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Explaining lecture attendance behavior via structural equation modeling: Self-Determination Theory and the Theory of Planned Behavior

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ABSTRACT

Some research suggests that university lecture attendance positively correlates with academic performance. Although there are several motivational pathways which may explain attendance, few studies have examined the psychosocial factors leading to student attendance intentions and behavior. Consequently, we evaluated via structural equation modeling (SEM) two prominent motivational theories to help explain lecture attendance: Self-Determination Theory (SDT) and The Theory of Planned Behavior (TPB). Undergraduates (N = 288) from two universities completed pre-semester motivation measurements and post-semester estimates of attendance. Student grades were also examined. SDT was not found to be an accurate model of attendance intentions or behavior. By contrast, TPB was found to be an adequate model to help explain attendance intentions and behavior. Lecture attendance did not significantly correlate with grades. If educators and students are committed to increasing lecture attendance rates, our findings suggest that the enhancement of perceived behavioral control, as well as optimistic intentions, may yield the greatest benefits with respect to students meeting their lecture attendance expectations.

1. Introduction

There is widespread evidence that lecture attendance is important for improving academic outcomes (Bos, Groeneveld, van Bruggen, & Brand-Gruwel, 2016; Credé, Roch, & Kieszczynka, 2010; Stegers-Jager, Cohen-Schotanus, & Themmen, 2012). In fact, a meta-analysis of 69 studies found that lecture attendance was a significant predictor of academic performance over and above prior academic performance (0.44; Credé et al., 2010). More recent studies have also reported a significant association between attendance and academic performance across a variety of disciplines (Hidayat, Vansal, Kim, Sullivan, & Salbu, 2012; Louis, Bastian, McKimmie, & Lee, 2016; Stegers-Jager et al., 2012). While some evidence suggests that lecture attendance is a stronger predictor of academic performance than watching lectures online (Bos et al., 2016), there is also emerging evidence that there is no association between lecture attendance and academic performance (Andrietti & Velasco, 2015; Azab et al., 2016). In practice, a common observation is that lecture attendance is high, initially, and then declines gradually throughout the semester (e.g., Bos et al., 2016; Nyamapfene, 2010; Traphagan, Kucsera, & Kishi, 2010). This pattern of behavior suggests a large proportion of students are capable of attending (e.g., they have the time and the means to travel to campus for a specified time), and may even intend to attend lectures regularly; however, there may be important psychosocial factors which may have impeded lecture attendance over time. Because the majority of available evidence to date supports that attendance is a predictor of academic performance, further work is needed to better understand the motivational factors which might predict lecture attendance.

To date, a number of factors have been found to predict lecture attendance, including prior grade point average (GPA), employment, travel distance, teacher quality, subject type, student age, gender and the availability of online learning materials (Credé et al., 2010; Dolnicar, Kaiser, Matus, & Vialle, 2009; Kelly, 2011; Oldfield, Rodwell, Curry, & Marks, 2017; Traphagan et al., 2010). Despite a considerable body of literature that has examined predictors of lecture attendance, the motivational processes which underlie why some students do not, or continue to, attend lectures remain poorly understood. In the current study, we used two prominent motivational theories, Self-Determination Theory and The Theory of Planned Behavior, to better understand the motivational factors which might explain the lecture attendance behavior of undergraduate university students.

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1.1. Self-Determination Theory

Self Determination Theory (Deci & Ryan, 1985) originally distinguished intrinsic and extrinsic motivation as constructs which occupy two opposing ends of a perceived locus of causality continuum (Ryan & Connell, 1989). More recently, intrinsic motivation has been conceptualised as self-determined, or autonomous, and involves satisfying personally relevant goals, in the absence of external rewards or reinforcement (Ryan & Deci, 2000b). This autonomy involves identification (the self-endorsement of goals), integration (the assimilation of these identified goals), and an inherent satisfaction in performing an action or pursuing a goal. In a higher education setting, more autonomous students might attend lectures, because they inherently value the acquisition of knowledge and experience satisfaction during the activity, independently of the possible academic outcomes.

By contrast, extrinsic motivation is conceptualised as non-self-determined, or controlled, and involves engaging in behaviors for the purpose of receiving an external reward or avoiding punishment (Ryan & Deci, 2000b). This controlled motivation involves external regulation (salience of extrinsic consequences), and introjection (experiencing pressure to maintain self-worth or avoid guilt). In a higher education setting, more controlled students might attend lectures, because they associate attendance with performance outcomes, intuitively, in addition to perceived social pressure. These students are, thus, motivated to improve their grades, avoid failing the course, and enhance their ego.

To date, few studies have investigated the association between autonomous and controlled motivation and lecture attendance behavior. In one study, Stegers-Jager et al. (2012) administered a subscale to measure a dimension similar to autonomous motivation (termed intrinsic goal orientation) in a sample of medical students. Stegers-Jager et al. (2012) reported a positive correlation between lecture attendance and intrinsic goal orientation ($r = 0.23$). Some research has also shown that autonomous motivation is a stronger predictor than controlled motivation of withdrawal from higher education (Charlton, Barrow, & Hornby-Atkinson, 2006). Arguably, lecture attendance behavior is, at least to some degree, sensitive to external reinforcement, as the implementation of attendance policies (which impose some grade penalty) have been shown to be effective for increasing attendance (Marburger, 2006; Subramaniam, Hande, & Komattil, 2013; Verbeeten & van Hoof, 2007). Ultimately, the paucity of studies that have examined autonomous and controlled motivation, according to the conceptualisation proposed by Deci and Ryan (Deci & Ryan, 1985; Ryan & Deci, 2000b), calls for new research to determine what relative role, if any, these two dimensions might play in explaining lecture attendance behavior in a higher education context. Consequently, the present study evaluated the role of both autonomous and controlled motivation with respect to lecture attendance, with a validated multi-item scale consistent with Self Determination Theory (Ryan & Deci, 2000b).

