Work in Progress: Teamwork Predisposition as an Indicator of Team Effectiveness in First-Year Engineering

Mr. Fazel Ranjbar, University of Cincinnati

Fazel Ranjbar is currently pursuing his Ph.D. in the Department of Engineering and Computing Education at the University of Cincinnati. He has 10 years of industry experience in Iran and holds a bachelor's degree in industrial engineering from Payam Noor University. His research area is workforce development and developing student teamwork skills.

Dr. Jutshi Agarwal, University at Buffalo, SUNY

Jutshi Agarwal is a Postdoctoral Associate with the Department of Engineering Education at the University at Buffalo. She was the first doctoral student to get a Ph.D. in Engineering Education from the University of Cincinnati. She also has a Master's degree in Aerospace Engineering from the University of Cincinnati and a Bachelor's degree in Aerospace Engineering from SRM University, India. Her research areas of interest are graduate student professional development for a career in academia, preparing future faculty, and using AI tools to solve non-traditional problems in engineering education. She is currently also furthering work on the agency of engineering students through open-ended problems. She has published in several international conferences.

Dr. P.K. Imbrie, University of Cincinnati

P.K. Imbrie is the Head and Professor of the Department of Engineering Education and a Professor in the Department of Aerospace Engineering and Engineering Mechanics University of Cincinnati. He received his B.S., M.S. and Ph.D. degrees in Aerospace Engi

Work-in-Progress: Teamwork Predisposition as an Indicator of Team Effectiveness in First-Year Engineering

Abstract

This work-in-progress paper is focused on teamwork in engineering classrooms. Effective teamwork skills are very important in today's world, which is constantly changing. An environment of collaboration encourages members to share their ideas and skills, which leads to more creative and efficient solutions to problems. Teamwork allows team members to integrate their skills and knowledge to accomplish a common goal while creating a sense of synergy among team members. Teamwork is a critical component of success in many fields, particularly in engineering education, where ABET requirements emphasize the importance of working in teams for engineering students. How to create and evaluate student teams has been the subject of numerous investigations. Measuring team effectiveness can involve trust, respect, and support among team members, as well as a sense of shared responsibility and mutual accountability for achieving the team's goals. Previous research has identified several factors contributing to effective teamwork, including communication, leadership, and conflict resolution. One factor that may influence team effectiveness is teamwork predisposition (teamwork predisposition refers to the individual's attitude toward teamwork), especially for first-year students. But little research has focused specifically on the relationship between an individual's teamwork predisposition and their perception of team effectiveness in an engineering education setting.

To address this gap, this paper examines the research question: "Is teamwork predisposition an indicator of team effectiveness?" In this study, team effectiveness is measured using a scale of four factors: interdependency, learning, goal setting, and potency. Surveys were administered at the beginning of the first semester and at the end of each semester of a 2-semester long course sequence at a large, midwestern, public, R1 university. We hypothesize that students' teamwork predisposition score on teaming may attribute to low evaluations of team effectiveness. The results may have important implications for engineering educators and practitioners who seek to develop effective teamwork among their students and colleagues. Using teamwork predisposition as a criteria for creating teams can be an important factor in better team effectiveness and learning outcomes in engineering coursework.

Keywords: Teamwork Predisposition; Team Effectiveness

INTRODUCTION

Effective teamwork is critical for professional success in today's complex and dynamic world [1]. Collaborative work environments promote sharing unique perspectives and skills, leading to more creative and effective solutions to global problems [2]. Teamwork allows individuals to combine their skills and knowledge to accomplish a common goal while creating a sense of synergy among team members [3]. In addition to higher job satisfaction, teamwork develops

meaningful connections, leading to a greater sense of shared responsibility and ownership over outcomes [2], [4], [5]. Teamwork in academic settings enhances academic performance, fosters creativity, and promotes a better understanding of complex concepts for students [6], [7], [8]. In academic settings, teamwork improves students' communication skills, engagement, motivation, effective collaboration, and active participation in learning [9]. Developing teamwork skills benefits students academically and has long-term implications for personal and professional development. It develops leadership skills, enhances problem-solving abilities, and develops decision-making skills, all contributing to students' overall growth and readiness for future efforts [2], [10], [11], [12]. Teamwork skills gained through academic settings are crucial for students' future careers as employers highly value them [13]. It also enhances empathy, social awareness, and improved decision-making abilities, which are essential for navigating diverse work environments and making informed choices [14], [15]. Effective time management skills and self-reflection abilities in students are being affected by developing teamwork skills, and enable students to set goals, prioritize tasks, allocate resources efficiently, and identify areas for self-improvement [16], [17].

