APPLICATIONS IN HARNESSING THE POWER OF BEHAVIORAL NUDGE THEORY

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Applications in Harnessing the Power of Behavioral Nudge Theory

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ABSTRACT

This research encompasses two experimental studies aimed at exploring the potential of behavioral nudges to instigate positive change. The first experiment evaluates the use of visual cues, such as posters and footprints, to nudge individuals towards choosing stairs over elevators, promoting physical activity. The second delves into the psychological impact of personalized praise on college students' motivation, efficacy, and confidence, correlating these factors with academic performance. By integrating quantitative and qualitative research methods, the studies intend to assess the effectiveness of these behavioral nudges in directing behavior towards desirable outcomes. Contributing to the expanding discourse on behavioral economics and nudge theory, this research underscores the transformative potential of strategic nudges in not only encouraging healthier physical habits and academic engagement but also in broader applications for behavioral modification. These findings illuminate the versatility and efficacy of nudges as tools for positive behavioral intervention across diverse contexts.

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DEDICATION

This thesis is dedicated to Mohammad Mehedi Hasan Akash for his tremendous support and being a great companion during this long process.

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LIST OF ABBREVIATIONS

PDP .....Point of decision prompts.

CGPA.....Cumulative Grade point average

POC.....Point of Choice

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1. INTRODUCTION

1.1. Conceptual background

The concept of behavioral economics focuses on understanding and influencing adaptive human behavior to attain key social and other objectives. Behavioral economics is a combination of cognitive psychology and economics that incorporates empirical findings about human behavior in economic models (Thaler, 2016). Unlike classical economics, which assumes humans to be rational agents who make decisions based on long term goals and under full information, the principles of behavioral economics maintain that emotion, impulsivity, and the environment influence choice (Reed et al., 2013). In other words, people do not make rational choices. Considering choice within the framework of behavioral economics can improve our understanding of decision-making, and our ability to predict and influence decisions.

"Nudge'' is a popular concept in the field of behavioral economics. It is used in a number of contexts such as by policymakers to help achieve social goals and firms to encourage purchasing behavior. Originating from the seminal work of Nobel laureate Richard Thaler and Cass Sunstein, behavioral nudges are subtle interventions designed to guide individuals towards specific choices without restricting their freedom of choice. They termed the idea of libertarian paternalism which represents the use of behavioral techniques to nudge economic agents towards particular decisions (Thaler & Sunstein, 2003). It is a bridge between two extreme concepts, libertarianism and paternalism. Libertarianism emphasizes liberty where consumers have the freedom to make free choices to maximize their utility in a self-regulating free market system as long as their choices do not infringe on the rights of others. On the other hand, paternalism restricts freedom of choice by involving acts of coercion. It is important to note that individual choice as respected under libertarianism can be subjective, and is therefore not perfectly

predictable. For example, an individual with information about the negative consequences of smoking may still choose to smoke because it increases their individual utility. Similarly, the anti-mask movement during the Covid-19 pandemic can be viewed as an expression of libertarianism. However, resistance to public health measures led to policies that restricted behavior and freedom of choice. Considered in its strictest sense, paternalism may result in the complete removal of independence in making choices (Zajma, 2023).

Nudge theory and libertarian paternalism connect these two concepts, focusing on allowing individuals to make their own choices with slight manipulation and without any regulation or coercion. As such, a nudge can be described as any element of choice architecture that, without prohibiting options or substantially altering economic incentives, influences people's behavior in a predictable manner. (Thaler & Sunstein, 2008, p.6).

Choice architecture is the environment or context within which people make decisions. In contrast to the rational choice model, where people make decision depending on new information and price signals, behavioral science suggests that decision-making is often influenced by the environment. Even minor factors in the environment can influence choice and behavior. For example, consumers may choose food products based on their placement in the supermarket. Products placed beside the cash counter tend to attract customers and trigger impulse purchasing. Such decisions are based on automatic heuristic processing (Kahneman, 2012), which reflects that individuals do not always have the time and motivation to think through all the decisions they make and therefore rely on mental shortcuts, that is, heuristics. This tendency amplifies the effectiveness of nudge interventions as tools to subtly drive people toward making choices for their own benefit without requiring conscious engagement (Lin et al., 2017; Marchiori et al., 2017).

The foundation of nudge theory is based on dual processing theory, introduced by Kahneman (2002, 2012). According to this theory, our brain functions in two distinct cognitive systems: System 1 and System 2. System 1 is an automatic system which is unconscious, can handle multiple processes at the same time and is fast, effortless, associative and affective. System 2 is a reflective , goal-directed system which is analytical, slow and controlled (Kahneman, 2012; Lin et al., 2017). This system uses model-based reasoning, which is a way of thinking that helps us figure out what will happen as a result of different actions. Since the reflective system is slow, it cannot handle the volume of alternative choices we face every day. Thus, many of the decisions that we make on a daily basis, even those we are unaware we are making, are driven by the automatic system. These two systems work simultaneously with the automatic system forming the initial responses from our surroundings. Most of our habits are formed through the automatic system. This system also has two distinctive ways of controlling behavior. One is the habit system which is based on performing repeated actions in a stable environment. As such, habitual response is triggered by environment. (Verplanken et al., 2007; Wood & Neal, 2007). Another is the impulsive system which prompts actions and responses based on connections between stimuli and desired outcomes, as well as underlying motivations (Tybur & Griskevicius, 2013). The goal-directed system, impulsive system, and habit system are three key brain systems for behavior change techniques. They produce psychological processes such as thoughts, emotions, mental and motor habits, and can each independently influence behavior (Vlaev et al., 2016). Figure 1 represents the self-regulatory processes involved in behavioral change.

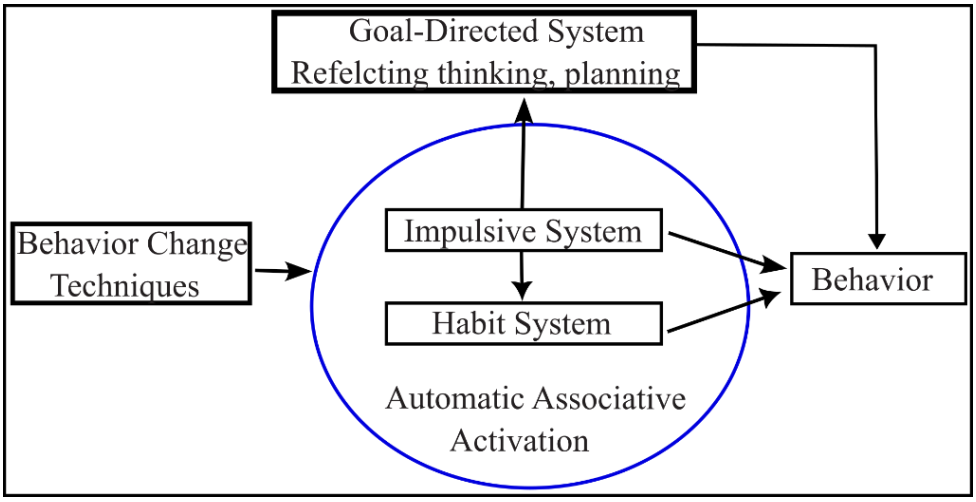

Figure 1: Self-regulatory process in behavioral change (adapted from Vlaev et al., 2016)

Utilizing the self-regulatory process of the human brain, behavioral scientists design subtle interventions that are low cost and relatively easy to implement compared to some more traditional policy interventions. Doing so can affect behavior and promote societal goals such as health and wellness, energy conservation, tax compliance, organ donation, and promoting worker productivity, and performance. This study aims to investigate the effectiveness of nudges in promoting: (1) health and wellness, and in particular the physical activity of using stairs rather than an elevator, and (2) increasing students efficacy through personalized praise.

1.1.1. Application

Lack of physical exercise and sedentary behavior are two of the major factors that lead to morbidity and non-communicable diseases (Proper et al., 2011; Rhodes et al., 2017), supporting the importance of physical activity. However, many do not get enough physical exercise due to circumstance, choice, or habit. One low-cost opportunity to increase physical activity is use of stairs rather than taking an elevator. Regular stair climbing contributes to cardiovascular fitness, reduced cholesterol level, and weight maintenance, and requires little or no monetary investment and does not add substantially to time to move from one floor to another

(Boreham, 2005; Eves & Webb, 2006; Kerr et al., 2001). Applying nudges has the potential to increase the use of stairs instead of the elevator. Several studies show the successful use of point of decision prompts such as, posters with informative messages, footprints, and changes in stair environments to reduce the use of elevators, which may already be a habitual behavior (Blamey et al., 1995; Kelly D. et al., 1980; Kwak et al., 2007; Olander et al., 2008). Such prompts change the environment which may evoke these automatic habitual behaviors by obstructing the automatic link and breaking the habit (Sheeran et al., 2005).

Behavioral nudges may also target the automatic system and influence behavior through positive reinforcement and indirect suggestions (Cohen, 2013; Sharif & Moorlock, 2018). Positive reinforcements are actions such as compliments, and personalized feedback designed to reinforce a positive behavior. These can stimulate an individual's intrinsic motivation such as when an instructor purposefully recognizes students' efforts and accomplishments, and may increase efficacy and improve performance. In economics, monetary incentive or reward is often considered a primary tool for motivation. However, according to Hansen et al. (2002), reward and recognition should be treated separately for proper motivation. Researchers have become increasingly interested in investigating whether providing personalized feedback can stimulate motivation (London & Smither, 2002; Medvedeff et al., 2008).

This paper presents two distinct experimental studies that apply behavioral nudges to tackle challenges relevant to personal goals. The first study uses behavioral nudges to drive positive behavior through indirect suggestion and the second study uses positive reinforcement as a nudge to foster motivation. These studies investigate the effectiveness of nudge strategies in guiding individuals towards desired external goals. The studies focus on two specific approaches: applying poster and footprint interventions to increase use of stairs, and improving

efficacy and confidence of college students through personalized praise based on their performance. Collectively, these experimental studies contribute to the growing body of research on behavioral nudges and their potential for promoting positive behavioral change. The subsequent chapters discuss the literature, methods, results and discussions for each experiment.

2. USING POINT OF DECISION PROMPTS TO INCREASE STAIR USE

2.1. Overview

Lack of physical activity and a sedentary lifestyle have increasingly become major health risks, the effects contributing to ailments including heart disease and type II diabetes. On average, adults in the United States engage in sedentary behavior for approximately 7.7 hours daily (Park et al., 2020). Stair climbing is proposed as a convenient form of physical activity that can be integrated into daily life to improve overall health benefits with little or no financial or time cost. A study conducted by Whittaker et al. (2021) revealed that individuals who do not regularly climb stairs are at a higher risk of metabolic syndrome, a cluster of symptoms including abdominal adiposity, high triglyceride levels, low levels of high-density lipoprotein, and diabetes. This increased risk is compared to those who climb stairs daily, highlighting the association between stair climbing and a reduced risk of cardiovascular diseases.

Michael et al. (2021) conducted a study that included assigning sedentary women to home-based and gym-based stair climbing tasks to compare the effects. In both cases, they found improved aerobic fitness, body composition, and serum lipids. In addition, home-based stair climbing reduced fasting blood glucose. Overall, the study supports that stair climbing improves overall heath. In spite of this benefit, when it comes to choosing between the stairs and the elevator, people tend to take the elevator as a general habit. Habit is considered an automatic behavior that results from a frequent association formed between a goal and a specific action (Aarts and Dijksterhuis, 2000). In part due to a formed habit, individuals may automatically choose the elevator even though it is not beneficial. Such habitual behavior can be transformed by changing the environment by prompting and thus disrupting the automatic link (Sheeran et al., 2005). Other factors such as lack of ability, lack of motivation, inability due to circumstance

such as carrying bulky or heavy items or wearing non-conducive footwear, or consideration of others are other potential influencers.

2.1.1. Point of decision prompts

One method to change behavior is to use point of decision prompts (PDP), motivational signs that are designed to change the physical environment to influence people to take an alternative course of action (Allais et al., 2017). These prompts can influence decisions by providing beneficial information and motivational messages through banners or posters and visually guiding individuals through lights, markers, footprints, and other indicators. Prompts have gained significant popularity in social research due to their simplicity in application, cost-effective implementation, and scalability as a strategy. A number of studies have applied different types of prompts and found evidence of effectiveness in encouraging activities such as stair use, physical distancing during pandemics, and increasing activities in parks. (Aarts and Dijksterhuis, 2000; Christiana et al., 2022; Kaczynski et al., 2014; Kwak et al., 2007). This research aims to investigate the impact of prompts on stair use. The hypothesis is that the use of PDPs (specifically, posters and guiding footprints) increases overall stair use in an office building.