1.2. Theory of Planned Behavior

The Theory of Planned Behavior (Ajzen, 1985; Schifter & Ajzen, 1985) is grounded by the assumption that the most immediate antecedent of human goal-directed behavior is an intention to perform the behavior. According to the theory, three determinants (or pre-intentions) are considered critical to forming an intention: attitudes; subjective norms; and perceived behavioral control (Ajzen & Madden, 1986).

Attitudes reflect the personal beliefs regarding the positive and negative evaluations of performing the behavior (e.g., the individual will somehow derive a benefit from engaging in the behavior). That is, beliefs regarding the likely consequences of a behavior are assumed to determine the attitudes towards the behavior (Ajzen, Joyce, Sheikh, & Cote, 2011). In a higher education setting, this would likely relate to whether lecture attendance is perceived to be beneficial.

By comparison, subjective norms reflect the social influence a person experiences with regards to the behavior (e.g., is the behavior expected or lauded by peers and family). That is, beliefs regarding the expectations and behaviors of others with regards to the behavior are assumed to determine subjective norms (Ajzen et al., 2011). In a higher education setting, this would likely relate to whether lecture attendance is perceived by the student to be beneficial by other students (and/or friends and family).

Finally, perceived behavioral control (PBC) reflects a person's perceived capacity to perform the behavior. This can include the availability of the necessary skills and resources (e.g., the extent to which a person possesses the ability, time, money, tools, etc.) required to perform the behavior (Ajzen & Madden, 1986). That is, beliefs regarding potentially inhibiting factors are assumed to determine perceived behavioral control (Ajzen et al., 2011). In a higher education setting, this could pertain to whether a student has the means to travel to, or make time for, attending lectures. Perceived behavioral control has been acknowledged to act as both a pre-intention (having an indirect association with behavior via intentions), as well as an immediate antecedent for behavior (having a direct association with behavior) (Ajzen & Madden, 1986). That is, it is possible for PBC to be partially or completely mediated by intention for some behaviors (Ajzen & Madden, 1986).

Evidence has shown that perceived behavioral control explains consistently more variance in intentions, in comparison to attitudes or subjective norms, whereas subjective norms typically explains the least amount of variance in intentions (Armitage & Conner, 2001; Godin & Kok, 1996). However, studies have shown that the contribution of subjective norms improves, when the behavior is socially unfavourable (Manning, 2009; Nemme & White, 2010). Importantly, when examined together, the sub-dimensions of the Theory of Planned Behavior have performed well, with respect to explaining a diverse range of behaviors, including conservationist and pro-environmental behaviors (Ajzen et al., 2011; de Leeuw, Valois, Ajzen, & Schmidt, 2015), the use of security controls on Facebook (Taneja, Vitrano, & Gengo, 2014), phone use while driving (Nemme & White, 2010), alcohol consumption and binge drinking (Ajzen et al., 2011), as well as various other health-related behaviors (Armitage & Conner, 2001; Godin & Kok, 1996).

To our knowledge, only two studies have used the Theory of Planned Behavior to predict lecture attendance and class participation behavior. In one of the earliest applications of the Theory of Planned Behavior, Ajzen and Madden (1986) investigated class attendance in a sample of US college students. All three pre-intentions predicted student attendance intentions, with Perceived Behavioral Control (PBC) showing the strongest association. Ajzen and Madden (1986) argued that PBC can influence behavior independently of its association with intentions. Given that the manner in which lectures are delivered today, in comparison to the 1980s, new research is needed to determine whether the theory still explains lecture attendance behavior in a contemporary higher education context.

Additionally, the Ajzen and Madden (1986) study had several methodological limitations. Firstly, when measuring lecture attendance intentions, Ajzen and Madden (1986) used summed scores from a three item scale which captured generalised ratings of attendance intentions (e.g., *every time* to *rarely*) or the likelihood of attending every class (*extremely unlikely* to *extremely likely*), rather than a specific estimate of participants' intended attendance. Given that there are a finite number of possible lectures to attend each semester in a course, it is possible for participants to offer a more specific estimate of their intentions. Therefore, asking participants to report the number of lectures they intended to attend at the start of the semester was considered a more direct approach to assessing lecture attendance intentions in the present study. Secondly, Ajzen and Madden (1986) used several different descriptions for the anchor points (e.g., *extremely unlikely* to *extremely likely*, *frequently* to *never*, *easy* to *difficult*) across and within the response scales for the items used to measure pre-intentions and intentions. While their multi-item assessments for each dimension yielded

acceptable levels of internal consistency, the present study used a standardized Likert response scale across all items to avoid the introduction of possible measurement confounds. Lastly, Ajzen and Madden (1986) reported results from hierarchical regression analyses in their study to provide direct associations but not indirect associations or estimates of model fit. Consequently, and consistent with assumptions that there would be indirect associations, the present study reports the results of a structural equation modeling approach, so that direct and indirect associations could be tested simultaneously, as well as an evaluation of model-fit.

More recently, Girardelli and Patel (2016) examined intentions to participate in class (answering and asking questions, activity participation) in a sample of Chinese university students. In a structural equation model, all three pre-intentions, attitudes, subjective norms, and Perceived Behavioral Control (PBC) significantly predicted participation intentions, with PBC again the strongest predictor. However, because only intentions were measured, the association between intentions and behavior was not reported. Furthermore, the Girardelli and Patel (2016) study was conducted with a sample of Chinese students, thus, the results may not generalize to Western higher education settings.