Teamwork is a critical element of success in many fields, particularly in engineering education, where ABET requirements emphasize the importance of working in teams for engineering students [7], [18]. Teamwork encourages creative thinking, enhances academic performance, and builds a sense of community and belonging between students [5], [7], [8]. Furthermore, teamwork provides opportunities for students to practice leadership skills and increases student motivation and engagement in learning [9], [12].

Team effectiveness refers to team's ability to achieve its goals. It includes how well team members work together to complete tasks, output quality, and team satisfaction [19]. Evidence suggests that effective teams are identified by high levels of communication, collaboration, and coordination [1]. Measuring team effectiveness is difficult and depends on several factors, including context and field [16]. Several methods are used to measure team effectiveness, including self-assessment, peer assessment, and objective measures [1]. Self-assessment involves team members evaluating their performance and providing feedback to one another [20]. Peer assessment refers to team members assessing the performance of their peers, often using structured feedback forms [21]. Objective measures include measures of team performance, such as productivity or quality of work, as well as measures of team satisfaction or team member retention rates [1]. Still, there is a lack of knowledge about evaluating effectiveness.

While previous research has identified factors such as trust, respect, communication, leadership, and conflict resolution as contributors to effective teamwork [1], [2], little research has focused on the relationship between an individual's teamwork predisposition and their perception of team effectiveness in an engineering education setting. We define "teamwork predisposition" as an individual's attitude towards teamwork, which can impact their behavior and perception of team effectiveness.

To address this gap, this study aims to examine the research question: "Is teamwork predisposition an indicator of team effectiveness?" The study uses two scales: the first scale measures teamwork predisposition using 7 items, the second measures team effectiveness with

24 items distributed over four factors, including interdependency, learning, goal setting, and potency. Surveys were administered at the beginning of the first semester and at the end of each semester of a 2-semester long course sequence at a large, midwestern, public, R1 university. The study hypothesizes that students' low teamwork predisposition may attribute to their low evaluations of team effectiveness.

This study may have important implications for engineering educators and instructors who aim to develop effective student teamwork, as well as early identification of dysfunctional teams. Using teamwork predisposition as a factor for creating teams may improve team effectiveness in engineering coursework. In engineering education settings, educators can enhance team dynamics and outcomes by considering individuals' attitudes toward teamwork when forming teams. By carefully considering the result of measuring students' teamwork predisposition, educators can create teams with one more important criterion. This approach to team formation may improve team members' collaboration and performance.

METHODOLOGY

The following section presents information about the educational context in which the research was conducted, describes the characteristics of the study participants, and outlines the data analysis techniques employed.

A. Educational Setting and Participants

The study was conducted at a large, public, urban, Midwestern R1 institution. In the engineering curriculum for the first year, students take two 3-credit hour courses over two semesters. Each course is structured around providing students with significant design experience. Students are required to actively participate in team-based projects in addition to engaging in different fundamental content areas such as design process, ethics, algorithmic thinking, modeling, statistics, statics, and electricity. At the start of each semester, student teams of three or four members are formed by the teaching team, considering factors such as prior experiences, knowledge, and demographics.

This research investigated the relationship between an individual’s teamwork predisposition and their self-reported team effectiveness score in an engineering education setting. To achieve this, data from three cohorts of engineering students from the years 2018, 2021, and 2022 (pre- and post-COVID pandemic) were analyzed. The study included a sample size of 1527 in all three surveys: the first survey at the beginning of the first semester, the second survey at the end of the first semester, and the third survey at the end of the second semester.

Student data was pulled from course surveys that students do as part of their assignments. The specific aim of the research was to examine the potential relationship between teamwork predisposition, measured by surveys administered at the beginning of the first semester, and team effectiveness, which was assessed using a scale comprising four factors: interdependency, learning, goal setting, and potency. The teamwork predisposition items (Table 1) contain responses on a 6-point Likert scale (1 = Strongly Disagree, 6 = Strongly Agree), and the team

effectiveness scale (Table 2) responses contain a 7-point Likert scale (0 = Strongly Disagree, 6 = Strongly Agree). The team effectiveness scale contains 26 items, including two reverse-coded items to validate students' responses.

