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IMPROVING CRITICAL THINKING SKILLS: AUGMENTED FEEDBACK AND POST-EXAM DEBATE: A FOLLOW-UP STUDY

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ABSTRACT

Studies have confirmed critical thinking skills contribute to the success of professionals; however, college graduates lack the critical thinking skills needed in today's workforce. "Student Self-Initiated Challenge of Examination Questions" encourages and increases critical thinking skills by allowing students to challenge objective examination question.. In this follow up study, researchers gather qualitative data based on student responses and sentiments towards the SSCEQ method.. Through this method, students noticed improvement in critical thinking, reasoning, and discussion. Furthermore, students enjoyed the ability to explain their perspective and hear other points of view. Overall, students responded positively to the SSCEQ method.

JEL: A22, K40, K41

KEYWORDS: Critical Thinking, Classroom Techniques, Objective Examinations, Class Discussion, Participation, Business Law Course

INTRODUCTION

Despite the resounding interests in developing and fostering critical thinking in higher education, there is evidence that college graduates lack the critical thinking skills needed in today's workforce (Shim & Walczak, 2012). Universities must do a better job to develop graduates who can make educated decisions and who make connections between their learning and practice. The reason for this prioritization is the desire for future graduates to solve unknown and complex problems that may not even currently exist. Crucial to achieving this outcome is critical thinking which is often seen as the hallmark of a well-educated person (Thomas, 2011). Critical thinking is a widely used term that encompasses skills in identifying, analyzing, processing, and evaluating information to make decisions, and the ability to apply these skills (Shim & Walczak, 2012). The U.S. Department of Labor's Commission on Achieving Necessary Skills made announced that critical thinking skills are a fundamental requirement for competing in today's global economy (Braun, 2004). Therefore, critical thinking skills should be embedded in course content so students develop stronger skills in critical thinking processes. Additionally, with a continued effort to include critical thinking in coursework, the business graduate will become habitually inquisitive, well-informed, open-minded, prudent in making judgments, and orderly in complex matters. These are all the skills of an ideal critical thinker. Unfortunately, a deficiency exists in critical thinking education at the university level (Thomas, 2011). This study serves to understand the practice of augmented feedback post-examination. Researchers attempt to discover if augmented feedback improves critical thinking skills to prepare students for a successful career. Research begins with a literature review of peer-reviewed articles, synopsis of the augmentation process with its impact on critical thinking skills, and the methodology of application. Finally, researchers discuss findings, conclusions, limitations of the study, and future research.

LITERATURE REVIEW

This research serves to understand the practice of augmented feedback in a post-exam situation. Researchers attempt to discover if augmented feedback improves critical thinking skills to prepare students for a successful career. A strong technique for reinforcing course priorities and enhance effective learning is to assess the process (Boylan, 2015). Current literature on the development of critical thinking has four consistent themes. First, many obstacles exist for implementing more effective classroom methods for the development of critical thinking. The gradual nature of cognitive development presents a challenge for incorporating critical thinking skills into the curriculum. Another obstacle is the introduction of critical thinking without interrupting other key topics in the course. However, by effectively engaging students in coursework through appropriate instructional methods, students will improve their critical thinking skills. Challenging students with constructive responses to questions is more effective than merely asking students to select correct answers among provided possible answers (Shim & Walczak, 2012). Second, research suggests that encouragement of critical thinking development cannot be relegated to a course in critical thinking, alone. Rather, the incorporation of critical thinking in subject-matter courses is most effective (Young & Warren, 2011). Third, to be effective, the pedagogical approach must embed the development of critical thinking skills within the student's learning of course concepts. Active engagement of students is essential in this process. Class discussion and debate bring content alive and facilitate deeper learning of the content (Braun, 2004). Moreover, disagreement in the construct of critical thinking leads to several competing measures for critical thinking (Shim & Walczak, 2011).

Furthermore, the critical thinking measurements most heavily researched are subject-independent assessments. These assessments allow measurements of critical thinking ability regardless of the context, making it possible to compare different groups of people. Also, previous studies indicate a positive correlation between the outcomes of subject-independent tests and students' performance in a course or on a task. Such studies, therefore, indicate that critical thinking is worth assessing. However, several problems exist with such general tests. First, faculty doubt that the measurements indicate anything useful about discipline-specific knowledge. Second, administration of these tests takes time away from the content of the course which is viewed by instructors as "wasted" time. Last, many faculty members lack the time to learn the underlying theory behind the tests (Bissell & Lemons, 2006).

Unfortunately, little substantiated knowledge on effective pedagogy comes from research on critical thinking. Few scholars have explored studies on critical thinking among college students and the impact of instructional factors (Tsu, 2002). Moreover, few scholars have explored student opinions about testing formats (Carlson, 2013). However, scholars who have researched testing formats found that students prefer a multiple choice testing format with an opportunity to earn extra credit (Scanlan, 2013). Although Americans are more highly educated than ever before, they are not *better* educated. Education largely emphasizes knowledge building through subject matter content which in turn teaches students what to think. Students rarely express an original idea or provide any evidence to back a claim (McEwen, 1994). However, for students to build high-order cognitive skills such as critical thinking, educators should focus more on teaching students how to think for themselves. Whenever this occurs, students are better prepared to tackle the numerous challenges found throughout their personal lives and careers. Installment of critical thinking in students places them on the path to be lifelong learners (Tsu, 2002). Research can and should assist faculty in their efforts to facilitate students' ability to think critically.

According to Thomas (2011), critical thinking should be developed from the first year of university for students to be useful to future employers. A recent report reveals that 93% of college faculty consider critical thinking skills to be among the most essential skills students can develop. However, according to that same study, only 6% of graduates can demonstrate critical thinking skills (Quitadamo, Faiola, Johnson, & Kurtz 2008). A California study found that only 19% of faculty could clearly define critical thinking while 89% included it in their curriculum (Murawaski, 2014). Moreover, it is argued that there are more

ways to fail than to succeed when teaching critical thinking. Often, poor teaching of critical thinking skills is a result of the lecturer mistakenly believing that critical thinking is solely up to them. Whereas, enhancement of students' critical thinking abilities is better accomplished when the teacher acts more as a facilitator than an instructor (Pithers & Soden, 2010). Students rarely use evidence to make judgments and use understanding as a goal. Rather, students often see a limited number of perspectives, fail to actively listen, judge quickly, and hold their ideas in high esteem (Murawaski, 2014). Critical thinking is applicable in situations where decision-making is required. Therefore, the practice of critical thinking encourages employees and managers in the workplace to observe situations and weigh all available solutions (Murawaski, 2014).

For students to better compete on the global stage, higher education faculty need to make practical instructional changes (Quitadamo, Faiola, Johnson, & Kurtz 2008). It is estimated that teachers in the typical classroom spend 80% of their time lecturing to students who are only attentive to what is being said 50% of the time (Tsu, 2002). To address this problem, methods to promote critical thinking must be explored. Communication and interpersonal skills were listed as two important skills by the then-Big 8 public accounting firms in 1989 (Boyle, Mahoney, Carpenter, & Grambo, 2014). Researchers found that communication skills are viewed as important for promotion to specific ranks. Also, The development of communication skills can enhance one's career prospects and the likelihood of advancement (Boyle, Mahoney, Carpenter, & Grambo, 2014). Communication skills can be improved through class discussion which in turn can enhance critical thinking skills.

Class discussion is an often used and embraced pedagogical strategy. Learning is an active process and students better retain information through engagement with students via classroom discussion and debate (Petress, 2006). Reported benefits of discussion include student involvement in their learning, learning through the contribution of peers, and the development of higher-level cognitive skills. Therefore, discussion helps students develop critical understanding, self-awareness, appreciation for diverse perspectives, and the ability to act (Dallimore, Hertenstein, & Platt, 2004). The aforementioned qualities give students what it takes to succeed in the professional world. However, classroom discussion, with its focus on active learning and critical thinking, is attractive in theory but often disappointing in practice (Bruss, 2009). Research shows that certain faculty behaviors and techniques can increase the effectiveness of discussion. Instructors can require and grade participation, incorporate instructor and student ideas and experiences, facilitate, ask effective questions, create a supportive classroom environment, and affirm student contributions while providing constructive feedback (Dallimore, Hertenstein, & Platt, 2004). Furthermore, to cultivate useful discussion, educators must guide the discussion and facilitate student participation. Instructors must know when to interject and pose thought-provoking questions. Students are more likely to comprehend and retain ideas when they participate in dialogue or debate (Tsu, 2002).

DATA AND METHODOLOGY

The researchers understood the need in a business program to incorporate critical thinking and augmented feedback into the entire curriculum. In order to improve critical thinking in the classroom without missing out on actual course material, instructors must modify their existing courses (Page & Mukherjee, 2007). Researchers developed a pedagogical method to address the need for critical thinking practice in the classroom. Augmented feedback is one of the most critical forms of guidance that a teacher can offer to students. Augmented feedback comes from a source external to the learner which includes knowledge of results. Knowledge of results (KR) is the extrinsic verbalize information about the outcome of an action. Augmented feedback also includes knowledge of performance (KP) which is the extrinsic verbalize information about the action itself. Advocates of augmented feedback recommend that practitioners develop students' self-evaluation skills by asking them questions during class or prompt and reinforce their evaluative thoughts. Last, advocates warn practitioners to avoid overloading the learner.

Methods Overview

The method used is a pedagogical technique that encourages and increases critical thinking skills by allowing students to challenge objective examination questions through written feedback and classroom debate. This research has the following research question: does augmented feedback and post-exam debate work? The null hypothesis is, H_0 , is that augmented feedback and post-exam debate does not improve student learning.

$H_0 = \text{augmented feedback and post-exam debate does not improve student learning}$

The alternative hypothesis, H_a , is that augmented feedback and post-exam debate does improve student learning

$H_a = \text{augmented feedback and post-exam debate does improve student learning}$

In order to accept or reject the null hypothesis, researchers have put in place a 70% threshold. If 70% of feedback on SSCEQ is positive then researchers can accept the null hypothesis. If below 70% of feedback on SSCEQ is negative than researchers will reject the null hypothesis. The “Student Self-Initiated Challenge of Examination Questions” (SSCEQ) is a new approach that was developed by previous researchers Brown, Worth, and Boylan (2017) . SSCEQ allows for the development of critical thinking skills over time without any loss of time to cover course material. Students can challenge objective examination items directly on their examinations during testing and orally in class following the return of the examinations. Class discussion and participation are improved because an improved score motivates students to engage with their peers and instructor. SSCEQ has become so popular students have affectionately deemed it the “Dot Method,” (Brown, Worth, & Boylan, 2017).

Participants, Sample, and Demographics of Population

In an prior quantitative study, titled “Improving critical thinking skills: Augmented feedback and post-exam debate” from 2017 the authors surveyed students, asking them to rate their agreement or is agreement with statements using a 5-point Likert-type scale gauging their perception of whether SSCEQ increased their understanding of the course material, aided in developing their critical thinking about the course material, encouraged them to participate in class discussion, and provided an opportunity to improve their grades? An overwhelming majority of students surveyed believed SSCEQ increased their understanding of and critical thinking about course material, gave them an opportunity to increase their grade, and encouraged them to participate in class discussion. 81% of students felt SSCEQ helped them develop a better understanding of the course material. 90% of students believed SSCEQ aided students in learning to think critically about the course material. 85% of students believed the method increased class discussion. 88% of students felt listening to others aided their understanding of the material. Significantly, over 90% of students felt their critical thinking skills were improved. With this research being a follow-up qualitative study to an original quantitative study the sample size shrank as students either dropped out of the study or graduated. Here is a comparison of the original study and this follow-up study (see Table 1 and Table 2).

Students were asked the following question about their experiences with the Dot Method:

Please explain/describe any benefits you believe were obtained from using the Dot Method.

Researchers identified six categories common throughout student responses to the above question. Categories included critical thinking, reasoning, discussion, opportunity to explain, ability to hear other perspectives, and others. The most popular category was critical thinking with six student responses and the second most popular category was other with six responses. This was followed by a discussion that had

five student responses, followed by an opportunity to explain with five student responses. The opportunity to explain was followed by the ability to hear other perspectives with three responses and then reasoning which accounted for two student responses.

Table 1: Original Population of Dot Method Demographics and Classes

Course	Type of Student	Class Standing	Age	Number of Students	Number of Each Sex
BUSA 2810	Mostly traditional (18-22 years old)	Lower level (freshmen/sophomore)	18-22 years old	305	131 males 174 females

Table 1 describes the demographics of the population. Researchers included the course number for each participant, along with the type of student. Researchers describe students as two different types. Traditional students are those who enroll in college full-time immediately after graduating high school. Non-traditional students are those who enroll in college long after graduating high school, those who have a spouse or children, or work full-time while going to school. Class standing and age are also provided for each participant in the population. Last, researchers describe the population as a whole when listing number of students and the number of each sex.

Table 2: Follow-up Sample of Dot Method Demographics and Classes

Course	Type of Student	Class Standing	Age	Number of Students	Number of Each Sex
BUSA 2810	Mostly traditional (18-22 years old)	Lower level (freshmen/sophomore)	18-22 years old	26	6 males 20 females

Table 2, like table 1, describes the demographics of the population. The biggest difference in this information is the number included in the sample. Here the sample size reduced to 26 as a result of students either dropping out of school (74) or graduating (205). The gender composition remained similar while going to school. Class standing and age are also provided for each participant in the population. Last, researchers describe the population as a whole when listing ethnicity mix, number of students, and the number of each sex.

Table 3: Common Categories of Student Responses to the DOT Method Questions

Rank	Category	Student Responses	Mean	Standard Deviation
1	Critical Thinking	6	14.1	2.14
2	Other	6	13.5	1.75
3	Discussion	5	13.4	2.25
4	Opportunity to Explain	5	12.3	1.17
5	Ability to Hear Other Perspectives	3	10.5	1.01
6	Reasoning	2	8.2	1.52
Total		27	12.7	1.71

Table 3 shows the rank and frequency of student responses to the six most common categories of responses to the DOT Method question.

The data shows that a very consisted response to the questions. In fact, all of the standard deviations are between 1.01 and 2.25 (see Table 3). Six students say that the Dot Method improved their critical thinking skills. One student said the following, "The dot method allowed me to express why I thought my answer was correct. It helped my critical thinking skills and also helped me grasp a better understanding of the material, whether or not I received credit for that question." Moreover, two students commented on how the Dot Method improved their reasoning skills. For example, one student commented, "It helped me to think about the question instead of jumping straight to the answer." Five students explained how the Dot Method allowed them the opportunity to explain why they chose an answer. One student remarked, "By using the Dot Method, I was given the privilege to show my professor that even though I was unsure about the correct answer to a particular question, I still understood the material and the concepts that the question was referring to. Many students study for long hours and are very knowledgeable on the subject but they are not naturally good test-takers. The Dot Method is a concept that aids students academically.

Table 4: Students Comments Concerning Benefits of Method

Critical Thinking Skills	
1	“Some test questions might be understood differently, and being allowed to explain the reasoning behind your answer not only clarifies how the question is interpreted but also critical thinking of the material. . . . And sometimes, while describing what I mean, I change my answer to the correct one!”
2	“The dot method allowed me to express why I thought my answer was correct. It helped my critical thinking skills and also helped me grasp a better understanding of the material, whether or not I actually received credit for that question.”
3	“I really enjoyed the dot method. When I was studying for the exam, it made me want to actually learn the material instead of memorize it.”
4	“It teaches people to clearly devise an argument and present it to the professor.”
5	“We were able to practice negotiation.”
6	“(The Dot Method) helped my critical thinking skills and also helped me grasp a better understanding of the material whether or not I actually received credit for that question or not”.
Reasoning	
1	“It helped me to think more about the question instead of just jumping straight to an answer.”
2	“Some test questions might be understood differently, and being allowed to explain the reasoning behind your answer not only clarifies how the question is interpreted but also critical thinking of the material.”
Opportunity to Explain	
1	“By using the Dot method, I . . . was given the privilege to show my professor that even though I was unsure about the correct answer to a particular question, I still understood the material and the concepts that the question was referring to.”
2	“I found the dot method very useful in challenging myself and the professor on questions that I found confusing.”
3	“The opportunity to use the dot method was amazing. It allowed me to challenge and professionally discuss the reasoning why my answer fit with the question. I never realized I was interested in anything legal/law before this class. And with the dot method, I was able to learn so much more because I was able to listen to various perspectives on how others viewed the problems. I also felt that I was able to prove to myself that I completely understood the material because I could further explain different approaches. The material stuck much more than normal testing situations because of the dot method.”
4	“When qualifiers such as ‘some’ or ‘many’ were used in T/F, I was able to explain why I chose the answer I did, and the dot method helped me gain insight about how/why the question was formulated as it was and allowed me to gain points when I otherwise would not have been able to do so.”
5	“My academics and studies are extremely important to me, so I try to always come as prepared as possible for all of my courses. If there were questions I didn’t understand or felt there were two clear answers, I knew I could write about it. . . . It’s not arguing for a better grade; it’s the chance to demonstrate your understanding of material and prove where you are coming from.”
Discussion	
1	“I really enjoyed the Dot Method. Not every question is black and white, so it was good to have room for discussion on the ‘grey’ areas.”
2	“It gives students the opportunity to debate questions that they find unfair on a test. Our voices can be heard.”
3	“A benefit from this method was that it made me care more about the material because with the dot method, we were able to go into depth and actually understand the correct explanation behind the question. It also helped me to socialize with others because most of the time, my classmates around me also would challenge the same question or questions that I also didn’t understand, and we would all talk about it with each other. I made some new friends, just saying.”
4	“Students who might not otherwise speak up in class have a chance to write their argument on the test. Also, if someone else defends an answer that a quiet person has wrong also, it allows those who would not normally speak up and just live with their grade a chance to earn points.”
5	“I found that discussing concepts is the most effective way to really understand the material, however it is usually hard to get a group of students to engage in a discussion. Allowing the class to challenge questions has led not only student involvement, but enthusiastic student involvement.”
Hear Other Perspectives	
1	“Learned different ways to look at the law.”
2	“I was able to see that I was not alone in thinking the way I did. I liked the ability to challenge questions I did not dot or did dot after the test was completed.”
3	“Helped me think of different ways to approach questions and how others thought about the question.”
Other	
1	“(The Dot Method) gave a sense of hope for getting questions correct that were hard to understand.”
2	“Dot Method is best. More professor should start using it.”
3	“I think that this method should stay the same and implemented in all classes.”
4	“I believe other professor should implement the Dot Method
5	“I believe it is a great method and should be used by all professors.”
6	“The way this is used is genius! All teachers should use it if it makes a difference in said class.”

Table 4 provides a list of the response categories, along with each student response that falls underneath that category.

Furthermore, students felt confident that the Dot Method improved classroom discussion. Five students commented on the motivation to participate in class discussions. One student says, "It allows students to debate questions that they find unfair on a test." Another student commented, "I really enjoyed the Dot Method. Not every question is black and white, so it was good to have room for discussion on the 'grey areas". Three students commented on the Dot Method's ability to allow students to hear other perspectives. One student voiced that the Dot Method allowed them, "to see that I was not alone in thinking the way I did. I liked the ability to challenge questions that I did not or did not after the test was completed." Another student claimed, "(The Dot Method) helped me think of different ways to approach questions and how others thought about the question." Last, students explained the benefits of the Dot Method in a way that did not fit into the researcher's categories. Students stated, "Dot Method is the best. More professors should start using it," and "(The Dot Method) provides a sense of hope for getting questions correct that were hard to understand." A full list of the student responses can be found in Table 3.

RESULTS

The results of this study are consistent with the prior study in which the overwhelming majority of students surveyed believed SSCEQ increased their understanding of and critical thinking about course material, gave them an opportunity to increase their grade, and encouraged them to participate in class discussion. The current research founds the ability to express their own opinions was the largest satisfier for students. This is different from the previous study that simply showed the success of the teaching technique. The responses to the statement, "please explain/describe any benefits you believe were obtained from using the Dot Method," reveal the perceived benefits of the Dot Method. These responses included improvements in critical thinking and reasoning skills, along with more effective classroom discussions. Furthermore, students commented on how SSCEQ allowed them to hear other perspectives. All of these results represent very positive results. More written comments included, "Dot Method is the best. More professors should start using it," and, "(The Dot Method) gave a sense of hope for getting questions correct that were hard to understand." Other students raved about the universality of the method with one student exclaiming, "I think that this method should stay the same and implemented in all classes." Another student echoed the same message by saying, "I believe it (The Dot Method) is a great method and should be used by all professors.

