THE ISSUE OF MOTIVATION AND EXPECTATION IN THE INTRODUCTORY STATISTICS - OBSTACLES AND OPPORTUNITIES

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In this article, we exam students' motivations and expectations in introductory statistics. An interview study was conducted to investigate student motivations and expectations before taking the introductory statistics course. The study was conducted in four different types of institutions. Interviews were conducted two to three months after completing an introductory statistics course. Interviewees were chosen to represent the grade distribution by selecting three students from each grade level of A, B, and C or lower. Students' motivations are analyzed and classified into five types based on the existing motivation theories. Four scenarios that commonly occur in introductory statistics are analyzed using existing motivation frameworks. It is suggested that learning goals, instructor's expectation of students, and instructor's caring for student's learning progress are important strategies for motivations.

INTRODUCTION

In recent years, statistics educators have been promoting statistics education reform. Moore (1997) presented the following recommendations for elementary statistics: the need for data; the importance of data production; the omnipresence of variability; the measuring and modeling of variability. Recently, the American Statistical Association (ASA) lunched a new initiative for Undergraduate Statistics and suggested some guidelines for undergraduate statistics curriculum, in which real world applications and communication skills are emphasized (see ASA website for details). The efforts made by statistics educators and professional organizations are aiming at providing better education of statistical thinking and basic knowledge of understanding data and uncertainty for college students in the modern society. By introducing more real world data applications, one hopes to increase students' motivation. Real world applications and hands-on activities are wonderful strategies for introducing statistical problem solving skills and they should help to increase student's interest in the subject. Such a hypothesis may have overlooked the issues of motivations and expectations that students have before coming to the class, and the difficulty of modifying these perceptions by changing instructional strategies alone.

This article presents some findings from an interview study conducted in four different types of institutions: a research extensive university, a comprehensive university, a liberal art private four-year college and a liberal art predominant minority college. One purpose of these studies is to investigate student's motivations of learning and their expectations for the introductory statistics course, and to exam these motivations using some existing motivation frameworks. In section Two, we present four scenarios typically occur in an introductory statistics class, and briefly review some motivation theories. In section Three, we interpret these four scenarios using the existing motivation frameworks. In section Four, the interview design is discussed. In section Five, some findings are presented and discussed using the motivation framework. This study is an attempt to understand how motivations and expectations affect student learning of statistical concepts by using interview approach. We do not suggest that the findings can be inferred to a general population. We believe much more further research will be needed in order to have a deeper understanding of the effects due to motivations and expectations.

WHY AND HOW PEOPLE ARE MOTIVATED TO LEARNING

Motivation problems are complicated. They come in a variety of shapes. As a consequence, there is no 'the theory' that is capable of explaining all of these motivation problems. Let's consider the following four scenarios. These represent four common types of students we interviewed.

Mary is a sophomore who has not yet decided her major. She had a 3.8 high school GPA. During her high school years, she purposely avoided content-intensive subjects such as advance mathematics or science-related courses. Mary does not like math, according to her. But she is capable of following step-by-step procedures, which were the most common approaches in her high school. Deep in her heart, she thinks she can not do math. She comes to every class and writes everything down, and seems to understand well in class. Her only goal is to get a good grade. So, she works very hard for the course and tries to memorize procedures that she thinks can help her for the tests.

Nancy is a straight A student. She is very active in many activities. Math has been easy for her. In her mind, Statistics is just another math. She thinks this is going to be an easy A. So, she skips classes, and occasionally skips homework, too. She does very poorly in her first test. How can this happen? She thinks this professor is too tricky, and test problems are way too difficult since they are not the same as examples in the textbook. For Nancy, grade has never been a problem. But, she is very worried that this course is going to be a nightmare. She tries to make up what she got lost by studying the material herself, since looking for assistance means failure to her. All the sudden, she has a great deal of stress.

John is a lay back junior. He cares for sports and parties more than academic progress. He has been trying to look for easy way out. Statistics is one that he hates, but is required for his major. He is smart, but only if he is forced to do; otherwise, he is not interested in his academic work. His goal is to get a college degree and go home to work for the family business. He does not think statistics is useful at all. This is his third time taking this course.

Steve is a senior. He also works off-campus for 30 hours a week, since he has a family to support. He is good at quantitative subjects. He realizes statistics will be useful for his career, and wants to do well. But, he is caught in between his job and academic work.

