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## Ebook Uses and Class Performance In A College Course

Wei Peng  
Dept. of Media & Information  
Michigan State University  
[pengwei@msu.edu](mailto:pengwei@msu.edu)

Rabindra Ratan  
Dept. of Media & Information  
Michigan State University  
[rar@msu.edu](mailto:rar@msu.edu)

Laeq Khan  
School of Arts & Sciences  
American U of Ras Al Khaimah  
[laeqk@gmail.com](mailto:laeqk@gmail.com)

### Abstract

*This research explores ebook use among undergraduate students, drawing from the technology acceptance model (TAM) to examine ebook usage and adoption. Undergraduates enrolled in a large course at a mid-western university in the United States completed surveys at the beginning and the end of the semester. A great amount of variance was found in ebook use. A small number of students made a large number of highlights, while the majority of students only made a small number of highlights. A majority of students did not utilize the note and bookmark features. Additionally, we found that perceived usefulness of ebooks positively predicted ebook views and perceived ease of use positively predicted ebook highlights. eBook views were also found to positively predict academic performance. Implications of the findings are discussed.*

### 1. Introduction

The rise of “ebooks”, formally defined as “text in digital form, or digital reading material, or a book in a computer file format, or an electronic file of words and images” [1], may be the most important development in the publishing industry since the Gutenberg press [2]. Compared to paper books, ebooks are more accessible and convenient [1], affordable [3], portable [1], and can be delivered to a range of digital devices, such as computers, smart phones, and tablets. In an educational context, where paper textbooks are often unwieldy and expensive, electronic textbooks provide an auspicious alternative for many stakeholders [4, 5]. For students, ebooks have the potential to augment learning, given their unique functionalities, such as search, copy-and-paste, and adjustable highlighting, which contribute to improving students’ comprehension and recall of information [6-9]. Further, ebooks potentially facilitate new types of interactions that revolve around text content and can enhance learning, such as cooperation amongst students, contact with faculty, and prompt feedback [10]. From a publisher’s perspective, ebooks are easier to update and correct errors when needed [11]. Teachers who use ebooks in

their classes are better able to measure student performance by monitoring which pages students read and for how long. Based on such information, teachers can identify the areas in a text where students face difficulties.

A number of studies have compared ebooks and traditional textbooks in terms of their impacts on learning and academic performance [12-14]. However, no previous studies have examined how facets of ebook usage contributes to academic performance. In this study, we explore how specific usage of ebooks, such as highlights, pages viewed, and notes, contribute to academic performance. More importantly, with the affordance of ebook, we are able to automatically and objectively gauge the ebook use data via server logs.

Although books are being increasingly published electronically, studies reveal that ebooks are not preferred by college students [15, 16]. Additionally, even though ebooks have many advanced features, such as search and annotation, these features are not utilized frequently, even among highly educated individuals with adequate skills in information and technology [17, 18]. The existing literature lacks a theoretical approach to understanding what predicts the use of ebooks as well as their various functions. One theoretical framework that is particularly powerful in predicting adoption and use of new technology is the Technology Acceptance Model (TAM) [19]. The present research examines the use and perception of ebooks in the higher educational context from the perspective of TAM.

### 2. Literature review

#### 2.1. Ebook uses and academic performance

The ebook user population is gradually growing. This increase may be especially significant amongst younger audiences. According to a 2011 PEW Internet and American Life report, the number of U.S. individuals who read ebooks increased from 16% to 23% for ages 16 years and older [20]. Another Pew Research report also indicated that ebook readers are avid readers since they had read 24 books on average in a year as compared to a non-

ebook consumer who had read 15 books [21]. It is notable that ebooks used as textbooks are not equivalent to ebooks used for leisure purposes. The electronic readers that make ebooks accessible in nearly any environment are not ready for the classroom [22]. Therefore, educational institutions have focused on making ebooks available on computer screens through course management systems [22], such as Desire2Learn, Angel, and Blackboard.