Table 5: Student Rankings of Survey Statements

Statement	Percentage of Total
Critical Thinking Skills	22%
Other	22%
Discussion	19%
Opportunity to Explain	19%
Ability to Hear Other Perspectives	11%
Reasoning	7%

Table 5 breaks down the percentage of total responses for each category. Out of 27 total responses, 22% related to critical thinking skills and other comments. Discussion accounted for 19% of the responses while an opportunity to explain totaled the same percentage (19%). Moreover, the ability to hear other perspectives totaled 11% of responses. Last, Reasoning accounted for the lowest percentage of responses with just 7% of the 27 responses.

Along with these results, researcher found little difference between male and female response in the study. Males tended to place more emphasis on "discussion" and "opportunity to explain items than females. Females, on the other hand, tended to appreciate the "ability to hear other perspectives" items.

CONCLUDING COMMENTS

Despite the resounding interests in developing and fostering critical thinking in higher education, there is evidence that college graduates lack the critical thinking skills needed in today's workforce (Shim & Walczak, 2012). Researchers attempted to discover if augmented feedback improves critical thinking skills to prepare students for a successful career through a qualitative study. Responses to the Dot Method were 100% positive which is 30% more than the 70% threshold needed to accept or reject the null hypothesis. Therefore, researchers accept the null hypothesis. The findings led researchers to conclude that augmented feedback improves critical thinking skills of students and therefore better prepares them for their future careers. Furthermore, students also reported that their reasoning skills were sharpened along with their ability to participate in classroom discussions. Students also described their ability to hear other perspectives and provided more opportunities to explain their perspectives.

Researchers identified two problems with the administration of critical thinking tests. First, faculty doubt that the measurements indicate anything useful about discipline-specific knowledge. Second, administration of these tests takes time away from the content of the course which is viewed by instructors as "wasted" time (Bissell & Lemons, 2006). SSCEQ overcomes both of the aforementioned challenges. First, although it is not a direct critical thinking exam, it forced students to think critically; therefore, the second challenge is overcome and it is not "wasted" time. Positive comments about the Dot Method's correlation with improved critical thinking skills made up the highest percentage of responses. Thus, researchers believe that the Dot Method improves the critical thinking skills of students.

Furthermore, researchers also estimated that teachers in the typical classroom spend 80% of their time lecturing to students who are only attentive to what is being said 50% of the time (Tsu, 2002). To address this problem, methods to promote critical thinking must be explored. One of these methods includes increased classroom discussion. SSCEQ increases the amount of class discussion and improves the quality of that discussion. The second highest percentage of responses from participants included positive comments about classroom discussion. The Dot Method incentivizes students to participate in classroom discussion. Classroom discussions also relates to the last three response categories: opportunity to explain, ability to hear other perspectives, and reasoning. When doing so the student rationalizes their position in hopes of gaining points back on their exam. This rationalization of their position improves critical thinking skills and also exposes other students to different perspectives. Limitations to this study existed. One limitation is that no measure existed between academic success and student satisfaction. Also, similar to the previous study, only one method was analyzed, the Dot Method. Furthermore, the sample size was relatively small with only 27 participants. Last, due to the nature of the sample, the research is susceptible to survivorship bias criticisms. Future research can be expanded to other areas. In future studies, the applicability of this method in business courses should be evaluated. Specifically, research on the method's applicability to Accounting and Finance courses.

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CHANGING PERCEPTIONS OF ORGANIZATIONAL CLIMATE AMONG MEXICAN BUSINESS SCHOOL TEACHERS

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ABSTRACT

This article investigates the relationship between organizational climate and faculty's perception of organization climate. Faculty members of a school of business in Mexico participated in a transversal study conducted in 2013 and 2018. A questionnaire was used to collect primary data on thirteen factors related to organization, work conditions, individual characteristics, and organization surroundings. Statistical tests including factor analysis, correlation analysis and level of reliability were used in the analysis. The results showed no significant difference in faculty perception even though the school had three different directors.

JEL: M140, L220

KEYWORDS: Organizational Climate, Professors, Conduct

INTRODUCTION

Organizations desire a pleasant coexistence among individuals so that firm objectives may be obtained under the best suitable conditions. This investigation analyzed changes perceived by the faculty regarding organizational climate in the Academic Unit of Accounting and Administration of the Autonomous University of Zacatecas (UACA UAZ) located in the center of Mexico. The University is a public entity with approximately 40,000 students. The Academic Unit is made up of more than 2,300 students and 103 staff. The one bachelor's degree has two categories: required schooling and semi required schooling. There are five postgraduate programs, one specialization, three masters, and one doctorate. The staff lectures in accordance to their level in the aforementioned programs. We utilize a questionnaire in this study. The same questionnaire was distributed in both, 2013 and 2018, to compare the perception of conditions expressed by the staff in 2013 and 2018. There have been three directors, at the school, during those periods with each applying their own style of administration. Because of varied style characteristics there were imperceptible changes that revealed themselves when said measures were taken. The existence of these changes will be expressed to the succeeding administrative team to facilitate appropriate decisions.

Organizational climate studies identify the existing conditions of the institution, permitting the necessary changes to be made so schools function adequately and satisfies the objectives for which it was created. The organization climate theme has been studied in diverse manners by investigators including Litwing and Stinger (1968), Schein (1973) Gonzalez and Parra (2011). The result of this type of investigation improves the studying of the organizations. Reed (1996) expresses the importance of analyzing the organization from its exterior context to find the condition it is in. This may be interpreted as the philosophical content of the moment, to its members and ties. Several studies measure the organizational climate of various institutions

including some of the most diverse university faculties in Mexico, Argentina and Spain. Results show they meet common conditions, yet differ in characteristics (Carmona, 2019).

Using different time periods, the authors examine a single organization to see how it has changed with respect to these situations. Various studies exist which permit identifying how the organizational climate has changed in the last decades. Vega et al (2006) give an account and present the form as to how this study has developed in Latin America. This theme study starts with few elements that define it bit by bit and winds up with many elements which better explain the organization (Alva & Dominguez, 2015).

Individuals that head an institution decide on the appropriate path to take to reach the objectives set forth from the start or objectives decided by the administration. The following issues should be taken in account in this type of study: personalities of each head, experience as head of other organizations and the ability or acquired studies in each professional preparation. Considering this idea, two administrators heading the same organization may lead to slightly different situations. They may have similar curriculum but have different personalities. This situation makes us raise the following investigative question. What factors changed in the perception of the professors in the Organizational Climate in the Accounting and Administration Academic Unit of the Autonomous University of Zacatecas in Mexico in the years 2013 and 2018? With this question it is possible to express the following objective: Identify factors that changed in the perception of the professors in the organizational climate in the Accounting and Administration Unit of the Autonomous University of Zacatecas in Mexico in the year 2013 and 2018.

To respond adequately to the question, we consider the following Hypothesis: No difference exists in the perception of the professors in the organizational climate in the Accounting and Administration Academic Unit of the Autonomous University of Zacatecas in Mexico between the year 2013 and 2018 in any of the factors. This work resolves the affirmation recently expressed from the introduction of the theme in question. Work the 1960 and 1970 are fundamental in understanding how we arrived at today's themes. These works include Latin American authors who speak of the organization being studied in more recent times. We pose a method utilized that involves the application of various statistical processes that permit us to compare the results obtained in the same organization at two different periods 2013 and 2018. The results are analyzed in light of the statistical analysis that permit to reject or not the expressed hypothesis.

LITERATURE REVIEW

Many theorists have studied organizational climate. Each theorist incorporates an aspect that distinguishes their perception from the others. Garcia Solarte (2009) argues that organizational climate is difficult to explain as in each organization there exists persons with different ideas, personalities and attitudes that make it an exclusive condition to the organization. This condition cannot be generalized throughout time, not even to its own organization. Given this condition, Carmona (2019) wrote of organizational climate conditions which can be conceptualized. He expresses conditions that should be considered. An important condition is the physical well-being of the person and team in which the work is carried out. Another consideration is conditions such as companionship, satisfaction and the aptitudes of those sharing day-to-day physical or virtual space. If we consider Shein's (1973) vision with regard to the organizational culture, we note that what occurs in the organization is a pattern of shared suppositions with which the group learns to live. These results are transmitted group by group, in conformance to the individuals being integrated to fill vacancies or posts for the development and good of the organization. Near the end of the 60's some investigators expressed that organizational climate could function in various dimensions: structure, individual responsibility, and remuneration, risks, support and conflict tolerance. We observe that different visions exist to describe the organization and each one intends to describe it as he/she believes this administrative situation should be studied (Litwin & Stringer, 1968).

Other authors argue organizational behavior should be an amalgam where such situations could be identified as the interpersonal relations that exist between the different individuals. This promotes achievement of the organization by having common visions that would be a greater collective than the sums of those of an individual (Rodriguez, 1999). Other authors propose the organizational climate should be an amalgam where situations can be identified as interpersonal relations existing with different individuals. These relations promote achieving the organization's objectives by having common visions which would be greater than the collective sum of the individuals (Rodriguez, 1999). Salazar and his collaborators (2009) include in their vision how the organizational climate should conform across characteristic integration of the following: the physical environment, the structure of the organization, the existing social environment, the personal characteristics. These characteristics coincide with those expressed by Rodriguez, who argued that organizational climate generates conditions which make it possible to promote, or not, the administration of its employees.

Reciprocity exists in the same dynamic. The organizational climate is not only defined by persons that influence it, but also as the sum of the attitudes of individuals. The organizational climate will also influence people as a cost of excellence, as expressed by Aubert and Gaulejac (1991).

Just as it is very important to speak about the impact that the organization has on individuals and then these on the organization, Gonçalves (2000) expresses that it is fundamental to include results of psychological factors as part of the basic components of the organizational climate. This situation permits adding personal characteristics, communication, and retribution of useful and potentially collaborative ideas. This idea permits the direct manner in how awards and merits are expressed across multiple conditions to feel recognized as part of the organization. Therefore, the organizational climate that exists results from individualized visions and what is perceived. It also results from perception ranging from what employees have done to the conduct or actions which persons say they feel, how the organization benefits some, and its prejudice of others (Anzola, 2003). Méndez Álvarez (2006) expresses his opinion about how organizational climate is perceived, noting that what is produced by the environment of the organization itself and perceived by the members themselves occurs thanks to social interaction which gives the feeling of credibility and participation. Perception is also affected by attitudes which directly impact the satisfaction and efficiency to carry out their daily work. An organization is not an isolated entity and does not exist for itself. Rather, it is an institution that interacts with other organizations or with other individuals. Individuals represent an immediate influence as to how the organizational climate is modified and exists, externally to its physical walls, and how this condition interacts with its outside members and re-arranges itself in different frameworks in accordance with the actions of its members and external stakeholders (Morgan, 1998).

The organization should be interconnected in such a way that members are cognizant of what is happening within its walls. We recommend the organization see itself as a series of interconnected systems in which there exists a flow. This flow is not only of information, but also of support and backup for the coalescence of the essential activities and to the related activities (Hall, 1996). If we take into account the vision regarding the organizational climate present in Latin American institutions, due to the strong cultural roots of its members, it may seem there exists changing conditions when there are not (Vizcaino & Martinez, 2014). We find special conditions where leadership is an important factor that permits reverting to those expressed by Vizcaino & Mendez (2014). With adequate conditions, it is possible throughout time, that the organization modify its actions and style to interact with the different members (González, 2014; Garcia Velázquez, et al 2017).

DATA AND METHODOLOGY

To contrast the expressed hypothesis, it was necessary to analyze various aspects that would permit us to gather trustworthy data to bring about the adequate comparisons. We present the detail in Table 1 of the

analysis group characteristics. We see an increase of staff from 2013 to 2018 and the applied surveys also increased.

Table 1: Faculty Professor Population 2013 and 2018

Year	Assigned Professors	Surveyed Professors	Response Percentage
2013	92	31	33%
2018	103	45	43%

Table 1. The table shows the staff population that existed at the Faculty in the applied periods of 2013 and 2018. It is possible to observe a slight increase in staff to meet the needs of the students. In the same manner we were able to increase the surveyed staff elevating the percentage to 10% in the second case.

The questionnaire was designed and applied to the first survey. The survey instrument was composed of 135 questions grouped into 13 factors. The questions were posed to obtain a response using a Likert 5 scale. For comparison, in group results, diverse techniques were utilized to locate main differences. The questionnaire starts with a comparison of means by using chi square for each variable. A concentrated variable is generated for each factor that consists of an average of all responses in this group. With this information, a radar type graph is presented that expresses the satisfaction for each factor. The graph presents a scale that is not from 1 to 5. Rather it is amplified from 3.5 to 4.2 to observe changes in the different faculty groups. As the line measurement in this polynomial nears 5 it indicates that perception of the organizational climate is better. In the same manner, when the line is closer to the center of the graph the organizational climate perceived is less pleasant. Statistical tests were conducted including factorial analysis, correlation analysis and a level of reliability. The statistical analysis was completed using SPSS version 22 software. By way of background, factorial analysis provides a way of looking for information in a questionnaire that permits identification of the existence of a group of responses that are identified in groups with similar characteristics to find existent correlations among the data (Sanchez Villegas et al, 2014).

Subsequently, multiple correlation is conducted to identify how, through a strategy of variable relations, we can identify the validity of the model starting from the lineal relations among the variables. The necessary conditions were satisfied to carry out this analysis. These conditions include presenting a minimum of 20 observations (Schervish, 1987). A reliability analysis is contemplated that permits identifying, how the sample can represent with confidence the data compiled by its counterpart. We also hope the completed questionnaires result in the desired variability and not in a mechanical way, maintaining the consistency and stability of the values found (Cohen & Manion, 2002). The two questionnaires were given to faculty in attendance when we decided to complete the survey. Questionnaires were given to the faculty in attendance. The selection was random without reason to exclude anyone. The first application corresponds to 2013 where all the questionnaires were in paper form. For the 2018 event, part of the faculty received a paper questionnaire and others received it electronically through a link to a page designed for this purpose. All the data was collected in a general file, therefore there is no paper/electronic response percentage available. The questionnaires were anonymous, but a control was instituted to avoid any duplication of responses. The surveys were carried out in the month of May for both years. May is identified as nearing the end of the school cycle. The questionnaires were directly given to the faculty by the investigators and in a few cases by students aiding in the process. After return of the faculty' responses, the questionnaires were reviewed to insure all the questions were answered. Table 2 shows the components of organizational behavior.

Table 2: Components of Organizational Behavior

Nr.	Name	Conditions
1	Organizational Structure	How is the structure integrated in the organization
2	Objectives	Organization’s goals
3	Decision making	How the decision making affects the individuals
4	Leadership	Guidance to achieve goals
5	Motivation	Actions of leaders to improve work
6	Communication	Dual messaging to the community
7	Values	Ethical values
8	Psychological	Psychological factors influencing the organization
9	Social environment	Interaction amongst people
10	Personal	Personal conditions that may affect companionship
11	Physical environment	Physical conditions allowing the performance of work
12	Linkage	Links between the organization and the exterior
13	Technology	Technology used to do the daily activities

Table 2: The organizational climate components. From the analysis of various authors, a system was designed contemplating 13 components (also called factors) that permit identification of how characteristics of the organizational climate can be studied.

RESULTS

We initiate the analysis through the comparison of methods obtained for the data. This is done by means of a table that expresses the simple way the values obtained and the data differences for the two sample periods. The first statistical result is presented in Table 3 which gives a comparison of the percentages obtained for each factor in the two sample periods. The results reported in this data are a simple frequency analysis. Some 10 negative differences stand out and only 3 positive.

Table 3: Comparative Averages of Perception of Organizational Behavior

Factor	2013	2018	Difference
Organizational Structure	3.52	3.45	-0.07
Objectives	3.96	3.90	-0.06
Decision making	3.82	3.75	-0.07
Leadership	3.59	3.53	-0.06
Motivation	4.10	3.92	-0.18
Communication	3.52	3.52	0.00
Values	3.94	3.78	-0.16
Psychological	4.08	3.96	-0.12
Social environment	3.66	3.64	-0.01
Personals	3.53	3.59	0.06
Physical environment	3.97	3.86	-0.10
Linkage	3.33	3.38	0.05
Technology	3.93	3.80	-0.13

Table 2: Results in the Accounting and Administration of the Academic Unit of organizational climate perception of the faculty in 2013 and 2018. At a quick glance, it is evident that there exists a decrease of climate perception after the two questionnaires were applied.

As can be observed in Table 3, differences exist, but they are negative, suggesting that the climate perception has been deteriorating. Faculty simply do not consider the working conditions at the school to be adequate. These same differences can also be observed in Figure 1. Figure 1 shows the means used in

2018 are closer to the center of the graph giving us the same lower perception. We can interpret this figure in such a way that if the measure were closer to the value of 5 the organization perception of the organizational climate is better. To the contrary, a data closer to the center would indicate a less favorable perception of the organizational climate. Observe that some data differentiates because the lines distance themselves from the faculty' perception of the organizational climate. In Figure 1, we observe data that presents the most difference is relative to the Motivation and Psychological factors. Notice how the second survey has values closer to the center of the graph, which makes for a less favorable perception of the organizational climate.

Figure 1: Faculty Perception of Organizational Climate

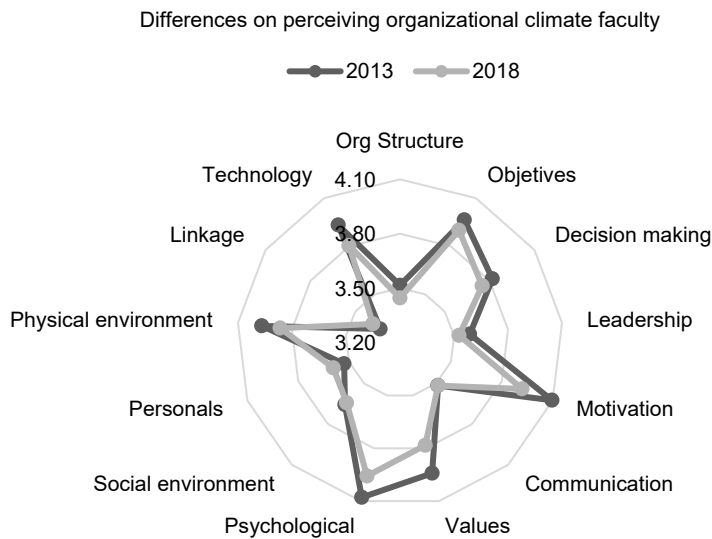


Figure 1. The Organizational climate differences of the Faculty. The corresponding line of faculty perception is closer to the center of the graph in 2018 which indicates a less pleasant environment during this period.

Factorial analysis, with the intention of reducing the variables, indicates a perception that in both years there is only one component that can describe the combination. The result is the grouping of all the given variables. These characteristics are found in both surveys. The other components represent low values of the variables that are not worth studying. The main difference of the data of 2013 and 2018 is that in the first sample the component describes up to 77% of the variance, and the second is reduced to 74%. This data is shown in Table 4, which shows how the combined variables are presented in the groups with similar characteristics.

Table 4: Explanation of the Total Variance 2013

Component	Initial Auto Values			Sum of the Load to the Square of Extraction		
	Total	Variant %	Accumulated %	Total	Variant %	Accumulated %
1	10.029	77.148	77.148	10.029	77.148	77.148
2	0.672	5.171	82.318			
3	0.599	4.609	86.927			

Method of Extraction: Analysis of Principal Components

a. Median = 1.00

Explanation of the Total Variance 2018

Component	Initial Auto Values			Sum of the Load to the Square of Extraction		
	Total	Variant %	Accumulated %	Total	Variant %	Accumulated %
1	9.719	74.758	74.758	9.719	74.758	74.758
2	0.684	5.264	80.023			
3	0.452	3.480	83.502			

This table shows a comparative of factorial analysis differences perceived by faculty in the organizational climate of 2013 and 2018. This examination utilizes principal components. Median = 2.00. There exists a great component that involves all the variables that describe the variants of the data in 77% and 74% of the values found.

Table 5 shows the components resulting from the factorial analysis applied to the two groups of data. Repeated situations are present in both years. For 2013 and 2018 the data presents a single component which can be expressed as small variations that should be analyzed in more detail with another type of statistics test. Table 5 shows the loads that exist between results of the samples obtained from factorial analysis. In this situation there is an increase in the psychological and physical environment, ethic value factors among others. In the rest of the results, as shown in the median difference the results remain less favorable.

Table 5: Load Comparisons of the Matrix Components 2013 y 2018

Component Matrix ^{a,b}	2013	2018
	Component	Component
	1	1
Psychological Fact.	0.759	0.798
Personal Characteristics	0.851	0.805
Social Environment	0.933	0.913
Physical Environment	0.749	0.797
Organizational Structure	0.860	0.826
Communication	0.928	0.899
Leadership	0.875	0.834
Technology	0.877	0.832
Motivation	0.871	0.894
Linkage	0.924	0.863
Ethic Values	0.882	0.901
Objectives	0.941	0.916
Decision Making	0.940	0.944

Table 5 gives the loads of the variables that constitute the organizational climate expressed in the years 2013 and 2018. There are small changes, but they demonstrate slight variation which defines a decrease in the organizational climate perception. Method of extraction: analysis of principal components a. Mediation = 1.00, 2.00 b. 1 component extracted.

