

# DESIGNING PERSUASIVE SYSTEMS TO INFLUENCE LEARNING: MODELLING THE IMPACT OF STUDY HABITS ON ACADEMIC PERFORMANCE

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## Abstract

*Human behaviour is complex and human beings are difficult to persuade. Technology has developed into a crucial tool to influence human behaviour. Computers have increased in power and mobility and have become ubiquitous in people's daily lives. Persuasive technology involves computers being designed explicitly for influencing behaviour. Social networking sites are good examples of how users can be conditioned to habitually check for updates each day. This habit-forming technology can be repurposed to be useful for education. Non-academically inclined university students often have poor study habits. It is possible to design and implement persuasive systems to influence these students to improve their study habits, which is likely to result in improved learning outcomes for them. However, for a persuasive system to be effective, it needs to target a specific habit. In order to help identify which habits to target, this research provides insights into which habits have the most significant impact on academic performance. Three models were constructed outlining the most important habits for three dimensions of academic performance. It was found that each model had unique habit predictors, except for a small overlap. Generally, study habits related to the management of resources, value placed by the individual student on learning tasks and expectations of learning were found to be the most impactful. These models allow designers to more confidently build educational persuasive systems, by providing evidence-based selection of target habits.*

*Keywords: study habits, persuasive systems, linear modelling, education*

# 1 INTRODUCTION

Human behaviour is a complex process that is made up of many aspects (Prochaska 2006; Prochaska & Velicer 1997; West 2005). As a result of this complexity, behaviour is not only difficult to completely understand and predict, but it is also quite difficult to alter or influence. This is because people do not consistently behave in a rational or logical way. Even if performing a certain behaviour is known by the individual to be detrimental to their health, such as in the case of smoking, they still continue to carry out the behaviour (West 2009). This is possibly due to habits that have formed in the individual over long periods of time. It is easier to predict behaviour when one has a strong habit, as it is highly likely that the person will carry out the same behaviour consistently (Aarts et al. 1998). However, this makes changing habits and behaviours far more difficult as the individual is accustomed to that behaviour.

One avenue to influence behaviour is through the use of technology. Technology has drastically increased over the last few decades in terms of availability and capability. Early desktop computers were originally intended to simply be “number crunchers” to help people to carry out their work more efficiently. However, as computers have become computationally more powerful and mobile, their ability to persuade behaviour has also increased. Take for instance any popular social networking site. Most users are very keen to share their personal moments in their life to their online friends. They enjoy doing this so much so, that it is common to see individuals irresistibly posting and checking for updates throughout each day. Social networking sites have successfully convinced individuals to alter their attitude towards privacy (Barnes 2006), and encouraged them to form a habit of continually sharing content with their friends and remain active users. The process of using computer systems to persuade has been referred to as “Captology” (Computers As Persuasive Technology) or more generally, “persuasive technology” or “persuasive systems” (Fogg 2002).

Persuasive technology can be applied to a variety of domains, including education, as it can be used to address common problems such as poor study habits. Most students are aware of the study habits they require to be high achievers, despite students tending to struggle with establishing them. For instance, many students try to improve their grades by developing a study plan at the start of semester to ensure they keep up to date with their coursework. However, as time goes on, the schedule is not followed and many ultimately return to their previously poor habits.

As with general behaviour, study habits can be complex to measure. This is because there are many components to a positive study habit (Pintrich 1991). Students who are unaware of which components of their study habit they should be focusing on may lead to reduced academic achievement. To address this, instructors may encourage their students to adopt behaviours that lead to better academic performance. Actively encouraging those behaviours takes time and resources, which are not always feasible with large numbers of students. Hence, the goal of this research is to devise a process for identifying the most influential study habits on academic performance, which can then be used as part of the design of future persuasive systems. To help guide this research, we have devised the following research question for this study:

- Which study habits impact on academic performance the most?

To answer this research question, we first review the existing literature regarding behaviour and persuasive design and then examine instruments designed to measure study habits. We then survey current students and graduates about their study habit experiences and develop several models that explain which habits have the most significant impact on learning performance.

## 2 BACKGROUND

### 2.1 Behaviour Change

As persuasive systems deal with altering behaviour, it is important to understand how behaviour works at a more general level. One such model is the Trans-theoretical Model for behaviour change, also known as the Stages of Change model. The premise of this model is that the process of behaviour change can be broken down into discrete stages, with those being: (1) pre-contemplation, (2) contemplation, (3) preparation, (4) action, (5) maintenance, and (6) termination (Prochaska & Velicer 1997). In the first stage, the individual has no desire to change until they reach stage two, in which they are actively considering a change. In stages three and four, the individual has decided to adopt a new behaviour by planning what they would like to do to change and then performing the new behaviour. Stage five involves the individual putting effort into continuing the behaviour, despite potentially relapsing to the old one. Finally, in stage six, the individual has completely let go of the undesirable old behaviour and completely adopted the new behaviour. Transition through the stages is traditionally time-based, with each stage usually lasting approximately six months.

