

ABILITY, CONFIDENCE AND GENDER: A CASE OF PAKISTAN

Muniza Askari
Independent Researcher, Pakistan
email : muneeza_askari@hotmail.com

Abstract

The article deals with the concept of confidence in one's own abilities under a natural environment. Sixty-six university students are observed over a semester in Economics at the Masters level. Subjective confidence estimates in successfully clearing the course is asked from each student just minutes before the start of three exams, respectively. Feedback was provided in terms of the marks attained after every exam. The students were graded into two groups, i.e., low- and high ability, depending on the percentage marks attained in the very first exam. Some existing results in the literature of Economics and Psychology were re-confirmed, like the availability bias and the Dunning-Kruger effect. The observed bias in confidence judgment estimates are explained by the Bayesian up-dating model by incorporating the element of doubt in one's prior perceptions. The main contribution of the article is that females, of an under-developing country, are found to be persistently under-confident in their own abilities. The result is contrary to what has been reported in the research literature of Economics and Psychology.

Keywords: Judgmental biases, Bayesian learning, Dunning-Kruger effect, Education.

1. Introduction

Self-confidence is one of the essential traits of human nature. It is defined as the combination of self-believes with optimism. Any departure of the conceived perceptions from actuality leads one either to be over or under confident. The latter is typically associated with emotionally sensitive individuals. However, research literature suggests that individuals normally exhibit the existence (and sometimes the co-existence) of the two traits conditional on various factors and situations (for further discussion refer to Healy & Moore, 2008; Grieco & Hogarth, 2009; Van den Steen, 2011; Ryvkin et al., 2012).

In view of the above argument, one finds that overconfidence as opposed to under-confidence has received much attention not only in the domains of Psychology but also in fields like Economics, Finance, Education, Business Studies and so on. . Moore and Healy (2008) in their article provide a comprehensive explanation on the term overconfidence and its three distinctive forms, namely overestimation, over placement and over precision. The present paper considers the first form of overconfidence in a natural setting. Overconfidence in terms of overestimation is defined in the words of Moore and Healy (2008) as "*the overestimation of one's actual ability, performance, level of control, or chance of success*" (page # 115). Keeping the definition in mind, we will consider how individuals over or underestimate their own absolute ability in performing a specified task, which in our case is the course exams during a semester.

Sixty-six University students from Pakistan were examined over a course of a semester in the field of Economics. The subjective confidence of the students was measured (in percentages) minutes before three exams, specifically, two term exams and a final exam conducted during and at the end of the semester, respectively. The interesting feature of the sample was that

students competed on a national level to attain a seat in the University. Thus, our sample had representation from all over Pakistan and with individuals receiving varying degrees of formal education. More specifically, three levels of educational standards are prevalent at the primary and secondary levels in Pakistan. They are the upper private schools with a high standard of international curriculum, the middle government schools with locally composed curriculum and lastly, the community operated schools (e.g., religious schools) which provide minimum levels of formal education. Hence, the study of overconfidence in a natural setting was even more important to see the behavioral patterns of the students belonging to diverse backgrounds. The study could be regarded as the first of its kind in Pakistan, to the best of our knowledge.

The students were separated into two groups depending on the percentage marks they obtained in the first term exam. The groups served as the ability variable as it distinguished high ability students from low ability ones. On average, we found that low ability participants were overconfident in their estimates of success. Moreover, their subjective probability estimates were higher than the high ability participants at the first term exam. On reception of feedback in terms of exam results, these individuals appeared to lack the ability to properly align their confidence percentages with the actual performance. An in-depth analysis of the data leads to the fact that low ability male participants were highly overconfident as opposed to their female cohorts. The highlight of the paper is that female students, whether low or high ability, are persistently underconfident as opposed to the male students. Even the high ability females who outperformed the male students in the first term exam remained underconfident in their probability estimates. The question arises if we could attribute this result to the upbringing of the females in an underdeveloped country or is it their innate nature to be underconfident?

The results are explained by using the Bayesian model of confidence introduced by Louis et al. (2015). The model helps to explain the reported Dunning-Kruger effect (Kruger & Dunning, 1999). Moreover, it clarifies how doubt plays a role in the over or underestimation of the probability estimates of the individual students of varying abilities.

2. Methodology

1.1. Participants, design and procedure

Sixty-six students were followed for the paper over the course of a semester at Quaid-i-Azam University (QAU), Islamabad (Pakistan). Two separate semesters were chosen, consisting of semesters two and four. The taught courses were Labor Economics and Institutional Economics respectively. During each semester students underwent three exams, namely two term exams (denoted as term exam 1 and term- 2) and the final exam. Under the term exams the students were tested on the course covered during two-month study period (which we denote as study period one and two respectively). However, under final exam the students were tested from the whole course covered under the said semester. Students were categorized into high ability and low ability groups after the term exam one. More specifically, students who managed to attain 75% marks or above in term exam one were termed as 'high ability' students and vice-versa.