Spearman’s correlations produced significant correlations in both samples with the following exceptions: the first sample only has two variables that do not have meaningful correlations, lower to 0.01. In the second sample there exists only one correlation with a significance value lower than 0.01. When the differences of means are applied comparing 2013 with 2018, we find no significant differences. Of all the variables we realize 8 results where there exists a statistical difference from the 135 total. Significant variables are appear in Table 6. The difference in the variables has to do with freedom of expression of ideas and the sentiments toward authorities. A difference exists in the treatment of the installations, and there is a difference in companionship. Recognition of the best members appears as a variable with a statistical difference, as well as with personal fulfillment, the assistance among them and a respectful coexistence.

Table 6: Statistically Different Variables

2013	2018
Freedom of expressions of ideas exist and sentiments toward the authorities	Your fulfillment as a member of the University
Are the installations and equipment given adequate treatment	The level of assistance between companions
The companionship factor influences the daily activities	The use and behaviors affect the daily coexistence of the University
The University recognizes the best members	The members of the University coexist respectfully

Table 6 shows the loads of variables that constitute the organizational climate. Results are presented expressed in the two moments 2013 and 2018. There exist small changes, but they have slight variation which defines a diminishing in the perception of the organizational climate.

This same analysis was applied to the factor differences as suggested in Table 4 and in Figure 1 which perceives this difference. The chi square test results do not have a significant value at the 0.05 level and even less at the 0.01 level which indicates that there is a different perception condition.

CONCLUDING COMMENTARIES

The objective of this work is to analyze changes in the organizational climate perception by the faculty in a business school. The analysis involved distributing two questionnaires to the incumbent staff. After applying an analysis of frequencies, factorial analysis, Spearman’s correlations and chi square tests the results are not statistically significant. We conclude the expected difference does not exist. Various analyses were carried out to demonstrate a difference in the organizational climate perception of the faculty. Even though the differential of means suggests there is a difference, the chi square test rejects that this situation exists. Other analysis, such as exploratory factorial and correlations give similar results showing a lack of significance. Even though there are differences in the means, the factors analyzed, are not significant. The results from the applied analysis with the chi square test demonstrates the contrary. This analysis is limited to the the applied questionnaires and to the geographical and political context both university and the country where it is located. The implications are necessary to pinpoint how, after having found procedural changes made by the directors, no significant statistical difference was found. Actions by the directors and the faculty, are very different where the sample was applied. An increase of students by group, aids the faculty to participate in conferences or investigative projects. Even though the faculty can perceive this difference it does not impact the global vision of the organizational climate. From the results obtained we conclude there is no statistical evidence to reject the hypothesis that there is a difference in the perceptions of the faculty in the organizational climate in 2013 and 2018.

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IMPACT OF DATE OF STUDENT ENTRY ON ONLINE HIGHER EDUCATION

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ABSTRACT

Online education has never been more relevant than after the pandemic in 2020. Many classrooms moved to the online format for the first time. This study looked at how date of student entry and activities in online learning affect final grades and student-reported learning in higher education. The author considered undergraduate and graduate students at an online university to learn whether early entry into a class could predict final grades of students. There was significant correlation between date of student entry and grade, especially for the undergraduate students, with weaker predictability for graduate students. The number of keyboard/course clicks within the online class by a student was found to be a predictor for students' performing well and for those students who were struggling with the content.

JEL: O31, T21, C80

KEYWORDS: Online Learning, Education, Date of Entry, Course Clicks, Perception of Learning

INTRODUCTION

In the post-pandemic era, distance education is required at many colleges. Online learning presents a new era not only for many students, administrators, and faculty, but for education strategists, data analysts, and statisticians. The time has arrived for further understanding of how to support online student learning. Unlike historical planning, which led to stagnation, strategy is used for reorienting learning organizations into new directions for managers and educators (Ansoff, Kipley, Lewis, Helm-Stevens, Ansoff, 2019).

Research shows steadily increasing motivation relating to career and employment goals among online students. Sixty-nine percent of online students identified employment as their primary goal for entering a degree program (Best Colleges, 2019). It is more likely that successful employment could occur if the individual has been successful in college. With thousands or tens of thousands of dollars invested in college tuition and preparation time, graduates may become financially overwhelmed, adding pressure in an uncertain job market (Selingo, 2016).

According to Shacklock (2016), learning analytics includes measurement, collection, analysis, and reporting of data about students and their contexts, to understand and optimize learning and its environments. In a similar definition, predictive learning analytics is looking at statistical measures of historical and current research from learners and the process of learning to create predictive models that improve the learning environment.

Colleges collect data on students, the classes they take, and the grades they receive; however, they are not doing enough to capture the predictions of students' success in data-driven businesses, such as health care, information technology, or even transportation (Anderson & Staub, 2015; Testa, 2008). Higher education needs to look for patterns in attrition rates, based upon student participation and completion of degrees. They need to pay attention to the growing role of educational online environments to find out more about

student participation and perception of learning. Tracking time-based data points in the online classroom can bring new insights into education outcomes (Armstrong, 2019). Currently, most data consist of attendance records, graduation rates, and standardized testing. There is a need for more specific, tangible indicators of student outcomes.

The following research questions will be discussed: 1) To what extent does the date of student entry to a class predict the final grade? 2) To what extent does the number of keyboard/course clicks in the online class predict final grade? 3) To what extent does the number of keyboard/course clicks predict student perception of learning? Date of student entry is explored as an indicator of early engagement and adds to the body of knowledge for online education tracking. This study will fill the research gap to better understand if those students who arrive in the online class early earn higher achievement levels. Thus, this study will consider whether date of student entry in the class impacts online learning. The overarching goal of improving educational tracking guidance is for students to become better prepared for the future workforce.

LITERATURE REVIEW

There are promises and pitfalls in online education. It breaks the boundaries of time, space, age, and reality, and it is extremely open (Zheng, Jiang, Yue, Pu, & Li, 2019). Because there is not as much supervision as in a traditional classroom, students must be self-motivated and organized. Online education is free of barriers between students and other students, the teachers, the platforms, or other roadblocks that could get in the way of interaction with learning. Of course, these are also the ways that learning happens in online education. This freedom to learn challenges students' abilities to work independently. There is a positive relationship between innovativeness and using online technologies, especially for those who are seeking information, such as learners (Roehrich, 2004).

Problems with online learning include lack of standards in quality, failing to achieve real learning outcomes, recognizing real learning, and lack of emotions from students online. Using data available from online tools, there has emerged new learning behavior analysis and new techniques for researching these behaviors (Carlson-Landy, 2012). The data of learning behavior is the data generated, such as the number of keyboard/mouse clicks, length of study, progress of learning, and activity, completed by the learner during the learning process (Zheng, et al., 2019). In some instances, students perform worse in the online class, especially if they have a weak grade point average (GPA) at the start of the term (Bettinger, Fox, Loeb, & Taylor, 2017; Bettinger & Loeb, 2017). Online or face-to-face delivery method showed no difference in student learning with undergraduate business students (DiRienzo, Lilly, 2014).

Clicks can be collected in keyboard/mouse clicks to gain insights into how students learn in the online classroom. This tool can be supportive and non-invasive monitoring for faculty to learn students' level of success (Rodrigues, Gonçalves, Carneiro, Novais, Fdez-Riverola, 2013). Some studies found that online and offline learning are essentially similar. Interactive learning in the online classroom can be essentially the same as learning in on-campus classes regarding pass rates, final exam scores, and performance on standardized tests (Bowen, Chingos, Lack, & Nygren, 2014).

Research in the online classroom considers relevant factors such as knowledge level, student demographics, and final grades with Pearson correlation coefficient algorithms. Zheng's research team in China used this Pearson correlation coefficient methodology and found that, although there were several problems with online learning, there was a correlation with the number of logins, time spent learning, and interacting led to increased student scores in the class (Zheng, et al., 2019). Time spent learning may be connected to personalities or lifestyles (Settle, Alreck, & Glasheen, 1978; Valette-Florence and Usunier, 2001). Personal value systems can contribute to how people spend their time which, for students, can amount to many hours spent in formal learning.

Education researchers (Zheng, et al., 2019) looked at online students in China to find out their learning behaviors. The researchers developed a neural network classification algorithm to see what factors affected student performance, using big data or machine learning to predict future outcomes. Overall, the researchers hoped to improve learning efficiency by studying which practices work for transforming education to the online classroom. Predictors of success include age and experience in online classes (Carson, 2011).

Predicting how students will achieve and complete at scale with big data has been studied to better understand students at risk of not completing their degrees (Herodotou, Rienties, Verdin, and Boroowa, 2019). Predictive Learning Analytics (PLA) says that it is necessary to capture and analyze the perceptions of those educational stakeholders, such as managers, teachers, and students. Teachers would like to predict which students might be at risk of failing in their class (Ferguson, 2012). Procrastination can affect final grade performance for online students in higher education, measured from the date of first access to the date of the first test (Elvers, Polzella, & Graetz, 2003).

Scaling predictability of student success or failure is a longitudinal challenge for the future (Herodotou, Rienties, Hlosta, Boroowa, Mangafa, & Zdrahal, 2020). Companies like Teradata are looking at this in new ways today. Tracking time that students spend in the online classroom produces new insights from the data and may predict what the grade will be based on factors, such as start times and end times in the platform. They can also track when students take a break, move to another learning resource, and track geography of students while learning on the go (Armstrong, 2019). Digital devices most people carry may also unlock new skills for advanced learning. Mobile devices from companies such as CourseKey now collect classroom data for attendance and participation.

In a study that analyze student engagement, student log times, tone and narrative, and keyboard/mouse clicks were collected in the form of days active, weeks active, forum posts, videos watched, problem submissions, time on task, and average problem score (Fincham, Whitelock-Wainwright, Kovanovic, Joksimovic, van Staaldunen, & Gasevic, 2019). The data revealed that academic and behavioral engagement are complicated. The conclusions were that each student's background and the course design must be considered for determining levels of engagement.

The response rates for end of course surveys can be problematic for measuring the adequate validity and reliability (Nulty, 2008). The challenge is to get a high response rate from students to self-report what they learn, especially if students never see the results of their responses. Infrequent, short, simple, and anonymous results should be displayed after the student completes a surveys (Moss & Hendry, 2002). Electronic End-of-Course surveys are best practices for educators when they require this consistently (Eveslage, Wilson & Dye, 2007). Online education student surveys were conducted (Eom & Ashill, 2016), and the strongest predictors of user learning outcomes were course design, instructor, and dialogue. Eom & Ashill, 2016 found that intrinsic student motivation affected learning outcomes.

DATA AND METHODOLOGY

The following research questions will be discussed:

To what extent is the date of student entry to a class predict the final grade?

To what extent will the number of keyboard/course clicks in the online class predict final grade?

To what extent will the number of keyboard/course clicks predict student perception of learning?

The data set contains a total of 516 cases with 296 cases undergraduate students and 220 graduate students. Multiple sections of one undergraduate and one graduate level course at National University were reviewed during an 18-month period for analysis of date of student entry as a predictor of academic success for these students. In addition to final grade data, self-reported data was collected through End of Course (EOC)

surveys. Data sets were analyzed to look for predictors. Multiple Regression Analysis will determine the predictors of student success. The primary dependent variable Y is student final scores in the course (0 to 100). The independent variable X is the date that the student enters the class for online learning, (day 1, 2, 3, etc.), as time stamped by the course electronic signature. Students can enter the class on day 1, one day before the official start date, at the earliest. Each keyboard/mouse click represents one student making one entry one time in the online class and are presented as totals for the term. That independent variable was collected to see the relationship to final grade. No other personal or demographic data is used for this study, which is discussed in the limitations. Correlation will describe the degree of association or concomitant variation between the two independently measured traits.

Student course data comes from National University’s Learning Management System (Blackboard) via the University’s Center for Institutional Learning (CIL), and EOC data is from the Institutional Research Department. Student enrollment and grade information were matched with hidden identification numbers. Dates of entry and perception of learning were tied to a specific student ID. The student ID info is hidden and anonymous. Students take one course per term, which lasts four weeks. Student data is voluntarily collected monthly through the EOC surveys from several different full time and part time faculty members teaching these classes during the study duration, which was 18 months and 18 courses, half graduate and half undergraduate. Students indicate their own Perception of Learning, i.e., “gain significant knowledge about this subject” (ranked 0-5, 5 is highest), which was a second independent variable. This data was all previously collected. No human subjects were identified, and IRB permission was granted in advance of the study.

Information on withdrawn students was removed from the data findings because of no final grade in the class. Dropping classes and attrition could be related to specific instructors or personal life issues, not just with the content and ability to learn, and is a threat to internal validity. There were often 4 to 5 students per class who dropped within the first ten days of the class.

A set of linear regressions and quadratic regressions were performed on the student data. The independent variables include First Access Day (date they log in to course) and Course clicks (keyboard/mouse strokes), both of which are numeric variables. The dependent variable for the main model is the total grade across undergraduate and graduate students. One additional dependent variable is Perception of Learning. Perception of Learning was measured for one third of students (n = 172) in the data sets. Total grade was measured for all students.

RESULTS AND DISCUSSION

The following are the findings of the analyzed data from the predictors of student success study. The analysis indicates relationships in both engagement and activity as they relate to the final grades and reported learning in higher education for online classes.

Research Question 1. To what extent did the date of student entry to a class predict the final grade? Date of student entry was more correlated with undergraduates, therefor a steeper regression graph. (.14) than with graduates (.06). The formula for this relationship is slightly different due to different course point values for total grades.

$$Total\ Grade = -0.369 * First\ Access\ Day + C\ (constant)\ for\ undergraduates \quad (1)$$

$$Total\ Grade = -0.236 * First\ Access\ Day + C\ (constant)\ for\ graduates \quad (2)$$

Undergraduates may have been less engaged with the learning platform and with online education resources in general, so date of entry was a significant factor. The first day they access could help determine what

their grade is, all other factors being equal. Those who start early may be more eager to learn, prepared, engaged, and earn higher grades (Table 1).

Research Question 2. To what extent did the number of keyboard clicks in the online class predict total final grade? Keyboard clicks impacted the student grades only to a certain level. The study found the more they clicked, the higher the grade; after a point, these clicks indicated the desperation of a student struggling with the content (Figure 2). The formula for this relationship for undergraduates is:

$$\text{Total Grade} = -0.0000392 * \text{CourseClicks SQ(Squared Term)} + 0.185 * \text{CourseClicks} + C (\text{constant}) \quad (3)$$

Research Question 3. To what extent did the number of keyboard clicks predict student perception of learning level? The number of keyboard clicks has a correlation (R square=0.152) that can indicate a positive perception of learning to a certain threshold (Table 3).

$$\text{Perception of Learning} = -1.1 * \text{CourseClicksSQ (Squared Term)} + 2.469 * \text{CourseClicks} + C (\text{Constant}) \quad (4)$$

Figure 1: Total Grade (Undergraduate) to First Access Day Correlation

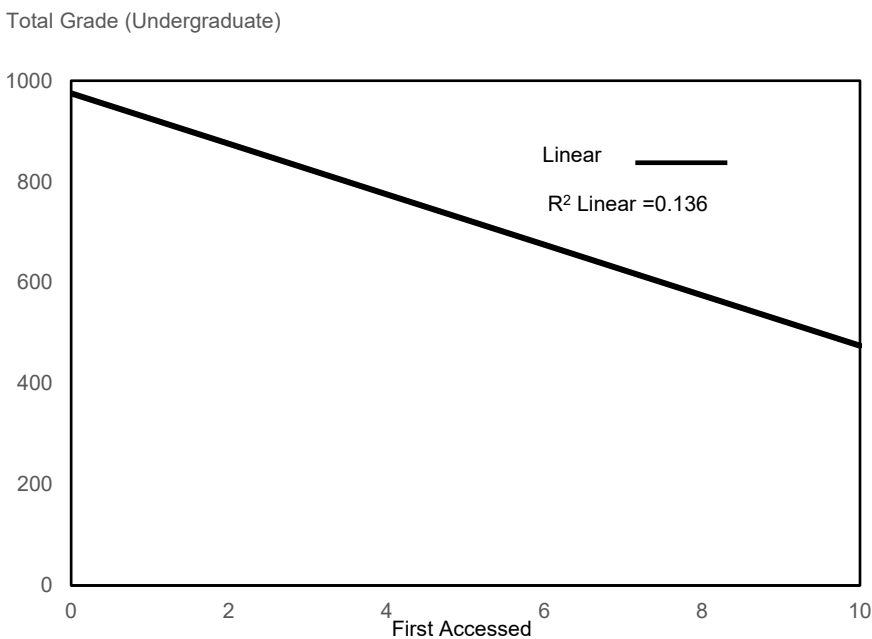


Figure 1 shows a negative correlation (R square= 0.136) This means that students who access the online class in the early days will more likely have higher grades at the end of the course. There is a negative, linear relationship between these two factors total grade and date of student entry to class.

Table 1: Undergraduate, Graduate Students First Access Day to Total Grade, Undergraduate Students Course Clicks to Total Grade

R	R Square	Adjusted R Square	Std. Error of the Estimate	
Undergraduate Students First Access Day to Total Grade	0.369	0.136	0.133	122.4669
Graduate Students First Access Day to Total Grade	.236	0.055	0.051	169.9516
Undergraduate Students Course clicks to Total Grade	0.320	0.102	0.096	125.0428

The first two sections of the table show the linear negatively correlated relationship between First Access Day and Total Grade for undergraduate students (0.136) and graduate students (0.055). The third part of the table shows a non-linear pattern, a correlation between undergraduate students Course Clicks to Total Grade (0.102).

Research Question (1) To what extent does the Date of Student Entry to a class predict the total grade?

A linear, negatively correlated relationship between Date of Student Entry and Total Grade (i.e., is found ($P < .0001$) for undergraduate students. This means the earlier a student accesses the course materials, the higher their total grade will be. The first access day accounts for 14% of the variance in a student’s final grade. ($R^2 = 0.136$) Figure 1 and Table 1 shows that there is a significant relationship (14%) between date of entry to a class and the final grade.

As with the observations on undergraduates, a linear, negatively correlated relationship between first access day and total grade (i.e., Total Grade) is found ($P < .0001$) for Graduate Students. This means the earlier a student accesses the course materials, the higher their total grade will be. However, for graduate students, the effect of the first access day is much smaller with a R^2 at 0.055 explaining approximately about 6% of the variance in the student’s total grade (Table 1). This leaves a great deal of room to think that there could be other much stronger predictors on the total grade for graduate students. Table 1 indicates that there is not as strong a relationship for accessing the class early, as we saw with undergraduate students.

Research Question (2) To what extent will the number of keyboard clicks in the online class predict the final grade?

The study considered the relationship between undergraduate students’ course clicks and total final grade (Table 1). Unlike first access day, course clicks do not translate into a straightforward linear increase on total grade. Course clicks has a non-linear, quadratic relationship with total grade ($R^2 = 0.102$). This means the total grade will tend to go up when the student’s course clicks increase.

However, after a certain threshold, increases in course clicks will result in a lower total grade. The implication is when course clicks exceed a certain threshold, that could signal to the teacher that a student might be challenged with the course materials. Based on this data, the finding in Table 4 indicates that there two types of students, one who clicks as they learn and another who click when they are not understanding the course content, which is demonstrated by the slope after the quadratic curve hits the peak in Figure 2. Table 4 indicates both the linear regression term and the quadratic regression term are statistically significant.

Table 4: Undergraduate students Course Clicks Regression Coefficients^a

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	693.154	30.771		22.526	***
Course clicks	0.185	0.142	0.791	4.461	***
CourseClicksSQ	-0.0000920	0.000	-0.548	-3.090	***

^aDependent Variable: Total Grade. ***, ** and * indicate significance at the 1, 5 and 10 percent levels respectively.

Figure 2 indicates the quadratic equation for undergraduate students of the total grade to course clicks indicating course clicks’ positive relationship with total grade up until the peak in the curve. Note that the bulk of the clicks are between 500 and 1500 clicks.

