



**TECHNIUM**  
**SOCIAL SCIENCES JOURNAL**

**Vol. 37, 2022**

**A new decade  
for social changes**

[www.techniumscience.com](http://www.techniumscience.com)

ISSN 2668-7798



9 772668 779000

## Who is Susceptible to Nudge? Nudge Susceptibility Clusters of Physical Activity in a College Setting

Xinghua Wang<sup>1</sup>, Guandong Song<sup>1</sup>, Xia Wan<sup>2</sup>

<sup>1</sup>Northeastern University, China, <sup>2</sup>Shenyang Sport University, China

[wangxinghua@pe.neu.edu.cn](mailto:wangxinghua@pe.neu.edu.cn)

**Abstract.** Currently, the settings of higher education system have made inactivity lifestyle already as social norms on campus. The World Health Organization encouraged to promote physical activity behaviors by setting-based approaches. Nudges could improve physical activity behaviors by changing college settings. However, not everyone could be “Nudgeable”. Finding the “High-Nudgeable” people would help the policymakers to understanding who can be nudged effective among the population. In the present study, we measured the susceptibility of physical activity nudges in a college setting by CPANSS. Based on the overall mean value of nudge susceptibility of five nudge types, we classified the degree of overall “Nudgeable” into “Low-Nudgeable”, “Medium-Nudgeable” and “High-Nudgeable” by a k-means non-hierarchical cluster analysis. This study conducted the target group index (TGI) to determine the demographic attributes (gender, major, and grade) of “High-Nudgeable” college students, and the findings indicated that individuals with following demographic attributes are nudgeable in a high level, which are female (TGI=124.29), be major in social science (TGI=105.02), medical (TGI=127.52) and sports (TGI=103.67), and in Grade 1 (TGI=118.88).

**Keywords.** Nudge, Physical activity, Nudge susceptibility, Cluster, College settings.

### 1. Introduction

Physical inactivity is one of the most important behavioral risk factors for non-communicable diseases (Thorp et al., 2011; Rhodes et al., 2017). However, the settings of higher education system have made inactivity lifestyle already as social norms on campus (Keating et al., 2005). The daily physical activity in the adult population can be increased and promoted through setting-based approaches, according to the World Health Organization (WHO, 2019). Nudge is an approach by changing “context” to influence behaviors, which is the “choice architecture” on changing behaviors, developed by Richard Thaler and Cass Sunstein (Thaler & Sunstein, 2008). It uses the term “contexts” to describe the setting in which we make decisions and react to cues. Now, there are hundreds of indications of nudges strategies influence on human behavior, especially in the health sector, including physical activity (Szasz et al., 2018). Although research indicated that nudging is effective in changing behaviors on average, it may be ineffective in some sub-groups of a population, which means not everyone could be “Nudgeable”. So, it is necessary to measure the susceptible to nudge, which could help policymakers to find the “Nudgeable” groups and to increase the effectiveness of nudges.

On measuring the susceptibility of nudging on physical activity in the college setting, Wang and her team (2022) made the first attempt to develop the College Physical Activity Nudges Susceptibility Scale (i.e., CPANSS), which was carefully developed based on the MINDSPACE framework often used in nudge development and described the physical activity nudges as situation items. CPANSS is a five-factor 21-item scale (see Appendix A), which are messenger and norms (6 items), incentives (3 items), default (2 items), priming, salience, and affect (5 items), as well as commitment and ego (5 items). The items were measured on a 5-point Likert-type scale (1 = not at all susceptible; 2 = not very susceptible; 3 = moderately susceptible, 4 = very susceptible; 5 = extremely susceptible). They validated it using factor analysis (Exploratory Factor Analysis and Confirmatory Factor Analysis) and reliability analysis. CPANSS with good reliability and validity fitted the data reasonably well.

By using CPANSS as the instrument, we could measure the susceptibility on physical activity nudges among college students, identify groups of “Nudgeable” individuals, and research the demographic characteristics (gender, grade, major) of “Nudgeable” students of physical activity in the college setting.

## 2. Methods

### 2.1 Procedure

Sufficient sample size and probabilistic random sampling are the guarantee of accuracy when using sample eigenvalues to estimate the population eigenvalues. This survey adopts stratified random sampling method, and samples each level according to the proportion of 10%. Each level is divided according to the four stratified variables of school, grade, major and gender. Data were collected using an online questionnaire by Wenjuanxing, which is the largest professional platform for online surveys in China. Questionnaires were sent to 4765 college students from four universities in China with 3143 respondents (66.0%). All participants in this survey were completely voluntary. Before filling in the questionnaire, all subjects were informed of the goal and purpose of this study in detail, and it was made clear to all subjects in the introduction of the questionnaire that these data would only be used for academic research. The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Bioethics Committee of Northeastern University (EC2022B027).

