Interest in statistics: Examining the effects of individual and situational characteristics differences

INTEREST IN STATISTICS: EXAMINING THE EFFECTS OF INDIVIDUAL AND SITUATIONAL CHARACTERISTICS

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Statistic lessons are often considered difficult and unpleasant. One reason for this is that many learners do not find statistics intrinsically interesting and engaging. Nevertheless, interest in a particular teaching session does not only depend on the characteristics of learners, but also on the characteristics of the session itself. The aim of the present study was to investigate the relationship between learner's characteristics (i.e., individual interest and intrinsic motivation) and situational interest. Participants were university students who participated in a tutorial activity. The results provided support for a moderated mediation model which showed that the relationship between individul and situational interest was dependent both on students' intrinsic motivation and the perceived appeal of the activity. The discussion underlines the importance of the interaction between individual and situational factors in the process of teaching statistics.

INTRODUCTION

Statistics is commonly viewed as a difficult and unpleasant topic and students often perceive statistics courses as a burden, they sometimes fail to pass the exams and, as a result, some of them might even abandon their academic and professional aspirations. Indeed, individuals are not always interested in what is being taught as part of their course (see Matarazzo, Durik, & Delaney, 2010), and this is especially true for domains that are unappealing or feared by students (e.g., Middleton & Spanias, 1999; Zeidner, Roberts, & Matthews, 2008). Low interest in a learning activity might also undermine students' persistence and performance (e.g., Durik & Harackiewicz, 2007). As a consequence, it is desirable that research focused on improving statistical education identifies variables that can promote or undermine statistical interest.

THEORETICAL FRAMEWORK

In the educational literature, several studies have focused on the concept of *interest* in college subjects . Recent reviews (see Linnenbrik-Garcia, Durik, Conley, Barron, Tauer, Karabenick, & Harackiewicz, 2010; Matarazzo et al., 2010), described two different types of interest: *individual interest* and *situational interest. Individual interest* is an enduring predisposition to engage in certain content domains, and it is accompanied by concentration and positive feelings (Hidi & Renninger, 2006). Once developed, individual interest is relatively stable across time and situations. High individual interest involves high levels of knowledge, experience, and the attribution of high value to the domain of interest (Hidi & Renninger, 2006; Renninger, 2000). In contrast with individual interest, *situational interest* is a short-term state of focused

attention and affective engagement (Matarazzo et al., 2010), which might be triggered by the characteristics of the learning situation (Hidi & Harackiewicz, 2000).
In the domain of mathematics, Durik and Harackiewicz (2007) found that situational interest was positively influenced by individual interest in mathematics. Moreover, these authors found that an important process which was related to both individual and situational interest was *intrinsic motivation*, i.e. the desire to engage in an activity for the value inherent in doing it (Deci & Ryan, 1985). According to Harackiewicz and Sansone (1991), the experience of intrinsic motivation during task engagement reflects the importance that a person places on competent performance, refers to the extent to which an individual feels focused on and absorbed in an activity during task engagement, and concerns an individual's self-assessment of competence while performing an activity.
Interest (individual and situational) and intrinsic motivation are closely related (see e.g., Deci, 1992; Ryan & Deci, 2000). Thus, it is important to understand the underlying mechanisms of how students become involved and interested in their courses. To the best of our knowledge, until now no study has investigated individual interest in statistics and its relationship with intrinsic motivation and situational interest in the context of a statistics class . The aim of this study was to fill this gap by investigating how individual interest and intrinsic motivation were associated with situational interest in the domain of statistics. Specifically, our research questions were the following.
First, we wanted to investigate the relationships between individual interest, situational interest, and intrinsic motivation in statistics. We hypothesized that there would be strong, positive correlations between these characteristics. Additionally,
we wanted to test a mediation model explaining the underlying mechanisms by which these individual characteristics are related to each other. We hypothesized that the relationship between individual interest and situational interest would be partially mediated by intrinsic motivation; that is, that higher individual interest would be directly related to both greater intrinsic motivation and greater situational interest in the learning situation (Durik & Harackiewicz, 2007), but there would also be an indirect link between individual interest and situational interest through intrinsic motivation.
Second, we wanted to test a model explaining the underlying mechanisms by which a characteristic linked to situational factors, i.e. the *perception of the appeal of the activity* or, in other terms, the extent to which participants like the activity, interacts with the other variables in the mediation model explaining the relationships between individual interest in statistics, intrinsic motivation, and situational interest in statistics. Specifically, given that Durik and Harackiewicz (2007) found that making the teaching materials appealing by using nice and colourful pictures had a positive effect on situational interest in mathematics, we hypothesized that the perception of the appeal of the activity, which was elicited by making the teaching materials as appealing as possible through the inclusion of pictures, images and colours, would have a significant positive effect on situational interest in the activity. We also predicted an interaction between intrinsic motivation and the appeal of the activity. In