Figure 2: Undergraduate Students Total Grade to Course Clicks Squared

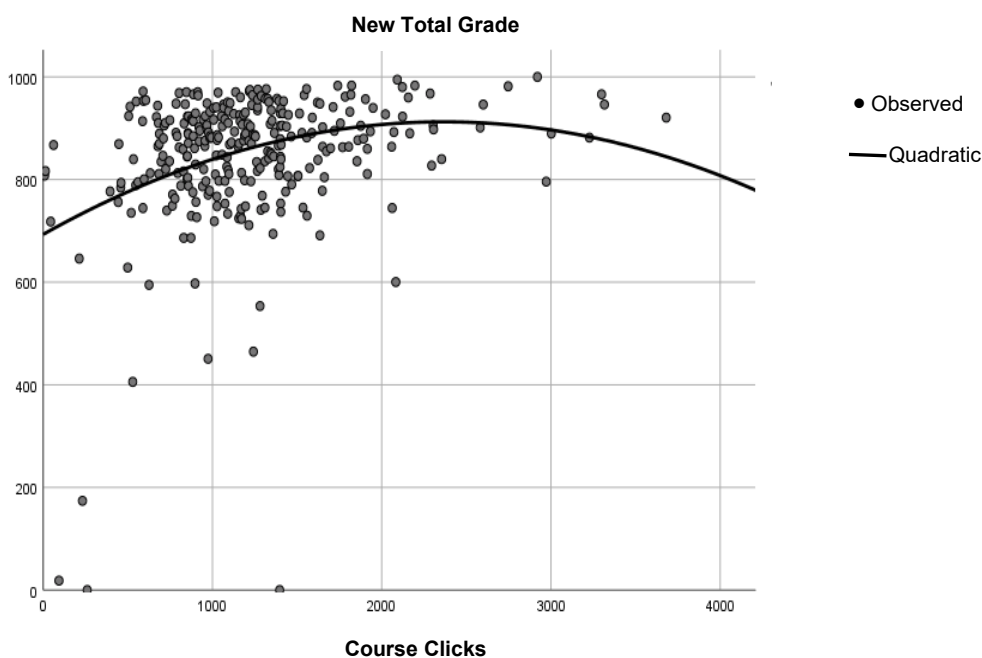


Figure 2 shows the relationship between Undergraduate Students Total Grade and Course Clicks. Each dot represents one student. Most students have between 500-1500 clicks in the course and most grades are between 85-95% in this figure.

In the case for graduate students, course clicks have a small but significant, positive linear relationship with total grade ($R^2=0.073$, $P<.0001$). The formula is Total Grade = $0.271 \times \text{First Access Day} + C(\text{constant})$. There is no figure presented because the quadratic equation line would not be meaningful.

Table 3 Graduate students Course Click and Total Grade; Course Clicks and Perception of Learning

R	R Square	Adjusted R Square	Std. Error of the Estimate
Graduate Students Course Clicks and Total Grade			
0.271	0.0723	0.069	168.3367
Graduate Students Course Clicks/Perception of Learning Model Summary			
0.390	0.152	0.134	0.843

Table 3 includes the graduate students course clicks in summary. The first section is about the graduate students' course clicks and total grades. Graduate student course clicks have a small but significant, positive linear relationship with total grade ($R^2=0.0723$, $P<.0001$). The second section is about graduate students clicks and the perception of learning from end of course evaluations. The number of keyboard clicks has a correlation (R square= 0.152) that can indicate a positive perception of learning.

Research Question (3): To what extent will the number of keyboard clicks predict student perception of learning?

Course clicks are not found to be significantly correlated with perception of learning among undergraduate students. Unlike the observations on undergraduate students, course clicks are found to have a significant correlation with perception of learning for graduate students ($P<.001$). Specifically, an increase in course clicks translates into a positive perception of learning up until a certain threshold. Table 3 includes the graduate students course clicks in summary. As mentioned earlier, the formula is Perception of Learning = $-1.1 * \text{CourseClicksSQ}$ (Squared Term) + $2.469 * \text{CourseClicks}$ + C(Constant).

Table 4 provides the influence of course clicks on the perception of learning for graduate students in the unstandardized and standardized coefficients. What this shows is that there is an increase in perception of learning as course clicks increase to a certain level or threshold, and then the perception of learning starts to decline despite even more increases in course clicks, which may be evidence of a student's struggle.

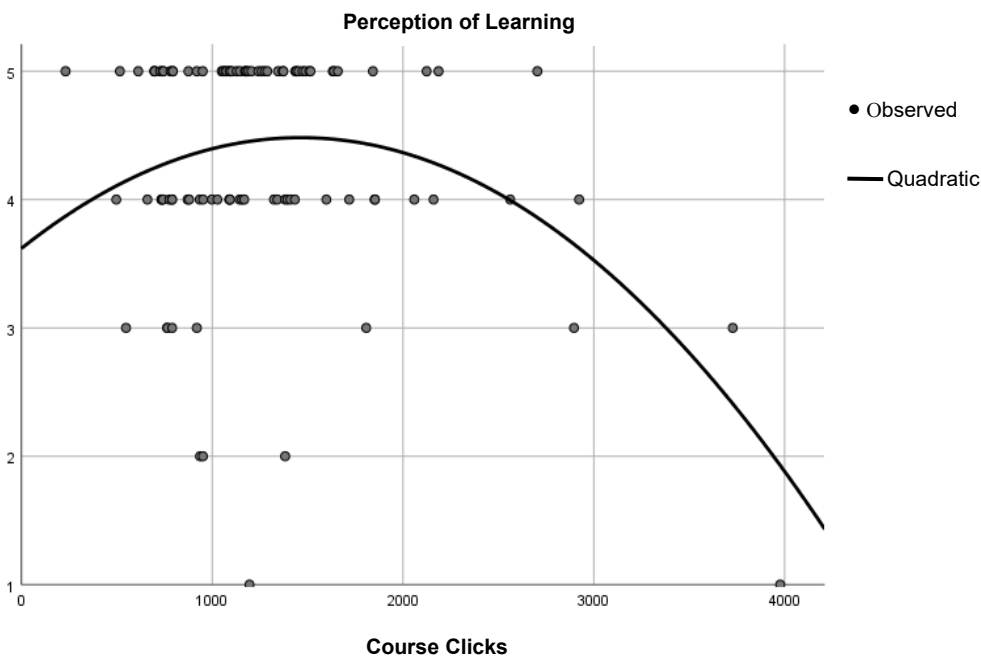
Table 4: Graduate Students Perception of Learning to Course Clicks Coefficients^a

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	3.620	0.389		9.304	***
Course clicks	0.001	.000	0.822	2.469	**
CourseClicksSQ	-0.0000004037	.000	-1.100	-3.303	***

Dependent Variable: Perception of Learning. Table 4 provides the course clicks on the perception of learning for graduate students in the unstandardized and standardized coefficients. With the increase in perception of learning, as course clicks increase to a certain threshold, the perception of learning declines, which may be evidence of need for help. ***, ** and * indicate significance at the 1, 5 and 10 percent levels respectively.

Figure 3 indicates the perception of learning for graduate students and the correlation to course clicks (CourseClicksSQ) where there is an increase to a level, but afterwards, there is difficulty and the perception of learning indicates a struggle with the content.

Figure 3: Perception of Learning to Course Clicks



The number of keyboard clicks to graduate student perception of learning has a correlation ($R^2=0.152$) that can indicate a positive relationship up until a certain threshold and afterwards, there could be a struggle of learning reported by students in end of course surveys (Table 4, Figure 3).

CONCLUDING COMMENTS

The study in summary was to better understand what successful student behavior data tell us. If accessing a class early will lead to a higher grade, higher perception of learning and more success, these are outcomes sought in the research. The data method in summary was reviewing 516 university student records of course activities, including date of access, course clicks, perception of learning, and total grades.

The findings in summary indicate that there are two segments of students: 1) students who study hard in the online classroom and do well and 2) students who are failing, but may not be able to get support and, therefore, fail. It would be good for the latter to have extra time for study or tutoring programs, such as 1-on-1 time with an aide or assistant teacher while the students are still in the course, rather than later.

Because date of access is somewhat relevant, but less predictive of student success, it could be recommended that students get a jump on their class early. Faculty can influence this by encouraging messaging and over-communication in the early part of the term or forming buddy groups for learning on day one. However, this may not influence the student's own perception of learning. If teachers are aware that there is a correlation between clicks and grades, and guidance provided about the data, perhaps they could determine what the student learning threshold is and, for students who struggle to that level, there could be an alert set in advance for the instructor to better identify those students who are more likely to fail and help them.

Based on the summary of findings, one of the recommendations may be to allow students to enter the class before the official start date, especially if it is their first online class. Students could become more familiar with the content, the format, the structure, and the outcomes that are expected. Those who start early may

be better planners, so students can be encouraged to know that early starts make a difference in final grades for some students, especially the undergraduates, with less education experience.

The limitations are that this study was conducted at only one university and in only one discipline. The variables did not reflect any demographic data or personality indicators. Attrition of students could invalidate some of the findings. For perception of learning, students self-selected. This may not have been representative of less engaged students, and it was completed during the final days of the class. Student learning may not always be recognized while still in the course. In the original study design, the author tried to find student satisfaction through annual graduation surveys, but the response rates were too low to include in this study (10%).

Future research could overlay student records, such as GPA, ethnicity, gender or number of courses completed. Other insights could come from personality characteristics of students to give additional insight to predict student success. Future considerations to minimize any threat to validity could include pre- or post-tests, i.e., students could be asked to participate in a survey. This survey could utilize a mixed methods approach, with both quantitative and qualitative research.

Further research could be about the distribution of the clicks. The more successful students may have an even distribution of clicks over time, while the struggling students may have bursts when they suddenly focus on an element that challenges them. Other research on date of entry could expand the sample size, with different academic disciplines, and long-term studies to correlate graduation rates of those who access early consistently. If students improve with each class, and they take between 10 and 30 courses, this could be extrapolated over their academic career. A study could look at students who arrive on later dates to see if they also turn in assignments late. Since day of access was clearly not the only predictor of final grades for graduate students, it would be interesting to test for other factors to learn more. This study could help create better course survey questions for student end of course assessments and post-graduation, for longitudinal data.

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12 ANGRY MEN: A BEHAVIORAL BIAS EXERCISE FOR FINANCE STUDENTS

Lynda S. Livingston, University of Puget Sound

ABSTRACT

*Undergraduate investments and portfolio management courses have traditionally prescribed the optimal choices for rational economic man—a creature who does not exist. Real portfolio choices, especially those by retail investors, are made by “normal” people, and normal people exhibit behavioral biases. In this paper, we use a classic play, *12 Angry Men*, to help students recognize the biases that have been highlighted in the professional Chartered Financial Analyst curriculum. This approach is engaging, “messy,” and fun, and it has helped my portfolio management students better appreciate the trade-offs that are necessary when putting theory into practice in the real world.*

JEL: G40, M2, A2

KEYWORDS: Behavioral Biases, *12 Angry Men*

INTRODUCTION

Investors are not the rational, expected return-maximizing automatons described by traditional mean-variance portfolio theory—as is obvious from the broad-market manifestations of “irrational exuberance” or herd behavior such as the 2021 run-ups of Game Stop stock or Bitcoin. Investors instead are creatures driven by emotional and expressive desires (Statman, 2017), operating in markets created by their own adaptation to their social, political, and economic environments (Lo, 2017). The curriculum for the premier professional finance designation, the Chartered Financial Analyst (CFA), recognizes this, noting “As a result of identified divergence between observed and theoretically optimal decision making, the global investment community has begun to realize that it cannot rely entirely on scientific, mathematical, or economic models to explain individual investor and market behavior” (Pompian, 2014a). Teaching students how to thrive in this less “rational” world requires novel assignments that go beyond simply teaching them to find a portfolio variance.

In this paper, we present a fun, motivating assignment designed to help students identify the types of behavioral biases addressed in curricula such as that of the Chartered Financial Analyst’s Level III (2014). (Earning a CFA charter requires passing three rigorous exams. Behavioral biases and their implications for client service are covered in the third. For an overview of the associated curriculum, see <https://www.cfainstitute.org/en/programs/cfa>.) Students are asked to identify common biases demonstrated by the characters in the play *Twelve Angry Men*. While this play’s film adaptations have been used before for pedagogical purposes—for example, by legal scholars illustrating jury dynamics (e.g., Sunstein, 2007) and by management scholars describing “interpersonal influence” (e.g., Buchanan and Huczynski, 2004)—our approach is novel in two ways. First, we focus specifically on an audience of finance students, rather than on general management students, allowing discipline-specific extensions; and second, we use the freely available (and much shorter) 1954 Studio One live TV version of the play. Using this version facilitates both the time and resource commitments that students and instructors must devote to the exercise.

The paper proceeds as follows. First, we review the pedagogical literature on the uses of *12 Angry Men* in the classroom, as well as the finance-oriented literature on behavioral biases. (For those unfamiliar with the play, we have included Vidmar, *et al.*'s, 2007, synopsis of the story in the Appendix.) We then turn to the individual biases exhibited by the characters, considering cognitive and emotional biases in turn. Next, we briefly consider the play's illustrations of group biases, both those depicted within the jury and those evoked in the audience. Finally, before concluding, we describe several possible teaching approaches that allow significant flexibility for instructors.

LITERATURE REVIEW

The exercise described in this paper relates most directly to three strains of research: investigations into behavioral biases, especially in financial affairs; pedagogical research into the use of film in classrooms, and especially the use of *12 Angry Men*; and, perhaps most interestingly, to studies of jury behavior. We discuss each in this section.

Behavioral Biases

From the enormous body of psychological research into heuristics and biases, the CFA curriculum highlights several relevant sets that include papers and books quite accessible to undergraduate finance students. The first set concerns four paradigms of behavioral finance that present alternatives to the construct of “rational economic man”: bounded rationality, behavioral portfolio theory, adaptive portfolio theory, and prospect theory. The second set, outlined in Table 1, describes specific behavioral biases that could affect financial decision-making. We will describe this set in detail, and identify relevant sources, as we identify examples of these biases in *12 Angry Men*. (An accessible, if somewhat cursory, introduction to these is Nofsinger, 2014.) In this section, we will consider the four paradigms in the first set of studies.

The first of these paradigms is bounded rationality (Simon, 1972), which acknowledges that people cannot actually assimilate all relevant information when making decisions. Our faculties are limited. Since we cannot truly optimize, we do the best we can and leave it at that. Simon calls this “satisficing” (from “satisfy” + “suffice”). As he concludes: “Whatever compromises [the decision maker] must make with reality in order to comprehend and cope with it, [heuristic models] make substantially more tractable the task of matching man's bounded capabilities with the difficulty of his problems.”

In behavioral portfolio theory, the second paradigm, this “matching” becomes explicit. As people attack the task of creating a portfolio, they match assets to goals, creating a layered pyramid. The base layer, for example, could represent the safety goal; bonds and cash are deployed here. Successive layers add risk and become increasingly aspirational. This approach reflects the cognitive biases of framing and mental accounting, as well as the emotional bias of self-control. As Statman (2017) stresses, it also reflects the nonpecuniary goals that drive investors—how investing makes people feel, and how it makes them appear to others.

Behavioral portfolio theory imagines risk as a shortfall. Similarly, adaptive portfolio theory (Lo, 2005) couches success as survival. Lo's paradigm draws on biology, ecology, mathematics, and economics to conclude that today's heuristics (e.g., loss aversion, overconfidence, and mental accounting) were yesterday's environmental adaptations. Just because some behavior seems odd now does not mean it was not beneficial in an earlier environment. Students who are interested in behavioral finance should read Lo's accessible popular treatment, *Adaptive Markets* (2017), in which he fleshes out these interdisciplinary connections in memorable ways.

Of the four behavioral paradigms covered by the CFA curriculum, my students are usually most familiar with prospect theory (Kahneman and Tversky, 1979), which is covered in many of their introductory

economics courses. Prospect theory is also arguably most directly related to the specific covered biases, since Kahneman and Tversky first rigorously identified many of them. Prospect theory asserts that individuals view losses and gains differently: losses are felt more acutely, and investors facing losses may actually prefer risk to certainty (which for gains they do not). Losses are measured relative to some (mobile) reference point (e.g., perhaps a stock's buy-in price, or perhaps its high price for the year). In contrast to rational economic man, real investors do not do a great job assessing probabilities, and may, for example, overreact to some small-probability events. Students interested in this theory, and in the biases investigated by Kahneman and Tversky, should read Kahneman's wonderfully entertaining and educational book *Thinking Fast and Slow* (2011).

Later, we will see the jurors from *12 Angry Men* demonstrating aspects of each of these behavioral paradigms. Before considering those, however, we turn first to the play's relationship to the pedagogical and legal literature.

Teaching with *12 Angry Men*

Video can be an excellent teaching tool. It can offer “new dimensions on old subjects, provid[e] meaningful embellishments to current curricula, or afford... educative experiences that no other medium can give” (McCambridge, 2003). Despite the initial shock of seeing something in black and white, old films can be especially useful, since “[l]ess-than-familiar classic films allow students to focus on communication patterns and concepts without distraction” (Proctor, 1991). For many who appreciate the pedagogical value of video, *12 Angry Men* has been a staple for years. In this section, we briefly review how instructors in several disciplines have used the film versions in the classroom. We then consider how the extras added by those films make the original play a better source for our purposes.

Law students are the most obvious audience for a classroom exercise with *12 Angry Men*, and indeed, many have used it. The story allows law students to see how a jury actually works—unlike most movies that just use jurors to connote legal time and place (there is a jury box, so we must be in a courtroom; nothing is happening, so the jury is still out). Since *12 Angry Men* takes us inside the “black box” (Bharara, 2019), it is “unique in the realm of popular culture” (Papke, 2007; see, also Hans, 2007, and Jimeno-Bulnes, 2007).

It is not just for law students, though. McCambridge (2003) uses the 1997 movie version of the play to teach management students about dialogue. His approach involves showing three to four five-minute clips in class, with subsequent small-group work—guided by prepared questions—asking students to evaluate things like the relative amounts of inquiry and advocacy in the characters' interactions and the jurors' progression toward effective dialogue. This focus is in keeping with Proctor's (1991) observation that the story is “frequently” used as a tool for demonstrating persuasion.

Marder's (2007b) approach is closer to ours, as she explicitly considers the depiction of some psychological biases in the script (e.g., “group bias”). However, she focuses in a very general way on prejudice (especially as it is demonstrated by juror #10); she does not consider the range of the cognitive and emotional biases covered by behavioral finance literature such as Nofsinger (2014), Lo (2017), and Statman (2017). Nonetheless, she does note that the jury's haste to reach a verdict (which she characterizes as “banal evil”) involves their desire to avoid the work of “serious thinking”—or what Kahneman (2011) would call “system 2” thinking.

Fried (1998) has her students consider a broader array of biases, specifically asking them to identify characters' belief perseverance biases (she asserts that juror #3 is “particularly prone to these cognitive shortcomings”). She also notes that the fact that the story was not explicitly designed to demonstrate social psychological principles is a strength: the examples are rooted in the narrative drive, and so are “messy.” Students must therefore engage more deeply with the material.

All of these authors use a film version of the story. However, the movies pad the play's narrative with details that are unnecessary for our examination. For example, we learn that it is the hottest day of the year and that the paper towel dispenser in the bathroom does not work. A guilty verdict means the electric chair. The defendant's father has been in jail for forgery, and the boy himself has lived in an orphanage. Hay (2007) interprets a lot of these new details as support for his thesis that the movie version of *12 Angry Men* is a religious allegory. However, for us, they are mostly immaterial.

(One bonus from the extra material, though, is that at least one author has used the details to demonstrate a bias himself. Garfinkle (2011), who uses the 1957 film version to explore "psychic barriers to truth," provides character sketches that can be used by instructors to illustrate the cognitive bias of representativeness. The best example is that of juror #2: "a mousy character, a bit of a milquetoast with a high voice who we later discover is a bank teller"; compare this to the description of Steve the shy neighbor who characterizes representativeness in Tversky and Kahneman, 1974.)

One important difference between the play and the 1957 movie version comes at the very end, when the protagonist, juror #8, and his first confederate, #9, exchange names on the courthouse steps after the verdict is rendered. In the play, we never learn the jurors' names—perhaps because they are meant to represent "Everyman" (Burns, 2007), people who choose their identities and are what they do (Hay, 2007). Their not having names may also strengthen the audience's own representativeness bias, as we discuss later.

A second important embellishment the films add is the race of the defendant. This detail has real-world implications according to empirical research on jury behavior, so we turn to that next.

Jury Behavior

Race plays a much more explicit role in the films than it does in the play. In the play, all we know is that the (unseen) defendant is one of "them." In the movies, we are told that he is Hispanic, and we see a brief shot of him in the courtroom. Actually seeing him underscores the fact that he is being judged by a jury of twelve white men (at least until the 1997 film version, which we are not considering here), and primes the audience's suspicion that he is not being judged by a jury of his peers.

Modern students will undoubtedly be quick to notice this racial disparity, as earlier commentators have been. Gertner (2007), for example, describes the jury as "wholly unrepresentative of the community," and Abramson (2007) summarizes his criticism by concluding that "the play's quaintness stems from its heroic image of the white man's burden." Nonetheless, Babcock and Sassoubre (2007) and Burns (2007) recognize considerable nonracial diversity within the jury, highlighting the clear differences in class, age, and occupation. Does the empirical record suggest that any of these demographic differences matter for the trial's outcome?