B. Table of survey questions

Table 1 TEAMWORK PREDISPOSITION ITEMS. RESPONSES ON 6-POINT LIKERT SCALE (1 = STRONGLY DISAGREE, 6 = STRONGLY AGREE)

Item.	***Statement***
1	In a team setting, I help others when they have a question about how to solve a particular problem.
2	It is important that team members provide each other the information they need to complete a job.
3	In a team setting, it is helpful for me to share ideas about problem-solving strategies with others.
4	When working in a team, I ensure that team goals reflect the input of all team members.
5	In a team setting, I value the input of others when making a decision.
6	In a team setting, it is every member's responsibility to ensure that other members feel valued.
7	I take responsibility to resolve team problems.

Table 2 TEAM EFFECTIVENESS SCALE. RESPONSES ON 7-POINT LIKERT SCALE (0 = STRONGLY DISAGREE, 6 = STRONGLY AGREE)

Statement	***Factor***
My team collaborated effectively to complete our assignments.	Interdependency
My teammates displayed appropriate interpersonal skills when conflict arose.	Interdependency
My contributions to the team were appreciated by each team member.	Interdependency
I had confidence in each team member to contribute his/her fair share of what was required.	Interdependency
My team used a process/method (e.g., code of cooperation) to hold each member accountable.	Interdependency
Team members were prepared for team meetings.	Interdependency
Team members arrived on time to team meetings.	Interdependency
I knew what to expect from them.	Interdependency
An outside observer would have concluded our team had an effective process to complete our assignments.	Interdependency
The solutions of my team to course assignments were better than what I would have done on my own.	Learning
This team helped me understand the material presented in this course.	Learning
Working on this team made me realize that some things about myself (e.g., communication ability, leadership) that I was not aware of.	Learning
This team enabled me to acquire the skills necessary to contribute to working on future teams.	Learning
This team enhanced my academic learning.	Learning

Statement	***Factor***
My team was confident in its ability to overcome adversity (e.g., interpersonal conflict, assignments).	Potency
I feel a sense of accomplishment in my team's ability to work together.	Potency
This team gave me confidence in the ability of teamwork to solve problems.	Potency
My team had the collective abilities (e.g., communication, interpersonal, technical) to accomplish course assignments.	Potency
I was confident that our team produced acceptable solutions to course assignments.	Potency
This team helped me accomplish my individual goals for this course.	Goal Setting
My team used clear, long-term goals to complete tasks.	Goal Setting
My team reflected upon its goals in order to plan for future work.	Goal Setting
My team made use of incremental goals (i.e., we set short-term goals) in order to complete course assignments on time.	Goal Setting
My team made use of incremental goals (i.e., we set short-term goals) in order to complete course assignments on time.	Goal Setting
Our team did not function well as a team; we did not establish any process to hold one another accountable nor did I ever know what individuals were responsible for.	Validity Item
Overall, I thought being on this team was a very negative experience.	Validity Item

C. Data analysis

For this study, we removed data from students who did not complete all three surveys. Also, considering that errors were identified by identical responses for all questions and a negative relationship with the validation question, the sample size was reduced to 1,527 (Table 3) including students in all three cohorts who answered all three surveys. The data analysis was performed using RStudio version 23.5 and the Lavaan package, and Minitab 21.4.2. We combined the three cohorts for the purpose of the analysis. The student surveys were investigated for evidence of reliability and validity before further analysis to confirm the data's quality. The overall teamwork predisposition score (Sum of numeric responses to 7 Items) and the scores for team effectiveness (Sum of numeric responses to 24 Items excluding the two validity items) were compared across the three cohorts using the four factors: interdependency, learning, goal setting, and potency. The impact of teamwork predisposition was assessed by analyzing the scores of student responses to the survey that we will call the first survey in this paper.