particular, we aimed to verify that the relationship between intrinsic motivation and situational interest was moderated by students' perception of the appeal of the activity. To provide evidence for these hypotheses, we tested a moderated mediation model in which individual interest in statistics affects situational interest in a statistic learning activity through intrinsic motivation, and this mediation effect is moderated by students' perception of the appeal of the activity.

METHOD

Participants

The participants were 127 psychology students attending the University of Florence in Italy, who enrolled in an undergraduate introductory statistics course. The participants' age ranged from 19 to 44 (Mean=20.44, *SD*=3.19). Most of the participants were females (79%). Students participated on a voluntary basis and they received course credit for their participation.

Materials and procedure

Participants were invited to engage in a statistics tutorial activity during one of the lectures of their introductory statistics course. The activity, which was introduced in the academic year 2013-2014 (and took place in November 2013), was conducted by a trainer who was different from the course lecturer. The activity started with the explanation of the phenomenon of *collective statistical illiteracy*, defined as a widespread lack of understanding of health statistics in society, and, ultimately, the tendency to draw invalid conclusions regarding the meaning of statistical information without noticing (Gigerenzer, Gaissmaier, Kurz-Milcke, Schwartz, & Woloshin, 2008). To illustrate this phenomenon, a real-world example of collective statistical illiteracy regarding birth control was presented[1].Then, the activity was organized in explanation of specific critical arguments particularly biased in health statistics, i.e. absolute and relative risk in medical fields and conjunctive and conditional probability of epidemiological data presented in contingency tables. The explanation was conducted using power point slides with imagines, animations and graphical examples. It was followed by demonstration of some exercises regarding real-life situations about the medical field. Each student received an individual workbook which contained, along with the exercises, a series of scales developed for the purpose of this research.

The following scales were developed for the purpose of this research.

[1] *In October 1995, the U.K. Committee on Safety of Medicines issued a warning that third-generation oral contraceptive pills increased the risk of potentially life-threatening blood clots in the legs or lungs twofold—that is, by 100%. This information was passed on in ''Dear Doctor'' letters to 190,000 general practitioners, pharmacists, and directors of public health and was presented in an emergency announcement to the media. The news caused great anxiety, and distressed women stopped taking the pill, which led to unwanted pregnancies and abortions (Furedi, 1999).*" (Gigerenzer et al., 2008, p. 54).

At the beginning of the session, individual interest in statistics (IIS) was measured using a seven-item scale that tapped into the general evaluation of statistics (e.g., "I find statistics enjoyable"). Participants indicated from 1 (*strongly disagree*) to 7 (*strongly agree*) the extent to which they agreed with each statement. A total score on the scale was calculated so that high scores corresponded to high levels of IIS. The internal consistency of this scale was good (Cronbach's $\alpha = .89$).

During the activity, when students were presented with practice exercises, they were invited to assess their intrinsic motivation (IM) in solving them. IM was measured using a twelve-item scale measuring self-reported competence valuation (e.g., "It is important to me that I perform well"); task involvement (e.g., "I got caught up in doing this exercise") and perceived competence (e.g., "I think I did well in the exercise"). The scale had a 7-point Likert response scale (from 1 = *strongly disagree* to 7 = *strongly agree*). Cronbach's α was .86 indicating good internal consistency. A total score on the scale was calculated so that high scores corresponded to high levels of IM.