Various studies have looked into ebook adoption and use as textbooks in academic settings [1, 12, 15, 23, 24] as well as for leisure [25]. Research comparing ebooks and traditional textbooks primarily attempts to answer two questions: 1) how do ebooks compare to traditional textbooks in terms of effectiveness in learning, and 2) how do users (students and faculty) perceive ebooks in comparison to traditional textbooks? Although the digital natives may generally be quite adept at technology use in comparison with previous generations [26], there are challenges that need to be considered in successful ebook adoption and use in the educational context. Among college students there is still a strong preference for hard copy texts instead of ebooks [15, 16, 27]. Only one study found that students had a slight preference for ebook over print-form when they were provided free of charge [12].

In terms of ebook effectiveness, some found that ebooks are as effective as traditional texts [23], although it took longer to complete the reading in ebook format than in print format, especially among those who reported significantly higher levels of multi-tasking [23]. However, some research indicated that students who chose ebooks had significantly higher perceived affective learning and psychomotor learning than students who chose to use traditional print textbooks [14]. Although we have some evidence comparing ebooks to traditional print textbooks in terms of preference, to our best knowledge, there seems to be no research examining the specific features of ebooks and their connection to learning effectiveness.

In comparison with paper books, ebooks have unique affordances, such as interaction and engagement with the course materials. With ebooks, beyond purely viewing and reading, it is possible to engage in behaviors such as text searching, highlighting, and even commenting [28]. Media engagement may manifest at different levels. The lowest form of engagement (passive) is paying attention to the message in a mediated setting. On a higher level (active), engagement moves a step forward into the domain of participation. Various media tools are interactive and may be used to

involve students in a way that contributes to their academic potential (e.g., Twitter [29]).

In the ebook context, active engagement is reflected in the active use of a number of features: highlights, notes and annotations, and asking questions. Research shows that text highlighting is a commonly used reading strategy amongst students [30]. On computers, highlighting may improve efficiency by reducing the time students need to review materials [31]. Previous research has found that highlights in text are beneficial for comprehension and recall [6-9]. In this study, we focus on ebook engagement as a combination of viewing, highlights, note taking and bookmarking activities. We explore students' uses of these features, their perception and evaluation of these features, and the relationship between the uses of these features and academic performance. This study explores three key questions:

RQ1: How do students use and engage with ebooks?

RQ2: How do students evaluate ebooks?

RQ3: How do ebook's various uses (e.g., page view, highlights, notes) contribute to class performance?

## 2.2. Understanding ebook adoption and use

Although research concerning ebook adoption and use is still in its infancy, a number of studies have examined predictors of ebook adoption and use. An experimental study found that reading an ebook caused greater eye fatigue and lower reading efficiency in comparison with reading a conventional book [32]. According to the authors, these findings were explained by habit, as individuals are more familiar with reading paper books from an early age.

In 2012, Internet2 conducted a survey that comprised students and faculty at five U.S. universities where e-textbook projects were implemented [33]. Results showed that students were receptive to ebook use because they were cost-effective in comparison with paper books; however, many students reported that ebooks were not used to interact with other students and professors and there was difficulty in navigating the ebooks.

A study by the UK's Joint Information Systems Committee (JISC) national ebooks observatory project [34] shed light on the importance of usability in ebook adoption, suggesting that ebook interfaces and platforms are "far from ideal, and in some cases, barely serviceable" (p. 6). Another report highlighted three major issues for institutions in ebook adoption—compatibility, digital rights management, and accessibility [35]. eBooks are available in a

variety of formats and standards, thus making it complicated for institutions to adopt ebooks [34].

Many of the existing ebook studies are descriptive in nature. Only a few studies are based on theoretical frameworks. For example, [Shin \(2011\)](#) employed the uses and gratifications framework, expectations conformation theory, and diffusion theory to examine ebook user experience, and found that the user's cognitive perceptions play a major role [25]. [Stone and Baker-Eveleth \(2013\)](#) applied the expectation-confirmation model and found that satisfaction and perceived usefulness of ebooks influence electronic continuance intention of ebook use [24]. However, none of this research examined the predictors of specific ebook feature use. In the institutional or organizational setting, the Technology Acceptance Model (TAM) has been frequently employed to predict user acceptance and adoption of information systems [36, 37]. Although there are updated frameworks on TAM such as the Unified Theory of Acceptance and Use of Technology (UTAUT) [38] and the recently extended Unified Theory of Acceptance and Use of Technology (UTAUT2) model [39], UTAUT and UTAUT2 are more suitable for the consumer use context and TAM is more suitable for the organization. eBook use in the current study resembles organizational uses of technology given that ebooks were provided by the university (organization) free of charge to the students. Therefore, we adopted TAM rather than UTAUT or UTAUT2 as the theoretical model for the current study.