White-majority juries are, in fact, much more likely to convict Hispanic defendants, rather than white ones ("jury-defendant similarity bias"). Similarly, discrepancies between the jurors' socioeconomic status and the defendant's increase the probability of conviction (Devine, *et al.*, 2001). However, demographic differences are not determinative. For example, in civil trials, the gender composition of juries does not affect awards (Devine, *et al.*, 2001). More relevantly for us, Hans (2007) reports that first-ballot votes are not reliably explained by demographic factors; even if there are "gaps" in jurors' initial opinions associated with race, these are often overcome through deliberation (Abramson, 2007). This is obviously what we observe in the play. Perhaps presenting the audience with an apparently monolithic, potentially hostile jury makes this transformation all the more dramatic.

In addition to studying the aggregate composition of the jury, legal scholars have identified two specific participants in the trial who may be significant: the jury foreman and the judge. In both cases, *12 Angry*

Men offers interesting narrative choices—interesting, because both men are so boring. The foreman acts against empirical type: while he does sit at the head of the table, speak early, and call for votes, he does not participate as much as we might expect, and he is not particularly influential (see Devine *et al.*, 2001). He never challenges the protagonist, juror #8, for center stage. As for the judge, he appears only in the first minute of the play, but has nonetheless drawn relatively extensive critical commentary—all centered around characterizations of him as as “bored” or disinterested (see, for example, Hay, 2007). Empirically, judges seen as “less professional, less dominant, less competent, less dogmatic, and less wise” have been linked to guilty verdicts (see Devine, *et al.*, 2001). Thus, our introduction to the case, through the boring judge and the scan of equally bored-looking jurors, primes us for the early moments in the jury room when the jurors declare how obvious the defendant’s guilt is.

Nonetheless, the content of the judge’s boring speech also primes us for some “talk,” since he tells us that the jury’s verdict must be unanimous. This requirement is the reason the play lasts more than three minutes. As Burns (2007) asserts, the unanimity requirement generates social pressure to invoke the “coercive force of reason,” leading the unanimous group to make a better decision than an individual juror might. (Such a rationale for the unanimity requirement is not simply a question of theoretical or historical interest. From 1974 to 2018, Louisiana allowed convictions on 10-2 in non-death penalty cases; the U.S. Supreme Court’s decision that all state criminal trials require unanimous decisions was handed down only in April of 2020. See American Bar Association, 2020.) Students will almost certainly leave the play believing that the group’s work does lead to a just decision. However, that outcome was achieved only after a fairly epic struggle against a myriad of behavioral biases. We turn to those biases next.

COGNITIVE BIASES

The CFA curriculum classifies behavioral biases as either cognitive or emotional. Cognitive biases are errors in information handling: for example, misuse of statistical base rates or overreliance on trends when forecasting. These biases can be related to the assimilation of information (processing errors) and to cognitive dissonance (selective exposure, selective perception, and selective retention—called belief-perseverance errors). We begin with the processing errors: anchoring and adjustment, framing, availability, and mental accounting.

Anchoring and Adjustment

The cognitive bias of anchoring and adjustment describes both people’s preference for anchors and their tendency to insufficiently adjust those anchors. Anchors are reference values that help with estimates; instead of having to generate an estimate out of whole cloth, one can adjust a given anchor value up or down. These anchors can even be meaningless or random. For example, Kahneman (2011) describes study participants who were asked to estimate the percentage of African countries in the United Nations; people who had just seen a large number come up on a wheel of fortune chose a larger percentage than people who had seen a smaller number on the wheel. In civil trials, Devine *et al.* (2001) note that ad damnum clauses (which specify the damages sought by the plaintiff) act as anchors to awards; similarly, Kahneman (2011) asserts that capping awards at a specific maximum increases judgments that would otherwise be much smaller.

In *12 Angry Men*, the jurors make several estimates. They pace off distances and mimic the hobbling of an old man as they recreate the testimony of the downstairs neighbor. More relevant, however, is their consideration of the female eyewitness. First, juror #8 asks, “How long does it take an elevated train going at top speed to pass a given point?” This initially elicits a response of “I wouldn’t have the slightest idea” (from #4, whose “only concern is with facts,” according to his profile), but then “About ten or twelve seconds maybe” from #5. #8 pronounces this a “fair guess,” then asks for others; #11 and #2 then pile on with “about ten seconds,” anchoring on #5’s estimate.

Perhaps a more subtle example of the anchoring and adjustment bias is revealed through the sequence of votes cast throughout the play. Here, it is the audience who anchors. We have not seen the actual trial, so our first impression of the weight of evidence comes from the initial 11-1 guilty vote; this functions as our substitute for the prosecution's case. But since this vote occurs at the very beginning of the play, we are "primed" to expect much more to the story (Heller, 2006). We then assess juror #8's "progress" throughout the play as we watch him gradually convince his fellows to change their votes and join him.

The jurors did not need to start with a vote. As we learn from the foreman: "[y]ou gentlemen can handle this any way you want to... If we want to discuss it first and then vote, that's one way. Or we can vote right now to see how we stand" (Act 1). Marder (2007a) identifies these deliberation approaches as evidence-driven and verdict-driven, respectively. Jurors using an evidence-driven process attempt to construct a common narrative when evaluating evidence, while those using verdict-driven deliberations—like the *12 Angry Men* jurors—may instead use deliberations to search for evidence supporting their votes. Verdict-driven juries also may be more likely to find the defendant liable (see Devine, *et al.*, 2001).

Thus, the jury's "let's vote now" decision at the beginning of the play meant that juror #8—our protagonist—faces a tough room even before that first vote comes back 11-1. But that vote does make things much worse for him. Devine, *et al.* (2001), after reviewing hundreds of academic articles on jury behavior, find that "[t]here are compelling data from numerous studies indicating that the verdict favored by the majority of the jury at the beginning of deliberation will be the jury's final verdict about 90% of the time." In fact, with an initial 11-1 vote, the probability is 92%. Sunstein (2007) summarizes this by putting the odds of one juror's changing the other eleven's minds at "essentially zero." What will probably happen instead is that the prevailing opinion will strengthen as it is echoed around the room, converting early outliers to the majority's opinion and leaving the group's consensus even more extreme than the initial position of the median juror. (This may be what happened after the initial 11-1 guilty vote in the trial of the murderer of George Floyd in 2021; see *The Week*, 2021. Also see Hans, 2007, and Devine, *et al.*, 2001, for a review of the literature on this point; see Babcock and Sassoubre, 2007, for a real-life, #8-like counterexample, and MacCoun, 2012, on a theoretical explanation for it.)

Thus, we the audience anchor on the strong reflection of the persuasiveness of the prosecution's case and the improbability of jury movement, yet we are primed to expect some drama. Encouraged by juror #8's likeability (which we discuss further, below), we therefore are prone to see each new vote—as the jurors cast one, two, six, nine, and finally twelve votes to acquit—as progress toward justice, and we are grateful to #9 (who says, "He gambled for support, and I gave it to him") for allowing the deliberation to continue (see Abramson, 2007, on the importance of support for minority-position jurors). Our anchoring on 11-1 makes us even more satisfied at the end of the play with the jury's long-shot decision.

Framing, Availability, and Mental Accounting

The 11-1 anchor also creates the frame through which we view the jury's deliberations. We are notified at the very beginning that there is a very strong case for the defendant's guilt (or at least that the jurors believe there is); on the play's first page, we hear: "Six days. They should have finished it in two. Talk, talk, talk. Did you ever hear so much talk about nothing?" (#3); and "A kid kills his father. Bing! Just like that" (#10). As the play progresses, the jurors who strongly believe in guilt will frame their interpretations of the evidence through the lens of guilt, especially when the evidence is direct (Heller, 2006).

There are other frames employed by individual jurors. #3 sees the defendant as another disobedient child, like his own son; #7 sees him as a criminal with a long record. Juror #5, the juror who "lived in a slum all [his] life" and "used to play in a back yard that as filled with garbage," and #11, the refugee who has "suffered through so much injustice," are more disposed to be sympathetic to the defendant. #8, of course, provides the most comprehensive compassionate frame: the boy has "been kicked around all his life...his

mother dead since he was nine,” tough and angry as many “slum kids” are because “we knock ‘em on the head once a day, every day.” This frame, while alone insufficient to cause his colleagues to change their votes, is nonetheless the catalyst for the logical examination of the evidence that will.

The framing bias leads people to answer the same question differently, depending on how it is asked. In *12 Angry Men*, that question is usually, “Is this piece of circumstantial evidence consistent with the defendant’s guilt?” given how the narrative has been framed. However, as just noted, there are also more intimate frames that come from the jurors’ individual experiences. These experiences also affect how those jurors assess the probability of certain events, which is an example of the availability bias.

This processing bias leads people to link the probability of an event to how easily they can imagine it. Events that are memorably dramatic, or that occurred recently, are easier to recall, and therefore are assessed as more likely. Thus, for the audience, the fact that the play ends on a high note makes the “not guilty” verdict memorable, facilitating a type of availability bias that strengthens our conviction that justice was served (Kahneman, 2011). We see the availability bias demonstrated by the play’s characters, as well. Once they have a coherent narrative for the crime, the availability of that narrative makes it more apparently probable, despite contrary evidence (Heller, 2006). Events within a juror’s range of experience are also seen as more likely, so juror #3 assigns a high probability to a boy’s violently hating his father, and juror #5 expects that experienced switch knife-fighters will stab from below. One way to combat this bias is to actively search out new information and consult those with different experiences, a strategy that was imposed on our jurors by the very system that brought them together.

That the jurors do draw on very different ranges of experience becomes clear as the play progresses. This can be illuminating for students, who—as noted above—will undoubtedly notice right away that the actors in the play are all white men, and may expect this lack of physical diversity to be reflected in a similarly monochromatic deliberation. This is the one point at which my classes have been able to link the final processing bias, mental accounting. This bias causes investors to break their investments into discrete layers or “buckets,” with each bucket tied to a specific goal. Such a scheme is a feature of behavioral portfolio theory (see Statman, 2017). The problem with this approach is its failure to capitalize on diversification potential among the layers—this can lead to a suboptimal risk-return trade-off. Linking this to our jurors is a stretch, we admit! Nonetheless, we have had students recognize that they come to play with certain expectations about the necessary diversity of the jury—certain buckets to be filled—and that they are subsequently surprised to see that, despite the existence of only one apparent bucket, there is actually significant variance of opinion reflected throughout the deliberations. (We note that the 1997 movie version of the play does reflect a much more physically diverse jury, as well as a female judge.)

Having considered the cognitive processing errors, we now turn to the belief perseverance biases: conservatism, confirmation, representativeness, illusion of control, and hindsight.

Confirmation, Conservatism, and Stories

Conservatism is a belief perseverance bias in which someone tries to avoid the cognitive strain of updating her prior beliefs, especially when responding to new information would require assimilation of complex or statistical information. Confirmation bias takes this perhaps a step further: the individual actively protects her prior beliefs by selectively perceiving and retaining consistent information, while downplaying or ignoring contradictory evidence. We have already seen that our jurors’ decision to use a verdict-driven deliberation style may exacerbate their tendencies to search for confirming evidence. Such tendencies are not uncommon in juries. In fact, Hoffman (2007) calls the whole trial process is “the mother of all confirmation bias problems”: if “the system” has already determined that the defendant is guilty, how is the jury supposed to decide otherwise? If the system also provides direct evidence, like eyewitness testimony,

this question becomes even harder. Heller (2006) identifies four ways that belief perseverance biases can “devastate” a defense in a trial with direct evidence. All four biases are present in *12 Angry Men*.

The first two relate to conservatism. Jurors may focus only on evidence supporting their belief in the defendant’s guilt, or, if they do do confront exculpatory evidence, they may do so only superficially or skeptically, especially when they are very confident in their initial assessment. As Hay (2007) puts it: “Whenever someone comes forward to suggest [people have] been deceived by appearances or that they’ve ignored significant details or that there’s more to this case than anyone understands..., they’re likely to dismiss him as a crank, ignore what he’s saying, and cling to their prior views as long as possible.” Juror #7 certainly does when someone suggests that “maybe you don’t understand the term ‘reasonable doubt’,” and he responds “angrily”: “What do you mean I don’t understand it? Who do you think you are to talk to me like that?”

In addition to confronting inconsistent evidence with skepticism, jurors confident in their positions will often “truncate their search for alternative hypotheses” (Heller, 2006). (“[W]hen rejecting an item as unreliable would require an individual to discard a narrative of an event that she finds causally convincing, *the individual will almost always hold onto the narrative and disregard the evidence instead*”; Heller, 2006; emphasis original.) There are numerous examples in the play. When #8 starts looking at the floorplan of the apartments, #3, #7, and #10 “barely bother to look at it.” Instead, #7 asks #10 to “Wake me up when this is over.” Nor does #3 want to look at the knife again: “We all know what it looks like.” Ultimately, he and #7 are not interested in continuing examination of *any* evidence: both want to “walk into court right now and declare a hung jury.” (This sort of conservatism recalls the real-life jurors described in Abramson, 2007, one of whom “busied herself clipping discount coupons,” while another “put on earphones and listened to music to avoid hearing the others.”) In some cases, it can be efficient to rush to judgment this way, *if* the judgment is likely to be correct. After all, as bounded rationality stresses, “jurors’ overall processing capacity is not unlimited, [so] they normally conserve their cognitive resources” (Heller, 2006). However, ignoring evidence is a risky strategy for novel, consequential circumstances for which it is not possible to gather more information (Kahneman, 2011).

Heller’s (2006) other two trial complications relate to the confirmation bias. In contrast to their skepticism regarding exculpatory evidence, jurors exhibiting the confirmation bias may simply trust the reliability of inculpatory evidence, and they may interpret ambiguous evidence as inculpatory. (For example, “People who stated their beliefs of guilt or innocence early in the review of a mock police file were disposed to seek confirming evidence and interpret ambiguous evidence as further confirming it”; Statman, 2017, citing Ellsworth and O’Brien, 2009.) In the play, when #8 asked how fast the elderly downstairs neighbor got to his door, #4 dismisses his question by saying that his testimony that he got there is “enough, isn’t it?” More dramatically, when #8 suggests that the downstairs neighbor could not hear boy yelling if the el train were passing by, #3 immediately counters: “What d’ya mean? Sure he could have heard it... He said the boy yelled it out. That’s enough for me... Are you calling the old man a liar?” And as for the female neighbor’s wearing glasses: “How do you know what she saw? Maybe she’s far-sighted... I think he’s guilty!” (juror #3, Act 3).

As noted, all four of these biases are exacerbated by jurors’ high confidence in their assessment. Our jurors are quite confident, as is made clear from the beginning of Act 1: “How did you like that business about the knife? Did you ever hear a phonier story?” (#7); “I never saw a guiltier man in all my life” (#3); and my students’ perennial favorite: “I think the guy’s guilty. You couldn’t change my mind if you talked for a hundred years” (#7). Part of the reason the jurors are so confident is the nature of the prosecution’s case, which includes direct evidence—eyewitness testimony—from the female neighbor living across the el tracks. Direct evidence strengthens belief perseverance, because *reliable* direct evidence equates to guilt—its probative value (the conditional probability that the defendant is guilty) is 100%. Of course, direct evidence might not be reliable, but “jurors rarely question the reliability of direct evidence” (Heller, 2006).

That is definitely true for eyewitness testimony. “Jurors dramatically overestimate the accuracy of eyewitness identifications... and convict in eyewitness cases even in the face of exculpatory evidence” (Heller, 2006). Error rates for eyewitness identifications are “extremely high,” and are even less reliable—with 60% to 90% false identifications, by far the greatest cause for false convictions—when the act being observed is violent and when visibility is imperfect (Heller, 2006). Nonetheless, eyewitness testimony is compellingly concrete, and it transports a jury in a way circumstantial evidence cannot.

Circumstantial evidence, such as fingerprints or other forensic evidence, requires a jury to make inferences and weigh probabilities. Heller (2006) identifies four crucial differences between direct and circumstantial evidence. First, direct evidence is representational and structurally coherent, providing a tidy representation of the crime itself, in chronological order (compared to the reversed structure of a trial, which flows backward from the crime to its precursors). In contrast, circumstantial evidence only offers “an abstract statement about the connection between the defendant and an incriminating physical trace of the crime.” Second, direct evidence is narrative—it is a story that allows the jury to “see” the event in their minds—while circumstantial evidence is simply an argument linking the defendant to the crime and making his guilt more likely. (As former U.S. Attorney for the Southern District of New York, Preet Bharara puts it, “You can have facts and figures and statistics, but they are powerless and unpersuasive if not woven into a compelling narrative, an understandable story”; Bharara, 2019.) Third, as just noted, reliable direct evidence is univocal: it allows only one interpretation—guilt. Circumstantial evidence is polyvocal, and can be interpreted as either damning or exculpating: “every fact has two faces” (Burns, 2007). Finally, direct evidence is unconditional, while circumstantial evidence is probabilistic. Jurors in a circumstantial case are likely to acquit “*even when their subjective probabilities of guilt are sufficient to convict*” (Heller, 2006, emphasis original; this is called the “Wells effect”). Jurors in a direct case, in contrast, can easily see how the crime could have happened as the prosecution says it did.

Given how compelling eyewitness testimony can be, it is not surprising that the female neighbor’s statement provides the final argument supporting the three jurors who persist in voting guilty through four rounds of voting. “I still believe the boy is guilty of murder... To me, the most damning evidence was given by the woman across the street who claimed she actually saw the murder committed” (#4). “That’s right. As far as I’m concerned, that’s the most important testimony... the whole case... You can throw out all the other evidence” (#3).

It is not easy for juror #8 to combat such evidence. His approach is therefore very delicate. He is careful to say that “maybe she honestly thought she saw the boy kill his father,” but that actually “she saw only a blur.” His interpretations may not be the most probable, as he recognizes—“It’s possible... I’m just saying it’s possible... Do you think this possible?”—but he just wants to create reasonable doubt. The reason we leave the play thinking he is brilliant is because he succeeds.

(As we see later, perhaps he should not have. Being able to imagine a factually exculpatory scenario is not the same as the legal standard of reasonable doubt, since “poor evidence can make a very good story”; Kahneman, 2011. Heller, 2006, asserts that judges should be sure to inform juries of this. Of course, our bored judge did not.)

Even after juror #8 was able to convince #4, whose “only concern is with the facts of this case” (Rose, 1954), there was still one more guilty vote: #3’s. His more emotional biases are more difficult to counter. Before addressing those sorts of biases, however, we will complete our discussion of the CFA’s roster of cognitive biases.

Representativeness and the Halo Effect

The representativeness bias is the tendency to classify a thing based on its similarity to a stereotype. It is a bias that allows us to avoid cognitive strain. We search for patterns, drawing on past experiences and underutilizing probabilities; we overweight information from small samples. We demonstrate “an excessive willingness to predict the occurrence of unlikely (low base-rate) events” (Kahneman, 2011). Vidmar, *et al.* (2007) show that mock jurors do all of this. Their evidence therefore suggests that jury deliberations—even fictional ones—can provide good examples of the representativeness bias.

Audience members might expect plays to offer other good examples, being populated by stock characters like the hero, the damsel in distress, or the nerd. Prince and Jackson (2005) describe these sorts of characters as “familiar...identified by an oversimplified pattern of behavior that typically labels the character as being part of a group of people.” Rose (1954) embraces this tendency in his audience by providing brief character sketches, employing juror descriptions such as “an angry, bitter man” (#10), “a mild gentle old man” (#9), “a refugee from Europe” (#11), and “a loud, flashy-handed salesman type” (#7). Hay (2007) calls these “the oldest, most vicious [stereotypes] in the book,” and asserts that Rose uses them to demonstrate the insidiousness of labels.

An interesting twist in *12 Angry Men* is that we also see the characters themselves exhibit the representativeness bias as they assess the probable guilt of the defendant. Juror #3 sees the boy through the prism of the troubled relationship with his own son—who he tried to “make a man” out of (“or bust... up into little pieces trying”)—concluding, “It’s the kids. The way they are—you know?” Juror #4 points instead to the defendant’s upbringing: “The children who come out of slum backgrounds are menaces to society.” But of the most interest to us are the perspectives of jurors #9, #10, and #8—the elderly man, the bigot, and the protagonist, respectively.

Juror #9, the elderly man, “mourns the days when it would have been possible to be courageous without shielding himself behind his many years,” and is now “merely waiting to die” (Rose, 1954). His perception is critical to the jury’s evaluation of the downstairs neighbor’s testimony, about whom #9 says, “I think I know him better than anyone here.” He then leads the other through what Vidmar, *et al.* (2007) call “untested speculation about his need to feel important,” after which he concludes that, “He wouldn’t really lie. But perhaps he’d make himself believe that he heard those words [‘I’m going to kill you’] and recognized the boy’s face.” Juror #9 assumes that his personal experience can be extrapolated—that his sample size of one is representative of the entire group of elderly men.