2.2. Literature

Behavioral nudge theory has gained significant attention in recent years as a powerful tool for influencing individual decision making. The advancement of behavioral economics was accelerated by the introduction of the idea of behavioral nudge by Thaler and Sunstein to a broader audience (Hansen & Jespersen, 2013). From improving savings through auto-enrollment to improving health by influencing food choices, use of behavioral nudges has become an effective tool for policy makers and others working to influence decisions. This literature review

explores applications of behavioral nudge theory in enhancing effective decision making across various domains.

The use of nudges has gained significant popularity in recent years for promoting a healthy and active lifestyle (Forberger et al., 2019). The most common nudge approaches to increase physical activities are type 1 nudges, or PDPs that use visual cues such as footprints to guide people to take the stairs instead of elevators, and type 2 nudges, which use educational information such as posters and banners (Lin et al., 2017). For example, Åvitsland et al. (2017) found a combination of footprints and banners led to an increase in stair use, although, used alone, footprints actually decreased stair use. Type 2 nudges are generally more widely used to motivate physical activity (Andersen, 1998; Blamey et al., 1995; Nomura et al., 2009; Marshall, 2002). Kwak et al. (2007) conducted a three-week intervention study in an office building and a paper factory with posters containing slogans to take the stairs. The study found a short-term effect of the posters on increasing stair use by approximately 5%. The study did not investigate whether this effect was sustained over the longer run.

Olander et al. (2008) attempted to encourage stair use in a train station by using a combination of a banner and a poster intervention where both included the same message: “Stair climbing burns more calories per minute than jogging. Take the stairs.” Banners had no effect but using both posters and banners increased stair use. This result is in contrast to the studies conducted in shopping malls by Kerr et al. (2001) and Webb & Eves (2005, 2007) which found a positive impact of banners on increasing stair use. Olander et al. (2008) hypothesized that pedestrian traffic, which is generally higher at train stations than shopping malls, may have obscured the view of banners, making them less effective. The interview results of their study supported this, indicating that excluding traffic volume and other factors in modeling may lead to

an underestimation of the effectiveness of interventions more generally (i.e., beyond the study). In a similar study, Sloan et al. (2013) applied a nudge at one of, two train stations in Singapore, with the other serving as the control. In this case, the prompts used were stickers and colorful stair riser PDPs. Unlike the previous study, this study considered rush hour at stations in the model. Applying a univariate and multivariate generalized estimation, Sloan et al. (2013) found an overall increase in the likelihood of stair use of 48.5% in the station including PDPs. The effect had dropped 12% from the high two weeks later. In addition, the result from the interaction between gender and PDP revealed a gender effect, PDPs had less impact on males than females. Allais et al. (2017) used PDPs including footprints, posters, stickers, and stair riser banners at two of three subway stations in Paris (the third served as the control). PDPs in one location were focused on the low immediate cost of climbing stairs, while prompts in the other station promoted the health benefits. Researchers found an immediate increase in the number of stair climbers after the nudges but the effects lasted only two weeks after the end of the intervention. The study suggests a longer intervention period to help the pedestrians form stair climbing as a habit, which can contribute to sustainable change (Becker & Murphy, 1988).

Gorczynski et al. (2013) investigated the effect of point of choice prompts such as posters , in a psychiatric setting, where the participants included both staff and patients of the institute. There was no impact for the patients but male employees and volunteers significantly increased the use of stairs.

Existing literature mostly focuses on encouraging stair use to increase physical activity among people, especially in workplace settings. Alternatively, Larouche et al. (2018) experimented with reducing sedentary workplace behavior by increasing the utilization of sit-stand workstations. In this experiment, they sent prompt messages through email to employees.

The goal of the study was to examine the efficacy, preference and acceptability of two POC prompt interventions; prompt with a theoretical basic reminder message (R-POC) and prompt with a theory driven message (TD-POC). The R-POC prompt featured the consistent message 'Time to Stand!', while the TD-POC prompt emails included the distribution of 40 different messages, with eight messages sent each day for a total of five days. The TD-POC prompt messages were based on the key components of Social Cognitive Theory such as, self-efficacy, outcome expectancies and proximal goal setting. Both prompt interventions were found to be effective in reducing sitting time of the participants. The TD-POC prompts were found less efficacious than the R-POC.

Other methods focusing on implementing nudge interventions have been tested. Rogers et al. (2010) hypothesized that ambient displays could be used as a nudge to influence decision-making. The ambient influence approach included several ambient displays, such as twinkly white lights installed on the floor in an aesthetically pleasing flowing pattern toward the entrance of the stairwell, cloud-shaped spheres in two different colors (an orange sphere representing usage of elevators and a grey sphere representing usage of stairs) hanging from the ceiling where the relative height of the clouds changed in relation to the number of people taking stairs versus elevators, and a large public digital screen that displayed a historical pattern depicting the ratio of daily utilization of stairs and elevators over time. The idea of a cloud was intriguing and confounding to most of the users and, over the six-month study, installation of the displays increased stair use.

Researchers have also tested the effectiveness of nudges to promote other forms of physical activity, such as park-based activities and walking. In a study conducted at an airport transportation mall, signage was used to influence people to walk instead of riding a train (Fulton

et al., 2017). Messages on the signs were developed based on surveys conducted beforehand with travelers. The signs had a positive result, with an increase of 6% in the number of people choosing to walk to their departure gate. Kaczynski et al. (2014) conducted a virtual experiment where participants were shown photos of a park with a sign containing a message about being more active (treatment) and without any sign (control). Afterwards, the participants were asked questions about their likelihood of being more active in parks. Participants in the treatment group were more inclined to participate in park-based physical activities than those in the control groups.

Christiana et al. (2022) used pavement markings illustrating 6-foot distances on trails as prompts to encourage physical distancing during the COVID-19 pandemic. The pavement markings had no effect on social distancing. Similar studies on encouraging off-trail walking and hiking behavior by using prompt messages and displaying images found no effectiveness (Goh, 2023; Guo et al., 2015). The difference in findings between studies may be attributed to the message emphasis, with physical activity studies focusing on personal health benefits, while other studies highlight benefits for both individuals and others (Christiana et al., 2022).

The literature demonstrates that behavioral nudge interventions can be a potential tool for encouraging healthier and more active lifestyles, as well as enhancing decision-making across various domains. However, the effectiveness of these decision prompts varies by environment and the particular message or form of message. This calls for further research with an emphasis on sustainability of the effect and adaptability to changing societal needs.

2.3. Methodology

This methodology section explains the methods used in this study, focusing on the analysis of the impact of point of decision prompts on increasing stair use. This section outlines

the intervention site and participants, study design, and the statistical approaches used to assess the effects of nudge interventions on making people more active.

2.3.1. Intervention site and participants

The experiment was conducted at the Barry Hall building of North Dakota State University, where the six-story office tower was the target location. There are two sets of elevators and one stairwell located at the front entrance and a single elevator and one set of stairs at the back entrance to the tower. Both the elevator and stairwell in the front entrance area of the building are frequently used by faculty, staff, and students. In contrast, the back-entrance area of the building is less frequented. Participants in the study included faculty, staff, and students with offices in the building, as well as anyone visiting the building. The majority of students in the building are graduate students who work as graduate assistants on the 4th, 5th and 6th floors.

2.3.2. Study design

The timeframe of the experiment was from March to April 2023. Four observers discretely collected the number of people ascending the stairs and elevator at the front entrance, coded by gender and race. Data was collected from 7 a.m. to 5 p.m. Individuals, such as custodians or anyone carrying heavy materials, were excluded from the observation. An automatic counting machine was used to collect data for the back elevator and stairwell. For the front section of the building, the frequency of stair and elevator use was collected manually by five data collectors stationed at a designated area beside a cafeteria near the entrance. They conducted rounds of data collection in shifts, each lasting 2 hours. In addition to recording the count of stair and elevator use, the data collectors also noted the apparent gender and racial groups of the users. Data was collected in three phases: baseline, intervention, and post-intervention periods. In this quasi-experimental design, a baseline period of five days was

followed by an intervention period of eight days. During the first week of the intervention period, 24 posters containing the health benefits of stair use and social norm messages were placed in easily viewable positions (figure 2). The messages include; “Burn calories, not electricity”, “The benefits of stair climbing: improved cardiovascular fitness, strengthen musculoskeletal system, fights stress, aids sleep”, “7 minutes stair climbing a day more than halves your risk of a heart attack over 10 years”. The posters were placed inside the elevators, as well as on the walls beside and opposite the elevators and stairways. The majority of the signs were made by the researcher, while some were collected from various campaigns, including a social online campaign titled 'Move it or Lose it', “Stepjockey”, “Support for Physical Activity” by Healthy University project, and the 'Take the Stairs' campaign by Grand Valley State University. The signs are included in the appendix B section of this paper. During the second week, yellow footprints on the stairwell floor were added in both entrances. After the end of the second week, both posters and footprints were removed, and data collection was paused for one week. Follow-up intervention data was thereafter collected for eight days. The required approval was acquired from the Institutional Review Board (IRB) (protocol number: IRB0004631, approval date: 02/10/2023). Participants were not informed of this experiment.

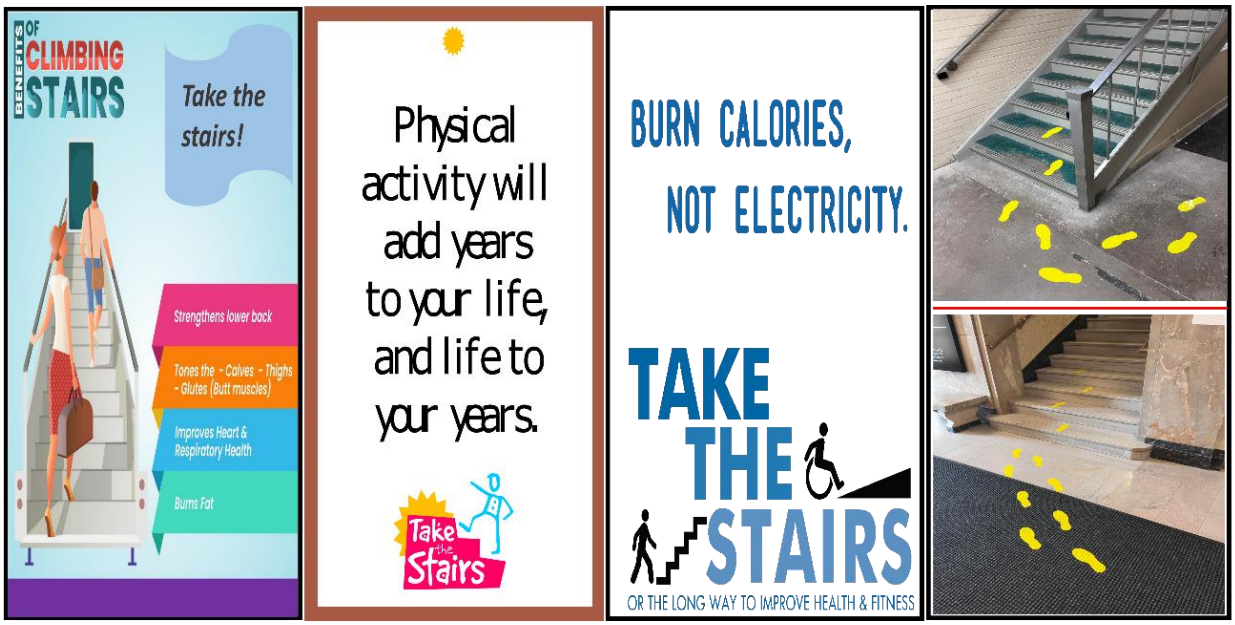

Figure 2: An illustration of the posters and footprints used in the experiment site

2.3.3. Statistical models

This study investigates the impact of PDPs on stair use. Two statistical methods are used to analyze data, depending on location. In the case of the front entrance data, logistic regression analysis is used. A one-way ANOVA was used to analyze data on the use of stairs and elevators at the rear entrance during three phases of the study, to measure any variation in their usage.

2.3.3.1. Analysis of front entrance data

The response variable in this experiment is the frequency of stair use, which is coded as 1 for stair use and 0 when an elevator was used. Logistic regression is a suitable statistical method for modeling this binary outcome (Kerr et al., 2001; Kwak et al., 2007; Nomura et al., 2009). It is a predictive analysis method that models the probability of a binary outcome based on one or more predictor variables. For this dataset, the independent variables include baseline period, intervention period, follow-up intervention, gender (male and female), and race (Asian, white, and black).