1.3. The present study

Because the pre-intentions in the Theory of Planned Behavior and autonomous and controlled motivation are argued to be modifiable constructs (Rutter & Quine, 2002; Tyson, Covey, & Rosenthal, 2014), research directed at quantifying their influence on lecture attendance behavior could inform effective interventions by assisting educators to improve the student learning experience and academic outcomes. Thus, the purpose of this study was to apply both Self Determination Theory and the Theory of Planned Behavior to help explain lecture attendance intentions and attendance behavior in a contemporary, Western higher education setting. In specific terms, the present study aimed to: (a) examine the pattern of lecture attendance and its association with academic performance, and (b) examine the utility of two theories for explaining lecture attendance behavior in undergraduate students. Thus, the following hypotheses were tested.

H1. Consistent with recent findings (e.g., Bos et al., 2016; Oldfield et al., 2017), lecture attendance was expected to decline across the semester.

H2. Consistent with meta-analytic and recent empirical reports (Credé et al., 2010; Louis et al., 2016; Stegers-Jager et al., 2012), lecture attendance was expected to correlate positively with academic performance.

H3. Consistent with reports suggesting that both intrinsic goal motivation and attendance policies are associated with attendance behavior (Marburger, 2006; Stegers-Jager et al., 2012), autonomous and controlled motivation scores were expected to correlate positively with lecture attendance.

H4. Consistent with findings by Ajzen and Madden (1986) and Girardelli & Patel (2016), lecture attendance intentions, as well as the three pre-intentions (attitudes, social norms, and perceived behavioral control) were expected to correlate positively with lecture intentions and estimated attendance.

H5. If hypothesises (3) and/or (4) were found to be supported, then both theoretical models were expected to offer adequate model fit and explain an appreciable proportion of the variance in lecture attendance behavior.

H6. According to Ajzen and Madden (1986), it was also expected that path analyses in the structural model for the theory of planned behavior would reveal both direct and indirect associations of perceived behavioral control (via intentions) on lecture attendance behavior, with the possibility of a full mediation of the direct associations.

2. Materials and methods

2.1. Participants

Participants were 288 undergraduate psychology students studying research methods from]The University of Western Australia (UWA; $N = 97$) and Edith Cowan University in Australia (ECU; $N = 191$). The mean age of students from UWA was 23.70 years ($SD = 8.34$) (77 female), and the mean age of participants from ECU was 31.40 years ($SD = 11.04$) (166 female). Students from UWA predominantly identified as Caucasian ($N = 76$, 78.4%), followed by Asian ($N = 13$, 13.4%), mixed ($N = 7$, 7.2%), and African ($N = 1$, 1%). Similarly, students from ECU predominantly identified as Caucasian ($N = 160$, 83.8%), followed by Asian ($N = 6$, 3.1%), mixed ($N = 16$, 8.4%), African ($N = 4$, 2.1%), Pacific ($N = 3$, 1.6%), Aboriginal ($N = 1$, 0.5%), and Hispanic ($N = 1$, 0.5%). Each university sample consisted of a similar proportion of international students (UWA: 14.4%, ECU: 16.7%). The UWA data was collected from a third-year psychology research methods unit and the ECU data was collected from both an introductory and an equivalent second-year psychology research methods unit (two independent samples across consecutive semesters). Each of the three units had approximately 350 enrolled students at the commencement of the semester ($\approx$27% response rate).

2.2. Measures

2.2.1. Theory of Planned Behavior questionnaire

A 10-item questionnaire was developed to capture students' Attitudes, Subjective Norms, and Perceived Behavioral Control towards lecture attendance (see supplementary Table 1). The items were developed in accordance with guidelines for creating questions based on the TPB (Francis et al., 2004). Three items were created to measure attitudes (e.g. “Attending all lectures is worthwhile”), four created to measure subjective norms (e.g. I feel under social pressure to attend all lectures), and three created to measure PBC (e.g. “It is easy for me to attend lectures”). Each question was rated on a 6-point Likert scale, ranging from one (*strongly disagree*) to six (*strongly agree*). All negatively keyed items were reverse scored prior to the analyses.

The Planned Behavior Questionnaire was specifically designed to measure three factors, consequently, a partial confirmatory factor analysis (maximum likelihood estimation with direct oblimin rotation) was conducted on the 10-item correlation matrix (Gignac, 2009). The three factor model was considered acceptably well-fitting according to the Root Mean Square Error of Approximation (RMSEA) = 0.037, (Comparative Fit index) CFI = 1.00 and Tucker-Lewis index) TLI = 1.01, which were derived from the null, $\chi^2(36) = 1078.96$, $p < .001$, and implied models, $\chi^2(12) = 7.26$, $p = .84$. The correlations between the factors were: Attitudes and Perceived Behavioral Control, $r = 0.44$; Attitudes and Subjective Norms, $r = 0.33$; Perceived Behavioral Control and Subjective Norms, $r = 0.32$. The pattern matrix yielded three clear factors (see supplementary Table 1). However, item 7 was associated with an appreciable cross-loading, consequently, item 7 was excluded prior to any analyses (including the fit estimates). Finally, the reliability estimates associated with all three subscales were acceptable: Attitudes, $\alpha = 0.79$; Subjective Norms, $\alpha = 0.72$; and Perceived Behavioral Control, $\alpha = 0.81$.