### 2.2 Sample

The present study with samples stratified by gender, major, and grade (total N = 3,143). The Descriptive demographic characteristics of participants as Table 1. For each demographic variable, more than half of participants are male (51.2%); nature science majors (31.0%), social science majors (23.1%), medical majors (19.5%), and sports majors (26.4%); grade 1 (29.7%), grade 2 (26.1%), grade 3 (22.6%), and grade 4 (21.5%).

**Table 1** Frequency Distribution of Demographics

Demographic	Frequency	Percentage (%)
Gender		
Male	1610	51.2%
Female	1533	48.8%
Major		
Nature science majors	973	31.0%
Social science majors	727	23.1%
Medical majors	612	19.5%

Sports majors	831	26.4%
Grade		
Grade 1	935	29.7%
Grade 2	821	26.1%
Grade 3	711	22.6%
Grade 4	676	21.5%

### 2.3 Data Analysis

We calculated an overall mean of nudge susceptible based on the susceptibility of the five dimensions of nudges (i.e., “messenger and norms”, “incentives”, “default”, “priming, salience, and affect”, as well as “commitment and ego”). A non-hierarchical cluster analysis (k-means algorithm, dictating the number of clusters) was applied to classify the degree of “Nudgeable” into “Low-Nudgeable”, “Medium-Nudgeable” and “High-Nudgeable”. Cronbach’s alpha ( $\alpha$ ) was assessed to verify the reliability. Calculating descriptive statistics, k-means algorithm, reliability were all done by using the SPSS V. 26 (IBM SPSS Statistics for Windows, Version 26.0).

In order to determine the attribute characteristics of “High-Nudgeable” individuals, the target group index (TGI) was conducted. Target Group Index also called as “efficiency indicator” and “Affinity Index”, which is the “preference degree” of a certain target feature. It can reflect the performance or tendency degree of the target group within the target feature. It is a statistical index used to find the target group. The TGI index is calculated by the following formula:

$$TGI = \frac{\% \text{ of target group}}{\% \text{ of people in entire population}} * 100$$

The standard value of TGI index is 100.  $TGI > 100$  indicates that the performance of target features in this population is higher than the total population. The larger the TGI value is, the more obvious the target features are.  $TGI < 100$  indicates that the performance of target features in the population is lower than the overall level of the population. The smaller the TGI value is, the more obvious and weaker the target features are.

## 3. Results

### 3.1 Reliability analysis

In Table 2, the Cronbach's alpha value of each dimension and in total were all higher than 0.7 ( $> 0.70$ ), indicating a high level of consistency or stability in the scale's measurement outcomes.

**Table 2** Reliability Analysis Results

Nudge types	Number of items	Cronbach's alpha
Messenger and Norms	6	0.875
Incentives	3	0.934
Default	2	0.828
Salience, Priming and Affect	5	0.841
Commitment and Ego	5	0.844
Total	21	0.728

### 3.2 K-means Algorithm

We performed a k-means non-hierarchical cluster analysis (11 iterations) to assign cases into the three groups, which is to identify “Nudgeable” groups by different degree of nudge susceptibility. k-means non-hierarchical cluster analysis is also called as “Fast algorithm”. K observation data are first selected as the initial clustering center point, and each measured data is allocated to these K classes according to the principle of minimum distance. Then, the real measurements in each category were used to calculate the mean value of the variables, which in turn formed a new K clustering center point. By analogy, the iterative process is carried out continuously until convergence or the number of clustering predetermined by the researcher is reached.

The final clustering center mean values were (Cluster 1=2.91; Cluster 2 = 3.45; Cluster 3=3.98), the distance between each cluster center is shown in Table 3. It can be seen that the distance between the center of adjacent categories is almost equidistant (the distance between cluster 1 and cluster 2 is 0.549; The distance between cluster 2 and cluster 3 is 0.526), indicating that the classification standard is reasonable.