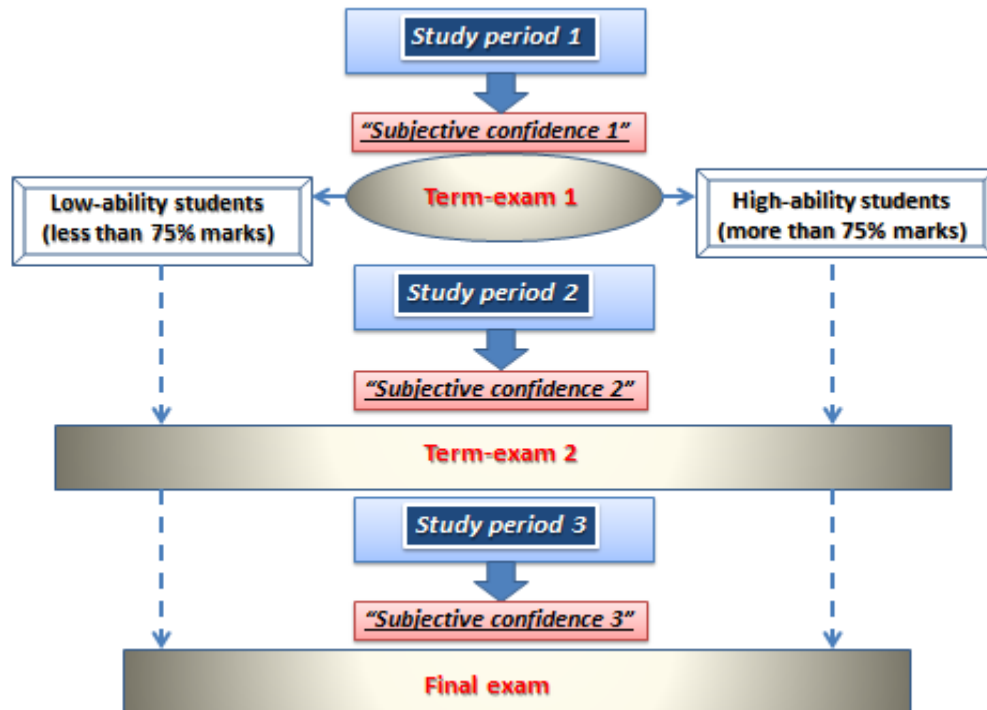


Figure 1: A description of the subjective confidence measurements before each exam (but after the respective study periods).

1.2. Confidence judgments

Confidence judgments were taken at the beginning of each exam on the full-range scale of 0% to 100% (Adams, 1957). These percentages represent the subjective probability estimates of success in an exam, e.g., stating 60% as confidence judgment meant that the individual's degree of belief in successfully clearing a particular exam is 60%. This probability judgment method is widely used in psychological research (a detailed explanation on the full-range scale can be found in Pulford, 1996).

Confidence judgment

At this point of the semester, state your level of confidence on the scale of 0% to 100% on clearing successfully:

- ❖ **Term-exam 1:**
- ❖ **Term-exam 2:**
- ❖ **Final exam:**

Figure 2: Confidence judgment question posed before the three exams (i.e., term exam one & two and the final exam)

1.3. Descriptive statistics

Main descriptive statistics are as follows:

Variables	Low ability	High ability	<i>Difference</i>
Female	39%	43%	ns
Age	22.0	21.0	ns
Admission on merit	77%	83%	ns
Understanding of the subject	2.67	2.70	ns
Domicile¹	1.88	1.96	ns
<i>Subjects taken at under-graduation:</i>			
Economics	94%	100%	ns
Mathematics	83%	80%	ns
<i>Number of individuals</i>	36	30	

ns: Not significant at 10% level of significance

¹ The domicile variable, in our case, refers to the province that a student belongs to. In most cases, it is the area from where the student has received her primary schooling. There are five provinces in Pakistan namely the Federal Area, Khyber Pakhtunkhwa, Punjab, Sindh and Baluchistan. The provinces were coded from 0 to 4, respectively, in our data. The QAU has a fixed and pre-specific quota for each province. Thus students are provided admission based on the quota system determined by the domicile certificate (which issued by the town hall of the city of residence). Thus QAU is one of the only universities which cater to students from all over Pakistan.

Table 1: Descriptive statistics for high and low ability individuals is shown above (note that high ability individuals are categorized as attaining 75% or more marks in first term exam). No significant difference is seen among the two ability levels in terms of descriptive statistics.

Note that no significant difference is found among the two ability groups. It means that two groups are comparable with each other. From the table note that the majority of the individuals had taken Economics and Mathematics as major subjects at the undergraduate level. Moreover, individuals in the two ability groups had attained sufficient marks at graduation level so as to be admitted in the university at the subsidized university fee. They are represented under the 'admission on merit' variable. The remaining individuals were admitted on the self-financed program, where they pay the major finances (i.e., university fees) by themselves. An important characteristic of the sample is that students belonged to different areas of Pakistan. Some of them came from remote areas of the country with questionable educational background. Some of the students either don't have access to reliable and registered schools while others live too far from government schools with limited transportation facilities. These features are captured in the 'domicile' variable above (see footnote 1). The numerical figures of the variable show that the majority of the students belong to the province of Punjab (the largest of the four provinces of Pakistan in terms of area as well as population).

1.4. Questions at a glance

Question 1: Are students well calibrated?

The calibration phenomenon under the two ability groups is undertaken for this question. Students are expected to be miscalibrated in their confidence judgments mainly overconfidence is expected to prevail. (It is the most reported result in the economic literature). Moreover, we also discuss if feedback plays a role in reducing the degree of miscalibration and how the ability groups respond to the available feedback.

Question 2: How does gender differ in their calibration patterns and the confidence judgment estimates?

The most prevalent result in the economic literature with respect to the above question is that both male and female participants are overconfident in their estimates, with males being slightly more overconfident than female cohorts (refer to Pulford & Colman, 1997; Skata, 2008; Neiderle & Vesterlund, 2011). Thus, the above question is analyzed with the expectation of finding gender overconfidence as the main result.

3. Results

3.1. Are students well calibrated?

The term calibration is defined as the comparison of the actual performance of an individual (which in our case is the percentage marks in the exams) with her subjective confidence judgment estimates. Literature on confidence judgment estimates suggests that individuals are not well-calibrated (refer to Fischhoff, Solvic & Lichtenstein, 1977; Lichtenstein, Fischhoff & Phillips, 1982; Brenner et al., 1996; Pulford, 1996). In comparison with their performance they either underestimate or overestimate their abilities depending on the nature of the task. Specifically, on hard difficulty tasks (normally on general knowledge questions), individuals are found to be over confident and underconfident on the easy difficulty tasks. The phenomenon is referred as the *hard-easy effect* in the economic research literature (Louis et al., 2015).

As for the current study, the comparison of marks attained and the confidence percentages regarding the two ability groups have been undertaken in the following table.