2.2.2. Autonomous and controlled motivation

To capture the two main Self-Determination Theory dimensions, autonomous and controlled motivation, we administered the 24-item (7-point Likert scale) Global Motivation Scale (Guay, Mageau, & Vallerand, 2003). Consequently, scores from four subscales (To Know, Towards Accomplishment, Identified and To Experience Stimulation)

and two subscales (Introjected, and External Regulation) were obtained to estimate autonomous and controlled motivation, respectively. An overall autonomous motivation score was calculated by averaging all 16 items from each of the respective subscales. Additionally, an overall controlled motivation score was calculated by averaging all 8 items from each of the respective subscales. Both autonomous ($\alpha = 0.84$) and controlled motivation ($\alpha = 0.70$) scale scores yielded acceptable internal consistency estimates.

2.2.3. Lecture attendance intentions and behavior

At the start of the semester, students were asked to estimate how many lectures they intended to attend. Additionally, at the end of the semester, the students were asked to estimate how many lectures they actually attended. Response options for these questions were 0–26 for UWA students (two lectures per week), and 0–13 for ECU students (one lecture per week). These data were converted to percentages for analyses as the two samples were combined for the structural equation model.[1] Also, at the end of the semester, students were asked to give permission to have their unit grade included in the analyses (as provided by the unit-coordinator). Headcount data was also recorded by a research assistant at each lecture for the UWA sample and the secondary unit at ECU (equivalent learning materials) during the same concurrently running semester. For the UWA classes, the maximum attendance for each given week was reported to offer a single weekly figure for attendance.[2] This headcount data provided an exact record of attendance figures for examining the pattern of attendance across the semester, as well as for comparing the two universities.

2.3. Procedure

Data were collected from two online surveys, one at the commencement of the semester and one at the completion. The first survey included questions to capture the motivation dimensions and lecture attendance intentions. The final survey collected retrospective lecture attendance and permission to use student grades for analysis. At UWA, two 45-minute lectures were delivered per week for 13 weeks. The equivalent secondary unit at ECU consisted of one 3-hour lecture delivered each week for 13 weeks, and the introductory unit consisted of one 2-hour lecture delivered each week for 13 weeks. All units offered recordings of the live lectures. In the first lecture of each unit, students were presented with information about the research project and how to access the survey link through the usual online teaching portals. The first survey took approximately 10 min to complete. All lecturers encouraged participation, although students were advised that participation was neither compulsory nor would it have any impact on their academic outcomes. Students had access to the initial survey for the first two weeks of the semester. The final survey was made available during the last week of the semester and the week following, which took approximately 5 min to complete. As an incentive to participate in the research, students who completed each survey were placed into separate draws for a $100 (AUD) gift voucher. These procedures were approved by both University's Human Research Ethics Committees.

2.4. Data analytic strategy

To determine the suitability of the motivational models for structural equation modeling (SEM), Pearson correlations were first calculated to examine the associations between the motivation dimensions and the lecture attendance and performance data. Although any effect size guidelines are to some degree arbitrary, correlation coefficients were interpreted according to meta-analytically-derived guidelines published by Gignac and Szodorai (2016) for individual differences research (i.e., |0.10|, |0.20|, and |0.30| were considered relatively small, typical and large). The model for the Theory of Planned Behavior model was then subject to maximum likelihood estimation analysis in the statistical modeling software Analysis of Moment Structures (AMOS; Arbuckle, 2014). Because autonomous and controlled motivation did not correlate with any of the attendance data, it was not considered relevant to test Self-determination Theory in a SEM.

The structural equation model for the Theory of Planned Behavior was based essentially upon the theoretical model developed by Ajzen (1985). The exception was that we included direct associations between Attitudes and Behavior, as well as between Subjective Norms and Behavior. The three latent variables were defined by the item indicators associated with each respective questionnaire. Specifically, these were Attitudes (items 1, 2 & 3), Subjective Norms (items 4, 5 & 6), and Perceived Behavioral Control (items 8, 9 & 10). Intended Attendance (the intention) and Estimated Attendance (the behavior) were both observed variables, represented by pre-semester and post-semester estimates of lecture attendance, respectively. Examining all possible direct and indirect associations between the three pre-intentions, intended attendance, and estimated attendance allowed us to evaluate whether there was any utility in proposing a competing model, in this context.

Finally, as recommended by Schumaker and Lomax (2010), several model-fit indices were used to evaluate the model, these were the RMSEA, the TLI, and CFI. A RMSEA of < 0.06, a TLI of > 0.90, and a CFI of > 0.95 were interpreted to indicate a good fit (Hu & Bentler, 1999; Schumacker & Lomax, 2010).

3. Results

3.1. Lecture attendance across the semester

As can be seen in Fig. 1, when averaged across both universities, there was a gradual decrease in objectively-measured attendance across the semester. This pattern of means was statistically significantly curvilinear ($y = .65x^2–15.75x + 144.07$) and accounted for 95% of the variance ($R^2 = 0.95$, $p < .001$).[3] Therefore, the first hypothesis (i.e., lecture attendance would decline over the course a semester) was supported.

3.2. Associations between performance, attendance and motivational dimensions

As can be seen in Table 1, there was no significant association between lecture attendance and academic performance ($r = 0.09$, $p = .130$, 95%CI: −0.03/0.21). Thus, the second hypothesis (i.e., lecture attendance would correlate with academic performance) was not supported. Furthermore, autonomous and controlled motivation did not yield any significant correlations with lecture attendance intentions nor with estimated attendance (see Table 1). Thus, the third hypothesis, that autonomous and controlled motivation would correlate with lecture attendance, was not supported. Finally, Attitudes, Subjective Norms and Perceived Behavioral Control were significantly and positively correlated with lecture attendance intentions and estimated attendance, which supported the fourth hypothesis (see Table 1). These correlation coefficients were all interpreted to be large and, thus, higher levels of positive beliefs regarding lectures, social expectations regarding lectures and perceived capacity to attend lectures were all

[1] When analysed separately, there was no indication that any of the key results differed between the two universities.