A crucial assumption in logistic regression is the absence of excessive multicollinearity among independent variables. To address this assumption, we consider each occurrence of stair use as an independent choice made at the moment of encountering the decision node, regardless of the individual making the choice.

The logistic regression model of this analysis can be expressed as:

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1\text{baseline} + \beta_2\text{intervention} + \beta_3\text{follow-up} + \beta_4\text{gender} + \beta_5\text{race} + \mathcal{E} \quad (1)$$

Where, p is the probability of stair use, β_0 is the intercept and β_1, β_2,.., β_5 are the coefficients of the predictor variables. The logit function $\log\left(\frac{p}{1-p}\right)$ converts the probability of the outcome from a binary scale (0 to 1) into a continuous range that extends from negative to positive infinity. This transformation enables the application of linear regression methods. In this model, logistic regression shows how the presence of the decision prompts influences the likelihood of stair usage while controlling for demographic variables such as gender and race. One limitation of this study is the absence of age as an important control variable. It was excluded because subjects were not approached or queried.

2.3.3.2. Analysis of rear entrance data

A one-way ANOVA is used for this dataset, where the dependent variable is the percentage of nodes resulted in stair (versus elevator) use each day. The independent variable is the study phase: baseline, intervention, and follow-up. The one-way ANOVA compares means of a dependent variable across two or more groups when the dependent variable is quantitative, thus allowing for examination of whether the dependent variable is affected by the category of the independent variable. The one-way ANOVA model can be expressed as:

$$Y_{ij} = \mu + \tau_i + \mathcal{E}_{ij} \quad (2)$$

Where,

- Y_{ij} is the observed dependent variable i.e. percentage of stair users.
- μ is the overall mean.
- τ_i is the effect of the ith level of the independent variable i.e. study phases on the dependent variable.
- $\mathcal{E}_{ij}$ is the random error term for each observation, assumed to be normally distributed with mean 0 and variance σ^2.

The null hypothesis for ANOVA is that the percentage of stair use is not different in the three periods. In other words, H_0: all group means are equal, $\mu_1 = \mu_2 = \ldots\ldots = \mu_k$.

ANOVA breaks down the variance observed in the dependent variable into two types: variance among groups and variance within groups. It then evaluates whether the variance observed among groups significantly exceeds what might occur by random chance.

The ANOVA test is based on several underlying assumptions: that residuals are normally distributed, and exhibit equal variances, and that observations are independent. To verify these assumptions, diagnostic tests were conducted. Analysis of the residuals from the predicted plot confirmed equal variances across groups. Additionally, the Q-Q plot and histogram of the residuals indicated that the error terms are normally distributed (Figure 3). Therefore, the three main assumptions required for the ANOVA test were adequately met in this analysis.

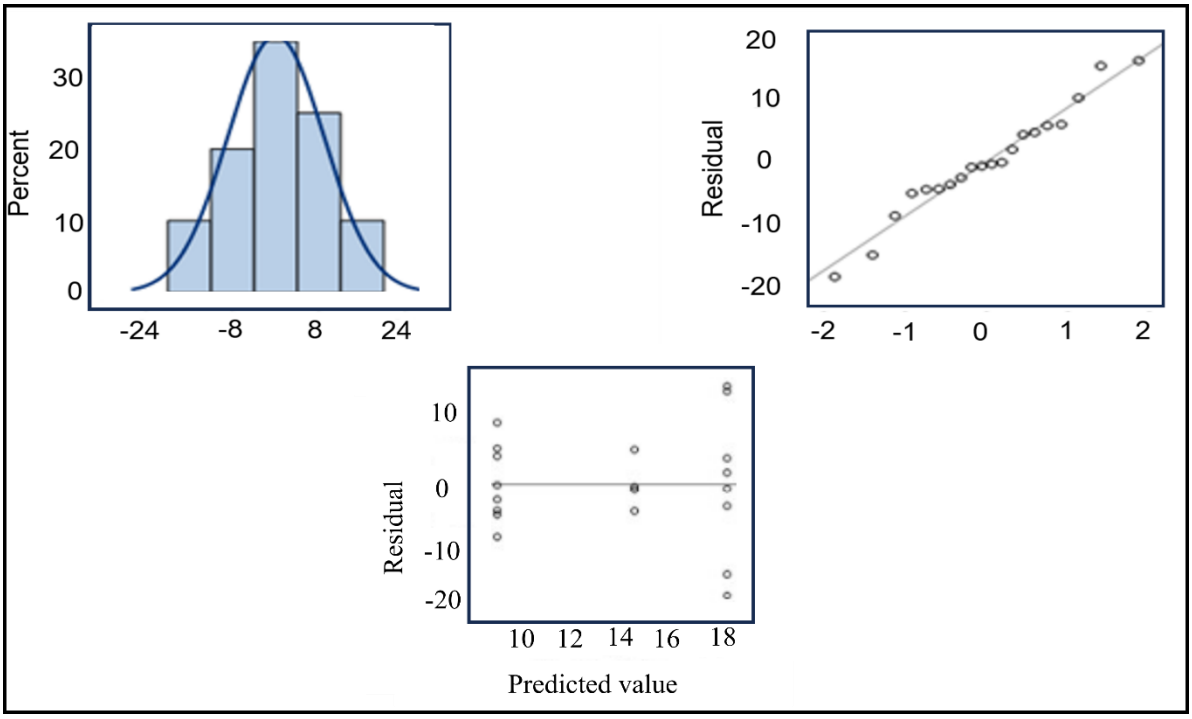

Figure 3: Diagnostic checks using residual plots and Q-Q plots to assess homoscedasticity

2.4. Results

2.4.1. Results from logistic regression

Over the three-phase intervention, 2346 observations were recorded. Participants were categorized by gender and race. There were significant differences in stair use percentages between the baseline period (43.59%), the intervention period (47.56%), and the follow-up period (52.99%). Gender is a statistically significant predictor of stair usage. Overall, the percentage of men using stairs (versus elevator) (n = 828) was 4% higher than the percentage of women (n = 322). Race is also another statistically significant predictor. Fifty-three percent and fifty-two percent of Asians and whites, respectively, used the stairs, as compared to 21% of blacks. There was no significant difference in stair use between men and women while controlling for the Asian population. However, the stair use for men was higher than that of women, controlling for both the black and white populations. Table 1 provides a representation of frequency distribution of elevator and stair use across study periods, gender and race.

Table 1: Summary statistics

1(a) Frequency distribution across study periods

Periods	Total Frequency	Total percentage	Number of trips via Elevator	Number of trips via Stairway
Baseline	507	21.61%	286 (56.41%)	221 (43.59%)
Intervention	820	34.95%	430 (52.44%)	390 (47.56%)
Follow-up	1019	43.44%	479 (47.01%)	540 (52.99%)

1(b) Frequency distribution across gender

Periods	Total Frequency	Total percentage	Number of trips via Elevator	Number of trips via Stairway
Female	700	29.86%	378 (54%)	322(46%)
Male	1644	70.14%	816 (49.64%)	828 (50.36%)

1(c) Frequency distribution across race

Periods	Total Frequency	Total percentage	Number of trips via Elevator	Number of trips via Stairway
Asian	281	11.99%	132 (46.98%)	149 (53.02%)
Black	236	10.07%	186 (78.81%)	50 (21.19%)
White	1827	77.94%	875 (47.89%)	952 (52.11%)

Table. 2 provides the maximum likelihood estimation results from the logistic regression analysis. The results reveal that gender has a statistically significant effect on the log odds of the

outcome variable, with a negative coefficient (-0.2645). Thus, the odds of the event (stair use) occurring are lower for females compared to males. Predictor race shows a significant effect of the event, with race=black having a highly significant negative impact on the log odds of outcome compared to race=white (the reference level). Thus, the odds of the event (stair use) occurring for the black population are lower compared to the white population. Race=Asian, on the other hand, has a positive effect on the log odds of the outcome, although this is not statistically significant. Finally, the intervention and post-intervention periods are associated with higher log odds of stair use compared to the baseline period. The follow-up intervention period has a statistically significant effect on the event (stair use). Although the effect of the intervention period on the event is not statistically significant at the 5% level, the p-value of 6.81% is close to the typical threshold of 5%.

Table 2: Analysis of Maximum Likelihood Estimation from Logistic Regression

Variable	**Reference level**	**Estimate**	**Wald Chi-Sqr**	**Pr>Chi-Sqr**
Intervention	Baseline	0.2117	3.3284	0.0681
Follow-up	Baseline	0.3931	12.4563	0.0004
Gender (Female)	Male	-0.2645	8.1173	0.0044
Race (Asian)	White	0.0725	0.3119	0.5765
Race (Black)	White	-1.4349	73.6747	<.0001

We also get similar results from the odds ratio estimates (table 3). Compared to the baseline, the event (stair use) is 23.6% more likely to occur in the intervention period. However, the 95% CI suggests that the difference in odds between baseline and intervention periods is not statistically significant. The odds of stair use occurring in the follow-up period compared to the

baseline period are significantly 48.2% higher. Women are 23.2% less likely to use stairs than men. Even though the difference in odds of stair use for Asian and white populations is not statistically significant, the black population is 76.2% less likely to use stairs.

Table 3: Odds ratio estimates

Main effects	**Estimate**	**95% confidence limit**	
Intervention vs. Baseline	1.236	0.984	1.551
Follow-up vs. Baseline	1.482	1.191	1.843
Female vs. Male	0.768	0.640	0.921
Race (Asian vs. White)	1.075	0.834	1.386
Race (Black vs. White)	0.238	0.172	0.33

2.4.2. Results from one-way ANOVA

A one-way ANOVA test was conducted for the analysis of stair use data collected from the rear entrance, where the dependent variable is the percentage of stair use within a day. As stair and elevator use were gathered using electronic counters, gender and race could not be noted or considered. In total, 20 days of stair use (%) data were used (n=20). The F-statistic is 2.27 and the p-value is 0.1340. We therefore do not have evidence to reject the null hypothesis that the percentage of stairs used is not different in the three periods.

2.4.3. Survey analysis

After the intervention period, a survey was conducted using Qualtrics with employees in the building, including the students who have offices at the faculty office tower. The survey questionnaire was emailed to all faculty, staff, and graduate assistants of the Barry Hall building. In total, 64 people responded to the survey (39.34% female and 60.66% male) (table 4). This

compares to the study population wherein approximately 30% of individual counts were females and 70% were males. Most respondents reported seeing the posters (87.30%) and the footprints (88.89%). Table 4 summarizes the responses from the survey. Among the respondents, 43.40% found the posters to be effective in increasing their stair use, whereas 3.77% said that the posters had decreased their use of stairs. Over half (52.83%) of the people reported their behavior was not affected by the posters. Footprints had a lower impact than the posters on the participants. Only 29.63% of people reported the footprints were effective in increasing the use of stairs. On the other hand, 5.56% of people responded that the footprints had decreased their stair use. Sixty-five percent did not find any effect of the footprints on their choice to use stairs. It is important to note that, because the footprint nudge occurred after and was in addition to the existing signage, wording of the survey question does not allow conclusions about whether the footprints would have been effective in the absence of a prior (and continuing) signage nudge.

In response to their perceptions about the effectiveness of posters and footprints, 36.17% of participants revealed that they perceive the posters as moderate to very effective, and 44.68% of people perceive them as very to extremely effective. Likewise, 35.71% of the respondents perceive the footprints as moderate to very effective, and 35.71% of the survey participants think of them as very effective to extremely effective. Among the people whose percentage use of stairs versus the elevator did not change during the study period, 42.11% of them habitually use the stairs more often than the elevator during an average week.

Fisher's exact test did not show a significant result, potentially due to the small sample size. Considered were gender, age, and profession as variables. Nonetheless, the survey data provides some noteworthy findings. The results show that 52.63% of female respondents reported increased stair usage due to the posters, whereas only 39.39% of male respondents

found the posters effective in increasing their stair use. Similarly, 35% of female respondents reported increased stair usage due to the footprints, which is higher than the percentage of male respondents (27.27%) who found the footprints effective. This survey data aligns with the observations made from the front entrance stair data. During the baseline period, 35.57% of females and 46.78% of males used the stairs. During the intervention period, the percentage of female stair users increased to 49.81%, whereas the percentage of male stair users remained nearly the same at 46.62% (figure.4).