	Marks attained	Subjective confidence		
		Term exam one	Term exam two	Final exam
		I	II	III
<u>Study period 1</u>				
Low ability	62%	73%	80%	86%
High ability	82%	68%	75%	79%
<i>Difference</i>	***	<i>ns</i>	†	*
<u>Study period 2</u>				
Low ability	67%		73%	83%
High ability	79%		77%	82%
<i>Difference</i>	***		<i>ns</i>	<i>ns</i>
<u>Study period 3</u>				
Low ability	79%			87%
High ability	86%			88%
<i>Difference</i>	**			<i>ns</i>

Significance: *** 0.1%; ** 1%; * 5%; † 10%; ns: not significant at 10%.

Table 2: Percentage of actual marks obtained coupled with the stated subjective probability of success (in percentage) expressed before each of the three exams.

The average marks obtained by low and high ability individuals have been stated in column 1 of the Table 2. As expected, and because of the categorization of the students, the low ability individuals attain significantly lower marks in the three exams as compared to high ability individuals (the difference in percentage marks attained is significant at 0.1% and 1% for the term and final exams respectively). The point to remark is that low ability individuals push themselves harder at the final exam and attain more than 75% marks. Had they failed the final exam then they would have had to repeat the course all over again. Moreover the failure would appear also on their final degree. Hence, to prevent this situation, these students strive hard and perform better at the final exam. However, note that the average percentage marks remain lower for low ability students when compared to the high ability students. Another observation from the data is that the future appears to be brighter than at the present moment for the two ability groups.

The comparison of percentage marks attained and the confidence judgment estimates have been made in the Figure 3 below:

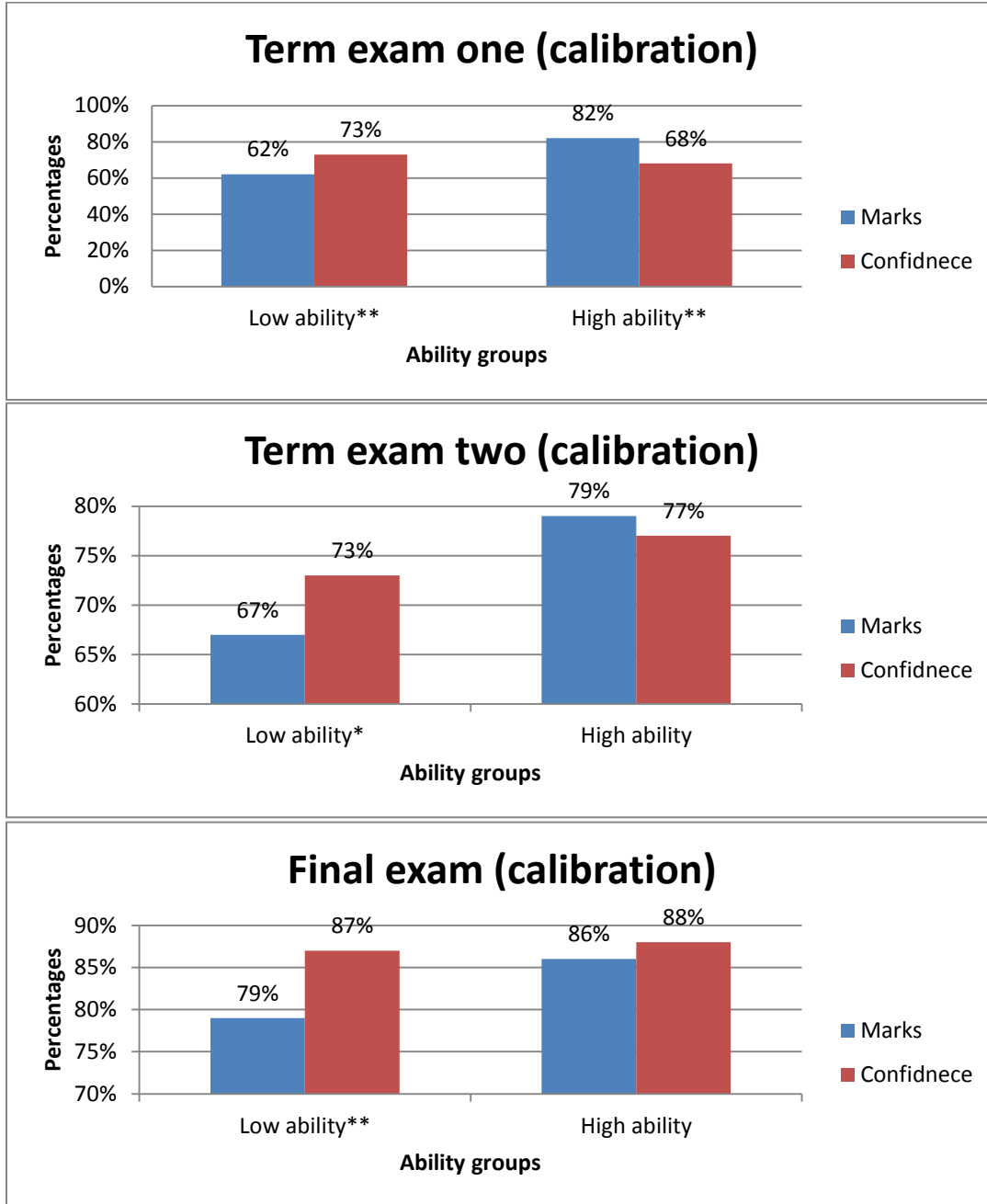


Figure 3: Calibration with respect to the two ability groups. Note the overconfident low ability group for the three exams, while, high ability group is first underconfident for term exam one and then they re-adjust their confidence estimates so as to match their abilities and are thus better calibrated for term exam 2 and the final exam.