Juror #10 is the play’s most obvious stock character: the bigot. He “places no values on any human life save his own”; he “has been nowhere and is going nowhere and knows it deep within him” (Rose, 1954). More harshly, Papke (2007) describes him as “a bigot whose racism is so deeply ingrained that he cannot imagine it to be anything other than common sense.” We see this first when he becomes perturbed when juror #8 suggests the group spare the boy’s defense “a few words,” saying, “You’re not going to tell us that we’re supposed to believe him, knowing what he is. I’ve lived among ’em all my life. You can’t believe a word they say.” Later, he is more explicit, calling the boy “a common, ignorant slob,” who “don’t even speak good English!” (#10’s own grammatical error here is immediately pointed out by #11, the immigrant.) Finally, in the third act, he reacts to the third vote—9-3 in favor of acquittal—with an extended, violent rant: “You know how these people lie... They don’t need any real big reason to kill someone... They get drunk, and bang, someone’s lying in the gutter... It’s like they have no feelings... These people are drinking and fighting all the time... Human life doesn’t mean as much to them as it does to us.”

This rant is too toxic even for his fellow jurors, who all rise and turn their backs on him. Their reaction is a delayed version of a dislike the audience has probably felt all along (as we were supposed to: Rose also describes this character as someone who “antagonizes almost at sight”). Our reaction highlights the

existence of two levels of representativeness bias in the play: that among the characters, and that between the audience and the characters. They stereotype each other, and we stereotype them.

Our characterizations are not always negative, of course. Rose offers us an antidote to the “humorless, intolerant, dull-witted, opinionated, loud, bitter” jurors with his protagonist, juror #8, who personifies the behavioral bias called the halo effect. This bias reflects our tendency to assume that someone with good traits is a good person. For example, juries are less likely to convict attractive defendants (Devine, *et al.*, 2001). In *12 Angry Men*, juror #8 exhibits so many positive characteristics—such as being “highly likeable, rational, and generally confident” (Sunstein, 2007)—that we are inclined to believe him. (However, some find him “too good to be true...above the law and unconstrained by its limits”—basically, a vigilante; see Landsman, 2007. These critics appear to be in the minority.)

Hay (2007) pushes the halo effect idea to the point of making it literal. For him, *12 Angry Men* is a religious allegory, with juror #8 cast as a miracle worker with “solomonic wisdom”—perhaps a martyr, a prophet, Jesus, or even God. He asserts that it was easy for audiences of the 1957 movie to view #8 as a Christ-like figure, since he was played by beloved actor Henry Fonda (whose character in *The Grapes of Wrath* was “widely understood in those terms”). Even without this context, student viewers of the 1954 play undoubtedly will be persuaded by #8’s humble and thoughtful evaluation of the evidence. However, by accepting #8’s interpretation of events, they themselves may be committing the cognitive error of hindsight bias.

Hindsight, Guilt, and the Illusion of Control

Things that we know actually have happened—like the acquittal of a defendant facing an initial guilty vote of 11-1—seem, after the fact, much more predictable than they really were. This is hindsight bias: the ex post overestimation of the probability of an event. In *12 Angry Men*, it is the audience who probably commits this error, when we leave believing that the defendant was not guilty even though, as juror #7 says in the movie version, “the odds are a million to one.” Astimow (2007), reassessing the evidence, agrees, concluding that the prosecution far exceeded its burden of proof, and putting the probability of the defendant’s guilt at “close to 100%.” Why, then, does it seem so obvious at the end of the play that he was innocent?

The most important reason is that *12 Angry Men* leads us through a compelling exculpatory narrative championed by a strongly sympathetic guide. Such a great narrative reduces our ability to consider critically (Heller, 2006): “Good stories can overwhelm good arguments” (Bharara, 2019). However, some observers who overcome that obstacle see “a veritable buffet of juror misconduct” (Weisselberg, 2007), where jurors replace reasonable doubt with *speculative* doubt (Hoffman, 2007), and “very arguably” acquit a guilty man “because they concocted alternative narratives that were not critically assessed for plausibility” (Vidmar, *et al.*, 2007).

Vidmar, *et al.*’s (2007) preferred narrative focuses on the circumstantial evidence, which, despite being harder to evaluate, is much more reliable than direct evidence. (“Circumstances cannot lie,” according to William Paley, or, perhaps, “Circumstances may sometimes lie, but witnesses lie far more often”; see Heller, 2006.) Vidmar, *et al.* (2007) therefore reconsider the salient circumstantial evidence. First, the knife. While it was not unique, it was unusual. Is it likely that a random killer would have used such a knife? And while supposedly “[a]nyone who’s ever used a switch knife would never have stabbed downward” (according to juror #5), that is exactly what the killer did do. Next, the motive. The boy clearly had one, but there is no evidence that anyone else did. Finally, the eyewitnesses. The woman was able to see well enough to observe the murder and identify the defendant, while the old man’s estimate of 15 seconds was just that—an estimate. The authors conclude that the jury “systematically dismantled inculpatory evidence without considering the plausibility of the deconstruction,” while manufacturing

motives “from whole cloth,” and failing to test the defendant’s story for internal consistency. They conclude that the boy was probably guilty.

Nonetheless, viewers of the play believe him innocent, and see that verdict as obvious in hindsight. Our (vicarious) active involvement in the deliberations reinforces our conclusion. This is an example of the belief perseverance bias called illusion of control. The jurors also exhibit this bias, as they explicitly link their conclusions about guilt to their reenactments. Seeking out information gives them more confidence in their interpretations, even though it is quite possible that the information they are using is misleading and that their conclusions are wrong. Having more information and being more actively involved in a decision foster the illusion of control, but they do not necessarily lead to better outcomes (Nofsinger, 2014; Kahneman, 2011). It is possible that in *12 Angry Men*, the jury, like us, “confuse facts for proof” (Babcock and Sassoubre, 2007).

The biases just discussed were all cognitive biases, which are relatively amenable to guided correction. Nonetheless, in our play, the jurors were “angry,” so we turn now to the more intractable problems: the emotional biases.

EMOTIONAL BIASES

Landsman (2007) describes the interactions among our jurors “more like a struggle for dominance than rational analysis,” but this is one of the selling points of the play. Angry people are interesting; rational people are not. (As Jimeno-Bulines, 2007, notes, *12 Angry Men* is a better title than *12 Impartial Jurors*; Preet Bharara says no one would go see a movie called *12 Angry Mediators*.) Anger actually feeds the narrative, since being angry can affect the way the jurors process information; for example, anger can focus inquiry, making it less likely that the jurors simply accept confirmatory evidence (Statman, 2017). (Even simply frowning reduces overconfidence and makes people think harder; Kahneman, 2011.) In general, however, biases driven by emotion move people farther from the ideal of rational economic man (as Kahneman, 2011, puts it: “The dominance of conclusions over arguments is most pronounced when emotions are involved”). In this section, we consider how our angry jurors exhibit each of the emotional biases described in the CFA curriculum: status quo, endowment, loss aversion, overconfidence, self-control, and regret avoidance.

Status Quo

The status quo bias reflects our tendency to just leave things alone, rather than undertake the taxing effort of considering alternatives. It is essentially inertia. For investors, it can lead to missed opportunities, and the attendant suboptimal risk-return trade-off. For the jurors, it helps explain why the majority of criminal juries convict (Preet Bahrara cites his conviction percentage at trial at “just a few points shy of 100 percent”): as noted earlier, there is “an all-too-human tendency to think the worst of a person, especially one whom the prosecutor has said is guilty” (Marder, 2007b). It can also mean overlooking critical pieces of evidence.

The jurors in *12 Angry Men* almost universally exhibit this bias. For example, by adopting a verdict-driven deliberation style, the majority clearly wishes just to vote and get it over with. Perhaps the best example of the ennui we might expect with this bias is juror #2’s contribution to the first round robin: “Oh. Well...(long pause) I just think he’s guilty. I thought it was obvious.” He is clearly not advocating for a deeper investigation of the issues.

As the play progresses, the status quo bias buttresses the more emotionally driven advocates for guilt, as conservatism supports the more intellectual. The former hold out longer. Emotional biases must be countered with more than basic logic, often making them much more difficult to overcome than are

cognitive biases. We should therefore not be surprised to find juror #3—a man who is “extremely opinionated...humorless...intolerant,” with “a streak of sadism”—remaining impervious to rational argument until he cracks at the very last line of the play.

Endowment and Loss Aversion

The endowment bias makes us value something more highly if we already have it, and loss aversion makes us especially sensitive to losing it. Both of these biases are exhibited by juror #7.

This juror is a “loud, flashy-handed salesman type who has more important things to do than to sit on a jury.” Hay (2007) identifies him the archetypal fool. In addition to being generally obnoxious, he is preoccupied with his theater tickets. These tickets are introduced at the very beginning of Act 1, even before everyone sits down: “This better be fast. I’ve got tickets...tonight.” Their pull appears again in Act 3, right before he changes his vote: “I’m a little sick of this whole thing already...Let’s break it up and go home. I’m changing my vote to not guilty.” Even though juror #11 pressures him into admitting that it was the evidence that caused him to reconsider, #7’s continued association with these tickets illustrates clearly the emotional salience of sunk costs.

Juror #7 considers his tickets to be part of his “endowment.” The endowment bias causes him to value his tickets more highly since he already owns them (and even more so if he bought them recently): he would charge someone more to buy them from him than he would be willing to pay for them himself today. For investors, the endowment bias can make someone unwilling to sell assets she inherited, even if those assets do not make sense within her portfolio; for juror #7, the bias makes him fixate on getting to the theater. This emotional attachment is linked to another bias, as well: loss aversion.

As noted earlier, Kahneman and Tversky’s (1979) prospect theory suggests that people view losses and gains asymmetrically, with losses of a certain size decreasing utility much more than corresponding gains increase it. Thus, #7 fears facing a loss if he is unable to use his tickets, and he wishes to avoid the corresponding decrease in utility. Juror #11 recognizes this motivation, saying to #7: “You have sat here and voted guilty with everyone else because there are some theater tickets burning a hole in your pocket. Now you have changed your vote for the same reason.” #11 finds this disgusting, angrily asking #7, “What kind of man are you?” This confrontation is emblematic of the tension between rationality and emotion, and helps explain why the CFA curriculum more often advocates for adaptation over moderation when advisors are working with clients governed by emotional biases. Unlike cognitive biases, emotional issues are not as amenable to improvement through education, and may need to be accommodated rather than corrected. However, this can be especially challenging when the emotional bias at issue is overconfidence.

Overconfidence

People who are overconfident “overestimate their knowledge, underestimate risks, and exaggerate their ability to control events” (Nofsinger, 2014). Men tend to be more overconfident than women, at least on tasks deemed “masculine” (Barber and Odean, 2001), and both men and women are more likely to be overconfident when they face a difficult task with low predictability and slow, vague feedback. For investors, this means that men’s portfolios are often more risky and less diversified than women’s (this is especially true for single men, who lack the moderating influence of a spouse). For the *12 Angry Men* jurors, it means initial verdicts defended with assertions rather than through examination of evidence; as Hay (2007) puts it, the jurors “overestimate themselves,” and “[c]ertitude and comprehension are inverse quantities for the characters.” (This conviction is not uncommon in capital trials: jurors who support the death penalty tend to have more confidence in their judgment than those who do not; see Devine, *et al.*, 2001.)

Not surprisingly, the characters prone to other emotional biases also show flashes of overconfidence, especially juror #3 (described by Rose as “extremely opinionated”), #7 (a “bully”), and #10 (who is “angry” and “bitter”). When #8 asks in Act 1 if the defendant may have lied, #10 “angrily” responds that “of course he lied!” In Act 2, when the jury is wondering which one of them could have changed his vote, #3—again “angrily”—asserts “I know who it was.” And of course #7, as we noted earlier, defends his immediate vote for guilty: first by denying that it was easy for him to do so—since he understands the (capital) consequences, but ultimately because “I think the guy’s guilty. You couldn’t change my mind if you talked for a hundred years.”

Also not surprisingly, the two angry and overconfident men in this group, #3 and #10, are some of the longest holdouts of the jury. They are also two of the jurors who most obviously exhibit the next emotional bias: lack of self-control.

Self-Control

“The exertion of self-control is depleting and unpleasant” (Kahneman, 2011). Delaying or forgoing what we want to do in order to accomplish necessary but more unpleasant things requires a successful struggle within a person’s “multi-self” nature: the triumph of the person’s “planner” over her selfish, myopic “doers” (Shefrin and Thaler, 1981). (Kahneman, 2011 describes this as a conflict between rational, calculating “system 2” and intuitive, subjective “system 1,” where system 1 “has a sweet tooth.”) In financial planning, self-control problems inhibit saving. We rationalize this aversion to saving by appealing to hyperbolic discounting—the idea that people discount cash flows much more heavily over the short term than they do over the long term (being willing to pay a high price for immediacy). In *12 Angry Men*, the self-control problem is more about time and effort than money: the sooner the jurors can reach a verdict, the sooner they can get back to doing what they would rather be doing. Those jurors with more self-control problems are more reluctant to devote the cognitive resources necessary to give the defendant’s case a thorough review.

The protagonist, juror #8, employs two mechanisms to combat his colleagues’ self-control issues, both of which are recommended by Shefrin and Thaler (1981). The first is moral suasion, which he effects through the adoption of a new norm. At the beginning of Act 1, after the initial 11-1 guilty vote, juror #3 “sarcastically” says, “Somebody’s in left field.” This prompts #8 to justify his vote, even while admitting that he does not know if the defendant is innocent. He just wants “to talk for a while” because it is “not so easy for me to raise my hand and send a boy off to die without talking about it first...maybe we owe him a few words.” This show of compassion is sufficient to begin a meaningful discussion of the facts, despite #10’s objection that “We don’t owe [the defendant] a thing.”

Juror #8’s second tactic is rules-based. Specifically, he employs an approach that Shefrin and Thaler (1981) call “externally enforced precommitment.” At the end of Act 1, he makes this proposal: “I want to call for a vote. I want eleven men to vote by secret ballot. I’ll abstain. If there are still eleven votes for guilty, I won’t stand alone. We’ll take in a guilty verdict right now.” This was an effective strategy, as juror #9 changed his vote to not guilty, ensuring that the deliberations would continue. The denouement to the self-control aspect of the play then follows in Act 3, when juror #7—the impatient “salesman type” who wants to go to the theater—changes his vote to not guilty. Despite his obvious endowment bias and his prefacing of his change of heart by saying “I’m a little sick of this whole thing already...,” this scene makes it clear that he now really believes the defendant is innocent. It plays more like an apology than an expedient. Juror #8’s strategies have successfully mitigated the self-control problems of his most recalcitrant colleague. They may also have saved him from regretting a hasty decision.

Regret Avoidance

Of all of the biases displayed in *12 Angry Men*, perhaps the one most important to the narrative is regret avoidance. Juror #8 repeatedly raises the specter of regret throughout the play, stressing that his colleagues' decision means a "man may die." The outcome of the trial affects not only the defendant, but the jurors as well; only their thoughtful discharge of their duties can mitigate the potentially negative effects of their decision on their futures.

Regret can arise from something we do (an error of commission) or from something we do not do (an error of omission). Errors of commission usually make us feel worse (see Kahneman, 2011). However, whether a choice counts as action or inaction depends on our perception of the default option. Juror #8 seems to demonstrate his appreciation of this distinction through his framing of the jury's responsibilities.

Juror #8 is process oriented. He sees the jury as a deliberative body; for him, the default option is to talk about the case. Other jurors are decidedly more task oriented: they see their job as delivering a verdict (as #10 says, "He got a fair trial, didn't he?"). #8 is able to shift their default toward deliberation, and he does so by explicitly exploiting regret aversion in multiple ways.

First, juror #8 reframes the decision from something that needs to be done "fast" so that "we can all go home" (#7) to something that needs to be taken seriously: a decision that could "send a boy off to die." By focusing on the severe and irreversible consequences of the decision—the "terrifying duty of rendering a verdict" (Bharara, 2019)—he stressed the "negative affect" of the decision and emphasized the potential for regret. He then subtly reminds his colleagues that this decision is theirs—an important reminder for those jurors (like #3 and #4) who might otherwise avoid regret by blindly trusting the neighbor's testimony (if she was wrong, that was her fault, not theirs; see Statman, 2017). He also invokes guilt, as is obvious by #7's reaction: "Who says it's easy for me?" Finally, he persuades the last holdout juror by employing a technique that Kahneman (2011) says is the most useful protection from regret: explicitly anticipating it. ("If you can remember when things go badly that you considered the possibility of regret carefully before deciding, you are likely to experience less of it.") At the end of Act 3, juror #3 shouts, "I'm entitled to my opinion! It's gonna be a hung jury!" To which #8 replies, "There's nothing we can do about that, except hope that some night, maybe in a few months, you'll get some sleep." #3 relents, and the play ends.

Having reviewed the individual cognitive and emotional biases, we now turn briefly to the biases related to group dynamics.

GROUP DYNAMICS IN *12 ANGRY MEN*

According to the CFA curriculum, group decision-making can mitigate or exacerbate the biases of members. It can also generate new biases (Pompian, *et al.*, 2014). In this section, we consider how these dynamics are reflected in *12 Angry Men*.

Opinions vary about the realism of depictions of group interactions in *12 Angry Men*. For supporters, "*12 Angry Men* remains one of the very few films to fashion a compelling account of how and why juries work" (Babcock and Sassoubre, 2007); "As a psychological study of what it takes to be persuasive in a small group setting, the film is a gritty portrait in psychological realism" (Abramson, 2007); and its deliberations depict the "convergence of reason, eloquence, and openmindedness" (Devine, *et al.*, 2001). However, detractors fault the film's "dramatic cleanliness" (Burnett, 2007) and its "striking dramatization" of an event that almost never occurs—one juror's turning around eleven others—for "encourag[ing] a naïve notion about what group decision making is like" (Landsman, 2007). In addition, the jurors' "decision metrics" (counting the seconds for the el train to pass, or for the elderly neighbor to reach his door) "buttresses a kind of collective fantasy about participatory judicial rationality" (Burnett, 2007).

Nonetheless, the movie does a good job highlighting the points made in the CFA's treatment of group behavioral issues. This is a minor part of its coverage of investment biases, since the primary purpose of the curriculum is to guide interactions with clients. There are essentially two main points that the curriculum seeks to deliver.

The first of these is that the process of reaching group consensus can smother contrary opinions, as “the nail that sticks up gets hammered down.” This is the external influence of the group upon the individual. It is easy to see such dynamics in the play. For example, we hear this from #3: “Somebody’s in left field...It’s not Sunday. We don’t need a sermon”; and, from #7: “You’re alone. What do you think you’re gonna accomplish?”

To combat this tendency and ensure that the full range of views is aired, the CFA curriculum suggests that a group’s chair ask each participant for her opinion in advance, then explicitly prompt for all comments during the meeting. Kahneman (2011) agrees that this is the best way to draw out everyone’s information. However, in *12 Angry Men*, a (bored) judge fails even to instruct the jurors to keep an open mind until they have deliberated, and an (indifferent) foreman calls for a vote before any evidence is discussed. Only as juror #8 presses them to talk about the case, and the foreman then suggests “we go once around the table,” do the others become more willing to contribute their own impressions (Marder, 2007b).

These deliberations reflect an unusual sort of group interaction, which MacCoun (2012) describes as the “deliberation paradigm.” While the jury structure imparts an egalitarian official power structure and fairly well-defined common sense of the ideal outcome, the jurors themselves are strangers. They have only one interaction, which makes it difficult for them to develop group norms and behaviors that mitigate biases (MacCoun, 2012, calls this “low dependence”). Thus, jurors are more like a “crowd” than a committee (see Pompian, *et al.*, 2014).

Nonetheless, once they start talking, the jurors do “the peculiar thing that juries do” (Babcock and Sassoubre, 2007): bring their own experiences and impressions to bear on the evidence. The experiences of the jurors in the play are more diverse than students may initially expect. According to Burns (2007), “Each person’s individuality plays an important role in the deliberation, but it provides diversity of perspective rather than diversity of individual interest.” The CFA curriculum stresses that diverse groups, whose members respect each other, may be better able to withstand the social pressure to conform to strong views expressed by group leaders. As the jurors provide their unique perspectives, they contribute to a sense of community (Babcock and Sassoubre, 2007), “develop a sense of ‘groupness’ through communication” (Proctor, 1991), and achieve “the emergence of common sense” (Burns, 2007). Viewers will believe the result is just.

This successful outcome is contingent upon the confident, independent actions of juror #8. This brings us to the CFA curriculum’s second main point about group interactions: that the individual members need to take responsibility for offering their opinions. This is not as easy as it sounds. People want to fit in, so as a group seeks to enforce consensus, its members seek to conform—preferring to be part of the herd rather than conspicuous outliers. This tendency drives the quick move to consensus, for good or ill, and is called the “social proof bias.”

