autonomous Motivation ($M = 3.11$, $SD = 0.92$) shows higher scores than those of Controlled Motivation ($M = 2.01$, $SD = 0.58$).

The qualitative results showed aspects found in the quantitative part. It was found that more than half were drawings and stories with negative perceptions of statistics, loaded with

anxiety and how difficult it is to understand statistics; however, several stories mentioned how useful and important statistics is in life. For example:

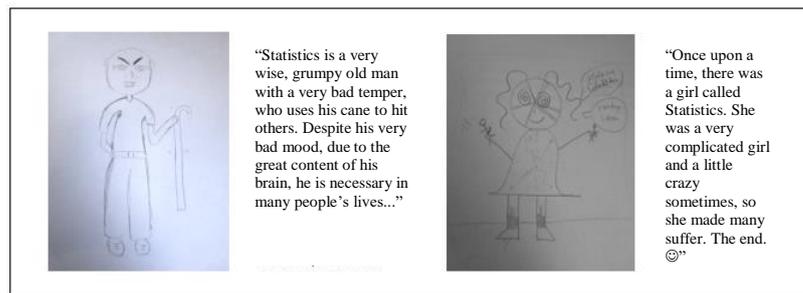


Figure 1. Examples of the activity to represent “Statistics”

To find associations between the study variables, correlations were made. Table 1 and 2 show these results. Table 3 shows the correlations of these study variables with the statistical academic performance of the students.

Table 1. Correlations between SATS-28 and SAS

		SATS-28			
		Affect	Cognitive C.	Value	Difficulty
SAS	Examination	-.636**	-.526**	-.212**	-.431**
	Asking for help	-.516**	-.430**	-.109	-.269**
	Interpretation	-.489**	-.533**	-.266**	-.341**

** $p < .01$

Table 2. Correlations between Academic Self-Regulation with SATS-28 and SAS

	SATS-28				SAS		
	Affect	Cog. C.	Value	Diff.	Exam.	Ask.	Int.
Controlled M.	-.521**	-.435**	-.304**	-.283**	.306**	.406**	.189*
Autonomous M.	.487**	.372**	.402**	.181*	-.224**	-.106	-.053

** $p < .01$, * $p < .05$

Table 3. Correlations between study variables and academic performance in statistics

		Test	Exam 1	Exam 2
SATS-28	Affect	.382**	.375**	.221**
	Cognitive C.	.356**	.263**	.150
	Value	.258**	.204*	.174*
	Difficulty	.090	.130	.060
SAS	Examination	-.182*	-.161*	-.090
	Asking for help	-.196*	-0.12	-.090
	Interpretation	-.237**	-0.09	-.130
Academic Self-Regulation	Controlled M.	-.181*	-.203*	.030
	Autonomous M.	.163*	.229**	.166*

** $p < .01$, * $p < .05$

The correlations found between attitudes towards statistics and statistical anxiety confirm the significant inverse relationship between the two constructs, with the affective component of the attitudes being the dimension that relates the most to statistical anxiety. Table 2 shows that the greater the autonomous motivation and the enjoyment of statistics itself, the more positive attitudes towards statistics and the less statistical anxiety about exams students feel. To further promote this

type of motivation, it would be appropriate for teachers to carry out ludic and entertaining experiences that generate positive emotions towards statistics from the first grades of basic education. On the other hand, the more controlled motivation, the worse the attitude towards statistics and the greater statistical anxiety. This conveys the message that carrying out an activity due to external pressures or without self-interest and/or enjoyment will bring less favorable attitudes towards statistics and greater anxiety about the subject.

Table 3 shows that, among the psychological variables studied, the one that relates the most to the grades obtained in the course are the attitudes toward statistics, especially the dimension of affect. So, to better attitude, better grades. As for statistical anxiety, lower, negative correlations are found with grades, there are also less significant correlations with exams 1 and 2. This would lead to infer that statistical anxiety is more variable in time than attitudes and it could be a first objective to be reduced and then improve attitudes towards statistics. Regarding the motivational aspect, it can be observed that the autonomous motivation is positively related to all the grades, and the controlled motivation is negatively related to the first two grades.

FINAL CONSIDERATIONS

The results of this research are expected to help raise awareness of the importance of relevant psychological factors in the statistics teaching and learning processes in students of humanities and social sciences. Likewise, the findings of this research provide elements to rethink the teaching methods in statistics classes, not only at the university level, but also in basic education and teacher training. Lets look for ways to generate positive attitudes and emotions towards mathematics and statistics in our students, so that their learning is more pleasant and they develop autonomous thinking.

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