A study of the above figure leads to the following calibration patterns:

- **Overconfident low ability students:** these individuals state significantly higher levels of confidence judgment estimates before each of the three exams as compared to

their actual performance. The difference between the two is significant at 1% for termexam one and final exam (with p-values (0.0018) and (0.0010) respectively at two-tailed test). However, it is significant at 10% and 5% with p-values (0.0901) and (0.0450) at two-tailed and one-tailed tests for the term exam two.

-
- ***Under and over confident high ability students:*** these individuals are underconfident before the term-exam one, as they state significantly lower levels of confidence judgment estimates (68%) as opposed to actual performance (82%). The difference is significant at 0.1% level of significance with p-value (0.0012). However, after term exam one, the individuals readjust their confidence judgment estimates and are therefore better calibrated for term exam two and the final exam, respectively. As no significant difference between confidence judgment estimates and the percentage marks attained was observed.

Result 1 (Low ability individuals are overconfident): Low ability individuals are not only overconfident about their success but they also lack the insight to correctly align their subjective confidence with the respective ability level. The behavior prevails even after the reception of feedback (in terms of percentage marks in the very first exam).

Result 2 (High ability individuals are both under and over confident): High ability individuals, on the other hand, are underconfident at the beginning of the task (i.e., term exam one) but as soon as they receive feedback (in terms of percentage marks) they appear to better align their confidence judgment estimates with their innate abilities.

How does gender differ in their calibration patterns and the confidence judgment estimates?

The above question has two parts, the calibration aspect and within one ability group, the gender confidence judgments. Both parts are discussed separately under:

3.2.1. Calibration pattern and gender

Term exam one: Note from

Figure 4 that before the term exam one only the low ability male students are highly overconfident about their success (with 62% actual marks attained as opposed to stated probability of success at 79%). The difference is significant at 0.1% level with p-value (0.000).

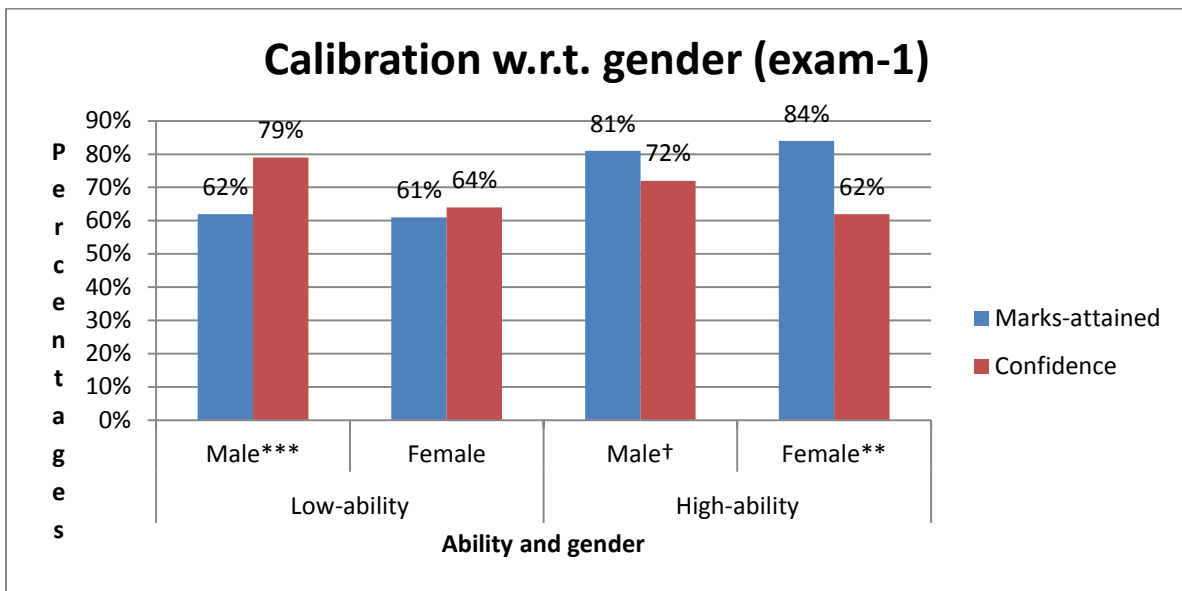


Figure 4: Calibration with regards to gender before term exam one.

However, observe that both high ability male and female participants underconfident (with 72% and 62% confidence percentages as opposed to 81% and 84% actual marks attained, respectively). (Sentence doesn't make sense. Try rephrasing) The difference between the two percentages is noteworthy at 10% level of significance (at one-tailtest, with p-value (0.0520)) for the male students and for female participants the difference is important at 0.1% level of significance with p-value (0.0038).

Term exam two: During this time, students receive first feedback in the form of marks attained in the term exam one. They are, therefore, expected to readjust their confidence percentages. From the following figure observe that low ability male participants are still overconfident at 10% level of significance (one tail test with p-value (0.0533)). They have, however, reduced their confidence percentages before term exam two (from 79% to 77% for the two exams, respectively, and the difference is insignificant) but the reduction is not sufficient enough.

High ability female students are still underconfident at 5% one tail test (p-value (0.0406)). They also increase their confidence percentages from 62% to 69% (the difference is insignificant) before the two exams respectively.