[2] Maximum attendance counts were used with the exception of week 6, when an in-class mid-term assessment was administered. Because the administration of this assessment upwardly distorted attendance rates, the headcount sum from the other lecture that week was reported.

[3] The significance of the correlation was tested via randomization and found to be beyond chance, $p < .001$

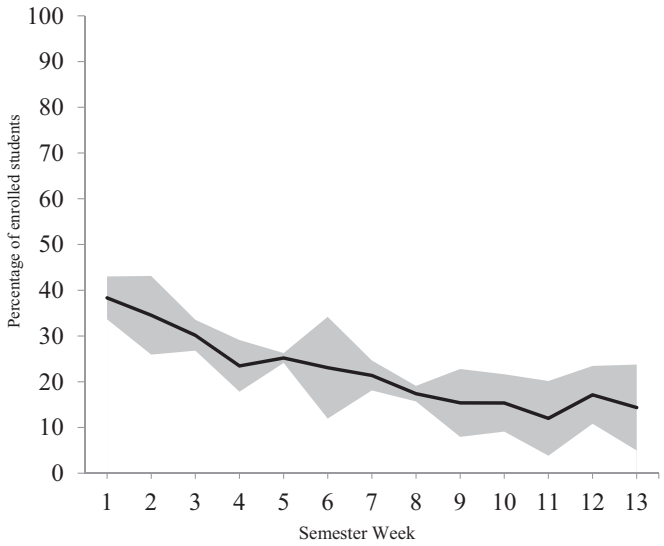

Fig. 1. Weekly student lecture attendance expressed as proportion of enrolment, averaged across both universities. Shaded area represents 95% confidence region.

Intended Attendance partially mediated the total association between PBC and Estimated Attendance (i.e., $r = 0.47$), supporting the fifth hypothesis. However, the difference between the direct association between Perceived Behavioral Control and Estimated Attendance and the indirect association via Intended Attendance was not statistically significant, $\Delta b = -0.13$ (95%CI: −0.42/0.23, $p = .544$). Therefore, both the direct and indirect associations (via Attendance Intentions) of PBC on Estimated Attendance are notable features of the model. As no other path combination met the conditions for testing additional mediation associations (Baron & Kenny, 1986), and none were expected (according to Ajzen and Madden (1986)), no further indirect associations were examined. Furthermore, removing any of the direct paths did not markedly change the other associations, improve model fit, or meaningfully change the key findings of the study.

4. Discussion

Lecture attendance was shown to decrease significantly across the semester, as hypothesized. However, we failed to find a significant association between lecture attendance and academic performance. Finally, while we did not find any evidence that Self-Determination Theory was useful for predicting lecture attendance, we did find evidence to support the Theory of Planned Behavior (perceived behavioral control and attendance intentions, in particular) as useful in predicting lecture attendance behavior.

Table 1
Descriptive statistics and Pearson correlations for motivation dimensions and lecture attendance and performance data.

	1.	2.	3.	4.	5.	6.	7.	*M*	*SD*	*Med*	*Skew*	*α*
1. Attitudes	–							5.10	0.92	5.33	−1.09	0.79
2. Subjective norms	0.37*	–						3.32	1.16	3.33	0.00	0.72
3. PBC	0.39*	0.40*	–					3.79	1.49	4.00	−0.34	0.81
4. Autonomous	0.16*	−0.03	0.10	–				5.29	0.81	5.31	−0.33	0.84
5. Controlled	0.01	0.21*	−0.05	0.05	–			4.26	1.07	4.38	−0.31	0.70
6. Intended attendance	0.41*	0.35*	0.67*	0.10	−0.05	–		63.50	41.57	88.46	−0.56	–
7. Estimated attendance	0.34*	0.26*	0.47*	0.01	0.01	0.53*	–	52.10	39.32	59.52	−0.20	–
8. Grade†	−0.09	−0.13*	0.00	−0.02	0.08	0.06	0.09	71.85	13.51	73.40	−1.14	–

Significance estimated via bias-corrected bootstrapping. PBC = Perceived Behavioral Control, *M* = Mean, *α* = Cronbach's alpha, *Med* = Median. Note that intended and estimated attendance are represented as a percentage (of total possible lectures).

* $p < .05$, $N = 288$.

† $N = 264$.

associated with greater intentions and estimated attendance.

3.3. Structural equation model: The Theory of Planned Behavior

Given the absence of significant correlations associated with the Self-Determination Theory variables, we did not evaluate this theory/model further. The Theory of Planned Behavior model (depicted in Fig. 2) was associated with acceptable levels of model close-fit, $\chi^2(36) = 78.47$, $p < .001$, and RMSEA = 0.064, TLI = 0.953, & CFI = 0.969. The model accounted for 56% of the variance in Intended Attendance and 34% of the variance in Estimated Attendance. Therefore, the fifth hypothesis was supported with respect to the Theory of Planned Behavior. The standardized beta estimates are presented with their respective paths in Fig. 2. Importantly, there were statistically significant direct associations between PBC and Intended Attendance ($\beta = 0.71$, $p < .001$), and between PBC and Estimated Attendance ($\beta = 0.32$, $p = .02$). That is, only one of the three pre-intentions (PBC) was found to predict Intended Attendance *and* Estimated Attendance. There was also a statistically significant direct association between Intended Attendance and Estimated Attendance ($\beta = 0.27$, $p = .002$). That is, PBC was found to predict Estimated Attendance, and with an essentially equivalent effect size to that of the association between Intended Attendance and Estimated Attendance. Furthermore, there was a statistically significant indirect association between PBC and Estimated Attendance via Intended Attendance ($\beta = 0.19$, $p = .005$). Thus,