These four scenarios may seem familiar to many instructors. These students have different backgrounds, different ways of learning, different goals, and face different obstacles in the elementary statistics class. They have different motivations, attitudes and expectations for taking the class. Each case requires different kinds of assistance in order to be successful in the introductory statistics. In this section, we give a brief review of motivation theories that may be applicable for explaining individual behaviors and possibly for helping predict and influence their actions. Detail discussion of motivation theories can be found in Stipek (1998).

The first motivation framework appeared in the literature is the Reinforcement Theory. According to this theory, individuals exhibit a particular behavior in achievement or other settings because they have been reinforced or rewarded for that behavior in the past. Consider grades, for example, if a student's main goal is to have a good grade, then, the student would ask for reviewing material before the test. Since, such a behavior has helped students for getting better scores. On the other hand, if such a review did not reward students for better grades, the request for such a review would be decreased.

The Reinforcement theory does not take individual's expectation, attitudes or emotion into account. It assumes that behavior is regulated by external forces only. The Social Cognitive Theory (Bandura, 1986) recognizes that, in addition to the external reinforcement forces, individual's beliefs and expectations about reinforcement for a behavior are more important than whether they have been reinforced for it previously. The Social Cognitive theorists believe that most people value the self-respect and self-satisfaction derived from the job well down more highly than material rewards. Thus, achieving personal goal or individual standard can serve as reinforcement effectively. Self-efficacy and self-regulation are important ingredients for achieving individual's own goal. Most students bring to each class their own generalized belief systems and expectations developed from the past experiences. Such beliefs are often difficult to change. Rotter (1990) proposed two dimensions of individual's generalized beliefs as internal locus of control such as ability and external locus of control such as luck. Skinner (1995) made a distinction of internal locus of control between strategy beliefs and capability beliefs. For an example, a student may ask ' *if s/he understands all material in the book, is it good enough for an A'* (a strategy belief) and further asks '*how am I able to understand the material'* (capability belief).

The Social Cognitive Theory assumes that beliefs come from individual's previous experiences and it is difficult to change. Weiner (1992) pointed out that people naturally search for an understanding of why events occur, especially when outcomes are important or unexpected, and make self-reflection about their belief systems. A student did poorly in a test may ask

question, *'Why I did so poorly?'* and draws conclusion from the self-reflection. The student may decide it is the instructor's fault, or s/he may review the test questions, make a self-reflection and modify the strategies for achieving better scores in the future tests.

Toddlers often repeat the same action many times without feeling frustrated or bored until they are comfortable with the action. The reinforcement believer would interpret it as reinforcement makes it perfect. The Social Cognitive believer would interpret it as self-satisfaction for achieving the goal. Yet, another group of researchers would interpret it as humans are born with intrinsic curiosity and motivation for achieving their goals. Infants and toddlers enjoy repeating the same activity simply because of their intrinsic motivation and are innately disposed to seek opportunities to develop competencies, and to seek novelty and challenges. When one discusses intrinsic motivation, it is important to address the effects of the social environment and external rewards. The effects of social environment and external rewards become more significant as individuals grow older. Students often ask for immediate feedback to determine if their answer is correct, instead of reading the related material and redo the problem themselves. To these students, the effect of social environment is more significant than their intrinsic motivation. The external reward may provide an immediate motivation, however it often undermines intrinsic interest in the long run (Lepper, Keavney, & Drake, 1996).

AN ANALYSIS OF THE FOUR SINARIOS USING MOTIVATION FRAMEWORKS

Mary has an anxiety of quantitative skills and her only goal is to get a good grade. She has weak internal locus of control. To her, external forces are her motivation. Nancy has been successful academically and socially. She is facing a great deal of challenge in her introductory statistics course. Her self-respect is extremely high, and locus of control of capability dimension is very good. However, she is facing the difficulty of strategy dimension of her locus of control, since she insists she can overcome the difficulty solely by herself. Her motivation comes from her beliefs of ability and goal. However, this time, she is losing her self-reflection and not willing to adjust her belief system.

John has little motivation, neither has self-satisfaction for achievement. His goal is not associated with his achievement. Statistics has no value to him. His goal is to get a degree and work in family business. A possible motivation would be to ask him conducting some projects that are associated with his family business. Steve is intrinsically motivated for statistics. However, the social environment seems to outweigh his academic work. A better time management and a clear goal would be important for Steve.