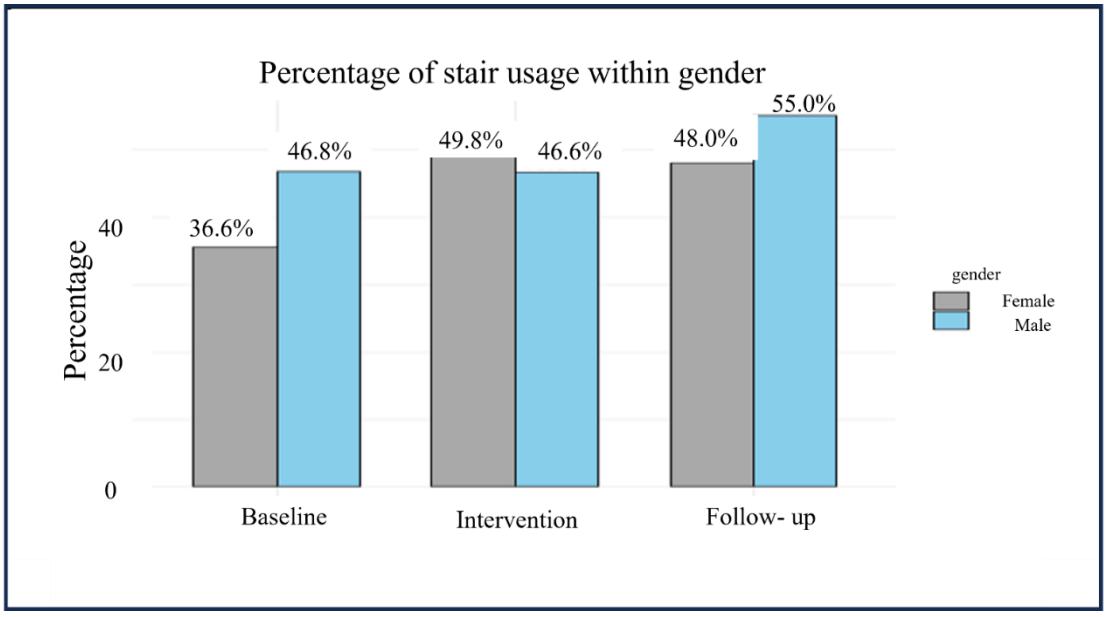

Figure 4: Percentage stair use by male and female in three periods

Thus, the observed data during baseline and intervention, and the survey data show a higher effectiveness of posters and footprints among the female population compared to male. Although, the percentage of female stair users later decreased during the follow-up period and the percentage of male stair users increased to 55.03%. One limitation of surveys is the potential for response bias, where respondents may not always provide entirely honest or accurate answers. This can affect the ability to draw accurate conclusions from the survey results.

Table 4: Survey results

Survey Questions	**Percent**
Whether consideration is given to increase stair use at the start of the semester:	
Yes	51.61
No	48.39
Change in the percentage of stair usage versus elevator usage since the beginning of the semester:	
No change	60.32
Increased	36.51
Decreased	3.17
Impact of posters on decision to use stair:	
The posters had no effect	52.83
Yes, increased use of stair	43.40
Yes, decreased use of stair	3.77
Impact of footprints on decision to use stair:	
The footprints had no effect	64.81
Yes, increased use of stair	29.63
Yes, decreased use of stair	5.56
Perception regarding effectiveness of using posters:	
Not effective	8.51
Slightly to moderately effective	10.64

Table 4: Survey results (continued)

Survey Questions	**Percent**
Moderate to very effective	36.17
Very to extremely effective	44.68
Perception regarding effectiveness of using footprints:	
Not effective	4.76
Slightly to moderately effective	23.81
Moderate to very effective	35.71
Very to extremely effective	35.71

2.5. Discussion

This study investigates the impact of using decision prompts on the choice of stairs in an office tower. Overall, an increase in the percentage of stair usage at the front entrance is observed during both the intervention and post-intervention periods when compared to the baseline period (figure.5). The result is consistent with existing literature, where the use of posters has increased the likelihood of using stairs (Kwak et al., 2007; Olander et al., 2008). The survey results reveal a lesser impact of footprints compared to posters, which aligns with the findings of a study conducted by Åvitsland et al. (2017) and may be in part due to the fact that the footprints were a secondary nudge added in combination with the initial signage nudge. The individual comments in the survey response also show a negative perception regarding footprints. For instance, some people commented that, “I thought the footprints were too heavy handed. The posters were appropriate, but in conversations that I had with people, the footprints

turned people off", "An occasional message of healthy practices is welcomed. The footprints for me presented a possible slip and fall situation. I do not step on anything that is on the floor. It could be a paper that slips out from underneath my footing. The footprints and posters were too much".

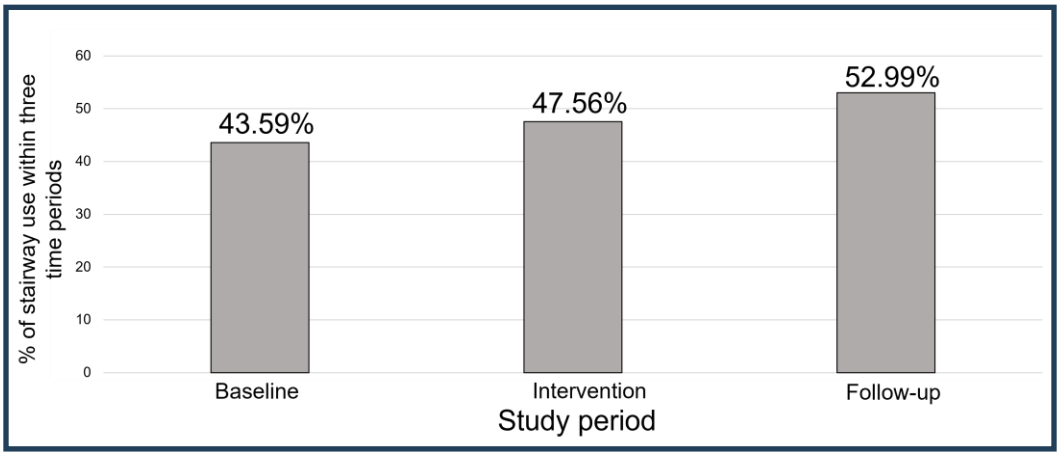

Figure 5: Percentage of stair users in three study periods

Even though the percentage of stair use in the front stairwell increased in the intervention and follow-up periods, the impact of the prompts differed by gender and race. The reason might be attributed to the fact that the participants include people from different parts of the world and also come from different professions. Hence, the effect of nudges may depend on the individual characteristics and be more effective for some groups than others. Unfortunately, not much research exists in the literature studying the effectiveness of nudges based on personality traits or participants characteristics (Ingendahl et al., 2021). Like the present study, Anderson et al. (2012) also found that men were more likely to use stairs than women. Sloan et al. (2013) suggested that one reason men tend to use stairs more frequently than women is because they may perceive stair climbing as less challenging. According to this study, such perceptions may be influenced by the fact that men often have greater lower body strength and higher cardiorespiratory fitness levels.

The current study distinguishes itself from other studies by emphasizing the significance of race as a demographic variable, which has not received much attention in earlier studies. In a healthy lifestyle nudge study by Tan et al. (2022), the acceptance of various nudges for a healthy lifestyle varied across different ethnicities in a multi-ethnic population. However, the impact of the intervention was not clearly discernible in this experiment across all racial groups, particularly among the black population. This is largely due to the fact that the proportion of this group is relatively small, and nearly all individuals from this ethnicity are graduate students who predominantly use elevators. The tendency of students to use stairs less often than faculty members is observed from survey data as well. Nearly fifty-seven percent of faculty members reported their habit of using stairs more often compared to elevators. While, one-third of the students (34.48%) reported using stairs more often than the elevator.

For the rear entrance section of the tower, the interventions had no impact on the use of stairs. It should be mentioned that the stairs at the rear entrance section are isolated from the building and quite cramped. It could be a possible reason that deters people from using stairs. Anderson et al. (2012) found in their study that people are more likely to use stairs when they are spacious and in an open environment. In addition, the rear entrance is less crowded than the front entrance, making it easier for people to take the elevator unnoticed; that is, there is little potential for implicit peer pressure for those using the rear entrance. Another possible reason is the stairs at the rear entrance are less convenient to use due to security measures. An individual using the stairs must use a particular key to open the door, and the door must be opened before the key is removed. Using the elevator only requires the individual's NDSU ID be in close proximity to a card reader. One response from the survey also supports this issue. One participant has commented that, "I know the back stairs requires a key to enter as a security measure but having

to use/fumble with my key when I have a handful of stuff in the mornings is a deterrent to using the back stairs in the morning. I know my ID card is in my purse and I can generally wave my purse at the elevator to access my floor - so I typically use the elevator then. "

2.5.1. Limitations

The present study has several limitations. The first limitation is related to the study's timeframe. The experiment was conducted during the winter, a season with highly unpredictable weather. Frequent university shutdowns occurred due to catastrophic weather events, disrupting the study's continuity and shortening the overall timeframe. Additionally, adverse weather conditions led to building employees occasionally working remotely, which in turn affected the sample size. A longer timeframe is recommended to identify a clearer impact of the interventions. Secondly, among the racial groups, the black population is significantly smaller in size compared to the other groups and this population is largely comprised of students who have offices on the higher floors (4^{th} through 6^{th} floors). Future studies should employ strategies to achieve a more balanced representation across all racial groups and potentially work to differentiate the designated floor. Thirdly, the present study does not incorporate the age variable specifically. Age could be a significant predictor in assessing the behavior of the participants and the effect of nudges on them. It is possible that race is confounded with age and/ or student status. As noted, most members of the black population in the building are graduate students (relatively young). Finally, the present study does not test the effect of nudges in the long run. Further study should be employed to determine the long-term effects of the interventions.

3. EFFECTIVENESS OF POSITIVE PRAISE AS A NUDGE TO BOOST STUDENT CONFIDENCE AND IMPROVE PERFORMANCE

3.1. Overview

Student motivation to learn has been identified as an important area to drive academic success, yet it can be a significant challenge for college students to maintain throughout the semester (Edgar et al., 2019). The most common reasons are lack of self-confidence, anxiety, depression, and having earned bad grades. Motivation is a process that helps students value learning and engage in classroom activities ((Ames, 1990; Brophy, 1983). McMillan & Forsyth (1991) developed a heuristic model of motivation for college students based on the assumption that learning is a cognitive activity and students' motivation is influenced by their belief in their capability to achieve. The model is presented as figure 6.

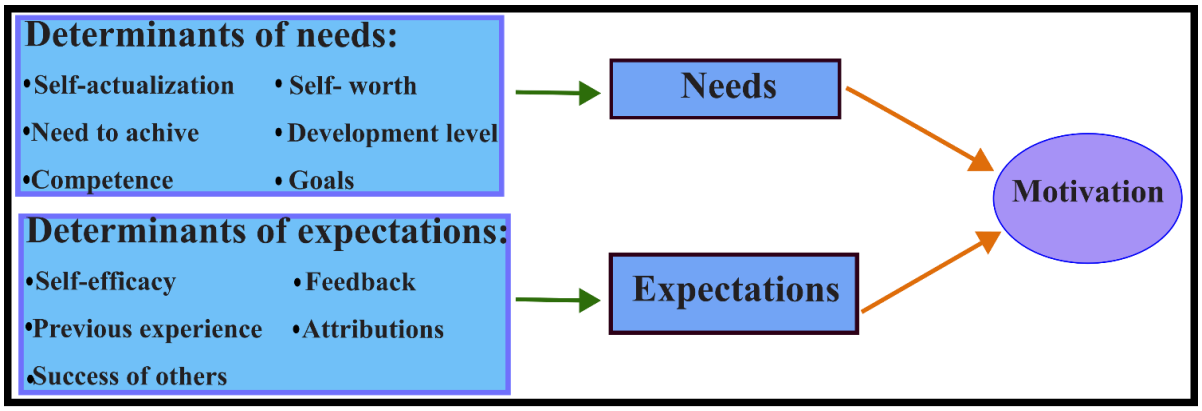

Figure 6: A heuristic model of college student's motivation (from McMillan & Forsyth, 1991)

According to this model, motivation is a function of needs and expectations. The presence of needs motivates a student to behave in a way so as to attain satisfaction and rewards (e.g. good grades). One of the determinants of need is self- actualization. Self-actualization and fulfillment are the needs that make human beings strive to be as competent, creative, and effective as possible (McMillan & Forsyth, 1991). Students' motivation enhances when they

receive approval and support for what they regard as important for their self-actualization (Rogers, 1995). According to Maslow's hierarchy of needs theory, students are more likely to be motivated to be creative and achieve when they have positive regard for one another and they receive proper support and care from their professors in class (Maslow & Frager, 1987). Cognitive evaluation theory suggests that intrinsic motivation is based on the need of self-determination (Deci & Ryan, 1980, 2013; Koestner et al., 1987). Intrinsic motivation arises from the enjoyment or satisfaction of a task, while extrinsic motivation is driven by external rewards such as grades, praise, and feedback. (Lin et al., 2003). Teacher-centered praise and rewards can be considered extrinsic motivation. In addition, extrinsic motivation can help cultivate intrinsic motivation in students who may initially lack it (Bear et al., 2017; Witzel & Mercer, 2003).