The idea of behaviour change being distinguishable into time-based stages has been questioned. Considering that human behaviour is often irrational and unpredictable, it is difficult to accept that behaviour is a definite linear process with a permanent end result. The idea of permanent termination of an undesired behaviour is also disputed as there have been instances of people who have seemingly terminated a behaviour, only to relapse after a long period of time (West 2005). The SNAP model was devised to better address the reality of human behaviour and overcome the limitations of the Stages of Change model (West 2009). It is an acronym for Staying the old behaviour, New behaviour engagement, Attempting to change and Planning to change. SNAP views behaviour as a never-ending series of states, where one can progress through any of the four states at any time and in any direction (refer to Figure 1).

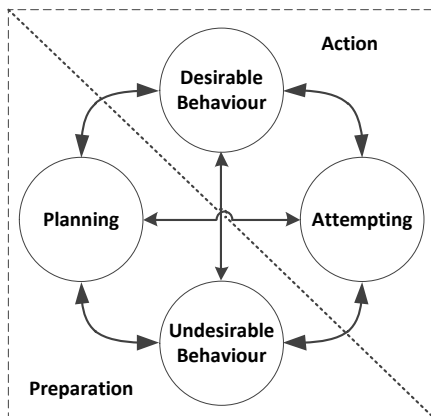


Figure 1 SNAP Model of Behaviour

Although the Stages of Change and SNAP behavioural theories describe how behaviour functions as a process, they do not prescribe a way to determine how to actually change the behaviour. This is a clear distinction between persuasive design theories and behavioural theories. It is important to note that although different, these theories do not compete with one another. Rather, they help provide more insight into the intricacies of human behaviour and the ability to persuade. Understanding models such as SNAP may also help to better understand and utilise persuasive design. For example, it is implied that once you have persuaded someone, that behaviour will progress towards being permanent. The issue here is that persuasive system design may not lead to permanent adoption of a behaviour, but instead will need continual triggers (as per the SNAP concept of states of behaviour) in order to achieve long term behaviour change.

Another approach to designing persuasive systems may be to try to predict how people are likely to behave. If behaviour can be predicted, then more timely or appropriate interventions can be developed to try and alter the person's behaviour. One prominent theory that deals this concept is the Theory of Planned Behaviour (Ajzen 1985). This theory explains how attitude, subjective norms, and perceived behavioural control impacts on intention to behave (Ajzen 1991), which then in turn impacts on actual behaviour. However, the model does not take into account environment and ability. The model has since been improved by also incorporating environmental factors and skills and abilities as being impactful on behaviour. As well as this, background factors were also added to the attitudes, norms and perceived behavioural control. The addition of attitude and ability correlates well with more modern models, such as the Fogg Behavioural Model (FBM). The FBM explains that provided an individual has adequate motivation and ability, a well-timed trigger will cause them to perform a certain behaviour (Fogg 2009a), arguably making behaviour somewhat predictable. Although it is logical that a person will likely behave in a certain way if they are capable and encouraged to do so, these models do not take into account the role of habits, which can be strong indicators of future behaviour (Ouellette & Wood 1998).

## 2.2 Study Habits

Habits are a common part of human behaviour and study behaviour is no exception to this. In particular, study habits have been shown to have a significant role in predicting academic performance (Credé & Kuncel 2008) just as habits in general are indicators of future actions (as mentioned previously). Given that the broader goal of this research is to improve academic performance, it is important to understand the types of behaviours that make up typical study habits. Learning encompasses many different skills and abilities and so it is expected that there are to be many types of habits that can either have a positive or negative impact on learning performance. As a result of this complexity, attempts have been made in previous work to identify and categorise all of the relevant types of study habits students typically demonstrate (Fitkov-Norris & Yeghiazarian 2013). Two such scales that measure study habits are the LASSI (Learning And Study Strategies Index) and the MSLQ (Motivated Strategies for Learning Questionnaire). The LASSI instrument consists of 80 items categorised under the following scales: *skill*, *will* and *self-regulation*. These scales are then further divided into subscales. The MSLQ consists of 81 items which are broadly categorised as either part of the *motivation* or *learning strategies* scales (Pintrich 1991). Those scales are then divided into two further levels of sub scales. Both instruments serve a similar purpose, which is to assess the learning strategies employed by students. Although a strategy may not necessarily be a habit, it is still a behaviour exhibited by an individual. Any behaviour carried out repeatedly can then become a habit. For this study, we are attempting to identify behaviours that we can then develop into habits through the development and use of a persuasive system.