4.1. Lecture attendance rates and academic performance

As was shown in Fig. 1, there was a notable decline in attendance following the first lecture. Specifically, initial rates of attendance were around 35–40%, with a steep reduction to approximately 10–20% by the end of the semester. Overall reductions in attendance of approximately 50% by the end of semester is consistent with several other studies (Bos et al., 2016; Nyamapfene, 2010). It is important to interpret the results of the present study in light of the noteworthy finding that attendance and grades failed to correlate statistically significantly. This is consistent with other studies also finding no association between attendance and academic performance when online recordings are offered (Andrietti & Velasco, 2015; Azab et al., 2016). The absence of such an association in the current study further raises concerns over the value of live attendance, when lecture recordings are available. Specifically, sufficiently motivated students are unlikely to require live attendance to perform well academically. However, the value of live classes can also be assumed to vary across different disciplines and, as such, may continue to be of importance in certain contexts (particularly when practical skills are taught and assessed). Furthermore, and because some students may perform best by attending live lectures, while others may not, it is plausible to expect potential moderating effects of

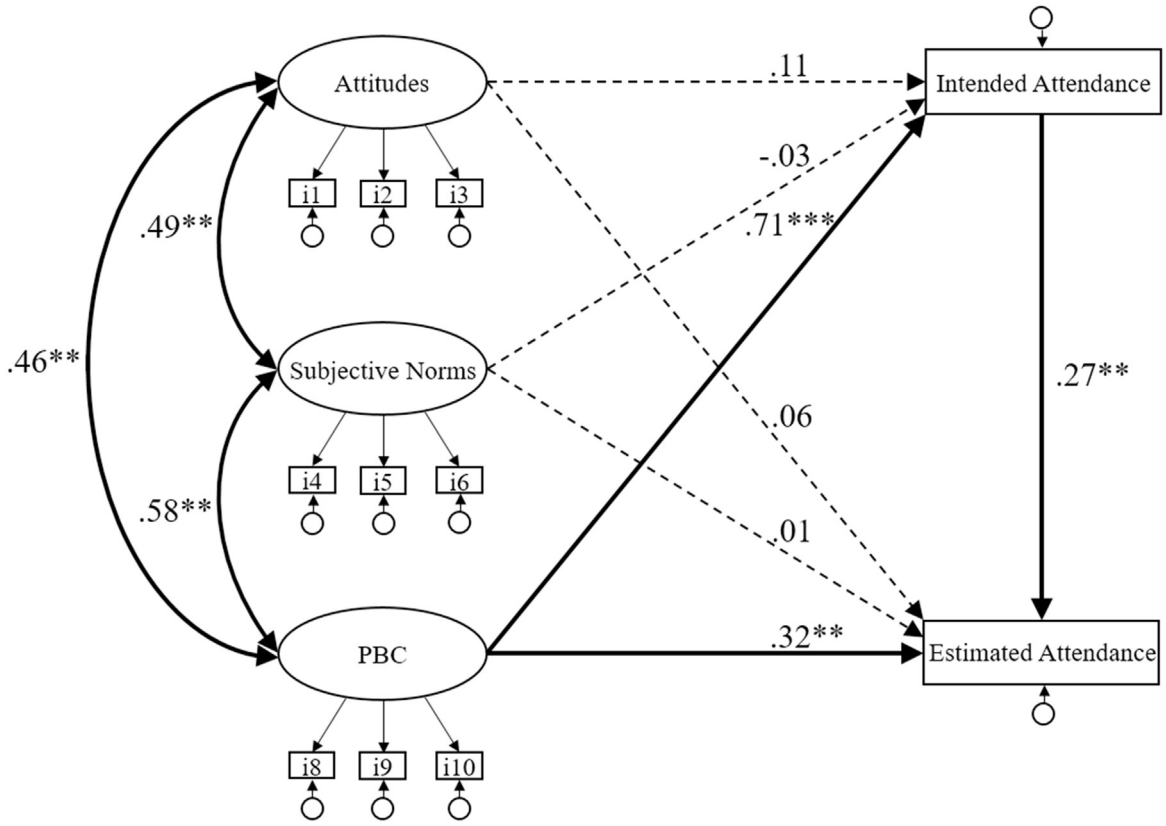

Fig. 2. Structural equation model for the Theory of Planned Behavior with standardized regression weights (*$p < .05$, **$p < .01$, *** $p < .001$). p values estimated via bias-corrected bootstrapping. Bold lines indicate statistically significant paths and dashed lines indicate non-significant paths; PBC = Perceived Behavioral Control.

contextual and student characteristics (e.g., discipline, motivation, intelligence) on the association between lecture attendance and performance. Consequently, understanding student lecture attendance intentions and actual student lecture attendance may remain an interesting effect to investigate theoretically and empirically.