Praise can be an important form of extrinsic motivation. Kanouse et al. (1981) defined praise as positive evaluations based on presumed valid standards that fundamentally diverges from feedback, acknowledgements, or encouragements. It primarily differs in its inherently positive nature, aiming to reinforce and motivate through the recognition of achievements or attributes, whereas feedback is more process-oriented, offering guidance for improvement regardless of positivity. Praise focuses on outcomes and personal traits, often without the specificity or constructive direction that feedback provides. The effects of praise vary depending upon the context in which it is delivered and the meaning it conveys (Henderlong & Lepper, 2002). Researchers and educators commonly hold the view that delivering routine praise has the ability to enhance student’s intrinsic motivation (Anderson et al., 1976; Cameron & Pierce, 1994).

3.1.1. Reinforcement theory of motivation

Praise, as a reinforcer is an important component in the reinforcement theory of motivation. American psychologist B.F. Skinner and his colleagues proposed the reinforcement theory of motivation in 1957 which is based on the law of effect (Mcleod, 2024). According to the law of effect, people tend to engage in repeated actions when they yield positive outcomes. (Skinner, 1958; Thorndike, 1933). Individuals learn from their positive experiences and tend to repeat those actions when they yield favorable results. Skinner (1958) talked about two types of reinforcement; positive and negative reinforcement. Positive reinforcement implies rewarding someone positively to get the positive response repeatedly (Gordan, 2014). On the other hand, negative reinforcement discourages a person from doing an undesirable behavior. Negative reinforcement is different from punishment as punishment is using unpleasant stimuli to discourage repeating an undesirable behavior, whereas, negative reinforcement is removing an aversive stimulus to increase the chance of repeating a desirable behavior (Gordan, 2014).

Teachers use strategies that incorporate reinforcement theory in the classroom setting. This theory is considered by some to be one of the building blocks of effective school management (Knoster, 2008). Omomia and Omomia (2014) referred to the reinforcement process as a catalyst that motivates teachers and learners through rewards, thereby positively enhancing the learning process. Thus, through the reinforcement process, students can be motivated to learn by consistently creating positive changes in the external environment (Weiten et al., 2003).

3.1.2. Praise as a positive reinforcer

Positive reinforcement is regularly being used in classrooms or offices where motivation is mostly needed. Since it offers a person a pleasant stimulus each time they emit an adequate

response, the person feels encouraged, motivated, and inclined to properly follow an instruction or execute a task (O'Connor & McCartney, 2007). Even though there are many ways to reinforce a positive behavior such as through offering incentives like food or money, praise and recognition are the most common forms of positive reinforcement used by behavior analysts, teachers, parents and employers (Flora, 2000). According to Gordan (2014), praise is a social reinforcement as it is communicated socially. Flora (2000) also mentioned that social approval and affection serve as reinforcers. In an experiment on college students, Deci (1971) found that while monetary rewards decreased the intrinsic motivation of the students, those who received praise showed an increase in intrinsic motivation.

3.1.3. Nudging through positive reinforcement

Behavioral nudges influence behavior and decision-making of individuals through positive reinforcement and indirect suggestions (Cohen, 2013; Sharif & Moorlock, 2018). Researchers at the Golub Capital Social Impact Lab in the Stanford Business Graduate School use behavior nudge tools to influence behavior through positive reinforcement and indirect suggestion. Praise can be a behavioral nudge tool as it can reinforce desired behavior and increase motivation by creating a link between the action and the rewarding outcome. Hence, this study aims to investigate whether personalized praise as a positive reinforcement tool has the efficacy to enhance student confidence and improve performance.

3.2. Literature

As popularized by Thaler and Sunstein (2008), the concept of behavioral nudge involves subtle changes in the environment to guide behavior without coercion. Positive reinforcement, in addition to being an integral component of reinforcement theory, is an important nudge in motivating positive behavior. Even though praise is the most common form of positive

reinforcement, studies have also used various reward systems as a form of positive reinforcement in educational and organizational settings. This review synthesizes literature on the efficacy of positive reinforcement in reinforcing positive or expected behavior.

3.2.1. Conceptual framework

Cooper et al. (2007) describe reinforcement as a stimulus change following a behavior that increases the likelihood of that behavior recurring. It serves as a key element in managing behaviors effectively. B.F. Skinner, often referred to as the father of Operant Conditioning, built on the law of effect by Thorndike (1933), which posits that behaviors followed by pleasant outcomes tend to repeat, whereas those followed by unpleasant ones do not. Skinner's innovation was to incorporate the concept of reinforcement, distinguishing between positive reinforcement, where desirable outcomes encourage behavior, and negative reinforcement, where removing an unpleasant stimulus encourages behavior. His foundational belief was that an individual's environment significantly influences behavior, and that the outcomes of actions determine their likelihood of repetition. This principle of reinforcement is vital in understanding motivation and has been supported by empirical evidence across various domains, illustrating the effectiveness of reinforcement in motivating desired behaviors.

3.2.2. Application

Positive reinforcement in the form of tangible rewards or verbal praise has been found to be an effective tool to increase student motivation in educational settings. Greene and Todd (2015) conducted an experiment to compare the effects of positive and negative reinforcement and found that motivation through rewards than punishment had greater positive impact on academic performance of students. In this study, students from a Midwest STEM school were divided into three groups; control, positive and negative reinforcement groups and were asked to

mentally calculate 20 math questions. Prior to the experiment, students in the positive reinforcement groups were informed that they would receive candy for correctly answering all questions. Conversely, students in the negative reinforcement group were informed that they would have to study overtime if any answers were incorrect. Students in the control group were informed that the result would not have any impact on their overall performance. The positive reinforcement group had the highest average score and the negative reinforcement group had the second highest average score. The control group had the lowest average score. Even though this trend in the data was consistent with the initial hypothesis of the study, the differences were not statistically significant. This may be attributed to the small size of the study sample (n=30) and high variability between the groups. However, the outcome suggests that students are likely to succeed more if there is a probability of getting rewards.

Alam and Alay (2018) conducted a similar study with two groups of students. Students in an experimental group were promised monetary rewards for correctly recalling 20 nonsense syllables in a recall test. Students in the control group were informed that there would be no punishments or rewards for their results. The study results support the hypothesis that students who receive positive reinforcement will achieve higher scores in the recall test compared to students with no reinforcement, showing a statistically significant difference between the scores of the two groups. The positive impact of reinforcement in this study is supported by the experiment conducted by Wheatley et al. (2009) where researchers applied positive reinforcement to promote lunchroom behavior management. High noise levels and messiness in the lunchroom are some of the primary concerns of teachers in schools (Wheatley et al., 2009). The authors suggest that improving behavior in the lunchroom could also positively influence other aspects of the learning environment. Hence, this study employed a praise note system as

intervention to decrease problem behaviors in the lunchroom of a Utah elementary school with three specific target behaviors; littering, inappropriate sitting and running. Students who showed appropriate behaviors in these three criteria received a praise note. Students were informed that consistent appropriate behavior would increase the probability of receiving the praise notes. The study result shows that the percentages of littering, appropriate sitting and running decreased during the intervention phase.

Even though tangible rewards are found to be effective in most cases, there is still an ongoing debate over their effects. Some theorists caution against the use of rewards as they tend to undermine intrinsic motivation (Carton, 1996). According to Carton, praise could be an effective tool for enhancing intrinsic motivation. Axelrod (1983) described a research case where a teacher used positive praise with a smile or a pat on the student's back when he was engaged in study behavior and ignored the student when he was not showing appropriate study behavior. The technique of verbal praise was used for nine sessions and during these sessions it was found that the student's study rate increased until it reached a mean point of 71% of expected study hour. After the praise technique was stopped, the student's study rate decreased to a mean point of 50%. Axelrod concluded that a simple technique of using positive praise could lead to an increase in student's study behavior. A similar study conducted by Hancock (2000) also found that students verbally praised by teachers spent more time on doing their homework compared to the students who did not receive any praise. Using praise on fourth grader students, Sarafino et al. (1982) test Deci's cognitive evaluation theory which states that intrinsic motivation enhances as the informational aspects of rewards; i.e. information on the recipient's competence and self-determination becomes more salient. In this experiment, the students were instructed to provide funny endings to riddles and two types of praise; high praise with more positive words and low

praise with generic and less positive words were provided to randomly selected students. The results reveal that students who received high praise showed higher inclination to continue the task compared to the students who received low praise.

Apart from classroom settings, positive reinforcement has also been shown to be effective to increase employee motivation in the workplace. Bonenberger et al. (2014) suggests that motivation is an important factor to increase job satisfaction, retention and job performance in health care. According to Hoskin (2016), both monetary and non-monetary incentives such as, feedback, praise and salary can influence employee motivation and thus, increase job satisfaction and performance. Alam et al. (2013) tested the relationship between appreciation and recognition, and employee satisfaction in the service industry with 109 participants and found a positive relationship. The researchers also found that the feeling of recognition significantly contributed to improving employee's overall job performance by 59.7%. However, the authors acknowledge that the result might be different with a larger sample size.

Positive reinforcement has not always been found effective in increasing employee performance in the literature. In an experimental study, Loewy & Bailey (2007) implemented two interventions to investigate the effect of graphic feedback, manager praise and goal setting on customer service behaviors in a retail store. Feedback graphs were posted in the employee break room as the first intervention and goal setting based on employee's prior performance and immediate, verbal praise by managers were delivered as the second intervention. The researchers only found a slight improvement in the targeted customer service behaviors; customer greeting, eye contact and customer smiling, following the implementation of the feedback graphs. However, the improvement was not sustained. Very little change in the targeted behavior was observed during the implementation of goal setting and positive reinforcement. Rather, the

presence of manager dramatically increased all targeted customer service behavior during a session but it decreased in the following session when the customer service manager was not present. Thus, the author did not find any significant positive impact of positive reinforcement such as, praise in this study.

3.2.3. Limitation

Despite evidence of a positive impact of praise in the literature, some researchers argue that praise and other extrinsic rewards may also have potential harmful effects on students (Kohn, 2001). Scott & Landrum (2020) suggest it is important to consider the time and way of implementing positive reinforcement under a variety of circumstances. External praise may decrease intrinsic motivation to achieve something if an individual gets dependent on it. It is also important to choose words carefully while delivering praise or feedback as wrongly constructed praise or feedback may have a negative impact. Reinke et al. (2008) suggests providing teachers with consultation, support and adequate training on the use of effective classroom management and reinforcement strategies. Diedrich (2010) posits that in order to successfully implement interventions, it is important for teachers to understand the limitations of positive reinforcement strategies. Thus, while positive reinforcement is a powerful tool to increase motivation and performance, it should be implemented carefully so as not to discourage and decrease intrinsic motivation of students and employees.

3.3. Methods

This section explains the methods used in this study, focusing on the analysis of the impact of personalized praise on student performance and confidence across two different courses. This section outlines the participants, study design, and the statistical approaches used to assess the effects of personalized praise on student performance.

3.3.1. Participants and settings

Participants in this study are comprised of students in two classes; Principles of Real Estate (AGEC 347) and Introduction to Agricultural Management (AGEC 242). Both of the classes are online based. Students in both of these classes are in their undergraduate level. The number of students in AGEC 347 and AGEC 242 are 266 and 168 respectively. In AGEC 347, the student age distribution is: 27.82% aged 15-20, 69.55% aged 21-25, 0.75% aged 26-30, 1.5% aged 31-35, and 0.38% over 36. In AGEC 242, the distribution is: 77.8% aged 15-20, 19.05% aged 21-25, 2.38% aged 26-30, and 0.6% aged 31-35. Regarding gender, in AGEC 347, 65.4% of students are male and 34.6% are female. In AGEC 242, the gender split is 56.5% male and 43.5% female. Table 5 provides the descriptive statistics of the exam scores from both classes. The required approval was acquired from the Institutional Review Board (IRB) (protocol number: IRB0004701, approval date: 05/30/2023). Participants were not informed of this experiment.