Although both questionnaires measure similar concepts and have been shown to be reliable (Obiekwe 2000; Pintrich et al. 1993), an advantage of using the MSLQ over LASSI is that there is no implied internal model that must be used to interpret results. The scales are also designed to be modular so as to allow a researcher to develop a model structure to fit the needs of a study (Pintrich 1991). This ability to customise the use of the MSLQ makes it an appropriate choice for use in this study, as our project is of an exploratory nature and would therefore allow greater freedom in interpreting the data collected.

As a result of the modular design of the MSLQ, studies have attempted to analyse the latent structure of the MSLQ and provide a framework for investigators to use. One such study attempted to validate the MSLQ by performing confirmatory factor analysis on the general model presented by the MSLQ, with that being the motivation and learning strategies scales, and all of the sub scales. This was unsuccessful and after modifications were made, the resulting model was a three-factor structure, including: expectancy, value and resource management (see Figure 2). Alternatively, other studies have simply used a subset of the lower level sub scales available, in order to develop a relationship model (as shown in Figure 3).

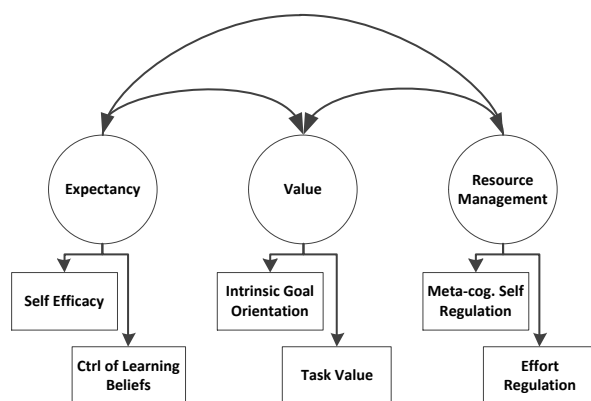


Figure 2 MSLQ three-factor model  
(reproduced from Hilpert et al. (2013))

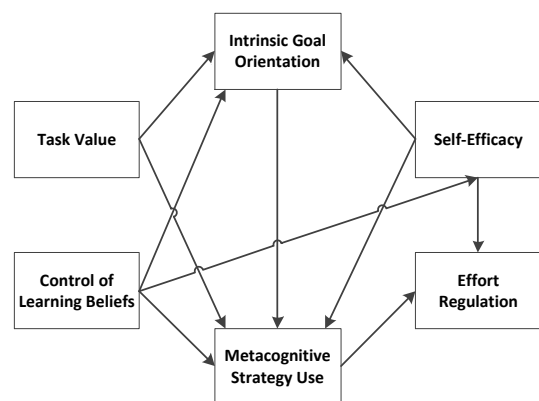


Figure 3 MSLQ subscale model  
(reproduced from Sungur (2007))

These examples demonstrate the versatility and adaptability of the MSLQ. Although these models perform well in explaining the relationship behind each of the scales, the purpose of our study is to identify specific behaviours rather than general concepts. Hence, these models will not be used to identify the most important study behaviours, although they may help in guiding the analysis of the results of this study.

## 2.3 Persuasive Systems

There are three main phases to designing persuasive systems, with those being: (1) understanding key issues behind persuasive technology, (2) analysing the persuasion context and (3) design of system qualities (Oinas-Kukkonen & Harjuma 2009). The first phase is of main concern to this study as it provides the broader picture in which persuasive systems work within. There are seven key postulates that underpin the design of persuasive systems, including:

1. Information technology is never neutral.
2. People like their views about the world to be organised and consistent.
3. Direct and indirect routes are key persuasion strategies.
4. Persuasion is often incremental.
5. Persuasion through persuasive systems should always be open.
6. Persuasive systems should aim at unobtrusiveness.
7. Persuasive systems should aim at being both useful and easy to use.

Unlike in earlier decades, technology can no longer be seen to be neutral. Technology is now far more engrained in our everyday lives, which is why technology can be so persuasive. Unlike traditional methods of persuasion such as billboard advertising, many people use technology to do everyday tasks. Therefore, building a persuasive system for the context of learning is suitable, as forming a study habit implies that studying becomes a routine as part of a student's daily life. The system must also be designed in such a way so as not to be overly intrusive, as it would counteract the effect of becoming seamless in one's daily activities, which would ultimately lead to discontinuation of use.