4.2. Self-Determination Theory and Theory of Planned Behavior

Overall, we failed to find support for Self-Determination Theory in this investigation. Specifically, the absence of an association between controlled motivation, attendance and grades suggests that attending lectures is not perceived by students to be related to tangible outcomes (e.g., grades). Furthermore, providing external reinforcement is unlikely to improve academic performance. Additionally, the absence of an association between autonomous motivation, attendance and grades suggests that attending lectures is also not perceived to be directly related for satisfying personally relevant goals, and achieving high grades does not necessarily represent a personally satisfying goal. Interestingly, however, controlled motivation did significantly correlate with subjective norms, consistent with theoretical arguments that social pressure is one form of external reinforcement (Ryan & Deci, 2000a). The lack of associations between controlled and autonomous motivation and lecture attendance, while inconsistent with the hypotheses for the present study, might reveal something meaningful about traditional lectures in modern higher education. That is, they may not reflect a means to fulfill autonomous or controlled motivational needs. It is possible, however, that these motivational needs are fulfilled through other means (e.g., using online provisions, private study) which would be consistent with reports that online lecture use and private study correlates with academic performance (Chen & Lin, 2008; Credé & Kuncel, 2008; Traphagan et al., 2010). Given that both universities in the present study offered online materials, this provided a behavioral alternative to students for fulfilling autonomous or controlled motivational goals.

Indeed, Ryan and Deci (2000b) argued that autonomous motivation is only relevant for activities that have the appeal of novelty, challenge or aesthetic value. In light of our results, it may be speculated that attending traditional (live) lectures in contemporary higher education settings does not offer sufficient novelty, challenge or aesthetic value over online recordings: a medium that can be accessed at convenience and manipulated according to the viewer's preference (e.g., playback speed, frequency of pauses etc.). Furthermore, our findings suggest that the impact of lecture attendance on grades is either non-existent or moderated by one or more variables, because live lecture attendance was not correlated with either controlled motivation or grades. While this contrasts with meta-analytic evidence that a robust association exists between attendance and performance (Credé et al., 2010), this previously robust effect has likely diminished in contemporary education settings, as attending lectures is no longer essential for accessing course material.

In contrast to Self-Determination Theory, we did find some evidence to support the Theory of Planned Behavior as a partial explanation for lecture attendance intentions and self-reported attendance. These findings are consistent with much earlier work by Ajzen and Madden (1986), as well as recent cross-cultural work by Girardelli and Patel (2016). In particular, perceived behavioral control emerged as the strongest predictor of both lecture intentions and self-reported attendance, showing both direct and indirect associations with behavior. Such an effect aligns with several studies that have reported lecture attendance to be affected negatively by factors that could be considered outside a person's control (e.g., paid employment, illness, subject difficulty, quality of lecture/lecturer, travel time; Bati, Mandiracioglu,

Orgun, & Govsa, 2013; Dolnicar et al., 2009; Oldfield et al., 2017; Westrick, Helms, McDonough, & Breland, 2009). However, what is particularly noteworthy about our results is that the strongest effect occurred between perceived behavioral control and intentions, both of which were collected at the commencement of the semester. The strength of this association implies that students are formulating strong intentions regarding their perceived inability to attend well in advance of their opportunities to attend. That is, the factors that are perceived to prevent them from attending may, at the outset, be considered fixed and unchanging throughout the semester. Given that a gradual decline in attendance was observed across both samples, the perceived external demands preventing students from attending may, in fact, change as the semester progresses. It is important to point out that the mean discrepancy between attendance intentions (63%) and self-reported attendance (52%), and the corresponding imperfect inter-correlation ($r = 0.53$), supports the notion that students do not accurately anticipate their capacity to attend. From our results, it can be assumed that students' intentions at the commencement of the semester are mostly driven by their perceived control over prospective behavior but, as uncontrollable factors persist, actual attendance is gradually undermined. However, it should also be acknowledged that, in light of the response rate, and when evaluating the headcount data presented in Fig. 1, a considerable proportion of low engagers did not complete the study, which would have inflated these estimates of intentions and attendance. Specifically, Fig. 1 suggests that actual attendance rates for any given lecture were, on average, approximately 14% - 40% of the enrolled students, whereas students participating in the study estimated their attendance to 52% across the semester. While these data are not directly comparable, this suggests that true attendance rates were likely lower than 52% by at least 10%. The grade distribution for participants (compared to the entire student cohort) was also upwardly biased (by around 10%) because engaged students were more likely to be more motivated and perform better academically than their non-engaged peers.

Despite the discrepancy between intentions and estimated attendance, the partial mediation of the direct effect between perceived behavioral control and attendance suggests that intentions are a critical feature of the model. Furthermore, the absence of a direct association between attitudes and both intended and estimated attendance, supports further the importance of intentions as the closest antecedent to predicting a behavior (Ajzen, 1985; Schifter & Ajzen, 1985). That is, these findings suggest that attitudes would not be sufficient for explaining the behavior, without the intermediate formulation of an intention. Only perceived behavioral control was found to have a significant direct association with both intentions and behavior. Furthermore, subjective norms was not found to account for any variance in intentions or behavior when tested in a structural model. The absence of an association between social norms and intentions or behavior is consistent with meta-analytic reports that subjective norms has limited utility for explaining behavior (Armitage & Conner, 2001). If this result is interpreted in light of evidence suggesting that the contribution of subjective norms towards intentions and behavior is improved when the behavior is socially undesirable (Manning, 2009; Nemme & White, 2010), it could be argued that lecture attendance might be viewed indifferently by students. Stated alternatively, our findings suggest there might be no particular preference amongst peers for attending lectures. While attitudes did account for some variance in intentions (see Table 1), the direct association was found to be non-significant statistically when tested in a structural model. This suggests that individual beliefs about the value of attending lectures has limited value for explaining attendance intentions. Therefore, improving student perceptions of lectures as beneficial is unlikely to increase attendance meaningfully.