Descriptive statistics were calculated for the student teamwork predisposition (Table 4) and Team effectiveness (Table 5) scores. The students were divided into two groups – one who reported low teamwork predisposition and two those who reported as high. For this study, we considered student responses that were *agree* or *strongly agree* as high (scores 5 and 6 for each item). The skewness and kurtosis for the distribution of the team effectiveness scores and teamwork predisposition scores were both under 1, suggesting normality of the distribution [22]. Two sample t-test was used to analyze significant differences between the means of the team

effectiveness scores of the two groups. We hypothesized that there would be significant differences in the team effectiveness scores, where the group with low teamwork predisposition would show lower team effectiveness. To investigate this hypothesis, we conducted one-tailed t-tests on the sum of team effectiveness scores (sum of 24 items) for both semesters separately and also the average of team effectiveness scores for both semesters collectively.

D. Tables of Distribution of Data

Table 3 DISTRIBUTION OF DATA POINTS ACROSS THREE COHORTS (N = 1527)

Cohort	*n*
2018-2019	394
2021-2022	647
2022-2023	486
Total	1527

Table 4 DESCRIPTIVE STATISTICS OF STUDENT TEAMWORK PREDISPOSITION (N = 1527) SUM OF RESPONSES ON A 6-POINT LIKERT SCALE FOR 7 ITEMS (1 = STRONGLY DISAGREE, 6 = STRONGLY AGREE), (MIN = 7, MAX = 42)

Measurement	*2018-2019*	*2021-2022*	*2022-2023*
Mean	37.05	35.72	35.23
Median	37	35	35
Range	21	21	19
SD	3.99	3.67	3.56
SE	0.20	0.14	0.16

Table 5 DESCRIPTIVE STATISTICS OF STUDENT TEAM EFFECTIVENESS (N = 1527) SUM OF RESPONSES ON A 7-POINT LIKERT SCALE FOR 24 ITEMS (0 = STRONGLY DISAGREE, 6 = STRONGLY AGREE), (MIN = 0, MAX = 144)

Measurement.	*2018-2019*	*2021-2022*	*2022-2023*
Mean	96.67	105.39	103.29
Median	102	111	111
Range	144	138	133
SD	32.11	28.16	28.89
SE	1.14	0.78	0.93

RESULTS AND DISCUSSION

Evidence of Reliability and Validity

The guidelines for evaluating the adequacy of fit indices in confirmatory factor analysis were derived from the recommendations provided by Immekus and Imbrie [23]. Our main goal in exploring Confirmatory Factor Analysis (CFA) was to evaluate how well the data aligns with the model, particularly by examining markers of construct validity. However, the chi-square test showed a statistically significant outcome $\chi^2 = 6328.734$, df = 246, $p < 0.001$, because the test is sensitive to large sample sizes. To strengthen our assessment, we examined alternative indices. The factor loadings of observable variables onto latent constructs (IN, LN, PT, GS) were highly significant ($p < 0.001$), showing strong correlations and giving evidence for the model's construct validity.

Our results showed approximate fit indices: CFI = 0.901, TLI = 0.899, and SRMR = 0.047. These indices assess the relative fit of our model compared to the baseline model. SRMR indicates a reasonable fit of the model. Additionally, the fit indices suggest that the theoretical model adequately fits the collected data, indicating a good alignment between the model and the observed data.

Cronbach's coefficient alpha can determine a data set's reliability [24]. The Cronbach's alpha coefficients for the teamwork predisposition measure were 0.85 for Cohort 2018, 0.81 for Cohort 2021, and 0.83 for Cohort 2022, indicating satisfactory evidence of reliability across different cohorts. Similarly, the Team effectiveness measure showed high evidence of reliability with alpha coefficients of 0.93 for Cohort 2018, 0.92 for Cohort 2021, and 0.93 for Cohort 2022, which all exceeded the desired criteria of 0.80 [25].

Relation between student teamwork predisposition and team effectiveness

Based on the team effectiveness survey results for the first and second semesters, the cohorts were split into two groups to examine the potential relationship between student teamwork predisposition and team effectiveness:

Group one: Students with high teamwork predisposition scores (n = 988).

Group two: Students with low teamwork predisposition scores (n = 539).

Based on the data provided, the analysis conducted in this study aimed to examine the potential relationship between teamwork predisposition and team effectiveness. The primary research question focused on determining whether teamwork predisposition could serve as an indicator of team effectiveness.

The first t-test was conducted to compare the average of both semesters' team effectiveness scores of two groups of students categorized based on low and high teamwork predisposition. The result shows that the differences between students with high teamwork predisposition scores ($M = 104.11$, $SD = 23.01$, $N = 988$) and students with low teamwork predisposition scores ($M=99.40$, $SD = 23.31$, $N = 539$) are statistically significant, with a P-value <0.001.