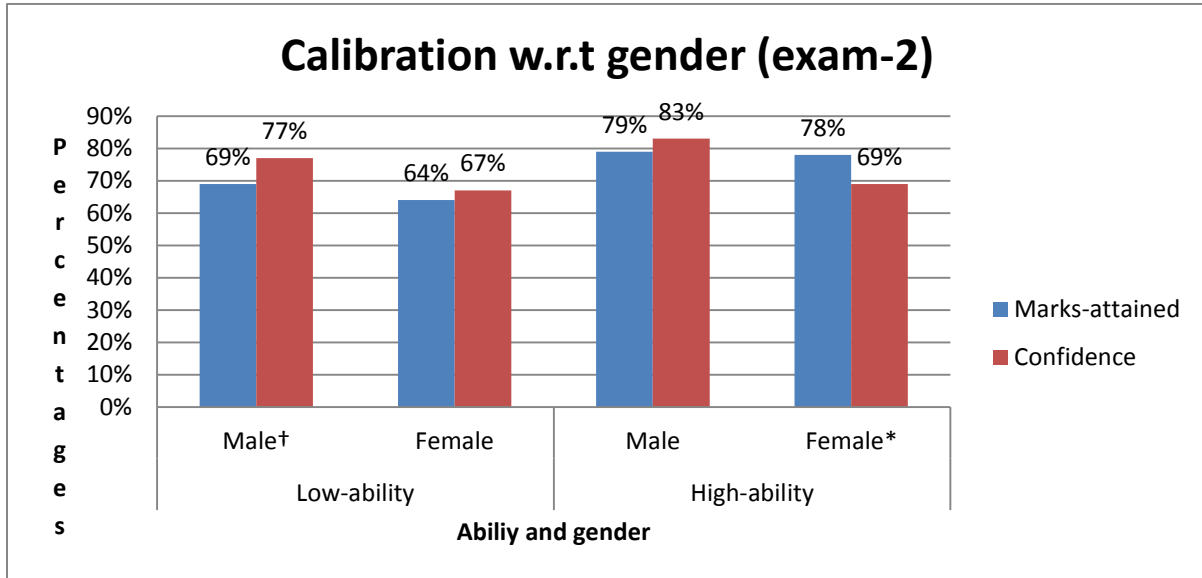


Figure 5: Calibration with regards to gender before term exam two.

Final-exam: The situation is different for the final exam. By this time, students have undertaken two term exams and they have the feedback on their respective position in the class. The final exam has more weightage in order to clear the course in the said semester. Therefore students have an incentive to work harder to attain success. Keeping that in mind, we observe (from Figure 6) that the low ability male students are over confident, once again. The same pattern is depicted by the high ability male students too. The two male ability groups attain higher marks (80% and 84% respectively) and also report a higher level of subjective confidence percentages (91% and 92%, respectively). The comparison of marks attained and probability of success percentages for these two male ability groups we find significance at 0.01% and 5% level of significance with p-values (0.0003) and (0.0415) at two-tailed test, respectively. Female students are observed to be better calibrated at this level.

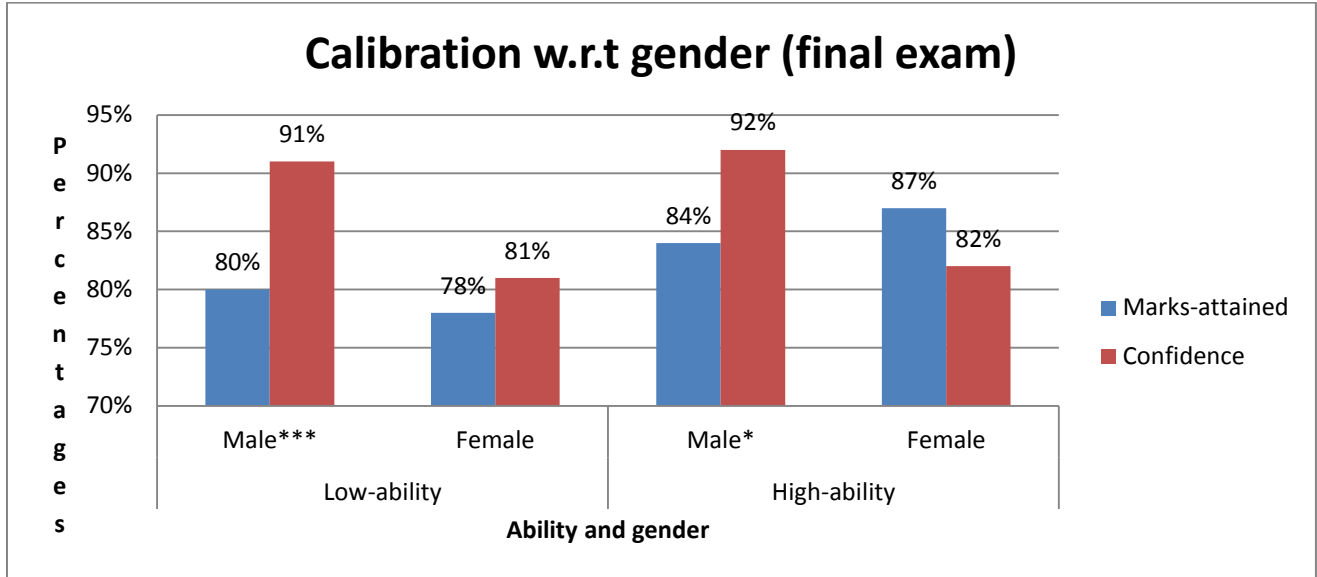


Figure 6: Calibration with regards to gender at the final-exam.

Result 3: Overconfident low ability male participants: Low ability male students are observed to be significantly overconfident before every exam (Dunning-Kruger effect, 1999). Thus, the overall overconfidence of the low ability group, reported in result 1, is mainly attributed to miscalibrated and overconfident male participants.

Result 4: oscillating from under to overconfidence: High ability male and female participants are found to be underconfident about their abilities just before the term exam one. This underconfidence remains prevalent for female participants for the next two exams. On the other hand, male students report significant overconfidence before the final exam. So the calibration pattern for males oscillates from under to overconfidence in the span of a semester.