**Table 3** The Distance between the Final Cluster Centers

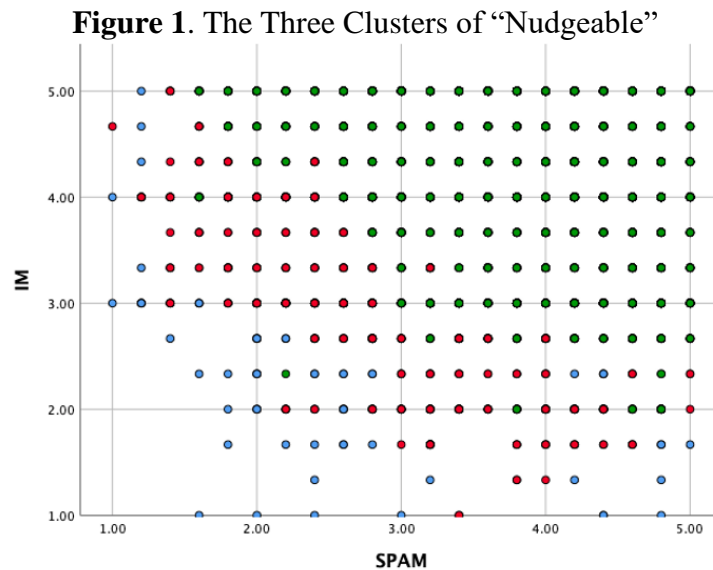
Cluster	1	2	3
1		.549	1.075
2	.549		.526
3	1.075	.526	

According to the preset clustering standard and their clustering center mean value, category 1 was defined as “Low-Nudgeable”, category 2 as “Medium-Nudgeable” and category 3 as “High-Nudgeable”. Table 4 showed the frequency and percentage of individuals with different “nudgeable” levels, among which the population of “Medium-Nudgeable” group is the largest (n=1383; 44.0%), followed by “High-Nudgeable” group (n=930; 29.6%), and the lowest population is the “Low-Nudgeable” group (n=830; 26.4%).

**Table 4** Descriptive Statistics for the “Nudgeable” Clusters

Nudgeable	Frequency	Percentage
Low-Nudgeable	830	26.4%
Medium-Nudgeable	1383	44.0%
High-Nudgeable	930	29.6%

In order to verify the quality of this cluster more intuitively, mean value of “salience, priming, and affect” nudge factor (SPA) was taken as the horizontal coordinate, mean value of “incentives” nudge factor (I) was taken as the vertical coordinate, and the category of this cluster is taken as the classification standard (blue is cluster 1; Red is cluster 2; Green is cluster 3), and a two-dimensional scatter plot is drawn, as shown in Figure 1. Among the three clustering categories, cluster 3 has the strongest susceptibility in the two boosting measures, cluster 2 is the second, and cluster 1 is the weakest. At the same time, the boundaries of the three clusters are clear. All the above prove that the quality of this clustering is good.



### 3.3 Attribute Analysis of “High-Nudgeable” Individuals

Descriptive statistics on demographic attributes for the “Low-Nudgeable”, “Medium-Nudgeable” and “High-Nudgeable” were shown in Table 5. And we calculated the TGI analysis of demographic attributes in three clusters, the results were showed in Table 6, and the histograms of TGI analysis results in gender, major and grade were showed in Figure 2, Figure 3, and Figure 4.

**Table 5** Demographic Attributes on the Clusters of “Nudgeable”

Demographics	Low-Nudgeable		Medium-Nudgeable		High-Nudgeable		Total
	Frequency	%	Frequency	%	Frequency	%	
Male	541	34%	703	44%	366	23%	1610
Female	289	19%	680	44%	564	37%	1533
Nature science majors	329	34%	426	44%	218	22%	973
Social science majors	172	24%	329	45%	226	31%	727
Medical majors	132	22%	249	41%	231	38%	612
Sports majors	197	24%	379	46%	255	31%	831
Grade 1	225	24%	381	41%	329	35%	935
Grade 2	197	24%	374	46%	250	30%	821
Grade 3	190	27%	330	46%	191	27%	711
Grade 4	218	32%	298	44%	160	24%	676