4.3. Implications

The findings of the present study have several implications for educators in higher education. The first is that lecture attendance may not be an appropriate behavioral marker for autonomous or controlled motivational inclinations. That is, students who attend are unlikely to be any more motivated than their non-attending peers, and are also unlikely to perform better academically. The second implication is that educators' efforts to facilitate perceived behavioral control would likely represent the most effective means to enhance lecture attendance. This would be important for subjects which heavily rely on live classes to deliver course material and develop important skills. Because perceived behavioral control may include factors that are difficult for educators to directly address (e.g., working hours, caring for family, physical health), provision of additional student support services at the institutional level could be an effective solution. For example, students with children might be afforded increased behavioral control if a university provided temporary childcare services during class times. Additional support provisions may also enhance a sense of belonging to a university (Oldfield et al., 2017) and commitment to a course, which could reduce the likelihood of drop-out. As these suggested factors were not specifically measured in the present study, it would be valuable to explore their relevance for perceived behavioral control in future research.

Finally, lecture attendance intentions also play an important role in understanding attendance behavior. Indeed, students who are optimistic about attending are more likely to attend. Therefore, educators might look to enhance intentions by encouraging students to make an informal commitment to attending at the start of a semester, when they are presumably most enthusiastic. This could involve suggesting to students that they make a record of their intentions in a relatable format (e.g., 5 out of 10 lectures) to enhance awareness of their intention and to facilitate the notion of a self-imposed agreement. That is, articulating and recording one's intentions could be a simple strategy for increasing the likelihood that they are followed through.

4.4. Limitations and future research

Because the present study employed a correlational design, causal conclusions regarding the impact of motivation on lecture attendance and grades cannot be implied. However, the temporal separation of the motivational measurements (pre-semester) and the behavioral outcomes (post-semester) does improve the predictive validity of the data. Furthermore, the reliance on self-report for estimating attendance behavior may have introduced further measurement error. Future research may benefit from examining the same motivational inclinations more regularly, and using objective measures, to determine if attitudes change throughout a semester and whether efforts to facilitate perceived behavioral control (e.g., support services) do lead to increased lecture attendance. Additionally, it should be noted that extrinsic and intrinsic motivation were captured with a global motivation scale, i.e., one that included trait-level motivation items not relevant to lecture attendance, specifically. By contrast, the theory of planned behavior items, by necessity, had to define the “behavior”. While our intentions were to use validated scales wherever possible, our use of a general scale may have weakened the likelihood of observing significant associations between self-determination theory and lecture attendance.

It should also be acknowledged that the current results may not generalize to all undergraduate disciplines. Given that research methods units are compulsory within psychology degrees, and fundamentally important for longer term success in the discipline, these units are of high stakes. Thus, we encourage further research in other areas of the undergraduate curriculum. Indeed, also, our sample included a high proportion of women, as is typical for research with undergraduates (e.g., Alatorre et al., 2020; Thomas et al., 2017), which may also impact the generalizability of the results. While there is limited evidence for

gender differences in lecture attendance, or the motivational variables examined in this study (Credé et al., 2010; Girardelli & Patel, 2016; Standage, Duda, & Ntoumanis, 2005), with larger sample sizes, gender could be examined as a potential moderator of the effects reported in this investigation. Additionally, we acknowledge that the student response rate of 27% may also impact the generalisability of the results of this investigation. However, it is important to note that a response rate of 25 to 30% is typical for studies based on student volunteers at the tertiary level (Nulty, 2008; Sax, Gilmartin, & Bryant, 2003). Furthermore, given that our investigation was longitudinal in nature and susceptible to attrition, we believe the response rate of 27% is relatively respectable for this sort of research (Rübsamen, Akmatov, Castell, Karch, & Mikolajczyk, 2017). Nonetheless, we recognise that self-selection amongst the responders in our study may have constrained the variability in our measures, because participating students were more likely to be academically motivated. As such, our findings may generalize only to students who are similar in profile to our respondents (e.g., largely female, attend around 50% of their lectures, and score around 70% in the unit).

Given that the present study did not examine online lecture use, future work should seek to test the predictive utility of these two theories with respect to online study behavior. Future research may also consider other psychosocial and contextual factors, such as belongingness to a university. While the TPB and SDT assume that important external influences (e.g., social and contextual) are captured by the subconstructs of each theory, these generalised categories do not appear to fully explain intentions and behavior. Indeed, the results of this investigation (and others; e.g., Ajzen & Madden, 1986; Girardelli & Patel, 2016) suggest that these theories do not account for the majority of the variance in behavior. Consequently, future higher education studies should examine these theoretical approaches, alongside other separable and contextually-relevant external influences (e.g., preferred learning styles, approaches and behavior), to determine their relative value for explaining lecture attendance intentions and academic performance. While there is some evidence that preferred learning style is unrelated to class participation and performance, individual behaviors such as time spent studying is a more promising correlate of performance (Farkas, Mazurek, & Marone, 2016; Horton, Wiederman, & Saint, 2012). Therefore, it might also be important to distinguish between the time spent engaging with formal learning provisions and independently-guided private study, as this would lead to a more comprehensive understanding of student motivation and subsequent success.

4.5. Conclusions

Live lecture attendance may no longer be an appreciable predictor of academic performance. However, what is particularly noteworthy about our results is that the strongest effect occurred between perceived behavioral control and intentions, both of which were measured at the commencement of the semester. For some students, lecture attendance may still be valuable, and many of those students do not meet their lecture attendance goals. In light of our findings, enhancing perceptions of behavioral control, as well as optimistic intentions, may help some students increase their attendance to lectures.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.lindif.2020.101907.

Declaration of competing interest

The authors report no conflicts of interest.

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