To ensure that a persuasive system is designed to be effective in changing people's behaviour, one can follow an 8-step design process (Fogg 2009b). This design process (outlined in Figure 4) begins with identifying the behaviour to be changed, as a first step. It is strongly advised that only a single behaviour is targeted because attempting to influence a range of behaviours at one time often results in very little change occurring at all (Fogg 2009b). Attempting to alter several behaviours would also

require more interventions and therefore would reduce unobtrusiveness and ease of use, violating some of the 7 postulates of effective persuasive systems.

The 8-step process also places a large emphasis on quickly trialling systems to persuade behaviour and to fail early and attempt again. This is to ensure that ineffective systems are corrected sooner rather than later. When a certain type of behaviour has been successfully adopted by the individual, then other behaviours can be targeted.

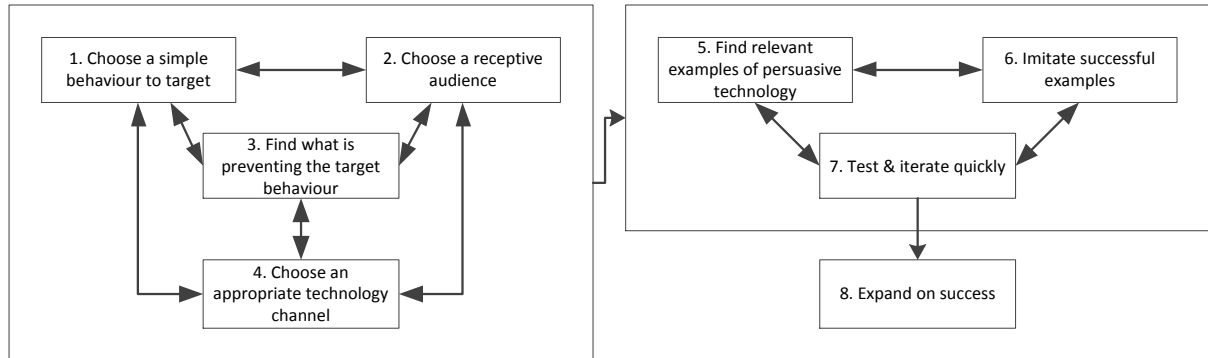


Figure 4 8-step Design Process for Persuasive Technology (reproduced from Fogg (2009))

### 3 METHODOLOGY

The purpose of this research is to identify study habits that have the largest impact on academic performance to inform the design of a persuasive system. To achieve this, an online survey targeting current students and graduates was distributed online. The questions for the survey were adapted from the MSLQ instrument with some modification. This section outlines the details on those modifications as well as the statistical approach used to determine the most important study habits.

#### 3.1 Instrument Design

The survey instrument consisted of two main sections. The first section enquired about the respondents' demographic details, namely: (1) age, (2) sex, (3) degrees undertaken, (4) current student status, (5) and predominant academic load. The second section featured the entire MSLQ questionnaire with some minor modifications.

Modifications were made to the MSLQ instrument, as there were two main issues with using it in its original form. Firstly, the MSLQ questions were designed to be answered for a single class. That is, the questions were to be answered about a specific class the student is undertaking. Secondly, the survey did not enquire about academic achievement. This was due to MSLQ's original intent to be administered in a single class and so actual academic performance was readily available to the instructors. This data was not available for analysis to our research, given our broader scope of university degrees in general.

To address the first issue, the wording of some questions were altered to be more general. This has been shown to be an appropriate process with previous work demonstrating that generalising the questions still results in instrument validity (Rotgans & Schmidt 2010). An example of some of the questions that were altered can be seen in Table 1. Care was taken not to alter the original meaning and purpose of the questions.

Original Question	Modified Question (generalised)
Getting a good grade <b>in this class</b> is the most satisfying thing for me <b>right now</b> .	Getting a good grade is the most satisfying thing for me.

<b>In a class like this</b> , I prefer course material that arouses my curiosity, even if it is difficult to learn.	I prefer course material that arouses my curiosity, even if it is difficult to learn.
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*Table 1 Example of MSLQ question generalisation*

The items in the MSLQ instrument measure learning strategies and motivation, which may not appear to be directly relevant to our study of measuring successful habits of students. Enquiring about a habit is not as likely to yield useful results as students may not be directly aware of their engrained habit. We can however, enquire about their strategies and then use this information to later develop these behaviours into habits. Hence, the original questions (modified as described above) were still relevant for use in this context.

To address the lack of questions regarding academic performance, three new questions were devised in an attempt to triangulate the general academic performance of the respondent. The questions were:

1. How would you describe your academic performance as a student?
2. How often did you receive high grades (over 80%) for assignments, exams or subjects overall?
3. How did your learning performance as a university student change over time?