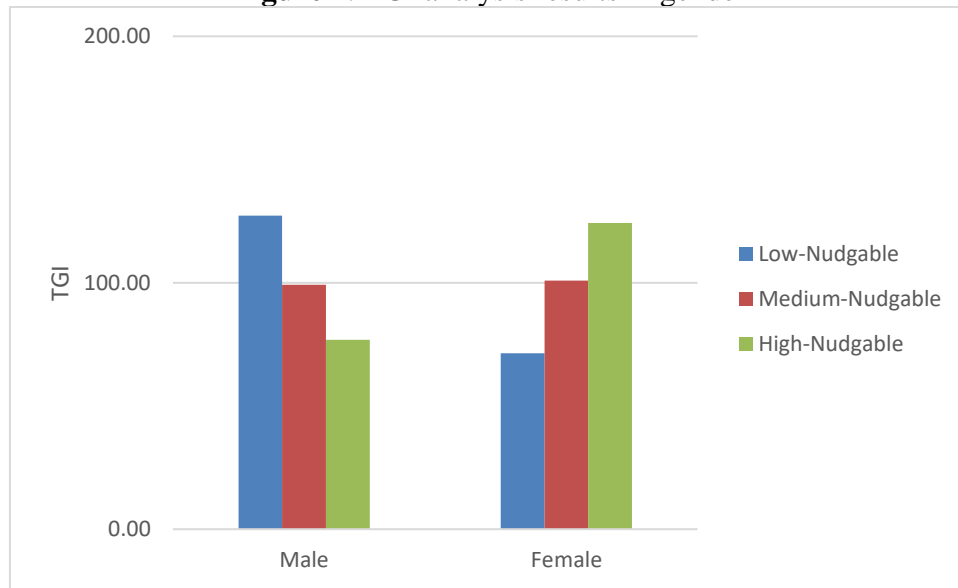
**Table 6** TGI Analysis of Demographic Attributes in Three Clusters

Demographics	Low-Nudgeable	Medium-Nudgeable	High-Nudgeable
Male	127.28	99.24	76.80
Female	71.41	100.81	124.29
Nature science majors	128.08	99.50	75.69
Social science majors	89.62	102.85	105.02
Medical majors	81.70	92.47	127.52
Sports majors	89.80	103.65	103.67

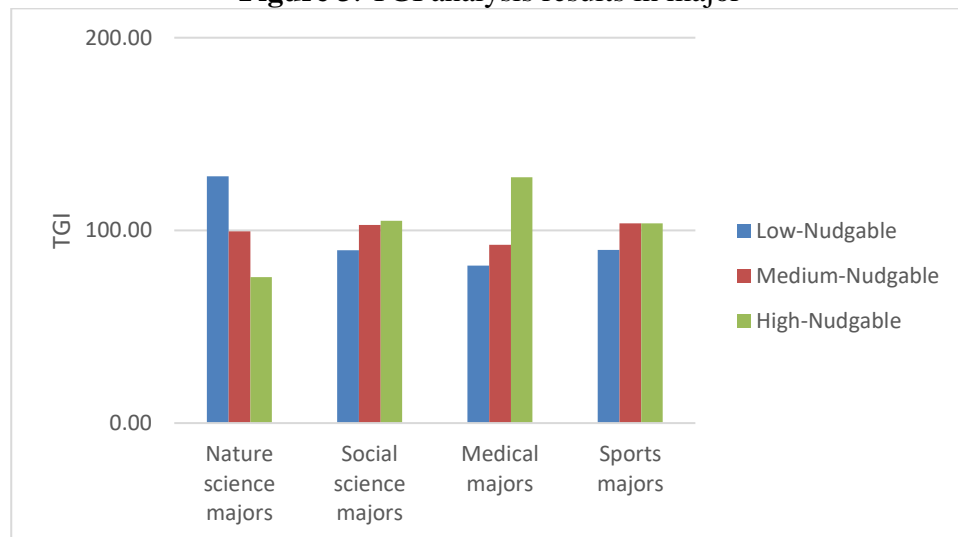


Grade 1	91.15	92.61	<b>118.88</b>
Grade 2	90.89	103.53	102.87
Grade 3	101.22	105.49	90.76
Grade 4	<b>122.15</b>	100.19	79.96