12 Angry Men’s jurors are clearly susceptible to this bias. As Hans (2007) describes their initial deliberations: “The discussion is cursory. The jurors exchange insults and put-downs. The comments about the trial and the defendant reflect judgments and prejudice. In short, the men are really bad jurors.” Two in particular are especially noteworthy here, and are critical foils for juror #8.

On one end of the jury’s personality scale is juror #2, a “meek, hesitant man who finds it difficult to maintain any opinions of his own.” His main contribution to the deliberations is to vote guilty, then explain himself

by “timidly” offering that “I thought it was obvious.” Juror #2 clearly has not developed a thoughtful rationale to support his initial vote—at least one he can articulate. It may even be too generous to suggest that he is satisficing. Were it not for the insistence of juror #8, juror #2’s blasé approach to his responsibilities would have helped to quickly convict a possibly innocent man.

At the other personality extreme is juror #3, a dramatic example of what Devine, *et al.* (2001) call “high-authoritarian” jurors: people who are “rigid, conventional, conservative, power-oriented, and deferential to authority.” (Notably, Rose, in his description of juror #3, starts with the power-oriented terms “very strong, very forceful,” then adds “extremely opinionated” and “intolerant.”) Juries with many high-authoritarian jurors are more likely to convict. However, these jurors are more susceptible to the influence of authority figures and to “group conformity pressure”; they are also more likely to change their verdicts after deliberating.

MacCoun (2012) asserts that a juror may change his vote not because of the weight of evidence but rather because of the pressure of the question “how unpopular must my position be before I’m willing to change it and adopt the majority view?” He calls this the “burden of social proof.” Rose uses juror #9 to explain it in the play: “It takes a great deal of courage to stand alone even if you believe in something very strongly.” Juror #3 must feel this sort of pressure at the end of Act 3, when three lines after his yelling that “you’re not going to intimidate me!” he “looks around at them for a long time,” and recognizes that “all of them despise him for his stubbornness.” Suddenly, “his face contorts,” he slams his fist, and he changes his vote. He finally “crumbles” in the face of social pressure (Astimow, 2007).

Of course, juror #8 is the main instigator of that pressure. As he models the CFA’s prescription to be responsible for offering his opinions in the face of colleagues who feel quite differently, he is aided by at least three things: the legal standard required for conviction in this case, the “visibility” inherent in the deliberations, and—most importantly—his very nature.

First, in capital cases like that faced by the *12 Angry Men* jurors, the beyond-a-reasonable-doubt standard gives asymmetric influence to jurors like our protagonist who argue for acquittal. “If jurors favoring conviction discover that well-meaning peers feel strongly that the defendant is innocent, this might serve as ‘social proof’ that there is, in fact, a reasonable doubt” (MacCoun, 2012). The standard of proof itself is a social construct.

Second, juror #8’s consistent defense of the boy increases the “visibility” of his minority position and enhances its persuasiveness (MacCoun, 2012). The numerous votes allow those voting for acquittal to “find” each other (as when juror #9 announces that he was the first to change his vote to not guilty), and for those favoring conviction to observe the opposition (higher “vision”—as demanded by juror #7: “Who was it [who changed his vote]? I think we have a right to know”). Higher visibility enhances the development of “social coordination norms” (MacCoun, 2012).

The most important element of the social pressure, though, is juror #8’s very character, whether one sees him as “Christ-like” (Hay, 2007) or as an “internal enemy” who must be dealt with if the jurors are to escape the hot jury room (Proctor, 1991). He is “generally confident” (Sunstein, 2007), and people are impressed by messages delivered with confidence. Thus, #8 is persuasive when he concludes that “he couldn’t have made the kind of wound which killed his father,” or “I say she saw only a blur” (Act 3). No other juror can match this persuasive eloquence (Vidmar *et al.*, 2007). He is also “highly likeable” (Sunstein, 2007). This very “agreeableness” bolsters his willingness to maintain his position when faced with opposition (MacCoun, 2012), as it allows him to appealing to the other jurors’ humanity with humility and without ridicule (Garfinkle, 2011).

He is also fortified by his desire to reach an accurate conclusion (MacCoun, 2012). He is rational, has more information than the jurors most enthusiastic about a guilty verdict (Sunstein, 2007), and is able to marshal more arguments and support them with “logic and experimentation” (Garfinkle, 2011; see also Abramson, 2007 and Gertner, 2007). As he builds his case, more jurors are swayed: “the ubiquitous majority effect is mediated by information exchange as opposed to conformity pressure” (Devine, *et al.*, 2001). Because the more “competent” jurors are the least invested in their initial positions—and therefore the most amenable to rational counterargument—juror #8 is able to persuade them by asking the right questions (Sunstein, 2007).

As he asks those questions, he reveals himself to be as Rose imagined him: “A quiet, thoughtful, gentle man. A man who sees all sides of every question and constantly seeks the truth. A man of strength tempered with compassion. Above all, he is a man who wants justice to be done and will fight to see that it is.” Less poetically, he is also the perfect embodiment of the CFA curriculum’s summary observation on group decision-making: “An individual expressing strong contrarian views within the group can help in avoiding too quick of a move to consensus before all evidence is discussed” (Pompian, 2014b).

CLASSROOM SUGGESTIONS AND CONCLUSIONS

I have used *12 Angry Men* for four years in my senior-level undergraduate portfolio management elective. This course’s content is informed by the CFA’s Level III curriculum (specifically, Pompian, 2014a; Pompian, 2014b; and Pompian, *et al.*, 2014). Each time I have used it, the heart of the students’ assignment has been to identify as many behavioral biases in the play as they can, justifying each of their answers. Students always work in teams.

Given time and pandemic constraints, the way I have used classroom time to support this exercise has varied. The least effective version was simply to have students do the assignment on their own, without any associated classroom discussion. Their answers were sufficient, but not having the classroom interaction robbed the exercise of most of its fun and obviously all of its potential to develop positive classroom dynamics. A better approach was to play clips in class (as McCambridge, 2003, does with the movie version) and have small groups work to identify relevant biases. However, the best approach for my classroom has been to have students watch the video on their own time, work in teams to identify biases, then come to class prepared with their own chosen clips to show their colleagues. This ensures that everyone is completely familiar with the entire play (which is a not an onerous requirement, since the play runs less than one hour and is freely available on the internet) and that everyone is prepared to discuss it. To ensure that all students’ views are aired, I ask everyone to prepare initial answers before meeting in teams. Finally, at the end of our classroom session, I introduce Vidmar, *et al.*’s (2007) arguments supporting the guilt of the defendant and ask students to consider whether their own conclusions were affected by social proof bias, the halo effect, or other biases as they reviewed the evidence through the play.

No matter how much classroom time I have devoted to *12 Angry Men*, incorporating it into my course has always been productive and engaging for the students. The play was meant to be entertaining, and it is. But that does not prevent it from being relevant and “teachable” (Babcock and Sassoubre, 2007), since it explores “universal themes” and inspires interpretations “on many different levels” (Marder, 2007a). The jurors’ interactions demonstrate the full range of the Chartered Financial Analyst curriculum’s individual behavioral biases—admittedly, some more clearly than others—as well as the associated group dynamics. It also may elicit some of those biases and group behaviors in its own viewers, which makes the classroom debrief all the more interesting.

Statman (2017) says that finance knowledge can be divided into financial-facts knowledge, human-behavior knowledge, and information knowledge. Finance professors are unlikely to omit information and facts from their courses, but may be less experienced and comfortable tackling human behavior. (Their

marketing counterparts, especially those teaching consumer behavior, are undoubtedly much more experienced in this area; they may also find the exercise described in this paper useful). Nonetheless, finance students are unlikely to encounter only rational economic actors in their portfolio management careers—in fact, a financial “consultant’s new role is not unlike the role of a psychotherapist” (Lo, 2005). Students therefore must be trained to mitigate or adapt to client biases. *12 Angry Men* is a fun way to begin that training.

Table 1: Examples of Individual Behavioral Biases in *12 Angry Men*

Bias	Example
<u>COGNITIVE</u>	
<i>belief perseverance</i>	
<u>conservatism</u>	
choose to maintain beliefs rather than experience the stress of updating them	juror #7: "You couldn't change my mind if you talked for a hundred years"; "wake me up when this is all over"
<u>confirmation</u>	
search for/notice information that confirms beliefs	juror #10: "Look, what about the woman across the street? If her testimony doesn't prove it, then nothing does."
<u>representativeness</u>	
use stereotypes/small samples/patterns to classify new information	juror #10: "...knowing what he is. I've lived among 'em all my life. You can't believe a word they say."; juror 3: "I think I know him [the old witness] better than anyone here."
<u>illusion of control</u>	
believe active involvement in a decision, more familiarity with choices, and incorporation of more information means better outcomes	jurors re-enact aspects of the trial evidence (e.g., neighbor getting out of bed and walking down hall; killer stabbing switchblade downward)
<u>hindsight</u>	
view outcomes as having been more predictable (once they have happened)	the audience sees innocence as more likely after having seen the play
<i>processing</i>	
<u>anchoring and adjustment</u>	
make comparisons by adjusting an initial anchoring estimate	the jurors estimate, then adjust, how long it takes an el train to pass a given point and how long it took the elderly neighbor to reach his door
<u>mental accounting</u>	
compartmentalize goals, addressing each separately and ignoring possible correlations	juror #5 separates his current life and his jury duties from his prior life in a bad neighborhood; audience initially may not appreciate the diversity of the jury, since there are no obvious visual categorizing clues
<u>framing</u>	
make choices based on how question is posed (e.g., "gain" v. "loss" frame)	juror #3 views the evidence through the frame of the defendant's being a "dangerous killer," while juror #8 sees it through the defendant's being 19 years old and a victim of paternal abuse; juror #2 says the boy is guilty because "nobody proved otherwise"; juror #5 says the others should "take a few tips from people who come running here"
<u>availability</u>	
assume things more easily recalled are more likely (e.g., more recent, more easily categorized, more resonant with personal experience)	juror #11 is very concerned with the democratic process underlying jury service, because things were so different in the country from which he came; jurors who have once constructed a narrative of the boy's guilt have that narrative easily available to them, making it less likely that they will abandon their perception of guilt

Table 1: Examples of Individual Behavioral Biases in *12 Angry Men* (continued)

EMOTIONAL	
<u>loss aversion</u>	
prefer to avoid loss than achieve gains, even if must accept more risk	juror #7 wants to end deliberations quickly so he does not waste his theater tickets
<u>overconfidence</u>	
have a illusion of knowledge; take credit for successes (but see failures as bad luck)	juror #10: "Sure he lied!"
<u>status quo</u>	
prefer to do nothing--it's easier (inertia)	juror #3 would rather play tic-tac-toe than consider evidence
<u>self-control</u>	
prefer smaller payoffs now to larger payoffs later	juror #10 displays a lack of self-control when he allows his temper to flare up, satisfying his immediate need for emotional release over the broader goal of group cohesion
<u>endowment</u>	
value something more highly if already owned; prefer status quo, but not because of inertia	juror #7 may value his theater tickets more highly since he already has them
<u>regret avoidance</u>	
prefer to make no decision than one that might end badly; error of commission worse than error of omission	juror #8 is unwilling to send a boy off to die without some "talk"; other jurors' acceptance of eyewitness testimony allows them to "launder" responsibility (Heller, 2006)

This table gives descriptions of each of the individual behavioral biases covered in the paper, as well as examples from 12 Angry Men.

APPENDIX

This summary of the case in *12 Angry Men* comes from Vidmar, et al. (2007).

Around 8:00 p.m. on the evening of the murder, the defendant and his father had an argument. The father hit the defendant at least twice. The father apparently had hit the defendant many times prior to this night. Shortly after this violent encounter the defendant left the apartment.

The defendant, whose mother had died when he was nine, had a troubled past. He had been in reform school. At approximately midnight a woman who lived in an apartment across the elevated train tracks from the father's apartment awoke from her sleep. Through the windows of a noisy passing train, she saw a man stabbing the father in the chest. Immediately after the attack ended, the lights in the father's apartment went out. The woman called the police and identified the defendant as the assailant.

An old man who lived in the apartment below the father's apartment testified that at approximately the same time that the woman witnessed the stabbing, he heard the defendant yell "I'll kill you" and a "second" later heard a body hit the floor. He got up from his bed, went to the door, and saw the defendant running down the stairs.

The defendant returned to his father's apartment at approximately 3:00 a.m. in the morning. The police questioned him in the kitchen... He later testified at trial that he went to the movies alone at about 11:00 p.m., returning home at 3:00 a.m. to find the police in his father's apartment. He could not remember the titles of the movies or their plots and he could not identify any witnesses who saw him at the theater.

The defendant admitted that shortly after the 8:00 p.m. fight with his father he went to a store and bought an "unusual" switchblade knife that appeared identical to the one found embedded in his father's chest. ...[H]e lost the knife when it fell through a hole in his pocket.

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NEED FOR ADVANCED IT SKILLS FOR ACCOUNTANTS – WHAT DOES ACCOUNTING EDUCATION LITERATURE TELL US?

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ABSTRACT

In the digital age, technology has a significant impact on the professional field of accountants. The constantly evolving digital technologies lead to changing tasks and require new skills. This has been the subject of accounting (education) literature for a long time. Using a structured literature review (SLR), we explore what IT skills have been required the last decade and conclude whether these skills meet the requirements of an advanced (semi-autonomous) accounting organization. Our study shows that the accounting education literature identifies the need to integrate advanced IT skills into educational programs. We conclude with a discussion of the drivers and obstacles for implementing IT skills in accounting education curricula. Our findings and derived recommendations should be of interest to accounting educators and professional bodies and highlight the need for further research related to IT skills for accountants in the digital age.

JEL: A22, A23, M41, O33

KEYWORDS: Digitalization, Accounting Education, IT Skills

INTRODUCTION

The ongoing digitalization of accounting creates new opportunities to automate accounting processes (Leitner-Hanetseder, Lehner, Eisl, & Forstenlechner, 2021) as well as increases the amount of data used in financial and managerial accounting (in the following accounting) (Oesterreich & Teuteberg, 2019; Vasarhelyi, Kogan, & Tuttle, 2015). The increasing digitalization is often associated with the massive loss of jobs in accounting (Agyemang, O'Dwyer, & Unerman, 2019; Frey & Osborne, 2017). This might be caused by the fact that accounting traditionally includes repetitive and rule-based tasks, which can easily be automated with digital technology. However, digitalization does not lead to a disappearance of the accounting department but rather to an upgrading of the accounting profession or new possibilities for the accounting department and the accountants themselves (Leitner-Hanetseder et al., 2021).

In particular, the possibilities of big data analytics could lead to an accounting establishing itself as a high-quality data provider of structured historical financial and unstructured non-financial data and internal advisers (Bhimani & Willcocks, 2014; Leitner-Hanetseder et al., 2021; Moll & Yigitbasioglu, 2019). However, this development requires a change in the tasks of accountants (Knudsen, 2020; Leitner-Hanetseder et al., 2021). We see that humans will no longer execute especially manual, repetitive and rule-based tasks. Tasks in accounting such as data collecting, recording and preparation of data will be taken over by integrated software solutions or software bots. A fundamental change in recording and reconciliation could be triggered by blockchain technology, which might enable triple-entry accounting.

Furthermore, BI-Tools based on AI-technology might lead to data-driven decision making (Leitner-Hanetseder et al., 2021). According to Lehner, Leitner-Hanetseder, & Eisl, 2019 advanced AI-algorithm might lead to the final level of digital development the fully autonomous accounting (FAAS), which is defined as follows:

“A FAAS is a firm-wide, fully autonomous, self-aware and self-improving accounting system. The centre of an FAAS is a state-based, multi-functional, deep-learning network as artificial intelligence (AI) that is able to holistically simulate and potentially outpace human-cognition and decision-making processes. This AI manages structured and unstructured data and regulations from various sources and delivers timely and apt information to the right audience in the right format.”

On the way to a fully autonomous accounting defined by Lehner et al., 2019 many stones have to be pushed away. Although a lack of IT skills is a significant hurdle to overcome, we are aware that IT skills are not the only competences that employees have to face in the course of digitalization. For example, understanding the key concepts and rules of accounting is necessary more than ever (Vasarhelyi, Teeter, Ryan, A., & Krahel JP, 2010). However, in the last decade, IT skills are nevertheless a competence that is brought up again and again in the accounting education literature (Howcroft, 2017; Leitner-Hanetseder et al., 2021; Moll & Yigitbasioglu, 2019; Tan & Laswad, 2018; van Laar, van Deursen, van Dijk, & Haan, 2017). To identify which IT skills have been discussed in the accounting (education) literature, we conduct a structured literature review (SLR). In an ongoing evolution of digital technology, IT skills depend on the level of digitalization in accounting. Therefore, we assign whether the discussed IT skills meet the requirements of a semi-autonomous accounting in the model of Lehner, Forstenlechner, Leitner-Hanetseder, & Eisl, 2021, which might be a scenario for many companies in the near future or might be existing in some companies. Consequently, we define the following research questions (RQ):

RQ1: What IT skills have been discussed in the accounting education literature in the last decade?

RQ2: Do these skills meet the requirements of an advanced (semi-autonomous) accounting?

This paper is structured as follows: In section two, we highlight the theoretical background and concepts of digital accounting. In section three, we describe the research process, including the method, steps and activities of the SLR to answer RQ1. In section four, we focus on the presentation of the results in responding to the RQ1. In section five, we answer RQ2 and provide insights into further research.

BACKGROUND

Digitalization is considered one of the most significant and most lasting challenges in today's society and affects many areas of our lives, including gainful employment. What exactly digitization means is complex and not clearly defined (Vial, 2019). Digitalization is often used synonymously with the term “digitization”, “digital transformation”. It will be associated with “technological disruption” (Cong, Du, & Vasarhelyi, 2018), “digital disruption” (Marrone & Hazelton, 2019) and at least a “technological (digital) revolution (Ackert, Church, & Zhang, 2018; Pan & Seow, 2016). It often refers to the reorientation of companies or even disruption of markets and existing goods and services (Vial, 2019). Digitalization is generally associated with increased efficiency, cost reduction and increased customer satisfaction through individualized products with the shortest possible delivery times (see business models such as Netflix) (Bhimani & Willcocks, 2014). Obviously, digitalization also has a major impact on accounting, and automation is not new to accounting and happened over the last decades. In an ongoing evolution of digital technology, the aforementioned FAAS provides a glimpse into a utopian future of accounting (Lehner et al., 2019). However, to close the skill gap in the near future, it is necessary to identify the IT that will be used in the near future or currently. As a framework, we refer to the semi-autonomous accounting proposed by Lehner et al., 2021. Within a semi-autonomous accounting, accountants focus on the interpretation of

system-generated information and take on a stronger internal advisory role supported by a fully-integrated accounting information system (AIS) for financial and management accounting. The AIS is characterized by high levels of automatization and is sourced from other sub-systems, and provides a much larger data pool. Within level two, automated document processing within a fully-automated workflow is employed, specialized (smart) software robots are used (see also Cooper, Holderness Jr, Sorensen, & Wood, 2018; Rozario & Vasarhelyi, 2018), digital reporting in XBRL-based and overall reporting-cycles enable near-time reporting (see also Cai, 2021; Clarkson, Li, Richardson, & Tsang, 2019). The AIS uses blockchain-based distributed ledgers (see also Cai, 2021; Dai & Vasarhelyi, 2017) and is connected with external data sources such as social media platforms for financial disclosures and non-financial insights (see also Arnaboldi, Busco, & Cuganesan, 2017; Hales, Moon, & Swenson, 2018).

Process-mining technology help to control and document all accounting processes (see also Chiu & Jans, 2019). Accountants include external and unstructured data in their enhanced Business Intelligence (BI)-solutions, which use InMemory-database (DB) technologies and use data science algorithms to tackle big data analytics, predictive analytics and fraud detection. Early-stage AI-powered applications provide human decision-makers with high-quality base for decision-making. Managers can retrieve ad-hoc information via corporate social media (Bellucci & Manetti, 2017) and chatbots (Blankespoor, 2018) and use cutting-edge technologies-based devices and BI digital boardrooms (smart meeting rooms) with multi-display environment for their meetings and video conferences (Rubart et al., 2017). Regarding the IT skills, data preparation is automated, accountants need an understanding of software robots, integrated ERP-Systems and blockchain technology. Furthermore, we expect that accountants need IT skills to handle (BI-)tools to check adequate types of data sources and data quality, analyze trends and patterns within data and visualize reports for end-users.