Table 5: Summary statistics of exam scores and CGPA from AGEC 242 and AGEC 347

Class 1: AGEC 242					
Variable	**Observation**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
CGPA	139	3.342	0.615	1.6	4
Exam 1 score	130	83.615	9.318	53	100
Exam 2 score	114	82.719	8.828	57.5	105
Exam 3 score	106	82.311	9.974	57.5	102.5
Exam 4 score	129	85.62	8.432	55	97.5
Exam 5 score	158	83.722	8.206	58	98
CGPA	256	3.286	0.494	2	4
Exam 1 score	181	117.304	17.227	63.77	147
Exam 2 score	199	114.569	16.206	67.06	169.26
Exam 3 score	238	121.672	14.598	75.03	148.5
Exam 4 score	168	115.999	14.637	56.52	143.01

3.3.2. Study design

The study consists of two steps. In the first step, personalized praise notes are emailed individually to students by the class teacher, based on their performance in each exam. The second step involves further assessing the students' efficacy and confidence. To achieve this, a survey questionnaire is provided to each student before each exam. Students must answer the survey questions to be able to start the exams. This survey contains questions about their preparedness and confidence regarding their performance and understanding of the course material. The pre-exam survey questions are described as follows:

- How prepared are you for the exam today? Indicate a number where 1 = very unprepared and 10 = very prepared.
- What is your level of confidence regarding the material in the course to date? Indicate a number where 1 = not confident at all to 10 = very confident.
- As of today, how satisfied are you with the course overall? Please indicate a number where 1 = very unsatisfied and 10 = very satisfied.

In each class, students are randomly divided into three equal-sized treatment groups (T0, T1 and T2). In T0, no student received any personalized praise note from teacher. Students in the T1 group received email containing personalized praise from teacher only after the first exam. In T2, students received praise email from teacher after every exam. Some of the sample praise emails are:

- For score above 80: Hi <first name>. You are doing good work in the class. Especially good performance on the first exam! Keep it up as we move into this second section. Your efforts are appreciated.
- Score between 70-80: Hi <first name>. Keep up your efforts in the class going into this second section. Your performance on the first exam demonstrates that you have a good understanding of a majority of the course material. Keep challenging yourself towards your full potential. Your efforts are appreciated.
- Score between 60-70: Hi <first name>. Keep up your efforts in the class going into the second section. Your chapter work grades show that you are giving it considerable effort and have good potential to perform well on subsequent exams. Keep challenging yourself. Your efforts are appreciated.

- Score less than 60: Hi <first name>. Keep up your efforts in the class going into the second section. Your chapter work grades show that you are putting in effort and have the potential to perform well on subsequent exams. Keep challenging yourself. Your efforts are appreciated.

The number of points possible for each exam is 100. AGEC 347 has four exams and AGEC 242 has five exams through the whole semester.

3.3.3. Statistical method

The data on student performance and confidence are analyzed using two methods. Initially, the analysis examines the variance between the mean exam scores and the mean responses from the pre-exam survey using a Likert scale. This step identifies if there is any significant variation between the treatment groups, which is conceptually framed as:

$$F = \frac{Variance\ between\ groups}{Variance\ within\ groups}$$

where F is the calculated F-statistic from ANOVA testing that indicates if the means across different groups are significantly different.

Following the variance analysis, if any significant difference is found, a regression analysis is conducted to investigate the linear relationship between performances on two exams. Performance on one exam is estimated as a linear function of the score on the previous exam, with dummy variables representing the treatment groups. Demographic variables such as, gender and cumulative grade point average (CGPA) are also included in the regression model to identify their relationship with the exam score. The model can be expressed as:

$$\text{Exam2} = \beta_0 + \beta_1\text{Exam1} + \beta_2\text{Gender} + \beta_3\text{CGPA} + \beta_4\text{Treatment 1*Gender} + \beta_5\text{Treatment2*Gender} + \beta_6\text{Treatment1*CGPA} + \beta_7\text{Treatment2*CGPA} + \mathcal{E} \quad (3)$$

A multivariate repeated measure analysis is useful when assessing multiple dependent variables measured across different time points for the same subjects. The repeated measure multivariate analysis of variance (MANOVA) is an extension of the ANOVA approach that handles multiple dependent variables at once. It is used when there are more than one dependent variable and the same subject is measured multiple times on these variables (O'Brien & Kaiser, 1985). This analysis uses a mixed-model that compares the mean differences between two factors where one factor is between-subject effect (treatment group) and one factor is within subject effect (time). The purpose of a mixed-model repeated measure approach is to investigate if there is an interaction between these two factors on the dependent variable. This method is employed to analyze both the exam score and pre-exam survey data. The dataset includes exam scores represented as percentages of the average score for each exam. The model can be represented as:

$$Y_{ijk} = \mu + \alpha_i + \pi_j + (\alpha\pi)_{ij} + \varepsilon_{ijk} \quad (4)$$

Here:

- Y_{ijk} denotes the dependent variable (exam score or survey response) for the ith treatment group, at the jth time point, for the kth subject.
- μ is the overall mean.
- α_i represents the effect of the ith treatment group (between-subject effect).
- π_j represents the effect of time i.e. multiple exams (within-subject effect).
- $(\alpha\pi)_{ij}$ _ij is the interaction effect between treatment group and time.
- $\mathcal{E}_{ijk}$ is the random error associated with each measurement.

3.4. Results and discussions

This study investigates the impact of using personalized praise as a positive reinforcement or nudge to improve the performance of college students and increase their confidence and efficacy into going exams. The effect of praise on performance is assessed by analyzing the exam scores of the students of two courses; AGEC242 and AGEC347. The confidence of the students regarding their exam preparation and overall understanding of the course materials are assessed from the analysis of the pre-exam survey answers.

3.4.1. Results from AGEC242

The results from the repeated measure MANOVA analysis with the exam score data shows that the p-value of the mean exam scores across the five exams for the three treatment groups indicated by the interaction of treatment and time variable is not significant (p=.085). The results outlining the effects of the fixed factors on multiple dependent variables are presented in table 6. Exam scores are represented as a percentage of the average grade on that exam to standardize across exams.

Table 6: Effects of fixed factors on exam scores from repeated measure MANOVA

Class 1: AGEC242		
Effects	**F-value**	**P-value**
Treatment	1.03	0.3586
Time	1.10	0.3617
Treatment*Time	1.77	0.0851

Given the p-value (p=.085), the interaction between treatment and time may be considered to have marginal significance. Thus, it could suggest a potential observable effect of

praise on students. To achieve a more accurate estimation and to account for variability in mean exam scores, gender and cumulative grade point average (CGPA) have been included as covariates in the model. The results from the MANOVA test, which includes these covariates, are summarized in Table 7.

Table 7: Effects of covariates on exam scores

Class 1: AGEC242		
Effects	**F-value**	**P-value**
Treatment	0.07	0.9296
Gender	1.60	0.2088
CGPA	18.40	<0.001

The results in Table 7 suggest that, across the five exams, the differences in exam scores in the AGEC 242 class are not associated with gender differences. Since the p-value for CGPA is statistically significant at 5% level and the variable is interval/ratio level, the result suggests that there is a linear relationship with a non-zero slope between the test score and CGPA.

In addition to student performance, the effect of praise on student confidence and efficacy is also assessed from the responses from the survey that are taken before each exam. Similar to the results in Table 6, the analysis from the repeated measures MANOVA yielded statistically insignificant variations in the mean responses to all three questions regarding preparedness, level of confidence, and satisfaction between the treatment groups across the five exams. The results for the survey responses are presented in table 8.

Table 8: Variation in mean responses to pre-exam survey questions

Class 1: AGEC242						
	Preparedness		**Confidence**		**Satisfaction**	
Effects	**F-value**	**P-value**	**F-value**	**P-value**	**F-value**	**P-value**
Treatment	1.43	0.9296	1.53	0.2192	0.93	0.3971
Time	21.11	<0.001	14.98	<0.001	3.11	0.0170
Treatment * Time	0.85	0.5632	0.29	0.9680	0.82	0.5837

The results from the repeated measures MANOVA test, analyzing data on exam scores and pre-exam survey responses, indicate that the variation in mean exam scores across different treatment groups over time is marginally significant. Additionally, the analysis reveals a linear relationship between CGPA and exam scores, suggesting CGPA as a significant predictor of exam performance. However, the analysis of pre-exam survey responses shows no significant differences in levels of confidence, preparedness, and student satisfaction among the groups. These results suggest that the treatment might slightly affect academic performance and confirm the importance of CGPA in predicting exam success. To confirm the results and the effect of praise, the data were further analyzed through linear regression by incorporating various variables into several models. The regression models examine the relation between the second exam and the first exam with additional variables including treatment groups, gender, cumulative grade point average (CGPA), and interaction between treatment groups and gender and between treatment groups and CGPA. The results from the regression analysis is summarized in table 9.

Table 9: Regression analysis between exam 2 and exam 1

Dependent Variable: Exam 2							
Independent Variables	**Model 1** Co-efficient (Standard error)	**Model 2** Co-efficient (Standard error)	**Model 3** Co-efficient (Standard error)	**Model 4** Co-efficient (Standard error)	**Model 5** Co-efficient (Standard error)	**Model 6** Co-efficient (Standard error)	**Model 7** Co-efficient (Standard error)
Exam 1	0.69**	0.69**	0.59**	0.70**	0.61**	0.61**	0.63**
	(0.08)	(0.08)	(0.09)	(0.09)	(0.09)	(0.08)	(0.09)
Treatment 1	0.015	0.009	0.029	-0.002	0.006	0.34**	0.319**
	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)	(0.14)	(0.14)
Treatment 2	__	-0.012	-0.004	-0.002	0.003	-0.07	-0.06
		(0.02)	(0.02)	(0.03)	(0.04)	(0.12)	(0.12)
Gender	__	__	0.008	0.004	-0.002	-0.0004	-0.005
			(0.02)	(0.03)	(0.04)	(0.02)	(0.03)
CGPA	__	__	0.044**	__	0.045**	0.058**	0.058**
			(0.02)		(0.02)	(0.03)	(0.03)
Treatment1* Gender	__	__	__	0.01	0.035	__	0.02
				(0.05)	(0.05)		(0.05)
Treatment2* Gender	__	__	__	-0.017	-0.006	__	-0.009
				(0.04)	(0.05)		(0.04)
Treatment1* CGPA	__	__	__	__	__	-0.094**	-0.09**
						(0.04)	(0.04)
Treatment2* CGPA	__	__	__	__	__	0.02	0.02
						(0.04)	(0.04)

Table 9: Regression analysis between exam 2 and exam 1 (continued)

Dependent Variable: Exam 2							
Independent Variables	**Model 1** Co-efficient (Standard error)	**Model 2** Co-efficient (Standard error)	**Model 3** Co-efficient (Standard error)	**Model 4** Co-efficient (Standard error)	**Model 5** Co-efficient (Standard error)	**Model 6** Co-efficient (Standard error)	**Model 7** Co-efficient (Standard error)
Constant	0.29 (0.08)	0.29 (0.08)	0.23 (0.09)	0.28 (0.09)	0.21 (0.09)	0.17 (0.13)	0.15 (0.13)
F	38.33	25.47	14.20	12.40	17.93	13.07	9.99
R^2	0.48	0.48	0.51	0.49	0.52	0.58	0.58
Adj. R^2	0.47	0.47	0.47	0.45	0.47	0.54	0.53
*, ** & *** indicate 1%, 5% and 10% significance level respectively							

Table 9 presents the regression results of seven models estimating the effect of positive praise after the first exam on student performance on the second exam. The coefficient on the variable exam 1 score is statistically significant across all the models and positive. The treatment 1 variable is not significant in the first five models. In models 6 and 7, treatment 1 has a positive effect on score on exam 2. Treatment 2 and gender are not significant in any of the models. Interaction terms between the two treatments and gender are also not significant.

CGPA is found to be an important predictor of exam 2 in model 4 through 7. The positive coefficients of CGPA in these models suggest that students with a higher CGPA had relatively greater increase in exam score. The interaction between treatment 1 and CGPA is significant and negative for models 6 and 7, suggesting that praise tempers improvement over exam 1 for those with higher GPAs. That is, that praise was less effective for those with higher CGPAs. The results from model 6 and 7 provide some important insights. The coefficients of treatment 1

variable in these models increase and become statistically significant with the addition of CGPA and the interaction between treatment 1 and CGPA. The value of R-squared also increases to 0.58 in both of these models indicating a better fit compared to other models.