The second and third t-tests were similar to the first, except they were performed separately for each semester. We examined team effectiveness scores for students with low and high teamwork

predispositions in both cases. The result shows that the differences between students with high teamwork predisposition scores ($M = 104.11$, $SD = 23.01$, $N = 988$) and students with low teamwork predisposition scores ($M = 96.80$, $SD = 29.12$, $N = 539$) are statistically significant, with a P-value < 0.001 for the fall semester. The third t-test result showed the differences between students with high teamwork predisposition scores ($M = 104.13$, $SD = 23.01$, $N = 988$) and students with low teamwork predisposition scores ($M = 102.15$, $SD = 28.82$, $N = 539$) are statistically significant with a P-value = 0.042 for the spring semester.

Based on the available data, the findings suggest a significant relationship between teamwork predisposition and team effectiveness within the context of this study. This suggests that a low predisposition towards teamwork may lead to low perceptions of team effectiveness. These results indicate the importance of teamwork predisposition in the context of students' teamwork. As teamwork predisposition can be measured at the beginning of forming teams, it may be a criterion for forming student teams to avoid leading to low team effectiveness. Furthermore, it can be considered as an early warning indicator for faculty to monitor student teams that include students with low teamwork predisposition scores.

This is just the preliminary analysis that precedes a deeper investigation. The overall goal of this study is to find a reliable model based on different factors to identify dysfunctional student teams as early in the team experience as possible.

It is important to note that the conclusion resulting from this analysis is only based on the data provided and the specific research question investigated. Therefore, the findings should be interpreted with caution in other contexts. Further investigation and in-depth analysis are needed to understand the multifaceted factors contributing to team effectiveness and explore the potential role of teamwork predisposition in different domains. These findings contribute to the existing knowledge of teamwork and team effectiveness. They underscore the complex nature of these constructs and highlight the necessity for future research efforts to develop a more in-depth understanding of the interrelationships between teamwork predisposition, team effectiveness, and other relevant variables.

Future work:

One of the important variables that might strengthen the predictor model can be students' peer evaluation scores. For the next step, the peer evaluation score will be added to the analysis to give a better understanding of variables that might influence students' team effectiveness.

In the next phase, we will add open-ended questions to the surveys to better understand students' perceptions of teamwork at the beginning of the first semester.

References

[1] J. E. Mathieu, P. T. Gallagher, M. A. Domingo, and E. A. Klock, “Embracing Complexity: Reviewing the Past Decade of Team Effectiveness Research,” *Annu. Rev. Organ. Psychol.*

Organ. Behav., vol. 6, no. 1, pp. 17–46, Jan. 2019, doi: 10.1146/annurev-orgpsych-012218-015106.

[2] J. E. Mathieu, M. M. Luciano, L. D'Innocenzo, E. A. Klock, and J. A. LePine, "The Development and Construct Validity of a Team Processes Survey Measure," *Organ. Res. Methods*, vol. 23, no. 3, pp. 399–431, Jul. 2020, doi: 10.1177/1094428119840801.

[3] M. A. Marks, "A Temporally Based Framework and Taxonomy of Team Processes," 2001.

[4] A. R. Rajabzadeh, J. Long, G. Saini, and M. Zeadin, "Engineering Student Experiences of Group Work," *Educ. Sci.*, vol. 12, no. 5, p. 288, Apr. 2022, doi: 10.3390/educsci12050288.

[5] L. A. DeChurch and J. R. Mesmer-Magnus, "The cognitive underpinnings of effective teamwork: A meta-analysis.," *J. Appl. Psychol.*, vol. 95, no. 1, pp. 32–53, Jan. 2010, doi: 10.1037/a0017328.

[6] R. Lingard and S. Barkataki, "Teaching teamwork in engineering and computer science," in *2011 Frontiers in Education Conference (FIE)*, Rapid City, SD, USA: IEEE, Oct. 2011, pp. F1C-1-F1C-5. doi: 10.1109/FIE.2011.6143000.

[7] R. Reiter-Palmon and J. J. Illies, "Leadership and creativity: Understanding leadership from a creative problem-solving perspective," *Leadersh. Q.*, vol. 15, no. 1, pp. 55–77, Feb. 2004, doi: 10.1016/j.leaqua.2003.12.005.