3.2.2. Gender confidence judgment estimates within an ability group

This section is the highlight of the paper as most of the confidence judgment studies in the economic literature are conducted in American or European countries. It is next to impossible to find any study worth mentioning on the topic especially one that specifically relates to Pakistani students or for that matter on the students of any underdeveloped country, to the best of our knowledge. Thus, to analyze the above statement in detail, consider the following table:

		Observations	Marks-attained	Subjective confidence		
				Term exam one	Term exam two	Final-exam
			I	II	III	IV
Study period 1						
Low ability	Male	22	62%	79%	86%	87%
	Female	14	61%	64%	71%	67%
	Difference		ns	*	**	*
High ability	Male	17	81%	72%	83%	86%
	Female	13	84%	62%	63%	67%

			Difference	†	†	***	**
Study period 2							
Low ability	Male	22	69%			77%	88%
	Female	14	64%			67%	74%
	Difference			ns		†	**
High ability	Male	17	79%			83%	86%
	Female	13	78%			69%	77%
	Difference			ns		*	†
Study period 3							
Low ability	Male	22	80%				91%
	Female	14	78%				81%
	Difference			ns			*
High ability	Male	17	84%				92%
	Female	13	87%				82%
	Difference			†			*

Significance: *** 0.1%; ** 1%; * 5%; † 10%, ns: not significant at 10%

Table 3: Actual marks attained (in percentages) with subjective probabilities of success with regards to gender at the three exams.

Three behaviors are highlighted from the above table:

- (i) **The low ability group performs better in final-exam:** Low ability individuals strive to perform better in the final exam with average percentages for both female and male participants reaching above the 75% level (80% and 78% for male and female participants respectively). It refers to the fact that this group, when required, shows the ability to perform better and moreover, they can push themselves to attain better grades.
- (ii) **Higher grades by high ability females:** High ability females attain higher grades than high ability male students at term exam one and the final exam. The difference is significant at one-tailed t-test with p-values (0.0776) and (0.0775) respectively.
- (iii) **Lower confidence judgment estimates by the female students:** the most prominent result is that male students (whether high or low ability) state significantly higher probability of success percentages at all levels than the female cohorts. From point (ii) of this section (above), we know that female students perform better in terms of grades than male participants at the high ability group but fortunately or unfortunately they report lower levels of confidence judgment estimates.

Result 5: Underconfident female students: Pakistani female students are observed to be underconfident in their estimates at all levels, in spite of the fact that they possess the ability to compete and prove themselves to be better than male students, in terms of marks attained, but they persistently report lower confidence in their abilities.

4. Theory and explanation

The main result is that students are not well calibrated in the two ability groups. The ability-groups demonstrate the following patterns:

- (a) Low ability male students are overconfident about their abilities. This pattern confirms the Dunning-Kruger effect (1999) reported in the confidence judgment literature for the unskilled students (which in our case are the low ability participants). For more details refer to Kruger and Dunning (1999); Miller and Geraci (2011); Ryvkin et al. (2012).
- (b) High ability male students shift their perspective from underconfident to highly overconfident with each success, although their performance is significantly lower than female cohorts.
- (c) Female students, whether low or high ability, are persistently underconfident about their abilities. They do not show significant overconfidence at any stage of the semester. This result is contrary to our expectations and to what has been reported in the economic literature on gender and calibration.

One of the explanations of the above behavior, specifically of *pattern (a)* is provided by Kruger and Dunning (1999). In their article they attribute the overconfidence of unskilled (i.e., low ability) individuals to the *metacognitive inability* of these subjects to recognize their own mistakes. However, the authors were unable to explain that why some of the skilled individuals (i.e., high ability students) over estimated themselves, refer to the section 'limitations of the study' (*page: 1132*). Another most recent explanation on confidence judgment bias has been provided by Louis et al. (2015). In the article, the authors state that individuals are rational Bayesians, but exhibit a myopic behavior as they base their confidence estimations on the available information. Thus, whenever higher weightage is attributed to the available information in respect to its salience it would lead to over or underestimation of the probabilities of success. Refer to the section below for further discussion:

4.1. Bayesian up-dating and confidence judgment estimates

This section explains the judgment bias using the Bayesian updating model. For a detailed mathematical representation of Bayesian updating refer to Louis et al. (2015) and Grieco and Hogarth (2009). Considering our case, let us assume that success is a random variable denoted by x . Let this variable take the values 0 and 1 for failure and success in an exam, respectively.

Judgmental bias: Bayesian up-dating model

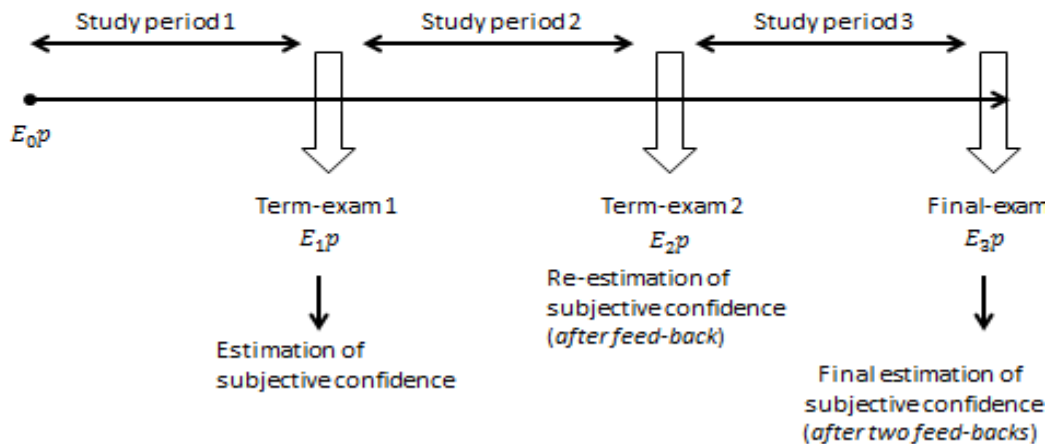


Figure 7: A diagrammatic representation of the Bayesian updating model.

Suppose that a student comes to the exam with a prior probability. Say that this prior probability corresponds to the true ability of the student so as to succeed in a particular exam, as the student can judge how well she is prepared for that particular exam. Now, when asked to state the subjective probability of success in percentages then it becomes an uncertain situation for the student. The uncertainty arises because of the non-availability of the probability of success estimate. In order to reduce the uncertainty, the students make use of all available information that she has gathered during the study period 1 (shown in Figure 7 above) in the form of the class lectures, behavior of the lecturer towards the student, lecturer’s reputation in terms of marking of the exams and so on (Kahneman & Tversky, 1982). In addition to all of these available aspects, an important factor is the element of doubt that arises because of the *objection to the prior probability*. This element of doubt is the central idea of the Bayesian model elaborated in our article.