The regression analysis was rerun to include variables of confidence, preparedness, and satisfaction from the pre-exam survey, aiming to assess their impact on scores for exam 2. The results are summarized in table 10.

Table 10: Regression analysis between exam 2 and exam 1 with survey response variables

Dependent Variable: Exam 2					
Independent Variables	**Model 1** Co-efficient (Standard error)	**Model 2** Co-efficient (Standard error)	**Model 3** Co-efficient (Standard error)	**Model 4** Co-efficient (Standard error)	**Model 5** Co-efficient (Standard error)
Exam 1	0.708**	0.69**	0.60**	0.70**	0.63**
	(0.08)	(0.09)	(0.93)	(0.09)	(0.09)
Treatment 1	__	0.011	0.03	-0.003	0.12
		(0.02)	(0.02)	(0.04)	(0.11)
Treatment 2	__	-0.011	-0.006	-0.006	-0.27**
		(0.02)	(0.02)	(0.03)	(0.08)
Preparedness (Exam2)	0.001 (0.008)	__	__	__	__
Confidence (Exam2)	-0.008 (0.008)	__	__	__	__
Satisfaction (Exam2)	-0.002 (0.007)	__	__	__	__
Change in preparedness	__	0.005 (0.01)	0.008 (0.007)	0.005 (0.007)	0.007 (0.007)

Table 10: Regression analysis between exam 2 and exam 1 with survey response variables (continued)

Dependent Variable: Exam 2					
Independent Variables	**Model 1** Co-efficient (Standard error)	**Model 2** Co-efficient (Standard error)	**Model 3** Co-efficient (Standard error)	**Model 4** Co-efficient (Standard error)	**Model 5** Co-efficient (Standard error)
Change in confidence	__	-0.005 (0.006)	-0.003 (0.006)	-0.005 (0.006)	-0.004 (0.006)
Change in satisfaction	__	-0.001 (0.007)	-0.004 (0.01)	-0.001 (0.007)	-0.006 (0.007)
Gender	__	__	0.009 (0.02)	__	__
CGPA	__	__	0.043 (0.02)	__	__
Treatment1* Gender	__	__	__	0.018 (0.04)	0.02 (0.03)
Treatment2* Gender	__	__	__	-0.008 (0.03)	-0.005 (0.03)
Treatment2* CGPA					-0.035 (0.03)
Treatment2* CGPA					0.08** (0.02)
R^2	0.49	0.49	0.52	0.49	0.57
Adj- R^2	0.47	0.45	0.46	0.44	0.50

*, ** & *** indicate 1%, 5% and 10% significance level respectively

The result from this regression analysis shows no significant impact of praise on the level of preparedness, confidence and satisfaction in terms of their relationship with exam 2 score. In other words, the score on exam 2 does not reflect any significant impact of praise treatment on increasing student confidence and efficacy. On the other hand, model 5 shows an interesting result where the coefficients of treatment 2 and interaction between treatment 2 and CGPA are negative and statistically significant. This indicates that holding other variables constant, the score on exam 2 decreases for treatment 2 group and this negative effect decreases as CGPA increases for treatment 2 students. This result is opposite to the result found for students in treatment 1 in the exam score analysis.

Figure 7 depicts the graphical representation of the exam scores for the three groups. According to our hypothesis, the performance of both Treatment 1 and Treatment 2 groups should follow the same trend in Exam 2, as participants in these groups were assigned randomly, they were not aware of the intervention and both received praise after the first exam. If students in Treatment 1 are influenced by praise, then students in Treatment 2 should experience the same effect. However, the trend in performance for the two groups shows the opposite. The mean exam scores on the five exams have an upward trend continued through exam 3 for the treatment 1 group, and that digressed towards the mean for exams 4 and 5. This suggests that receiving positive praise one time (after exam 1), may improve performance but, if not repeated, the effects are transitory. On the other hand, the mean scores for treatment 2 group decreased through exam 3 and increased in both exam 4 and 5. Despite the insignificant results, the performance of treatment 1 students is consistent with the study hypothesis showing a positive effect of praise in exam 2. However, the positive effect of praise for treatment 2 groups on exam scores are

observed later than expected. It might be due to the effect of other covariates such as CGPA as found in the above results. Further study should be conducted to determine this gap in this result.

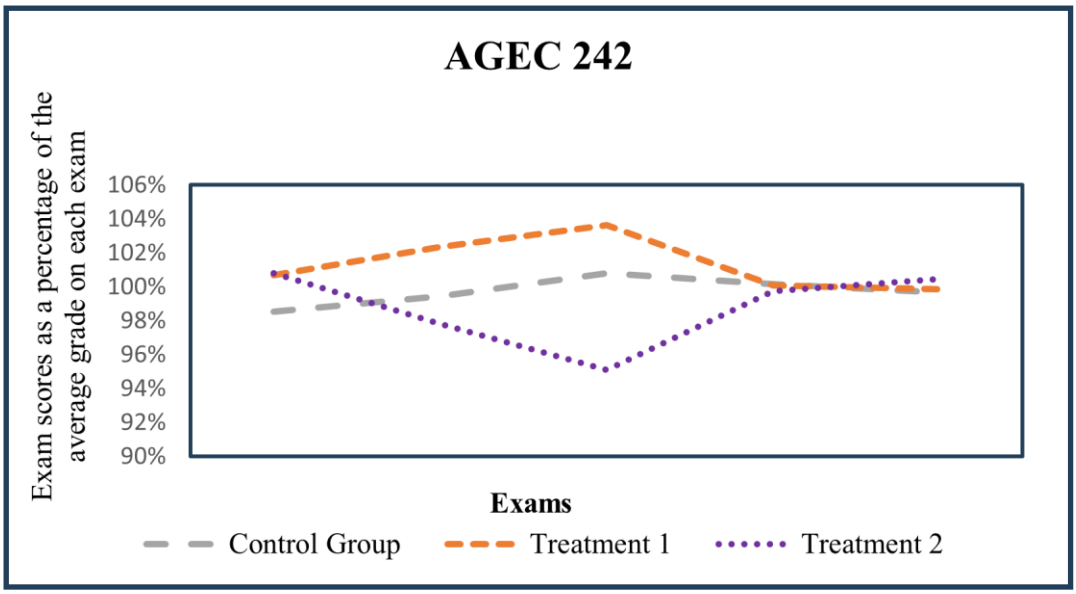

Figure 7: Graphical representation of exam score data of the three groups

3.4.2. Results from AGEC 347

Similar to the AGEC 242 class, the exam scores and pre-exam survey responses of the AGEC 347 class were analyzed using repeated measures MANOVA. The findings indicated statistically insignificant variations in the mean exam scores among the three treatment groups across the four exams. This suggests that the differences in mean exam scores are not associated with the varying levels of intervention across the three groups. These results are summarized in Table 11.

Table 11: Effects of fixed factors on exam scores from repeated measure MANOVA

Class 2: AGEC347		
Effects	**F-value**	**P-value**
Treatment	0.63	0.5332
Time	3.08	0.0284
Treatment*Time	0.95	0.4565

Including gender and CGPA as covariates in the analysis reveals a statistically significant variation in the mean exam scores over time. This outcome suggests that, although praise does not affect the variation in mean exam scores across the four exams, gender and CGPA can be considered significant predictors of student performance. Table 12 represents the result of the covariates.

Table 12: Effects of covariates on exam scores

Class 2: AGEC347		
Effects	**F-value**	**P-value**
Treatment	0.39	0.6797
Gender	22.17	<0.001
CGPA	55.03	<0.001

Positive praise is also not found to increase students' confidence and efficacy. The analysis from the repeated measures MANOVA yielded statistically insignificant variations in the mean responses to all three questions regarding preparedness, level of confidence, and

satisfaction between the treatment groups across the five exams. The results for the survey responses are presented in table 13.

Table 13: Variation in mean responses to pre-exam survey questions

Class 2: AGEC347						
	Preparedness		**Confidence**		**Satisfaction**	
Effects	**F-value**	**P-value**	**F-value**	**P-value**	**F-value**	**P-value**
Treatment	1.41	0.2465	1.36	0.2593	0.98	0.3766
Time	8.64	<0.0001	3.66	0.0138	2.16	0.0947
Treatment * Time	1.45	0.1943	0.33	0.9228	1.05	0.3923

The graphical representation of the exam score data from AGEC 347 (figure 8) does not indicate a clear trend in student performance across the four exams. A potential explanation for this could be the difference in how praise was delivered compared to AGEC 242. In AGEC 347, besides the targeted praise sent to specific treatment groups after each exam, general praise notes were distributed to all students throughout the semester, regardless of their group affiliation. This approach may have neutralized any distinct impact the targeted praise might have had on the different treatment groups.

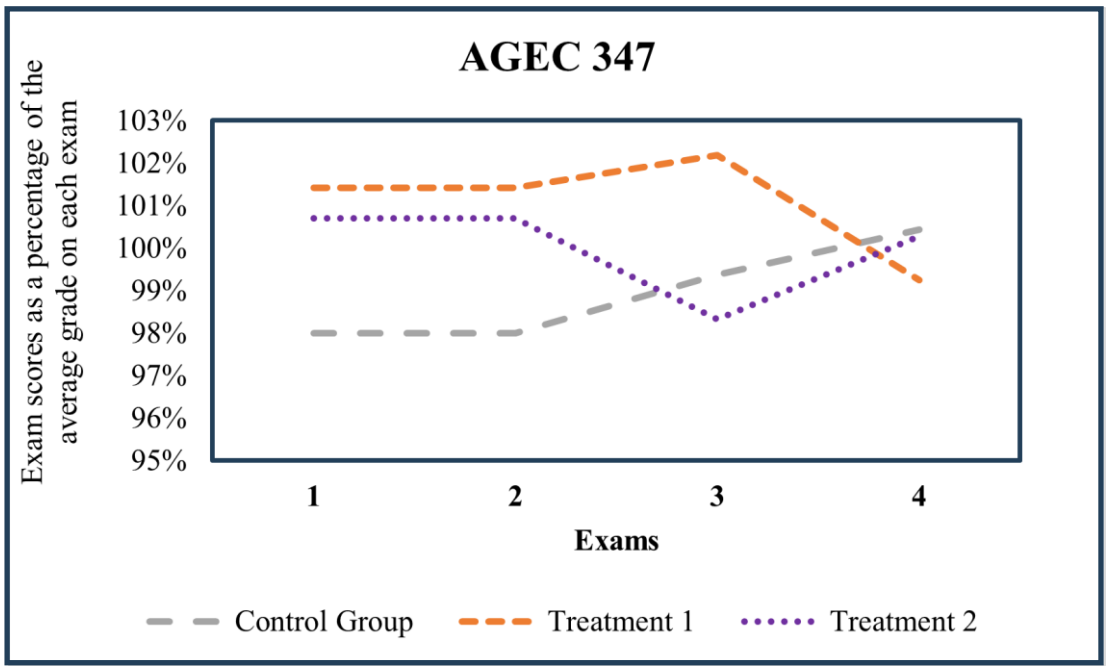

Figure 8: Graphical representation of exam score data of the three groups

Existing literature suggests that praise is not always effective; rather, it can sometimes stifle individuals' development (Cannella, 1986; Faber, 1995; Farson, 1963). Despite the evidence of praise's effectiveness from the review of existing literature, it can undermine the intrinsic motivation of children and students by creating excessive pressure to continue performing well (Birch et al., 1984; Kohn, 1993). Praise may have opposite effects when given for easy tasks, as it might imply low ability (Graham, 2014; Wulf-Uwe et al., 1979). In the present study, students with lower exam scores also received praise notes. This might have had a negative effect on them rather than the intended positive one, possibly explaining the performance of the treatment 2 group in the AGEC 242 class. However, the study does not further investigate whether this was one of the reasons for praise not working on the students. Future studies should account for the conditions under which praise does not work to provide a clearer perspective on its effectiveness.

3.4.3. Limitations

To gain a comprehensive perspective on the study results, it is important to address several limitations. First, both classes in this study were conducted online, where opportunities for academic dishonesty are prevalent. This condition may hinder the effectiveness of praise in impacting students positively. Additionally, the study did not assess whether students who were supposed to receive praise notes actually read them. Students often disregard emails unless they perceive them as important, potentially influencing our findings on the effects of praise on college students' performance and confidence. Finally, there was no means of determining whether the wording of the praise messages was sufficient to motivate students. The wording of praise messages is crucial, as inappropriate wording may have adverse effects on students.