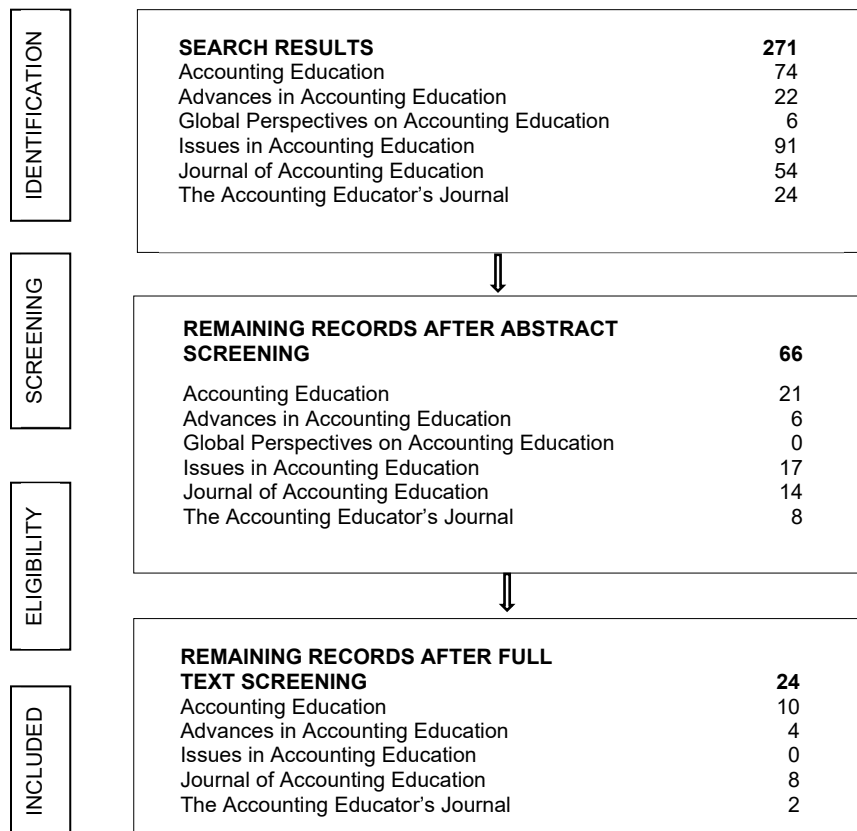
The semi-autonomous accounting proposed by Lehner et al., 2021 indicates that the implementation of the digital technologies in the digital accounting impacts tasks and therefore IT skills of accountants. However, we are aware that IT skills are not the only competences that employees have to face in a highly digitalized business environment. We see that accounting practices become a crucial role in providing financial as well as non-financial reporting. However, in a highly digitalized work environment, accountants need different or additional skills in order to be able to deal with various information and communication technologies in a way that does not create a burden, but rather increases productivity and efficiency. The need of IT skills in the digital era is brought up again and again, especially in the accounting (education) literature (Howcroft, 2017; Tan & Laswad, 2018). Accounting educators and researchers are aware of the importance of technological development and that graduates need to be better prepared for the working environment to fill the skill gap (Kotb, Abdel-Kader, Allam, Halabi, & Franklin, 2019). Therefore, accounting educators suggest adaptations of the accounting curriculum (Al-Htaybat & Alberti-Alhtaybat, 2018). In this paper, we provide insights in the IT skills discussed in accounting education literature and assess whether they meet the requirements of a semi-autonomous accounting proposed by Lehner et al., 2021.

DATA AND METHODOLOGY

We started the research process with three meetings in which we discussed current literature relevant to the field and agreed on our specific research goals after clearly defining the research gap and the aim of our research. In order to answer the aforementioned RQ1, “What IT skills have been discussed in the accounting education literature in the last decade?”, we found a structured literature review (SLR) suggested by (Massaro, Dumay, & Guthrie, 2016) the most appropriate approach. Analyzing existing literature in detail allows to gain insights into prior research and summarize and compare the results within a specific field. We conducted a keyword search in six popular and major Accounting Education journals, namely in Accounting Education, Advances in Accounting Education, Global Perspectives on Accounting Education, Issues in Accounting Education, Journal of Accounting Education and The Accounting Educators’ Journal. Four of the six journals are listed in der Academic Journal Guide (2018) by Chartered ABS and the VHB-

JOURQUAL3. The search process was organized as follows. We performed the keyword search within the full text of the articles using the publishers’ websites and, in case the publishers’ websites did not provide an advanced search option, Google Scholar. Several search criteria have been defined to select the relevant articles. The search was limited to articles in English language published between 2010 and 2020, as it is assumed that IT skills as an emerging research field gained relevance in the last ten years. The search action included terms related to digitalization and information technology, as well as terms related to skills and competences. We used a broad search scope. Therefore, we used synonyms for the keywords to ensure that all relevant articles were included and reduce the likelihood of overlooking relevant articles. The search action was performed with the following keywords, their respective multiples, and Boolean operators: (“information technology” OR “digital” OR “digitalization”) AND (“skill” OR “skillset” OR “competence” OR “competency” OR “qualification” OR “fluency” OR “literacy”). To ensure the quality and reproducibility of the literature search, a spreadsheet was created to document the search process and the search results in detail. This search resulted in a set of 271 articles. The next step was to review this set of articles to determine which articles are relevant for further examination. By analyzing the abstracts of the articles, we identified 205 that were out of the scope of the research question. After excluding these articles, we were left with 66 relevant articles. In the next step, the full texts of the remaining 66 articles were screened for eligibility. 24 articles either deal with the empirical investigation of IT skills and competences or the conceptualization of these or highlight certain IT skills and competences’ relevance, thus constituting the final sample for our structured literature review. The selection process is summarised in Figure 1.

Figure 1: Results of the Research Process



The figure includes detailed information about the results of the keyword research in the main accounting education journals and indicates the 24 articles left for further analyses.

RESULTS

Based on the SLR, results indicate that digital technologies are seen as a driving force and game changer for the accounting profession in the accounting education literature (Pincus, Stout, Sorensen, Stocks, & Lawson, 2017). Al-Htaybat, Alberti-Alhtaybat, & Alhatabat, 2018 conclude that “the accounting profession is predicted to experience a significant change in the future, due to technological developments.”, which lead to a transformative effect on accounting practice because of automated and integrated workflows. Therefore, accounting education should include more contemporary technological features, especially IT skills, to meet the demands of employers in the digital era (Al-Htaybat, von Alberti-Alhtaybat, and Alhatabat (2018). The study of Tan & Laswad, 2018, which provides an analysis of job advertisements, highlights the need for accountants to use IT and close the IT skills gap between accounting education and professional needs. Having a look at the discussed IT skills in more detail, intermediate proficiency requires the ability to process transactions in an Enterprise Resource Planning (ERP)-system, to understand the structure and to be able to navigate within ERP-System (Sledgianowski, Gomaa, & Tan, 2017; Spraakman, O’Grady, Askarany, & Akroyd, 2015). The automation of processes means integrated processes within one system and/or data model but is also connected with RPA tools. RPA tools allow accountants to automate processes by themselves (Leitner-Hanetseder et al., 2021) and reduce human labour in accounting (Herbert, Rothwell, Glover, & Lambert, 2021). In times of rare IT staff, employees without special IT training can create applications according to the modular principle in a very simple way.

Therefore, in the future, the accountant himself will not only identify the process to automate, but also implement it. Professional software developers are often lacking, but the digital transformation can still gain momentum through citizen developers. According to Brink & Stoel, RPA enables transactions to be captured and analytics to be performed instantly. This finding may suggest making efforts to incorporate RPA into the classroom. Additionally, an understanding of blockchain technology with its potential to transform and reshape accounting (triple-entry accounting or identify use cases) is seen as relevant in accounting education (Felski & Empey, 2020). In the last years, spreadsheet packages such as Excel (Ragland & Ramachandran, 2014; Ramachandran Rackliffe & Ragland, 2016) are seen as necessary IT skills for accountants. In accounting education literature, there are some teaching cases that highlight the need to encourage students to handle Excel (see, for example, Willis, 2016).

Excel skills seem particularly important in accounting to prepare, analyze, manipulate, and report financial data. Advanced Excel features are considered the most important IT skills regarding applications (Brink & Stoel; Ragland & Ramachandran, 2014). To close the skill gap, excel is used in accounting courses for which students need a significant amount of data analytic skills (Ramachandran Rackliffe & Ragland, 2016). Thus, we conclude that Excel skills and data analytic skills often go hand in hand. Results show that data analytic skills are gaining importance in accounting practice (Ballou, Heitger, & Stoel, 2018). Therefore, Richardson and Shan (2019) propose introducing data analytics courses for accounting at both undergraduate and graduate levels.

Even if Excel skills are considered to close the skill gap in the last years, accounting education literature points out that due to the increasing amount and complexity of data in the digital era, the complexity of spreadsheets is expected to increase (Awayiga, Onumah, & Tsamenyi, 2010). Therefore, applications for business analytics are changing, and students need to be aware of the dangers of spreadsheet errors and need to know how to minimize them (Schneider, Becker, & Berg, 2017). Advanced BI-intelligence tools such as Power BI, QlikView and Tableau provide the ability to easily integrate data sources, provide greater flexibility and provide the ability to handle bigger datasets and enable traceability (Schoute, 2019). Self-service BI-tools connect structured data contained in the ERPs with non-transactional but unstructured and semi-structured information from the environment, such as social media sources and allow end-users insights into the data based on their special needs (Vasarhelyi et al., 2015). Accounting education literature sees the need to teach BI-tools (Brink & Stoel; Riggins & Klamm, 2017). Accountants as power users

should have the skills to create dashboards for end-users and have the skill to decide what information is available for which end-user (Riggins & Klamm, 2017). Additionally, accountants are seen as the ones who create awareness of the appropriate use of self-service BI-tools (Riggins & Klamm, 2017). Additionally, to handle BI-Tools, Schoute, 2019 highlights the need for a basic understanding of programming languages. Coding might be necessary to adapt BI-tools to individual needs or gain insights into the data base without using specific BI-tools. Furthermore, BI-tools enable accountants to detect trends and anomalies by using machine learning algorithms or visualizing (Cunningham & Stein, 2018). Using these BI-tools requires an understanding of machine learning and visualizing techniques (Leitner-Hanetseder et al., 2021).

In times of Big Data analytics, there is also evidence that it is valuable for accountants to have skills for working with cloud services and cloud-based systems (Wells, 2018) as well as relational database management systems (RDMS) or even NoSQL databases (Awayiga et al., 2010; Brink & Stoel; Richardson & Shan). Another topic related to working with (big) data is data quality as well as data and cyber security (Brink & Stoel). This means that students know quality criteria and are able to update and retrieve the data source using structured query language (SQL) (Lawson & Street, 2021). Similarly, recent cybersecurity incidents highlight the need to complement accounting curricula, sensitize students for cybersecurity and teach them how to recognize, assess and mitigate cybersecurity risks (Roohani & Zheng, 2019).

CONCLUSION AND DISCUSSION

The ongoing digitalization of accounting has far-reaching implications for the skills and competencies needed by accountants. Literature identified a rising skill gap between education and professional needs caused by the digitalized economy (Jackson & Meek, 2021; Oesterreich & Teuteberg, 2019). This paper takes a closer look at this gap and is therefore timely and highly relevant both for accounting education literature and practice. It answers the questions of which IT skills have been discussed in the accounting education literature in the last decade and if these skills meet the requirements of an advanced semi-autonomous accounting presented by Lehner et al. (2021). For this purpose, a structured literature review (Massaro, 2016) was conducted. The first keyword search resulted in 271 hits, and after several screenings, the final sample contained 24 articles from the accounting education literature that deal with IT skills in times of digitalization. In the following Figure 2, we summarize the key IT skills discussed in the last decade in accounting education literature. What we see is that accounting education literature discusses IT skills in the context of transaction automation (software robots, integrated ERP-Systems, blockchain technology) as well as gaining insights into internal and external data with software applications (spreadsheet packages such as Excel, BI tools) as well as an understanding of cloud services and cloud-based systems, RDMS & NoSQL database, programming languages (such as SQL, R+, Python, SAS) and AI-based algorithms. Finally, there is a need to know how to provide data and cybersecurity. According to the results of the SLR, accounting education literature discusses IT skills that go hand in hand with the tasks and digital technologies used in a semi-autonomous accounting proposed by Lehner et al., 2021. This means that the discussed IT skills enable accountants to become data analysts and internal advisors.

Figure 2: Information Technology Skills in Accounting Education Literature

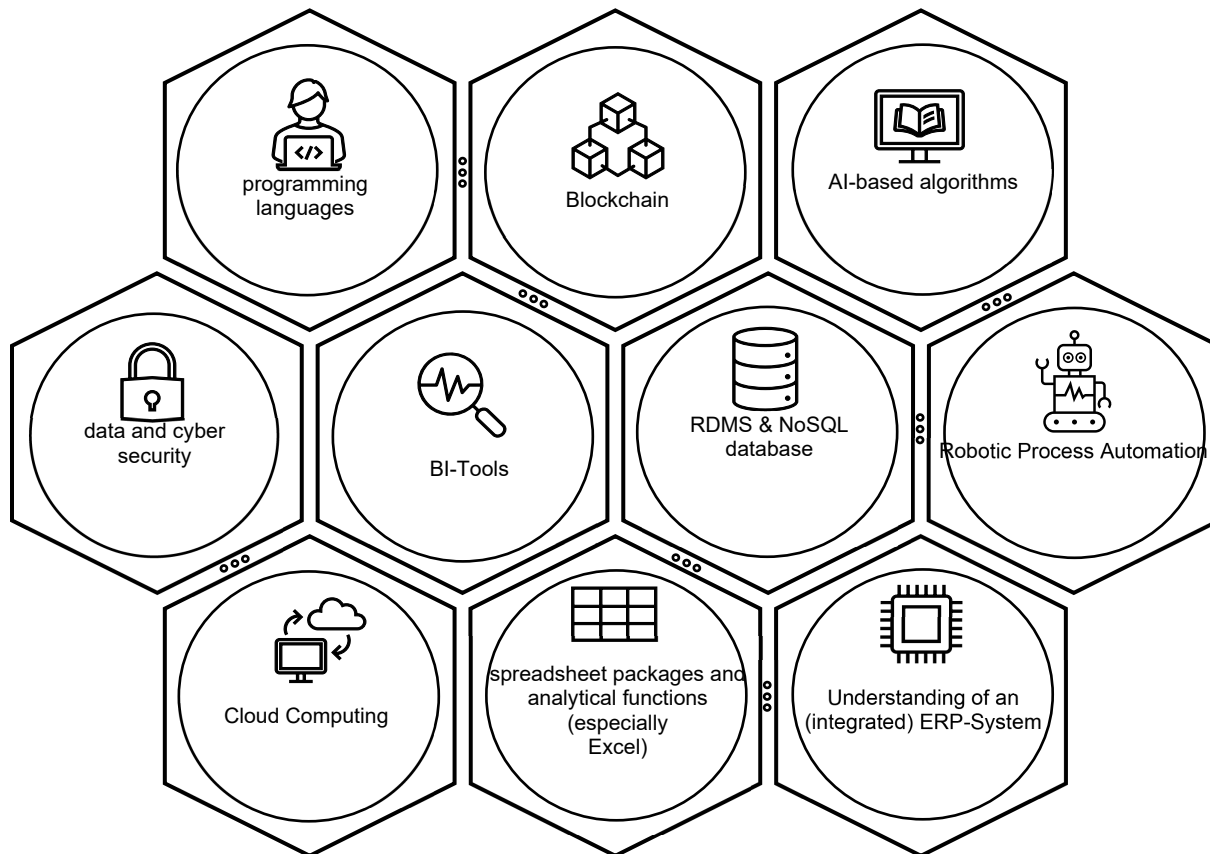


Figure 2 indicates the discussed IT skills within accounting education literature in the last decade, which meet the information technology in a semi-autonomous accounting proposed by Lehner et al., 2021

From these IT skills identified from the literature, we believe that some are more important than others or should be given special attention in accounting education because of their relevance in a digitalized economy and their contribution to the field of accounting. As efficient processes and near time reporting is essential to be competitive in an highly volatile environment. We see that it is necessary that accountants have deep understanding of integrated ERP-Systems and tools to automatize processes and reduce manual interfaces. In the next decade, process automation within ERP-Systems or by using Robotic Process Automation-Technology will be an essential IT skill to automatize recognition, closing and reporting. Accountants might be able to identify potentials for automation and based on a citizen developer concept should be able to automatize processes. There are also indications, that blockchain technology could have a revolutionary impact on the efficiency as well as transparency. For example using blockchain technology for intercompany reconciliation might increase efficiency in reporting and allow transparency within the group and for external auditors. In contrast to ERP-Systems and RPA, user skills are not relevant. For accountants, it might be necessary to identify and assess use cases for blockchain technology. We believe that technologies such as ERP-Systems, RPA and blockchain technology should be included in accounting curricula, for example in a process automation course.

Besides skills to automatize processes, we think that data analytical skills are important more than ever. Because of big data, it is essential that accountants know about ways to hold data in a relational database management system (RDBMS) and how to retrieve data from it by using programming languages such as SQL or Python. Additionally, we see that the use of BI-Tools enables accountants to create individualized dash boards for decision makers. In times of Big Data, Excel and Power Point skills won't be as relevant

as in the last 20 years and due to our experience are seen as tools that are taught during school time. We also see that a basic understanding of logic-based machine learning algorithm (so called AI) used for predictive and in the long run prescriptive analytics will be essential. We do not believe that accountants generate or decide which algorithm is used for which use case but we see that accountants need to be able to understand and interpret the results generated by advanced IT-Tools for decision making. Therefore, we recommend to implement basic data analytical course in the accounting curriculum. Finally, we see that to students need to know about concepts to provide data and cyber security. This course might enable students to be able to know about data storaging, get an understanding of AI based descision making, know how to retrieve and analyse data with one specific programming language and use BI-tools to create reports. Table 1 summarizes those IT skills required in a process automation course and business data analytical course that the authors consider particularly important and the related level or recommendations for accounting education.

Table 1: Summary of Important Courses and IT Skills and Recommendations for Education

Process Automation course	
IT skills	Level and/or recommendation
ERP-Systems	Understanding of integrated ERP-Systems User knowledge to handle processes within a system and identify automation potential
RPA-Tools	User knowledge to automatize processes
Blockchain Technology	Basic understanding to be able to identify and assess use cases
Business data analytical course	
IT skills	Level and/or recommendation
Understanding of data basis	basic knowledge
Programming languages	include a basic user knowledge in SQL, Python or R in data
BI-tools	advanced user skills
AI-based algorithms	basic knowledge to understand decisison making
Data and cyber security	sensitize students for cyber crime and cyber attacks and provide preventive measures

Table 1 summarizes those IT skills that the authors consider particularly important and the related recommendations for accounting education

In order to provide students with these competences it is necessary to integrate IT skills into accounting curricula. As mentioned above, we suggest two courses. However, we identified that IT skills are still seen as a “peripheral component in an accounting degree” (Kotb et al., 2019). For these reasons, it is not or not sufficiently integrated into accounting courses, and training “on the job” is seen as sufficient (Kotb, Abdel-Kader et al. 2019). In a dynamic and volatile environment, IT-tools and data sources might come and go. This uncertainty about technological developments is seen as a main driver, which boosts or delays the implementation of IT skills in the accounting curriculum. In the last century, there was the agreement that Excel is a useful spreadsheet to meet the professional skills. This led to the fact that in many accounting curricula Excel is implemented. For the next years, we see that the above mentioned IT skills are required or have a potential to be required. However, a steady analysis of the needs is an essential key factor for successful education. We also see four main driving forces, which might boost or delay implementing IT skills in the accounting curriculum.

First, uncertainty about technological developments and related skills to be taught. Second, the financial resources of the faculty impede or delay the implementation of technologies in accounting curricula (Andiola, Masters, & Norman, 2020). Third, missing training concepts, which facilitate the accounting students to handle accounting concepts in a digital economy with Big Data and automation in the field of accounting. Fourth, in order to create a learning environment in which accounting concepts but also IT skills are taught, an interdisciplinary faculty staff is necessary, that might handle the challenges of developing and teaching the accounting concepts with IT tools (Andiola et al., 2020). In business practice, teamwork and interdisciplinary is becoming more and more important in the course of digital transformation, and the same must apply to accounting faculties.

The structured literature review was limited by focusing on articles published in six relevant accounting education journals from the years 2010 to 2020. Consequently, articles published early or in non-accounting education journals, books or conference papers are excluded from the analysis but might have also provided valuable findings. Furthermore, although we have taken great care to ensure validity, the choice of the keywords and the screening process are based on subjective valuations. Therefore, it cannot be guaranteed that all relevant publications are included in the analysis. We see that future research to understand the impact of the transformation of accounting could go in many directions. With this paper, we would like to highlight the need for further research concerning the boundary of the transformation of accounting and the impact on accounting education to avoid a rising IT skill gap.

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