4.1.1. Doubt and subjective probability estimates

Once again, consider the above student and suppose that the student knows that she has prepared well for the relevant course material and that the preparation will surely lead her to clear the exam successfully. In this case, the *subjective prior probability* will have the tendency towards being successful (i.e., $x = 1$). When asked to translate this prior probability into percentages then it raises doubt in the mind of the student, as there is the ‘possibility of failure’. This doubtful and uncertain area leads the student to understate her probability of success. It happens as more weightage is given to the available doubt, (the availability bias discussed by Kahneman & Tversky, 1973), as opposed to the subjective prior probability of success. This results in underconfident, high ability students.

On the other hand, now consider another student who has low ability or she has not prepared well for the exam, for whatever reasons. Under this case, her prior probability will have the

tendency to be unsuccessful (i.e., $x = 0$). When asked to state the probability percentages then because of the prior objection in the form of the prevailing “possible success” a doubt is created in the mind of the student. Hence, in this case the probability of the success estimate is overstated as more importance is attributed to the prevailing possible success than its salience. This leads to overconfident, low ability students.

Mathematically, the same argument is represented as under:

$$\begin{aligned}
 \text{Probability of success} &= \text{weighted average of prior \& doubt (objection to the prior)} \\
 E_i p &= (\mu)\text{Prior} + (1 - \mu)\text{doubt} & i = 1,2,3 \\
 &= (\mu)E_0 p + (1 - \mu)\text{doubt}
 \end{aligned}$$

Recall from above that two possibilities are attainable i.e., success (denoted by 1) and failure (shown as 0), so by incorporating them in the equations we get the following:

$$\begin{aligned}
 E_1 p &= (\mu)E_0 p + (1 - \mu)0 = (\mu)E_0 p \leq E_0 p & \text{Highability group} \\
 E_1 p &= (\mu)E_0 p + (1 - \mu)1 = (\mu)E_0 p + (1 - \mu) \geq E_0 p & \text{Lowability group}
 \end{aligned}$$

4.1.2. Feedback and up-dating of probability estimates

Recall from the above figure that reestimation of subjective confidence takes place just before term exam two. For this reestimation, students have received feedback in the form of the marks they have attained in the term exam one and also their respective standing in the class. These factors act as signals that are processed in the reestimation of the subjective confidence estimates before term- two. The feedback is important as it helps the students to readjust their confidence percentages and thus to be better calibrated.

If a student receives term exam one actual marks more than her subjectively held expectations, then she will increase the confidence percentage positively before the term exam two and vice-versa. Let the expectation variable is denoted by X_1 , which takes values 1 if individual subjective expectations are met and 0 otherwise. This Bernoulli variable cannot be measured or observed because of its subjective nature. Suppose the variable has an unknown mean, denoted by p . Assuming that the prior distribution of p follows the beta distribution with a reported mean $E_1 P$. Then the confidence percentages are updated as:

$$\begin{aligned}
 E_2 p &= \text{weighted averag of prior confidence \& expectation variable} \\
 &= \frac{v'}{v' + 1} E_1 p + \frac{1}{v' + 1} X_1
 \end{aligned}$$

Referring back to our data, we found in Table 4 (below) that the low ability students did not incorporate the negative feedback in their reestimation figures. As the confidence percentages are seen to be not significant at 10% level. Our results are explained aptly by Pulford and Colman (1997) as “*feedback may be misinterpreted or not used to alter confidence sufficiently*” (page # 125). However, the high ability individuals did significantly increase their reestimates of confidence percentages. The difference between term exam one and term exam two confidence percentages for this ability group is significant at 5% level with *t-value=-2.2439 with p-value (0.0326)*. On further analysis, it was found that only high ability male students significantly increase their confidence percentages (from 72% to 83% in term exams one and two respectively). The difference was found to be significant at 5% level with *t-value=2.1875 and p-value (0.0439)*. High ability female participants also positively increase their confidence percentages but the difference was not significant.

	Term exam one	Term exam two	Difference
Low ability	73%	73%	Ns
High ability	68%	77%	*

Significance: * 5%; ns: not significant at 10%

Table 4: Confidence figures before term-exams 1 & 2 with ability groups.

Observation 1: *Negative feedback is not incorporated into the reestimation process. As low ability students (both male and female) are conservative in reducing their confidence percentages. However, for the high ability group, it is only the male participants who respond to feedback in terms of significantly increasing their confidence percentages.*

In the same manner, the confidence percentages are updated before the final exam as:

$$E_3p = \text{weighted average of prior confidence \& expectation variable}$$

$$= \frac{v' + 1}{v' + 2} E_2p + \frac{1}{v' + 2} (X_3)$$

Where X_3 is the combined expectation variable for the term exams one and two. It is to be noted that the available immediate information which is easily recalled by the participants is the success in term exams one and two, while the percentage marks attained in the exams are ignored easily. Thus the X_3 variable should boost confidence before the final exam. The positive confidence judgment behavior has been exhibited by the participants of both ability groups (refer to

Table 5 for the percentage figures). From the table it is observed that the male confidence increases to 91% and 92% for the low and high ability participants respectively. However, confidence percentages remain lower for females than the male students. They are found to be 81% and 82% for the low and high ability female students, respectively.

	Subjective confidence			F-value	p-value
	term exam one	term exam two	Final exam		
Males:					
Low ability	79%	77%	91%	5.91	(0.0044)* *
	Diff: a** : percentages of term exam one and final exam				
High ability	72%	82%	92%	6.23	(0.0039)* *
	Diff: a** : percentages of term exam one and final exam				
Females:					
Low ability	64%	67%	81%	5.34	(0.0429)*
	Diff: c† : percentages of term exam one and final exam				
High ability	62%	69%	82%	4.91	(0.0131)*
	Diff: b* : percentages of term exam one and final exam				

Significance: ** 1%, * 5%;

Diff: a**: difference between two percentages is significant at 1%.