3.5. Recommendations for future research

This study examines the impact of positive praise on the performance and efficacy of college students across two distinct classes, with two treatment groups and one control group. Analysis of exam scores and pre-exam survey responses revealed no significant effect of praise on student performance improvement. Instead, CGPA was found to be a significant predictor of performance in both classes. Additionally, while students in Treatment Group 1 displayed improvements aligning with the hypothesis after the first exam, those in Treatment Group 2 did not. Despite random group assignments, the mean scores of students in Treatment Group 2 decreased after the first exam, in contrast to those in Treatment Group 1. This discrepancy may indicate that praise had no discernible impact, or a factor that the study did not measure could be influencing the performance of students in these groups. Future research could explore different levels of intervention and treatment groups to address this study's findings. Moreover, the duration of the study, limited to a single semester, might have been insufficient for praise to

manifest any significant effects on students. It is recommended to conduct longer-term studies spanning multiple semesters to observe the cumulative effects of praise over time. This study was conducted in a college setting. Future studies could include various educational settings beyond the college environment, such as high schools or training programs. Additionally, this study did not account for how praise operates across different cultures. Thus, future research could explore how cultural differences influence the effectiveness of praise. Moreover, it is necessary to control for additional variables that could impact academic performance, such as intrinsic motivation, any disabilities of the students, mental health issues, and variations in the difficulty levels of exams and course materials.

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APPENDIX A. SURVEY QUESTIONNAIRE

Introduction April 16, 2023

Hello Barry Hall Faculty, Staff, and Students

We have been conducting research on the use of behavioral interventions to promote stair use among faculty, staff and students in Barry Hall. We are now following up with a survey to investigate the visibility of these efforts and their effects. Because you are a faculty, staff, or student working in Barry Hall, you are invited to take part in this survey. Your participation is entirely your choice, and you may change your mind or quit participating at any time, with no penalty to you. If you do not want to be included in this research project, you may inform me or simply not submit the survey

It is not possible to identify all potential risks in research procedures, but reasonable safeguards have been taken to minimize any known risks. One known risk is the potential for loss of confidentiality should data be compromised. The risk is small and precautions will be upheld to protect the data. Another risk is that a survey respondent may be identifiable based on their responses because of their social demographic information. We will keep private all research records that would allow an individual to be identified and will not use any identifying information that includes fewer than three survey respondents (e.g., work classification, gender). Your information will be combined with information from other people taking part in the study, and we will write about the combined information that was gathered. As a result of these procedures, the risk that you would be identifiable in any reporting of this research is small.

There are no particular immediate benefits that will accrue to you as a result of your participation. However, a future benefit is increasing physical activity among those working in Barry Hall by understanding what encourages use of stairs.

It should take no more than ten minutes to complete the survey.

If you have any questions about this project, please contact Cheryl Wachenheim (cheryl.wachenheim@ndsu.edu; 701-231-7452). You have rights as a research participant. If you have questions about your rights or complaints about this research, you may talk to the researcher or contact the NDSU Human Research Protection Program at 701.231.8995, toll-free at 1-855-800-6717, by email at ndsu.irb@ndsu.edu, or by mail at NDSU HRPP Office, NDSU Dept. 4000, P.O. Box 6050, Fargo, ND 58108-6050.

If you wish to receive a copy of the results, please contact me.

Thanks for your consideration,

Cheryl Wachenheim, Professor, Agribusiness and Applied Economics

Ayesha Tasnim, Graduate Student, Agribusiness and Applied Economics

First, we have a few questions about your use of the stairs and elevators in Barry Hall.

- On what floor is your office located?
- During an average week, how many times do you use a staircase in Barry Hall? Count each use as one. For example, if you use the stairs to go to your floor and to return to the main level, that is two uses.
- During an average week, how many times do you use an elevator?

Next, we have some questions about recent stair and elevator use and intention.

- As of the beginning of the semester, had you given any consideration to increasing your use of the stairs?

  O Yes O No

- Please indicate your level of consideration using the slider where 0 = no consideration to 10 = planned to increase the use of stairs for sure. Since early in the semester, how has the percentage of time you use the stairs versus the elevator changed?
- O Increased O No change O Decreased

Now we have a few questions about your observation of our behavioral nudges.

- There were posters near the elevators and stairs at each level in the Barry Hall office wing between March 6th and March 26, and footprints leading to the stairs were added on the main floor between March 20 and remained until March 26.

  Did you see the posters?

  O Yes O No
- What did you take away as the general message from the posters?
- Did the presence of the posters have any impact on your decision whether to use the stairs rather than the elevator?

  O Yes, increased use of stairs

  O Yes, decreased use of stairs

  O The posters had no effect
- Please move the slider to the level of impact where 0 = no impact and 10 = great impact. If you did not observe the posters, please indicate NA.
- Did you see the footprints?
- O Yes O No
- Did the presence of the footprints have any impact on your decision whether to use the stairs rather than the elevator?

  O Yes, increased use of stairs

O Yes, decreased use of stairs

O The posters had no effect

- Please move the slider to the level of impact where 0 = no impact and 10 = great impact. If you did not observe the footprints, please indicate NA.
- Please indicate how effective you would consider the posters and the footprints where 0 = not effective at all and 10 = extremely effective. If you did not observe one or the other (or both), please check not applicable.
- Do you have any other ideas on how we could increase the use of the stairs to promote employee and student health? If so, please share them.

Finally, we have a few demographic questions to help us understand how our intervention was perceived by different groups.

- Which describe(s) your role at NDSU? Check all that apply currently.

  O Undergraduate student

  O Graduate student

  O Staff member

  O Faculty member

  O Researcher

  O Other

- What is your gender

  O Female

  O Male

  O Other

- What is your age (years)?

O 21 or younger

O 22 to 24

O 25 to 29

O 30 to 34

O 35 to 44

O 45 to 54

O 55 to 64

O 65 or older

- On average, how many days each week do you conduct cardiovascular exercise (e.g., walking for exercise, running)
- On average, how many days each week do you do strengthening exercises (e.g., weight lifting, yoga)

APPENDIX B. SAMPLE POSTERS AND FOOTPRINTS

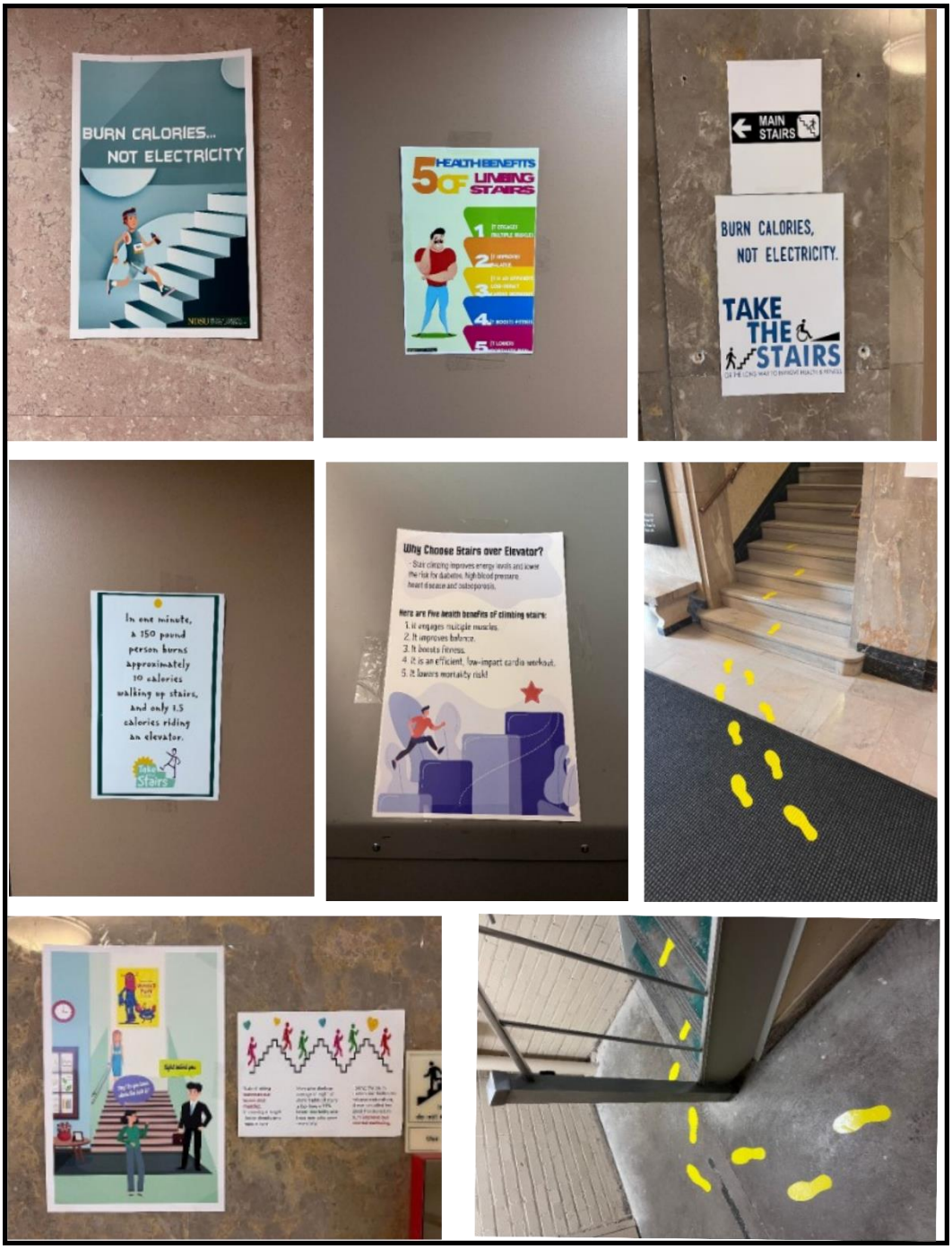

Figure B1: Images of posters and footprints used in different parts of the building

APPENDIX C. IRB APPROVALS

1.

02/10/2023

Dr. Cheryl Joy Wachenheim
AES Agribusiness & Appld Econ

Re: IRB Determination of Exempt Human Subjects Research:

Protocol #IRB0004631, “Behavioral intervention study to promote stair use among college students”

NDSU Co-investigator(s) and research team:

- Cheryl Joy Wachenheim
- Ayesha Tasnim

Approval Date: 02/10/2023

Expiration Date:
02/09/2026
Study site(s):
Barry Hall
Funding Source:
The above referenced human subjects research project has been determined exempt (category 2) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, *Protection of Human Subjects*).

Please also note the following:

- The study must be conducted as described in the approved protocol.
- Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
- Promptly report adverse events, unanticipated problems involving risks to subjects or others, or protocol deviations related to this project.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.

NDSU has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.

2.

04/13/2023

Dr. Cheryl Joy Wachenheim
AES Agribusiness & Appld Econ

IRB Approval of Amendment to Protocol #IRB0004631 , “Behavioral intervention study to promote stair use among college students”

Co-investigator(s) and research team: - Cheryl Joy Wachenheim

- Ayesha Tasnim

Funding Agency:

Research site(s): Barry Hall
Change: Survey added
The protocol amendment request and all included documentation for the above-referenced project have been reviewed and approved via the procedures of the North Dakota State University Institutional Review Board. Current protocol approval expires - 02/09/2026.
Thank you for cooperating with NDSU IRB procedures, and best wishes for a successful study.
NDSU has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.

3.

05/30/2023

Dr. Cheryl Joy Wachenheim
AES Agribusiness & Appld Econ

IRB Approval of Protocol #IRB0004701, “Effectiveness of positive feedback in increasing student efficacy, confidence, and performance”

Co-investigator(s)

and research team:

- Cheryl Joy

Wachenheim

- Ayesha Tasnim

Approval Date: 05/30/2023

Expiration Date: 05/29/2026

Research site(s): Via computer
(from the office) Funding Agency:

Review Type: Expedited category # 7

The above referenced protocol has been reviewed in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, *Protection of Human Subjects*).

Additional approval from the IRB is required:

- Prior to implementation of any changes to the protocol.
- For continuation of the project beyond the approval period. A task will automatically generate for the PI and Co-PI 8 weeks prior to the expiration date. To avoid a lapse in approval, suspension of recruitment, and/or data collection, a report must be received, and the protocol reviewed and approved for continuation prior to the expiration date.

Other institutional approvals:

- Research projects may be subject to further review and approval processes.

A report is required for:

- Any research-related injuries, adverse events, or other unanticipated problems involving risks to participants or others within 72 hours of known occurrence.
- Protocol Deviations
- Any significant new findings that may affect risks to participants.

Thank you for cooperating with NDSU IRB procedures, and best wishes for a successful study.

NDSU has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.