Finally, after the activity, situational interest (SI) and perceived appeal (PA) of the activity were assessed. SI was measured through an eight-item scale (Cronbach's $\alpha = .91$) referring to the student's specific interest in the ongoing learning activity (e.g., "I have found this activity very interesting"). PA was measured by a four-item scale (e.g., "I liked the slides very much") (Cronbach's $\alpha = .93$). For both scales, participants indicated from 1 (*strongly disagree*) to 7 (*strongly agree*) the extent to which they agreed with each statement. A total score on the scales was calculated so that high scores corresponded to high levels of SI and PA.

In line with the usual course lessons, the total duration of the activity was two hours.

RESULTS

Relationships between individual interest in statistics, situational interest in statistics, and intrinsic motivation: To analyze the relationships between individual interest in statistics, situational interest in statistics, and intrinsic motivation, correlations between the variables were calculated (Table 1). Situational interest was significantly and positively correlated with individual interest in statistics and intrinsic motivation. Moreover, there was a significant positive correlation between individual interest in statistics and intrinsic motivation.

	1	*2*	*3*
1. Individual interest	-		
2. Situational interest	.40**	-	
3. Intrinsic motivation	.34**	.58**	-
M	38.88	43.19	125.38
SD	9.50	8.75	18.25

Table 1: Summary of Intercorrelations, Means, and Standard Deviations for Scores of the individual interest, situational interest, and intrinsic motivation.

To evaluate the adequacy of the hypothesized mediation model explaining the underlying relationships between individual interest in statistics, intrinsic motivation, and situational interest in statistics, we tested the extent to which the relationship between individual interest in statistics and situational interest was mediated by intrinsic motivation. Specifically, we verified whether individual interest in statistics had both a direct and an indirect effect on situational interest in the statistics tutorial activity through intrinsic motivation. We used the INDIRECT macro for SPSS (Hayes, 2013), which tested the hypothesized mediation model using the bootstrapping procedure (with 5000 bootstrap samples) to estimate the 95% confidence interval (95% CI; for more details, see Preacher & Hayes, 2008). The bootstrapping procedure is considered to represent the most reliable test for assessing the effects of mediation models (Hayes & Scharkow, 2013). As shown in Figure 1, the mediation model was estimated to derive the total, direct, and indirect effects of individual interest in statistics on situational interest in the activity through intrinsic motivation. We estimated the indirect effect of individual interest in statistics on situational interest in the activity, quantified as the product of the ordinary least squares (OLS) regression coefficient estimating intrinsic motivation from individual interest in statistics (i.e., Path a in Figure 1) and the OLS regression coefficient estimating situational interest in the activity from intrinsic motivation controlling for individual interest in statistics (i.e., Path b in Figure 1). A bias-corrected bootstrap 95% CI for the product of these paths that does not include zero provides evidence of a significant indirect effect (Hayes, 2009; Preacher & Hayes, 2008). Results showed a significant positive direct effect of individual interest in statistics on situational interest in the activity (point estimate = .19, 95% CI = [.02, .35]). Moreover, results showed a significant positive indirect effect of individual interest in statistics on situational interest through intrinsic motivation (point estimate = 0.16, 95% CI = [0.06, 0.31]).