The questions cover three different dimensions of academic performance. The first question is about a student's self-perception of academic performance. The intention is to use the study habits from the MSLQ to be able to identify which habits lead to students believing that they are good performers. The second question is more objective in soliciting data about performance as it clearly asks for the frequency that students received over 80% on an assessment. The percentage level was set in accordance with Mastery Learning theory which suggests that receiving a grade above this level indicates real understanding (Block & Burns 1976). No restrictions were placed on geographic location for respondents and so this is also a more flexible way to enquire about performance given the differences in grading systems around the world. Finally, the third question is concerned with performance over time. This is particularly important because habits are behaviours accrued and developed over time. The purpose of this is to see the long-term effects of study habits over the course of an entire university degree.

### **3.2 Survey Distribution**

In order to maximise exposure, the web-based survey was distributed through the use of links on our personal Facebook and LinkedIn accounts. The survey was open to respondents for six weeks. The general approach was to post an announcement with a message instructing potential respondents to fill in the survey and also asking to help spread the link to their friendship networks by using the social networking site's sharing facilities. This was done to encourage a 'snowball effect' to take place and increase the likelihood of potential respondents seeing the link. Facebook was selected as it is a popular choice for online social networking for undergraduate students. LinkedIn was selected as there is an active community of alumni that regularly communicate with their former instructors at university, hence increasing the odds of obtaining graduate respondents. That is not to suggest that Facebook will only provide undergraduate respondents and LinkedIn will only provide graduate respondents, but rather, that it may be more likely to do so.

### **3.3 Data Modelling Process**

The collected data was analysed by testing each of the original MSLQ questions on each of the three academic performance questions we devised. The software that was used for this process is SPSS as it contains a feature known as Automatic Linear Modelling (SPSS 2010) and will be of assistance to the eventual process of narrowing down the most important study habits on academic performance.

*Step 1: Automatic Linear Modelling (ALM)*

Performing exploratory linear modelling can be a time consuming process, particularly when there are many items that can potentially be used. In this scenario, Automatic Linear Modelling helps the researcher to test many individual linear models quickly, and provides a ranked list of items and their impact factor. To perform this test, we selected the academic performance item as the target, and then selected all of the MSLQ items as contributing factors to the target. The software then tests every possible combination and produces a list of the items with the largest impact. The top ten items that result from this process were then used in the following step.

#### *Step 2: Multiple Linear Regression (MLR)*

The resulting items from the ALM were used in the construction of several Multiple Linear Regression models. The significance of each of the factors was assessed and any that did not fall below 0.05 significance were excluded and the MLR was performed once again with the reduced set of factors. This continued until all remaining items were significant. It was expected that the final models would have 3 to 5 items that were significant.

## **4 RESULTS AND DISCUSSION**

The survey was distributed and analysed as per the process described in section 3.3. The data that was collected appeared to be biased towards higher performing students. Although this was an unexpected occurrence, it is plausible that good students would be more likely to respond to a survey enquiring about their learning performance as opposed to lower performing students. However, the data is still valuable to this study as the greater purpose is to model the habits that result in higher performance.

### **4.1 Data Analysis**

The ALM feature of SPSS provides an option to automatically prepare the data for analysis, which we elected to use. The process involves date and time adjustment, measurement level adjustment, outlier handling, missing value handling and supervised merging. There were 84 respondents to the survey, including 67 complete usable samples. The data was representative of younger aged students (both current student and graduate) with gender being evenly distributed and respondents typically aged between 18 and 29, which aligns with the demographic we wanted to target. Given that Facebook and LinkedIn were used as the means of communication, this was to be reasonably expected. Table 2 outlines in more detail, the descriptive statistics of the usable dataset.

Characteristics	Count	Percentage	Characteristics	Count	Percentage
<i>Gender</i>			<i>Mode of Study</i>		
<b>Male</b>	34	50.75%	<b>Full-time</b>	62	92.54%
<b>Female</b>	33	49.25%	<b>Part-time</b>	5	7.46%
<i>Age group</i>			<i>Status</i>		
<b>18-29</b>	60	89.55%	<b>Current Student</b>	28	41.79%
<b>30-39</b>	6	8.95%	<b>Graduate</b>	39	58.21%
<b>40-49</b>	0	0%			
<b>50-59</b>	1	1.50%			
<b>60 and over</b>	0	0%			

*Table 2 Descriptive statistics*



## 4.2 Results and Findings

Data analysis resulted in three academic performance models, which were successfully modelled by using the MSLQ items as independent factors. We set the threshold for ALM accuracy to be above 60%. For the MLR analysis, the acceptable range for the Durban-Watson value after removing non-significant items was set between 1 and 3 (Field 2009). The following discusses in further detail, each of the models that were constructed.