[8] R. E. Slavin, "Cooperative Learning and Academic Achievement: Why Does Groupwork Work?. [Aprendizaje cooperativo y rendimiento académico: ¿por qué funciona el trabajo en grupo?]," *An. Psicol.*, vol. 30, no. 3, pp. 785–791, Oct. 2014, doi: 10.6018/analesps.30.3.201201.

[9] Y. Chang and P. Brickman, "When Group Work Doesn't Work: Insights from Students," *CBE—Life Sci. Educ.*, vol. 17, no. 3, p. ar52, Sep. 2018, doi: 10.1187/cbe.17-09-0199.

[10] J. R. Hackman, "From causes to conditions in group research," *J. Organ. Behav.*, vol. 33, no. 3, pp. 428–444, Apr. 2012, doi: 10.1002/job.1774.

[11] J. E. Mathieu, J. R. Hollenbeck, D. Van Knippenberg, and D. R. Ilgen, "A century of work teams in the Journal of Applied Psychology.," *J. Appl. Psychol.*, vol. 102, no. 3, pp. 452–467, 2017, doi: 10.1037/apl0000128.

[12] T. Rapp, T. Maynard, M. Domingo, and E. Klock, "Team Emergent States: What Has Emerged in The Literature Over 20 Years," *Small Group Res.*, vol. 52, no. 1, pp. 68–102, Feb. 2021, doi: 10.1177/1046496420956715.

[13] E. Salas *et al.*, "Does Team Training Improve Team Performance? A Meta-Analysis," *Hum. Factors J. Hum. Factors Ergon. Soc.*, vol. 50, no. 6, pp. 903–933, Dec. 2008, doi: 10.1518/001872008X375009.

[14] J. N. Cummings and M. R. Haas, “So many teams, so little time: Time allocation matters in geographically dispersed teams,” *J. Organ. Behav.*, vol. 33, no. 3, pp. 316–341, Apr. 2012, doi: 10.1002/job.777.

[15] S. Reeves *et al.*, “A BEME systematic review of the effects of interprofessional education: BEME Guide No. 39,” *Med. Teach.*, vol. 38, no. 7, pp. 656–668, Jul. 2016, doi: 10.3109/0142159X.2016.1173663.

[16] J. Long, A. R. Rajabzadeh, and A. MacKenzie, “TEACHING TEAMWORK TO ENGINEERING TECHNOLOGY STUDENTS: THE IMPORTANCE OF SELF-REFLECTION AND ACKNOWLEDGING DIVERSITY IN TEAMS,” *Proc. Can. Eng. Educ. Assoc. CEEA*, Feb. 2018, doi: 10.24908/pceea.v0i0.9486.

[17] S. Park, T. J. Grosser, A. A. Roebuck, and J. E. Mathieu, “Understanding Work Teams From a Network Perspective: A Review and Future Research Directions,” *J. Manag.*, vol. 46, no. 6, pp. 1002–1028, Jul. 2020, doi: 10.1177/0149206320901573.

[18] “2022-23-ABET Criteria” [Online]. Available: https://www.abet.org/wp-content/uploads/2022/01/2022-23-ETAC-Criteria.pdf

[19] M. A. West, *Effective teamwork: Practical lessons from organizational research*. John Wiley & Sons, 2012.

[20] M. Davies, L. Stankov, and R. D. Roberts, “Emotional intelligence: in search of an elusive construct". *Journal of personality and social psychology*, *75*(4), 989.

[21] P. Black, C. Harrison, and C. Lee, *Assessment for learning: Putting it into practice*. McGraw-Hill Education (UK), 2003.

[22] A. Field, *Discovering statistics using IBM SPSS statistics*. sage, 2013.

[23] J. C. Immekus and P. K. Imbrie, “A Test and Cross-Validation of the Revised Two-Factor Study Process Questionnaire Factor Structure Among Western University Students,” *Educ. Psychol. Meas.*, vol. 70, no. 3, pp. 495–510, Jun. 2010, doi: 10.1177/0013164409355685.

[24] R. K. Henson, “A Primer on Coefficient alpha”.

[25] T. Raykov and G. A. Marcoulides, *Introduction to Psychometric Theory*, 0 ed. Routledge, 2011. doi: 10.4324/9780203841624.