Under TAM, use of technology is viewed in terms of two factors — perceived usefulness (PU) and perceived ease of use (PEU) [40]. *Perceived Usefulness* (PU) is defined by [Davis \(1989\)](#) as the person's belief about the extent to which performance would be enhanced due to the use of a particular technological system and its various features [19]. In this case, the user's belief would be measured about how useful an ebook is in enhancing student's performance, student interaction, new ways of learning, etc. *Perceived ease of use* (PEU) is defined as how much a person believes a particular technological system "to be free from effort" (p. 985) [19]. In the case of ebooks, perceived ease of use is how effortless it is for the users to benefit from such a system as well as its various features for educational purposes. Thus, we expect the following:

H1: Perceived usefulness of ebooks is positively related to page views.

H2: Perceived ease of use of ebooks is positively related to page views.

H3: Perceived usefulness of ebooks is positively related to highlights.

H4: Perceived ease of use of ebooks is positively related to highlights.

### 3. Methods

#### 3.1. Participants

Our sample was comprised of undergraduate students recruited from an introductory course in media history and theory at a large Midwestern university in the United States. Students were provided free ebook access from the university via the course management system ANGEL.

There were two textbooks in the course: one consisted of 579 pages, and the other was 336 pages. Of the 259 students enrolled in course, 223 students completed consent forms to voluntarily participate in the research study. One survey was administered at the beginning of the semester (n=205) while another was administered at the end of the semester (n=187).

Of the 169 students who completed both surveys, seven students did not use any of the two ebooks, resulting in a final sample size of 162. Among the 162 participants, 72 were female (44.4%), 89 were male (54.9%), one student did not disclose gender (.6%). One hundred and fifty-three (94.4%) were domestic students, seven (4.3%) were international students and two (1.2%) did not disclose their country of origin. Five participants were Hispanic (3.1%). A majority of the students were White (n = 134, 82.7%); nine were Asian (5.6%); ten were African American (6.2%), two were mixed race (1.2%), and seven did not provide racial information (4.4%).

#### 3.2. Class setting

The class met twice a week in a large lecture hall. iClickers ([www.iclicker.com](http://www.iclicker.com)) were employed throughout the course and students were required to participate in every class session. Additionally, students could use CenterClass ([www.centerclass.com](http://www.centerclass.com)), a web-based tool where students can ask and vote on questions in real-time during class or after class.

#### 3.3. Procedures

Both surveys were hosted online at Qualtrics and distributed to students who provided consent. The surveys did not obtain any identifiable information from students and thus were completely anonymous. Upon completion of both surveys, data was downloaded and cleaned for analysis.

### 3.4. Measures

The TAM measures of perceived usefulness (PU) and perceived ease of use (PEU) were adapted from the original scales [19]. A reliability analysis showed good internal consistency for the scales.

Perceived usefulness of ebooks was a three-item scale ( $\alpha = 0.90$ ) comprised of the following questions: “I have found the ebooks effective for learning”; “Using the ebooks has made it easier to learn”; and “Using the ebooks has enhanced my chances of getting a good grade”.

The perceived ease of use of ebooks scale ( $\alpha = 0.94$ ) was comprised of five items: (1) “I have found the ebooks easy to use”; (2) “Learning to use the ebooks has been easy for me”; (3) “My interaction with the ebooks has been clear and understandable”; (4) “I have found the ebooks to be flexible to interact with”; and (5) “It has been easy for me to become skillful at using ebooks”.

Ebook use was objectively measured via the system logs of the number of pages viewed, highlights, notes, and bookmarks.

A number of specific ebook features were evaluated in terms of their usefulness and ease of use. Specifically, the participants were asked to use a 5-point Likert scale to rate the usefulness and ease of use for the following ebook tools and features: own highlights and/or annotations, instructor’s highlights and/or annotations, other students’ highlights and/or annotations in the ebooks, asking questions in the ebooks, and getting responses to questions in the ebooks (usefulness only).