### 4.2.1 Model 1 – Self-perceived level of academic performance

The accuracy of the results of the ALM performed for this model was 67.7%. Upon refining the model to remove items above the significance threshold, we were left with three habits as determinants of self-described academic performance. The final model (refer to equation 1) had a Durban-Watson value of 2.28 and had an  $r^2$  value of 0.41.

**Equation (1)** 
$$f(x) = (0.18)x_1 + (-0.21)x_2 + (-0.28)x_3 + 4.39$$

Where:

$f(x)$  = How would you describe your academic performance as a student?

$x_1$  = When I study for a class I pull together information from different sources, such as lectures, readings and course materials\*

$x_2$  = I often get so lazy or bored when I study for a class that I quit before I finish what I planned to do\*\*

$x_3$  = When a subject's work is difficult, I either give up or only study the easy parts\*\*

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

The inclusion of *Habit 1* ( $x_1$ ) in the final model indicates that students are aware of using multiple sources when gathering information, in order to improve their learning. Respondents who reported that they did this more often also reported that they believe themselves to be good students. This may also suggest that higher performing students have a stronger desire for knowledge acquisition, as they are routinely seeking out information from a wide variety of sources. Seeking multiple sources has long been advocated by instructors, however, it may also be due to the wealth of information available to people on the internet. Students may have become used to the ability to seek out multiple sources for their information. For example, many students use multiple social networking sites including Facebook and Twitter, in order to source information about their friends' activities.

Despite seeking out multiple sources of information, there are times when students lose interest in the information they have at hand, as *Habit 2* ( $x_2$ ) describes. Logically, this has a fairly strong negative association in how students perceive themselves as academic performers. Students are now accustomed to interactive and engaging experiences and so it may be because the way in which they are studying does not fit into their desired experiences. However, this primarily addresses the “bored” aspect to studying; the “lazy” aspect of the question may be because of high difficulty. When students find a learning task too stressful to achieve, they often procrastinate (Pychyl et al. 2000). Hence they are then likely to terminate their study session before completion. This correlates very well with *Habit 3* ( $x_3$ ), where students who find study too difficult ultimately end up only studying what is easy. *Habit 3* also had a negative impact on self-perceived academic performance. Interestingly, the fact that students still attempt to study even the easy parts, suggests that they are aware that studying is a good thing to do to improve grades, however, the difficulty or boredom of doing so inhibits their ability to study effectively.

#### 4.2.2 Model 2 – Objective measure of academic performance

The ALM process performed for model 2 resulted in an accuracy of 71.2%. Five habits were included as determinants of receiving grades over 80% after refining the model to remove insignificant items. The final model (refer to equation 2) had a Durban-Watson value of 2.22 and an  $r^2$  value of 0.49.

**Equation (2)**  $f(x) = (0.24)x_1 + (0.30)x_2 + (-0.19)x_3 + (-0.19)x_4 + (0.14)x_5 + 2.16$

Where:

$f(x)$  = How often did you receive high grades (over 80%) for assignments, exams or subjects overall?

$x_1$  = When I study for a class, I pull together information from different sources, such as lectures, readings, and discussions\*\*

$x_2$  = I usually study in a place where I can concentrate on my work\*\*

$x_3$  = I find it hard to stick to a study schedule\*\*

$x_4$  = It is my own fault if I don't learn the material in a subject\*

$x_5$  = When I study for a subject I write brief summaries of the main ideas from the readings and my class notes\*

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

Seeking out multiple sources of information (*Habit 1* ( $x_1$ )) is common to both models 1 and 2, with both models demonstrating that it has a positive impact on academic performance. Once again, this is logical as model 2 explains factors that lead to grades over 80% and utilising only one source of information would severely limit the student's ability to perform well in an assessment. Furthermore, *Habit 5* ( $x_5$ ) indicated a strong positive relationship to performance for those of which summarised notes after class and from readings. Having the ability to distill the vast amount of information available should lead to improved grades as it allows the student to solidify their understanding of the topic. However, this may not lead to gains in performance for students who are unable to stick to a study schedule (*Habit 3* ( $x_3$ )) as not being able to do so was found to be negatively related to performance. This may be the case as it potentially is related to *Habit 2* ( $x_2$ ), which showed a strong positive impact on performance for students who were usually able to find quiet places to study. Some students may not be able to identify when and where an appropriate time for them to study is, and hence, this impacts their ability to form a regular study schedule that they can follow.