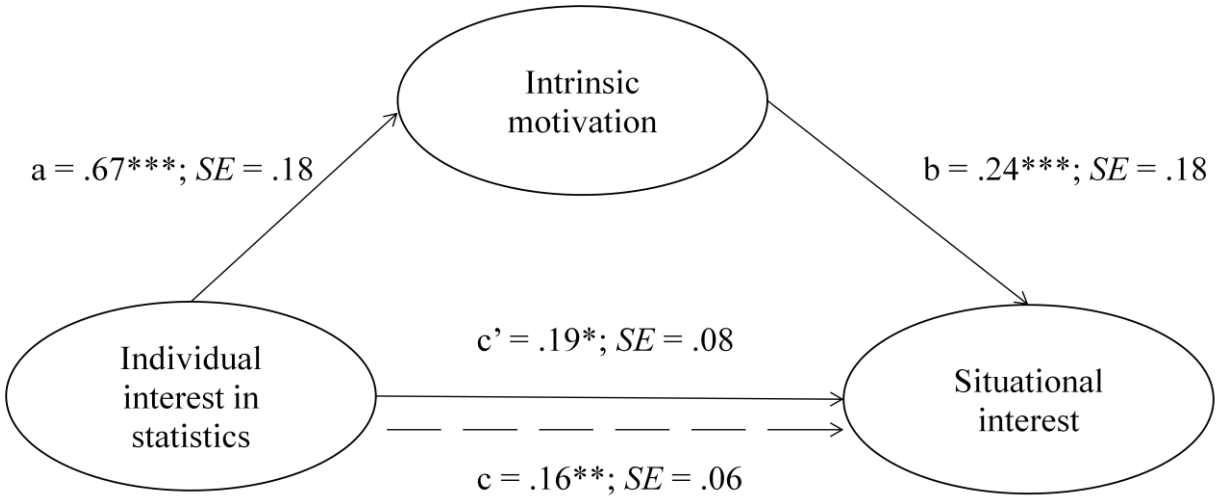

Figure 1: Path coefficients for mediation analysis on situational interest in the statistics activity. Dotted line denotes the effect of individual interest on situational rest in the statistics activity when intrinsic motivation is not included as a mediator. a, b, c, and c′ are unstandardized ordinary least squares (OLS) regression coefficients. *p < .01 **p < .001 ***p<.001.

To evaluate the adequacy of the hypothesized moderated mediation model explaining the role of the perceived appeal of the activity in the above described mediation model, we tested the extent to which perceived appeal had a positive main effect on situational interest and whether the mediation of intrinsic motivation between individual interest in statistics and situational interest in the statistics activity was moderated by the perception of the appeal of the activity. In order to verify this model, we conducted a moderated mediation analysis as suggested by Preacher, Rucker, and Hayes (2007). Similarly to the mediation analysis, this analysis tested the hypothesized model using the bootstrapping procedure (with 5000 bootstrap samples) to estimate the 95% confidence interval. As shown in Figure 2, the results confirmed a significant positive direct effect of individual interest in statistics on situational interest (point estimate = 0.16, 95% CI = [0.04, 0.28]). The results also showed a significant main effect of the perception of the appeal of the activity on situational interest in the statistics activity (OLS coefficient=2.35; *SE*=.65, p<.001) as well as a significant interaction between intrinsic motivation and the perception of the appeal of the activity on situational interest in the statistics activity (OLS coefficient=-.01; *SE*=.01, p<.05). Given the evidence for this interaction, we estimated the conditional indirect effect of individual interest in statistics through intrinsic motivation on situational interest at various levels of the perceived appeal of the activity. We found that the indirect effect of intrinsic motivation on situational interest was significant only for low (point estimate = - 0.11, 95% CI = [0.03, 0.23]) and medium (point estimate = 0.08, 95% CI = [0.03, 0.16]) levels of perceived appeal of the activity. The effect was not significant for high levels of perceived appeal of the activity (point estimate = 0.04, 95% CI = [-0.01, 0.12]).