### 3.5. Control variables

We included several control variables: self-rated Internet skills, social class, gender, self rating for being a good student, and class engagement. Social class has a strong relationship with young people’s technology use [41]. The digital divide and a variation in Internet skills also follows the patterns defined by a difference in socio-economic status [42]. Besides social class, gender has shown to impact technology use, especially Internet use [43]. We used self rating for being a good student as a proxy for general academic performance because we have a large number of missing data for SAT score and GPA. Class engagement was measured by the number of class attended which is obtained from iClickers, and the number of questions asked and answered via CenterClass.

## 4. Results

In order to examine how the students used and engaged with ebooks (RQ1), we calculated descriptive statistics (Table 1) for ebook views, highlights, notes, and bookmarks across the entire semester. The mean number of views suggests that a large portion of the students were not reading all of the assigned pages. Furthermore, the variance for highlights was very large, suggesting that a small number of students made a large number of highlights, while the majority of students only made a small number of highlights. Indeed, the distribution of highlight frequency exhibited exponential decay. In order to account for this, the analyses that included the number of highlights as a variable of interest utilized the natural logarithm of this number as the metric representing highlights. The means for notes and bookmarks illustrate that the majority of students did not utilize these features of the ebook, so these variables were not considered in other analyses.

Table 2 included the participants’ evaluation of the usefulness and ease of use of various specific ebook features as well as their evaluation of the overall usefulness and ease of use of ebooks. In order to address RQ2 (how do students evaluate ebooks?), we conducted a series of one-sample t-tests comparing the participants’ evaluation with the middle point of the 5-point scale. Participants positively evaluated the following features: usefulness of the instructor’s highlights and/or annotations,  $t(159) = 3.02, p = .003$ ; ease of use of highlights and/or annotation,  $t(159) = 8.96, p < .001$ ; ease of use for the instructor’s highlights and/or annotations,  $t(159) = 5.60, p < .001$ . The participants negatively evaluated the following features: usefulness of the highlights and/or annotations by other students,  $t(159) = -9.33, p < .001$ ; usefulness of asking questions in the ebook,  $t(159) = -8.62, p < .001$ ; usefulness of answers to the questions asked,  $t(159) = -5.32, p < .001$ . The participants evaluated the rest of the features as neutral in terms of usefulness and ease of use, as their evaluations were not statistically significant from the middle point. One-sample t-tests were also conducted to compare the overall ebook usefulness and ease of use scales against the middle point. eBook usefulness ( $t(161) = 2.63, p = .01$ ) and ebook ease of use ( $t(161) = 12.89, p < .001$ ) were slightly above the midpoint on the scale, suggesting that students’ attitudes toward the ebook were positive, but not overwhelmingly so.

To answer RQ3, hierarchical linear regressions were conducted. Gender, internet skills, social class, and self rating of being a good student (i.e., the control variables) were entered in the first regression

block; class attendance, use of CenterClass (questions asked and questions answered) were entered in the second regression block; ebook views and log transformed ebook highlights were entered in the third block. The results of the hierarchical linear regression presented in Table 3 indicated that ebook views were positively related to class final grade ( $\beta = .309, p = .001, R^2 = .238$ ). However, ebook highlights were not correlated with class final grade ( $\beta = .009, p = .916$ ). Class attendance also positively correlated with class grade ( $\beta = .284, p = .000$ ).

Another set of hierarchical linear regressions were conducted to test H1 and H2. The same set of control variables were entered in the first block and perceived usefulness of ebooks and perceived ease of use of ebooks were entered in the second block. The results of the hierarchical linear regression (Table 4) indicated that perceived usefulness of ebooks was positively correlated with ebook views ( $\beta = .208, p = .045, R^2 = .171$ ). However, perceived ease of use of ebooks was not correlated with ebook views ( $\beta = .139, p = .184$ ). Gender was also correlated with ebook views such that females were more likely to view ebook pages than males ( $\beta = -.202, p = .009$ ).