In summary, achievement motivation occurs in the external environment and in person. Individual's beliefs, values that are influenced by the recent experiences in achievement situation as well as by the variables in the immediate environment are important ingredients to form motivation. Individual's intrinsic motivation and external social environment and rewards are another important part of the puzzle.

THE INTERVIEW DESIGN

The interview study was first conducted by Lee (1999b) at Central Michigan University, a research intensive university. It was repeated in three other institutions: one was at a research extensive university, one was at a liberal art private college, and one was one a predominant minority liberal art college. The purpose of the interview was to investigate students' beliefs, attitudes, learning styles, motivations and their content knowledge retained. It was conducted two to three months after students took their introductory statistics course. At Central Michigan University, students from two classes were interviewed. One class was taught using the traditional lecture and note-taking instructional method, and the other was taught using the PACE strategy (Projects, hands-on Activities, Cooperative learning in a computer classroom, and Exercises) (Lee, 1999a). Nine students (3 A's, 3 B's and 3 C or lower) were randomly selected from each class. Thirteen students agreed for the interview. The interview protocol consists of two parts: A 45 minutes interview on beliefs, learning styles and motivations, and a 75 minutes interview on the content knowledge. The other three institutions used the same interview protocol and design. Nine students were selected in each institution. A total of twenty-one students agreed for the interview in these three institutions. A typical interview started with the questions such as

Why did you take this class? What is your background? Before taking this class, what have you heard about statistics and what were your perceptions? Have you changed your perceptions after taking the course? How do you compare a math class with your statistics class? What would be the best way for you to lean quantitative subjects? Why? How can technology make the difference to help your learning? What factors motivate you to study?

We tried to conduct the interview as similar as possible in all four institutions. However, due to the differences of instructional methods, topics covered, student backgrounds and different interviewers, some modifications were made in each institution to fit its situation. This article presents the findings on the issues related to motivations and expectations.

RESULTS AND DISCUSSION

A total of 34 students were interviewed in four institutions. The distribution of their grades is approximately evenly distributed. The interview data related to students' impressions and expectations is summarized in Table 1. Three aspects of their impressions and expectations are summarized: Feeling/Impressions, How it is alike, and the level of difficulty. Table 2 summarizes students' responses to motivations. These motivations are classified based on the motivation theories discussed in section Two into (1) Goal Oriented, which is divided into two subcategories of Grade-related and Career/Major-related, (2) Value Oriented, (3) Intrinsically Motivated, (4) Social Environment Oriented, and (5) External Forces Oriented.

Table 1
Impressions/Expectations about Statistics Before Taking Introductory Statistics

Feeling/Impression		Alike		Difficulty	
4	Boring	1	Number crunchy	1	Common sense
5	scared, afraid	2	Abstract concepts	5	Easy
1	Nervous	6	Just like math	2	Did not expect to be easy
1	Confusing	4	A bunch of equations and formulae	10	Hard, very difficult
3	Very negative, horrible	2	Use numbers to predict		
1	Keep a clear mind	1	Odds and probability		
6	Did not know much	2	Like averages, percentages		
		3	Like surveys and polls		
		2	Graphs		

Before coming to the class, students seem to have rather negative impressions about statistics. Among the responses in the feeling/Impression aspect, no one mentioned any positive phrases, although several responded '*they did not know much about it*' or '*to keep a clear mind*'. The overwhelmingly negative impressions ought to be a serious concern for instructors. In the aspect of 'How the course will be alike', many students perceived that introductory statistics is *number crunching*, *formulae*, and *just like math*. One implication of such perceptions is that students expect the subjects will be math and formulae. So that memorization of formulae and learning procedures will be the key to succeed in the course. Active learning with real world data and hands-on activities are good strategies for changing these perceptions. Among those mentioned about the level of difficulty in their impressions, most of them indicated they thought the class was going to be difficult. Such an impression may have some positive impact as it makes students aware that they will have to work hard in order to pass the course.

Social Cognitive Theory indicates that people's beliefs are formed from their previous experiences and environment, and are often very difficult to change. Teaching elementary statistics is not only the matter of instructional strategies, more critically, it is a matter of changing student's attitudes. In addition to changing teaching strategies, the instructor needs to provide a learning environment that is capable of motivating students to learn. The first step of developing such a learning environment is to find out the factors that may help to motivate students.