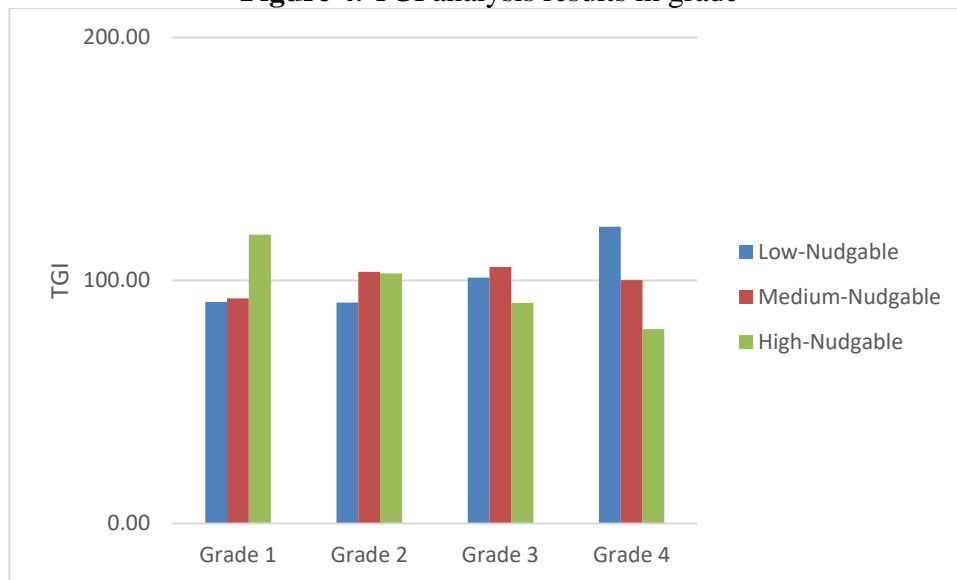
**Figure 2.** TGI analysis results in gender



**Figure 3.** TGI analysis results in major



**Figure 4.** TGI analysis results in grade



From the analysis results, individuals who are “High-Nudgeable” with following demographic attributes, which are female, be major in social science, medical and sports, and in Grade 1. Among these demographics, be major in medical showed the most significant performance in “High-Nudgeable” (TGI=127.52), female with the second significant performance in “High-Nudgeable” (TGI=124.29), in Grade 1 (TGI=118.88), be major in social science (TGI=105.02) and be major in sports (TGI=103.67) are ranked in the third, fourth and fifth.

#### **4. Conclusion**

In the present study, we measured the susceptibility of physical activity nudges in a college setting by CPANSS. Based on the overall mean value of nudge susceptibility of five nudge types, we classified the degree of overall “Nudgeable” into “Low-Nudgeable”, “Medium-Nudgeable” and “High-Nudgeable” by a k-means non-hierarchical cluster analysis. In the last, we conducted the target group index (TGI) to determine the demographic attributes (gender, major, and grade) of “High-Nudgeable” college students, and the findings indicated that individuals with following demographic attributes are nudgeable in a high level, which are female, be major in social science, medical and sports, and in Grade 1.

Finding the “High-Nudgeable” people is necessary for the policymakers to design policies, because the “High-Nudgeable” people could be the key minorities to influence others’ behaviors by social networks. Moreover, to identify the “High-Nudgeable” people could make policymakers understanding who can be nudged effective among the population.

#### **Funding:**

This work was supported by the Economic and Social Development Research Project of Liaoning Province in 2021 (No. 2021lslybkt-048), Scientific Research Funding Project of Liaoning Education Department in 2020 (No. WZK2020ST04).

## References

- [1] Thorp, A. A., Owen, N., Neuhaus, M., & Dunstan, D. W. (2011). Sedentary behaviors and subsequent health outcomes in adults: a systematic review of longitudinal studies, 1996–2011. *American journal of preventive medicine*, 41(2), 207-215.
- [2] Rhodes, R. E., Janssen, I., Bredin, S. S., Warburton, D. E., & Bauman, A. (2017). Physical activity: Health impact, prevalence, correlates and interventions. *Psychology & Health*, 32(8), 942-975.
- [3] Keating, X. D., Guan, J., Piñero, J. C., & Bridges, D. M. (2005). A meta-analysis of college students' physical activity behaviors. *Journal of American college health*, 54(2), 116-126.
- [4] World Health Organization. (2018). *Global action plan on physical activity 2018-2030: more active people for a healthier world: at-a-glance* (No. WHO/NMH/PND/18.5). World Health Organization.
- [5] Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving Decisions About Health, Wealth and Happiness*. Yale University Press: New Haven & London.
- [6] Szaszi, B., Palinkas, A., Palfi, B., Szollosi, A., & Aczel, B. (2018). A systematic scoping review of the choice architecture movement: Toward understanding when and why nudges work. *Journal of Behavioral Decision Making*, 31(3), 355-366.
- [7] Wang, X., Song, G., & Wan, X. (2022). Measuring “Nudgeability”: Development of a Scale on Susceptibility to Physical Activity Nudges among College Students. *Behavioral Sciences*, 12(9), 318.