Similar hierarchical linear regressions were conducted to test H3 and H4. The control variables were entered in the first block and perceived usefulness of ebooks and perceived ease of use of ebooks were entered in the second block. We also used the perceived usefulness and perceived ease of use of highlights and/or annotations rather than perceived usefulness and perceived ease of use of ebooks in the second block and the results were similar. Note that given the nature of the highly skewed distribution of the highlights data, the log transformed highlights data was used as the dependent variable. The results of the hierarchical linear regression (Table 4) indicated that perceived ease of use of ebooks was positively related to ebook highlights ( $\beta = .223, p = .034, R^2 = .168$ ) after controlling gender, internet skills, social class, and self rating of being a good student. However, perceived usefulness of ebooks was not related to ebook highlights ( $\beta = .050, p = .631$ ). Gender was also related to ebook highlights such that females were more likely to make highlights in the ebooks than males ( $\beta = -.302, p = .000$ ).

## 5. Discussion

In order to develop an understanding of how ebooks can be integrated into formal learning environments to improve learning, we conducted a study on the uses, perceptions, and effects of ebooks

within a large semester-long undergraduate course, using the TAM as a guiding framework. Although most students did not read all of the assigned pages or engage actively with the text (via highlights, notes, or bookmarks), overall, students evaluated the ebook positively in terms of usefulness and ease of use. Students' evaluation of specific ebook features were mixed; they perceived highlighting by the instructor and themselves positively, but perceived highlighting and interactive features with other students negatively. Regardless, students who highlighted more text rated the ebook as easier to use. Further, students who viewed more pages in the ebook rated the ebook as more useful and also received higher final grades in the class. Together, these findings suggest that the ebook was an integral component of the learning experience, although the study cannot support a specific causal relationship.

The most notable finding from this study is the positive relationship between perceiving the ebook as useful and viewing ebook pages, the latter of which was related to receiving a higher class grade. One interpretation that students who think the ebook is more useful choose to view more pages and this leads to better grades. However, we should be cautious given that the survey results cannot establish causality, and other explanations are possible. For example, viewing more ebook pages for a reason besides perceived usefulness (e.g., general motivation) may cause an increase in perceived usefulness that is independent from increases in class grade resulting from ebook viewing.

The finding of a positive relationship between highlighting and perceived ease of ebook use can also be interpreted in multiple ways. From an individual differences perspective, students who are more technologically adept should be more likely to highlight text and also to perceive the ebook as easy to use. Conversely, highlighting may be unrelated to technological adeptness given that Internet skills were included as a control variable in the analysis; and so it is possible that some other factor encouraged students to highlight text, and doing so improved their attitude about the ebook's ease of use. The direction of causality for this relationship could be examined in an experimental study. But regardless of causation, this finding, along with the students' positive evaluation of the highlighting feature, supports the notion that usability is important for ebooks in the educational setting. If educators want to fully take advantage of ebook functionality, publishers need to make all features – especially those that encourage more active use, such as highlighting – easier to use.

The finding that students generally perceived the ebooks positively, with respect to usefulness and ease of use, suggests that ebooks are likely to be adopted in education with positive results, but this should be considered in light of a few caveats. First, we did not compare preference of ebook with that of traditional print textbooks. Second, ebook use in general was quite low, with most students not reading all of the assigned pages. This was not likely because of any inadequacy of the ebooks, but instead due to the nature of the large introductory course in which paying attention and taking notes in lecture was sufficient for most students to earn a passing grade. Thus, we would expect that reading from the paper text to be equally low, if not lower. This illustrates one important value of using ebooks: the instructor is able to objectively gauge how much the students are reading and adjust the course accordingly. In the present case, the instructor should make changes to the class lectures to encourage more reading, perhaps by explicitly not covering certain topics that are in the book and then telling the students that these topics will be on the exams. Further, future research on ebooks in education would perhaps benefit from using courses in which the students must rely more heavily on the text.

In addition to the low amount of reading, another caveat to consider is the small minority who engaged actively with the text. Specifically, of 162 students, only 78 (48.1%) made at least one highlight and only 29 (17.9%) made at least one note. This finding is consistent with the students' negative evaluations of the usefulness of highlights and/or annotations by other students, which may be due to the design of the class, which did not encourage or reward student interaction through the use of these features. Further, this finding may highlight another limitation in the present design. Namely, the class included a number of other interactive tools besides the ebooks that were available to the students (e.g., CenterClass). The availability of these tools may have detracted from the extent to which highlighting and note taking in the ebook were useful to the student, thus reducing the validity of findings regarding these features.