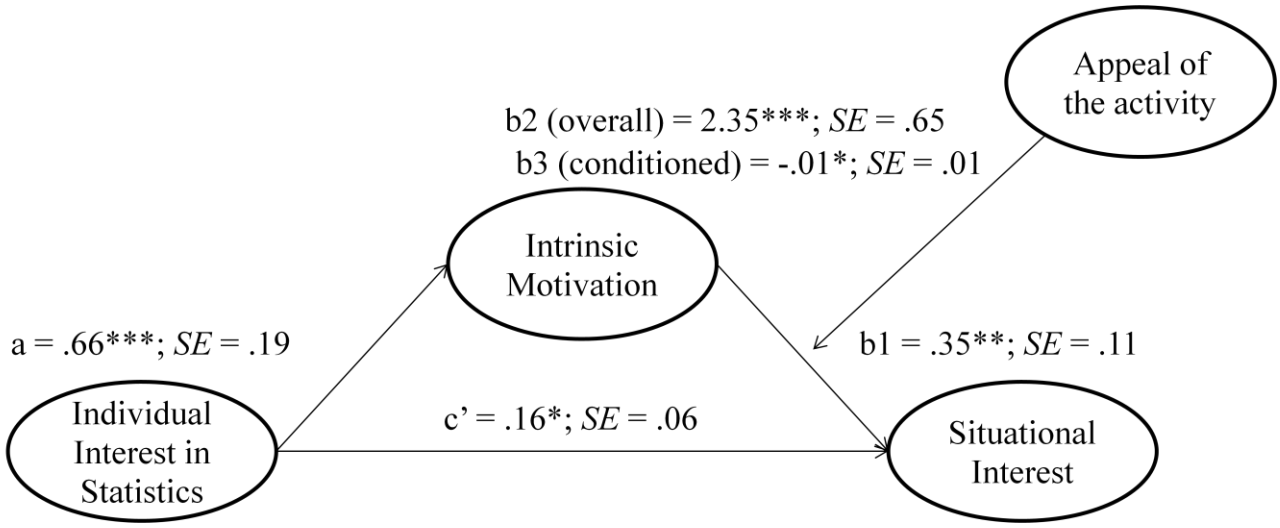

Figure 2. Path coefficients for moderated mediation analysis on situational interest. a, b1, b2, b3, and c′ are unstandardized ordinary least squares (OLS) regression coefficients. *p < .05, **p < .01, *** p < .001.

Thus, the results suggested that the positive indirect effect on situational interest through intrinsic motivation (controlling for individual interest in statististics) was significant for low and medium levels of perceived appeal of the activity but not for high levels of perceived appeal. In other words, among students who perceived the activity as poorly or averagely appealing, results showed significant differences in situational interest between those with low, medium, and high motivation. By contrast, among students who perceived the activity as highly appealing, there was no significant difference on situational interest between those with low, medium, and high motivation. This meant that if a statistics activity is perceived as highly appealing by the students, it is likely that they will perceive the activity also as highly interesting, regardless of their motivation.

DISCUSSION AND CONCLUSION

Given the relative lack of studies on interest in the statistics domain, the present work was aimed at investigating the relationship between individual interest and situational interest in the statistics domain. Specifically, our aim was to develop and test a model explaining how specific features of the teaching session, as perceived by students, act in concert with some individual differences in individual interest, intrinsic motivation, and situational interest. Overall, three important findings emerged from this study.

First, individual interest was found to have a direct effect on both situational interest and motivation in the statistics domain. This result is in line with Durik and Harackiewicz's (2007) earlier findings in the mathematics domain. Second, our study is the first to provide evidence that intrinsic motivation mediates the relationship between individual interest in statistics and situational interest in a statistics activity.

More specifically, greater individual interest in statistics appears to be related to greater intrinsic motivation, which, in turn, is related to a greater likelihood to show interest in the activity. Third, our results suggest that the indirect effects of individual interest in statistics on situational interest through intrinsic motivation is moderated by the perceived appeal of the activity. In other words, the extent to which intrinsic motivation mediates the relationship between individual and situational interest, interacts with how the student perceives the appeal of the activity. Specifically, if a student perceives a statistics activity as highly appealing, even if he/she was poorly motivated to participate in the lesson, he/she is likely to be very interested in the statistics activity.

These results have important implications. First, these results indicate that intrinsic motivation plays an important role in the relationship between individual interest and situational interest in statistics, Thus, interventions aimed at increasing students' interest in statistics activities could be focused on improving intrinsic motivation, for example by highlighting the importance of statistics in everyday life and in the profession of a psychologist. Second, as our study shows that students' perception of the aesthetical appeal of teaching materials moderates the effect of intrinsic motivation on situational interest, educators who are interested in finding ways to involve the highest possible number of students (including the less motivated ones) in statistics learning, could aim to prepare teaching materials with the highest possible level of esthetical appeal.

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