Diff: b*: difference between two percentages is significant at 5%.

Diff: c†: difference between two percentages is significant at 10%.

Table 5: Evolution of subjective confidence reported before each exam for male and female participants with respect to their ability group.

The positive boost of confidence percentages before the final exam comes from the following two aspects:

- (i) **Availability bias:** As stated above, the immediate information which is easily recalled by the participants are the past successes in the term exams. Tversky and Kahneman (1974) explain the phenomenon as the “*likely occurrences are easier to imagine than unlikely ones*” (page: 1128). Thus past success information is processed and is incorporated into the confidence percentages. This leads to the bias occurring from the availability of immediate information with high confidence percentages.
- (ii) **Improving the grades:** The final exam is seen as the last chance for the students to improve on their grades (for the official marks sheet), on one hand, but also to clear the optional course requirement by the university to attain the degree. Thus, students have high incentive to study for the final exam. The preparation to clear the final exam impacts the confidence percentages positively too.

In a nutshell, the source of bias at this stage is the excessive weightage of the past successes in proportion to their salience. This argument is the baseline of the *cognitive consistency theory* under belief building. (For further details on cognitive consistency theory refer to Levy-Garboua & Blondel, 2000). On top of that, to avoid the possibility of repeating the course all over again, the students study harder at the final exam, adding to the bias even more.

Conclusion

This article studies Pakistani university students on the topic of confidence judgment biases by accounting for the ability variable. Some of the existing results in the research literature of Psychology and Economics have been reaffirmed. For example, the well-known Dunning-Kruger effect (1999), the retaining and recalling of the positive feedback, the ignorance of the negative feedback in confidence judgment estimates (Kahneman & Tversky, 1973) and lastly, the availability bias. We report further how with time and experience the under-confidence changes to overconfidence in one's own abilities.

The main contribution of the article is two-fold. On the one hand, the observed bias in confidence judgment estimates are explained with the help of the Bayesian up-dating model with the incorporation of the doubt element i.e., the doubt in one's prior perceptions (Louis et al., 2015). On the other hand, we find that Pakistani females are consistently throughout underconfident in their own abilities. They state significantly lower confidence estimates than their male cohorts, in spite of possessing the skills to perform better. It is to be noted that the existing research literature states that females tend to be less overconfident than males. This result may have an interesting implication for developing countries as in these countries, females not only report less confidence estimates than males, but they also reduce it to the extent that it turns into underconfidence, as opposed to overconfidence, in one's abilities. The institution's nature as well as nurture plays a big role in this reported female underconfidence. As Neiderle and Vesterlund (2011) in their article argue that “[...] it is possible to nurture women to be more

competitive” (page 624). If that is the case then underdeveloped countries need to put more effort in nurturing their female population so that they can at least start to believe more in their own abilities; a statement that merits further research.

3

References

- i. Adams, J., 1957. A Confidence Scale Defined in Terms of Expected Percentages. *The American Journal of Psychology*, 70(3), pp. 432-436.
- ii. Barber, B. & Odean, T., 2001. Boys Will Be Boys: Gender, Confidence and Common Stock Investment. *Quarterly Journal of Economics*, 116(1), pp. 261-292.
- iii. Brenner, L., Koehler, D., Liberman, V. & Tversky, A., 1996. Overconfidence in Probability and Frequency Judgments. *Organizational Behavior and Human Decision Processes*, 65(3), pp. 212-219.
- iv. Fischhoff, B., Solvic, P. & Lichtenstein, S., 1977. Knowing With Certainty: The Appropriateness of Extreme Confidence. *Journal of Experimental Psychology*, 3(4), pp. 552-564.
- v. Kahneman, D. & Tversky, A., 1973. Availability: A Heuristic for Judging Frequency and Probability. *Cognitive Psychology*, 5(2), pp. 207-232.
- vi. Kahneman, D. & Tversky, A., 1982. Heuristics and Biases. In Kahneman, D., Solvic, P. & Tversky, A. (eds.) *Judgement Under Uncertainty: Heuristics and Biases*. Cambridge: Cambridge University Press.
- vii. Kruger, J. & Dunning, D., 1999. Unskilled and Unaware of it: How Difficulties in recognizing One's Own Incompetence Lead to Inflated Self Assessment. *Personality and Social Psychology*, 77(6), pp. 1121-1134.
- viii. Levy-Garboua, L., Askari, M. & Gazel, M., 2015. *Confidence Biases and Learning Among Intuitive Bayesians*. CES Working Paper.
- ix. Levy-Garboua, L. & Blondel, S., 2000. *From Normative Rationality to Cognitive Consistency*. University of Paris 1: Working Paper.
- x. Lichtenstein, S., Fischhoff, B. & Phillips, L., 1982. Calibration of Probabilities: The State of The Art To 1980. In Tversky, A., Kahneman, D. & Solvic, P. (eds.) *Judgment Under Uncertainty: Heuristics and Biases*. Cambridge: Cambridge University Press.
- xi. Neiderle, M. & Vesterlund, L., 2011. Gender and Competition. *Annual Review of Economics*, 3, pp. 601-630.

- xii. Pulford, B., 1996. *Overconfidence in Human Judgement*. Doctorate Thesis, University of Leicester.
- xiii. Pulford, B. & Colman, A., 1997. Overconfidence: Feedback and Item Difficulty Effects. *Personality and Individual Differences*, 23(1), pp. 125-133.
- xiv. Skata, D., 2008. Overconfidence in Psychology and Finance: An Interdisciplinary Literature Review. *Financial Markets and Institutions*, 4, pp. 33-50.
- xv. Tversky, A. & Kahneman, D., 1974. Judgment Under Uncertainty: Heuristics and Biases. *Science, New Series*, 185(4157), pp. 1124-1131.