Besides these caveats with respect to the findings, we should also mention some limitations of the study in general. First, the study did not randomly assign students to conditions of ebook usage, so it is not possible to determine causality from any of the findings. Further, because the students knew that their ebook usage was being tracked as part of the study, and because they received the ebook for free, they may have acted in ways that differed from their normal behavior. Also, the use of self ratings of being a good student,

instead of GPA or SAT scores (for which we had a large amount of missing data), potentially detracts from the validity of the results. Further, we did not measure previous experience with ebooks in educational (compared to pleasure) settings, which may have influenced the ways that the students used and perceived the ebooks in this class. Perhaps most importantly, the course was taught in the same way as it would have been taught had the instructor used a paper book. Thus, there were no assignments or other encouragements for students to use the unique features provided by the ebook. While the instructor did this in order to not unduly influence the students' behavior, the present findings seem to indicate that ebooks features, especially those that encourage interactivity, have the potential to drastically augment student engagement. In other words, the course should have been designed to take advantage of the features offered by the ebook.

These limitations aside, overall, the present research contributes to a greater understanding of ebook adoption and usage. By applying TAM in this context, the present work provides a theoretical foundation upon which future ebook research can build. We hope that these foundations will help promote the implementation of ebooks in educational settings in ways that enhance student learning and engagement to the fullest extent possible.

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Table 1. Descriptive data of ebook use

	<i>N</i>	Minimum	Maximum	Mean	Std. Deviation
View	162	1	639	132.49	157.97
Highlights	162	0	3454	118.97	392.43
Note	162	0	200	3.19	18.25
Bookmark	162	0	51	1.47	5.39

Table 2. Evaluation of ebook specific features and overall usefulness and ease of use

Variable	<i>N</i>	Minimum	Maximum	Mean	Std. Deviation
Usefulness: Highlighting and/or annotations	160	1	5	2.89	1.23
Usefulness: Highlights and/or annotations by instructor	160	1	5	3.31	1.31
Usefulness: Highlights and/or annotations by students	160	1	5	2.17	1.12
Usefulness: Asking questions in the ebooks	160	1	5	2.22	1.14
Usefulness: Getting responses to questions in ebooks	160	1	5	2.45	1.31
Ease of use: Highlights and/or annotations	160	1	5	3.71	1.01
Ease of use: Instructor's highlights and/or annotations	160	1	5	3.49	1.12
Ease of use: Other students' highlights and/or annotations	160	1	5	3.00	1.18
Ease of use: asking questions	160	1	5	2.98	1.17

Table 3. Hierarchical Multiple Regression Analysis for Variables Predicting Academic Performance

	$\beta$	t-value	$\beta$	t-value	$\beta$	t-value
Sex	-0.02	-0.20	0.04	0.46	0.09	1.18
Internet skill	-0.07	-0.81	-0.04	-0.46	-0.04	-0.56
Social class	-0.01	-0.16	-0.05	-0.63	-0.03	-0.45
Good student self rating	0.21	2.55 *	0.19	2.50 *	0.13	1.79
Class attendance			0.31	4.09 ***	0.28	3.89 ***
Center class participation (question)			0.11	1.30	0.06	0.67
Center class participation (answers)			-0.07	-0.78	-0.04	-0.48
ebook view					0.31	3.46 **
ebook highlights (log transformed)					0.01	0.11
$R^2$		0.04		0.15		0.24
$N$		159		159		159

Note. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Table 4. Hierarchical Multiple Regression Analysis for Variables Predicting ebook view and highlights

	eBook view				eBook highlights			
	$\beta$	t-value	$\beta$	t-value	$\beta$	t-value	$\beta$	t-value
Sex	-0.20	-2.50 *	-0.20	-2.65 ***	-0.31	-3.91 ***	-0.30	-3.96 ***
Internet skill	-0.01	-0.11	-0.03	-0.45	-0.01	-0.08	-0.02	-0.31
Social class	-0.03	-0.44	0.00	0.01	0.02	0.29	0.05	0.64
Good student self rating	0.19	2.41 *	0.14	1.75	0.13	1.72	0.08	1.04
eBook usefulness	0.07		0.21	2.02 *	0.10		0.05	0.48
eBook ease of use			0.14	1.34			0.22	2.14 *
$R^2$			0.17				0.17	
$N$			159				159	

Note. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$