Table 2 summarizes the responses about factors associated with students' motivation. It is not surprising that almost every interviewed student immediately mentioned that *they want a good grade,* and they study *if the subject is related to their future career or if it is required*. To these students, an important reason for studying is *their goal of getting good grades or preparing for career*. This result is consistent with a national survey study by Angelo and Cross (1993) on

Teaching/Learning Goals by surveying faculty members and students from two-year colleges and four-year universities. The top two essential teaching goals for faculty are '*Higher-order Thinking Skills*' and '*Discipline-Specific Knowledge and Skills*'. The top two essential learning goals chosen by students are '*Personal Development*' and '*Work and Career Preparation*'. If students' motivation is goal-oriented, instructors ought to consider strategies that are goal-oriented and attempt to integrate high-order thinking skills into these goal-oriented strategies.

Table 2:
Students' Responses on their Motivations for Studying

1. Goal-Oriented : (a) Grade-related	(b) Career/Major-related
Job requires high grade.	If the subject can help me out to build base.
Get good grades, keep up the GPA	Want to know more about the subject I am going to need.
Graduate study asks for high grade.	If the subject is related to my career or experience.
I always like to be perfect.	It is something that I can use it my life and career.
To get an A in the course.	Is useful for career, I needed it for my major.
Get a good grade to go where I want to.	I can use this knowledge in my life or career.
2. Value-Oriented	
Pride - Good grade makes me feel good, because that worth the work I put in.	
I think the main reason you go to college is for learning skills that prepare you for the future. So if you pass this chance then it will be late to catch the train.	
Knowing that knowledge brings life to your life and knowledge benefits you in the long run is a continuing motivation for me to learn.	
You will never advance in life if you don't study whatever subject you chose for your life.	
Knowing that it was going to be beneficial in the future.	
3. Intrinsically Motivated	
More or less is my interest.	I want to learn something new.
If the course is interesting.	Real world relations. Something I can identify.
I learn because I have a desire to learn.	Knowledge is something I want to possess.
4. Socially Environmental-Oriented	
It has to do with professor.	The attitude of the instructor
If I like the way the professor teaches, it gets more involved and more willing to do well.	
If the instructor has a high expectation, and make you do daily work, I will work harder.	If instructor is kind of laid back, I would do the same.
If teacher can show you how you may use it.	If teacher can show how you may use to learn other things
5. External Forces-Oriented	
The subject that I am behind.	If the subject is difficult, I put more time in.
If I don't know what I'm doing.	I want to continue my education after College.
If I find that I am having more difficulty in the class I spend more time on it.	My parents motivate me to do well by offering me to buy gifts if I get 4.0 GPA

Some students mentioned they are motivated to learn because of the value of learning such as '*this is important for life*' and '*pride*'. Their motivation comes from the value they perceive of the subject. They often have high self-respect and self-satisfaction toward achievement (Stipek, 1998). A group of students are self-motivated. They want to '*learn something new*'. They learn '*because of their own interest or desire*'. These intrinsically motivated learners are often active participants. For this type of students, social environment obstacles such as those faced by Steve need to be properly dealt with, if existed. Some students are highly affected by their instructor's attitude. Their motivation relies heavily on how much the instructor cares for their learning and the interaction with students. This evidence suggests that teaching is not only a mater of lecturing. An instructor should also pay a close attention to student's learning progress, and willing to offer helps. There is yet another type of students who are willing to share their time for studying only when they absolutely need to do so, especially, when they feel failure. This type of students is external-forces oriented. Rewards and punishment may be two essential ingredients to keep their motivation. However, some external forces are positive motivators. For example, students study because they want to go for graduate study. Their motivation comes from self-regulation and self-control more than external forces.

In this article we present four scenarios in introductory statistics class, review briefly some existing motivation theories, interpret the scenarios using the motivation frameworks, and discuss the results with respect to students' expectations, perceptions and motivations from an interview study in four types of institutions. The major motivation is students' goals, which include grade-related, career and major-related goals. This suggests that the instructor should consider goal-oriented strategies. These strategies may include (1) a clearly communicated expectation in the beginning of the class, (2) a clear set of learning objectives for each topic to be covered and responsibilities that students are required in order to accomplish the learning objectives, (3) a constant emphasis of the values and applications that are related to students' career and/or current events, and (4) a proper assessment activities that assess not only student's progress of learning but also the attitudes. Another noteworthy finding is the social environmental related motivations, which are highly associated with the instructor. Teaching is not only a matter of lecturing. Students are more motivated if the instructor cares for their progress and makes active interactions with students.

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