*Habit 4* ( $x_4$ ) is somewhat at odds with the rest of the indicators with responsibility of learning having a negative relationship to performance. It would be expected that high performing students would take responsibility for their learning outcomes, however, if one views this from a different angle, it may be that high performing students who stick to a schedule and source appropriate material believe that have done all they can to achieve their best possible mark. Hence, the keyword in this question is "fault", in that good students do not believe it is a fault in their effort or ability, but perhaps simply an area that requires further understanding.

#### 4.2.3 Model 3 – Academic performance change over time

Model 3 had a similar ALM accuracy result as Model 2 with 72.3%. Model 3 (refer to equation 3) had the most determinants after removing insignificant items, with six habits. The model had a Durban-Watson value of 2.35 and an  $r^2$  value of 0.64.

**Equation (3)**  $f(x) = (0.23)x_1 + (0.27)x_2 + (0.18)x_3 + (-0.30)x_4 + (-0.25)x_5 + (0.30)x_6 + 2.75$

Where:

$f(x)$  = How did your learning performance as a university student change over time?

$x_1$  = *I try to change the way I study in order to fit the subject's requirements and the instructors teaching style\*\**

$x_2$  = *When I study for a subject, I often set aside time to discuss material with a group of students from the class\*\**

$x_3$  = *When I study for a class, I practice saying the material to myself over and over\**

$x_4$  = *During class time I often miss important points because I'm thinking of other things\*\*\**

$x_5$  = *When studying for a subject, I often try to explain the material to a classmate or friend\*\**

$x_6$  = *I'm confident I can understand the most complex material presented by the instructor in a subject\*\**

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

In the context of learning performance over time, *Habit 1* ( $x_1$ ) indicates that students who adapt their learning style to their instructors and material see their results improve over time whilst they progress through their studies. It is not clear if this is something that is planned or whether respondents came to this realisation in retrospect when answering the question. Regardless, this flexibility in approaches to learning has wider implications for behaviour change and persuasion. That being, it is possible to adjust a student's learning habit and style, as the data indicated that high performing students are indeed capable of altering their learning style, whether it is intentional or not. Being inflexible or unaware of different learning approaches could be considered a behavioural barrier to improving performance over time.

Study-group related habits also featured quite prominently in the model. For instance, discussing material with friends after class (*Habit 2* ( $x_2$ )) had a strong positive relationship to improvement in performance over time. Discussing materials with others helps students to better understand what they know as well as gain different viewpoints on the same material. Hearing what others have to say about material helps to identify gaps in understanding or confirm aspects for which one is unsure, both of which help improve learning. It stands to reason that this would lead to improvements in study performance over time as it provides a means to continually measure one's own level of understanding against peers. At the individual level, those who also rehearsed material to themselves (*Habit 3* ( $x_3$ )) found their performance improved over time. Rehearsal helps to build confidence and in turn, confidence is likely to lead to better performance in assessments, making it appropriate to include *Habit 6* ( $x_6$ ) as a positive habit.

Interestingly, the inclusion of *Habit 5* ( $x_5$ ) creates some contradiction in the model. *Habit 5* implied that there was a negative relationship with performance over time when respondents would try to explain material to a classmate or friend. On the surface, this habit appears to be very similar to *Habit 2*, except for *Habit 2* having a positive relationship to performance over time. However, the difference between the two may be in the terms "discuss" and "explain". Although explaining something you understand in simple terms can be indicative of deeper understanding, this is often carried out as a kind gesture and not strictly as part of a study schedule. That is, students typically do not plan to do this as part of their regular study habits. Reading the question more closely, it suggests that in order for learning to improve over time, one must explain their knowledge to their friends. However, high performing students are most likely occupied with their own learning process at that time and are not actively pursuing people to teach or tutor. If the question stated, "I am often asked" then perhaps the relationship would be more positive.

Students who are occupied with their learning are most likely to be highly focused on learning the material. This could explain why *Habit 4* ( $x_4$ ) indicated a negative relationship to performance, in that a student who is not interested in the subject material is obviously likely to see their performance decrease over time. Surprisingly though, the question of whether one enjoys the subject material of their degree overall did not appear as a significant item in this model. Perhaps students' expectations

for the subject material and actual material are not aligned. Hence, as they come to realise this over time, their interest wanes and they achieve lower results.

### 4.3 Findings

Upon analysing the three different models for academic performance, it was found that there is very little commonality between each of models habit predictors. In fact, there is only one instance of two models sharing the same habit, which is “*when I study for a class, I pull together information from different sources, such as lectures, readings, and discussions*”. This reinforces the idea that learning is a complex process, and no single habit is responsible for complete learning performance. The variation in the types of habits identified in the models makes it difficult to design a system that covers all the habits at once. This correlates the literature that suggests a persuasive system should select only a single behaviour to target at a time, and once successfully persuaded, expand to other behaviours. A persuasive system for improving learning will need to also adopt this approach, by initially targeting one habit from the models and then progress to habits over time.

Although the individual habits that were uncovered in this study are varied, there are some general themes that emerged. Firstly, a number of habits are related to resource management, including seeking information from multiple sources and note-taking. The value students place on a task emerged more prominently in the results with several habits including: *feeling lazy or bored whilst studying, giving up when a subject is difficult, or missing important details in class because of disinterest*. These all indicate that students were not engaging with the material in a way that kept them focused. Finally, there were also examples of learning expectancy in habits such as: *feeling confident in learning difficult material and not blaming oneself for failing to learn in class*. These three themes: resource management, task value and learning expectancy correlate very strongly with the three-factor MSLQ model identified in the literature. This implies that focusing persuasive system design on these key areas is likely to lead to significant return on investment in terms of academic performance.

### 4.4 Implications

As a result of this research being carried out, persuasive system design researchers now have a range of study habits to select from as a target. Furthermore, by developing three models measuring different aspects of academic achievement, more specific learning outcomes can be targeted, rather than academic performance in general. This research is expected to lead to higher quality persuasive system design, and more effective implementation. This is due to more time and effort being allocated to the design process rather than to identifying appropriate target behaviours and desired outcomes.

This research has implications for educators in that the models shed more light onto how certain study habits lead to changes in performance, as well as their relationships to one another. By understanding the relationships between habits and different areas of performance, instructors are better able to identify how to develop their curriculum to empower students to develop a wide range of study skills and habits. This, coupled with a potential prototype persuasive system to support educators in instilling these habits may lead to improvements in student learning outcomes.

### 4.5 Limitations

Although we were able to construct reliable models that measure study habits on academic performance, two limitations of the research were identified. Firstly, the sample size was fairly small. This may have resulted in some study habits failing to meet to the reliability criteria for inclusion in the models. Secondly, it was evident that the types of students who responded to the survey were typically “good” students. That is, they were high performing and generally exhibited positive study habits. This did not cause issues for identifying important study habits as it provided insight into the key habits that good students perform. However, we were unable to obtain insights into the behaviours

that inhibit good study habits, which would have been more evident from lower performing students. Hence, we were required to extrapolate potential behavioural barriers from the “good” student data we collected.

## **5 SUMMARY**

Computers have developed into powerful tools that are capable of influencing human behaviour. The marketing and advertising industries have clearly capitalised on this power to persuade, which is particularly evident in e-commerce and social networking services. Although marketing and advertising might sometimes use these tools questionably to their advantage, other sectors can use this to the benefit of individual customers. This is the case for education, where educators desire tools to help them improve the study habits of their students. Persuasive systems that have been effective are those that target a single behaviour and then build on that success. This raises an issue, particularly for education, as there are a multitude of behaviours that make up a student’s study habits. To address this issue and answer the research question, we used a statistical process to identify which study habits have the greatest impact and significance on academic performance. Three models were created that covered different dimensions of performance, including: self-perception, objective results, and performance over time. We found that only one study habit (*seeking information from multiple sources*) was included across multiple models, indicating that there are several habits which play a crucial role in academic performance. The models outlined in this paper form the behavioural basis from which persuasive systems can be designed to improve learning outcomes, as they provide a range of options from which designers may wish to select.

### **5.1 Future Work**

This research executed the first three steps of the 8-step design process for persuasive systems. Therefore, the next steps for future work should be to continue the process by selecting a behaviour from those identified in the models and developing a prototype system that attempts to influence good study habits in students. An important consideration for this prototype development is to ensure that the ethics of persuasive systems is evaluated. Although the goal of building a persuasive system for study is to be beneficial to students, designers should ensure that designs are not too invasive and do not interfere too far into the personal lives of students.

Another avenue for future work may be to improve the models presented in this research by addressing the limitations of the sample. Future work may involve redistributing the survey to a wider audience and using a larger sample size to identify significant study habits on academic performance. This may also provide an opportunity to collect data from poorer performing students in order to discover behaviours that inhibit a student’s ability to improve their habits.

A longer term study could involve investigating whether acquiring the study habits identified in this study have an impact on workplace habits. Workplace habits are arguably similar to study habits, such as taking notes after class being similar to doing so after a meeting. Future work may shed light on whether establishing good study habits translates directly into the workplace, and the impact this has on productivity. This would be of particular interest to both educators and employers.

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