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An Introductory Study of the Impact of Implementation Intentions on Assignment Completion Rates with an Emphasis on Engineering Technology Students

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Introduction and Literature Review

Faculty at our university have grown frustrated with low completion rates on homework assignments. While often a low percentage of the students' grade, such practice is especially important for the quantitative courses that make up much of the engineering technology curriculum. What if there was a simple way to significantly increase the percentage of students completing their homework assignments, with little effort on the part of the instructor? An implementation intention is a clear strategy for achieving a goal, in the form of an "if-then" plan, that specifies the when, where and how a goal is to be reached[1]. For example, "If I have just finished my 10AM circuits class, then I will go to the library and work on my calculus homework until my next class." There is a rich body of literature in the field of psychology showing the success of implementation intentions, applied to things as diverse as exercise, impulse control, and overcoming addiction. However, prior to this study, very little work has been done applying this practice to academics.

Authors of motivational theories assert intentions play a causal role in behavior, including the theory of reasoned action[2] and the theory of planned behavior[3]. Implementation intentions are an extension of the behavior or goal intention construct. They are "an if-then plan specifying when, where and how the person will instigate responses that promote goal realization"[4]. Importantly, implementation intentions require the specification of a cue (either internal or external) that signals to the person performing the behavior that it is the time to behave, making the individual always ready to act[4]. It is hypothesized that the formation of an if-then action plan makes the behavior more resistant to distractors and situational contingencies that would otherwise derail the behavior. This plan can bridge the intention-behavior gap.

However, there appear to be two significant limitations to the current literature on behavior and implementation intentions. First, the majority of the research focuses on correlational, instead of experimental, data in establishing the intention-behavior link. Second, there is a dearth of studies on behavioral or implementation intentions that investigate non-health-related behaviors.

With regards to the first limitation, in one study compiling the data from multiple meta-analyses, intentions were shown to account for 28% of the variance in behavior[5]. However, the studies investigated were correlational and thus were subject to the well-known limitations of this type of research, namely that one cannot draw causal conclusions about the effect of intentions on behavior. Webb and Sheeran[1] conducted a meta-analysis to address this limitation, focusing only on experimental research. Their data demonstrated that interventions targeting intentions were effective in improving them and that these interventions, if successful, led to a small but measurable change in behavior. Further, analyses of their data showed those interventions that had a larger impact on intention had a subsequently larger effect on behavior.

Nevertheless, this meta-analysis demonstrated well the second limitation of this literature: its focus on health-related behaviors. Of the 47 studies included, 38 were explicitly related to health (e.g., low fat diet[6], breast self-examination[7]).

The majority of the literature on behavioral and implementation intentions focuses on health-related behavior, specifically health-protective behaviors (e.g., condom use[8]) and its associated theories and models (e.g., prototype-willingness model[9]). While these theories and the resulting studies have established the role of intentions in the pursuit and attainment of health goals, the scope of this research has perhaps been limited. Those studies, with a few exceptions, that are not focused on health-related behavior can be considered primary laboratory research using paradigms that may not generalize outside of the laboratory (e.g., cue detection in an illusion paradigm[10]). Gollwitzer and Sheeran[4] conducted a meta-analysis of the effect of implementation intentions on goal achievement, and notably they separated the goals into eight domains, one of which was academic. Their data demonstrated the impact of implementation intentions on achievement was similar across domains, with academic goals falling squarely in the middle of the range of effect sizes found (*d*s range = .41 to 1.12; academic $d = .72$). The goal of the present research is to extend the study of implementation intentions into the undergraduate classroom, focusing on an academic goal in a real-life setting.

It is worth considering two articles that share similarities to the study outlined in this paper. First, Webb, Christian and Armitage[11] conducted an experiment examining the effect of implementation intentions on class attendance. They found that, alongside certain personality variables, students who participated in the implementation intention intervention specifically targeting class attendance were more likely to attend. Further, and remarkably, this intervention was *more* successful among those *lower* in Conscientiousness (i.e., it was most effective for those least likely to attend class). Second, Sommor and Haug[12] investigated the impact of naturalistic (not guided) implementation intentions and goal intentions on studying for exams. The authors found that goal intentions (intentions to attain a specific outcome) were correlated with implementation intentions (plans for how to work toward these goals). Notably, this was a correlational, not experimental study; however, these authors did note that it is possible the strength of one's goal intention impacts the strength of corresponding implementation intentions. The research outlined below includes an explicit assessment of this variable.

Finally, studies indicate two other empirical variables impact this research, namely time and objective vs. self-report assessment of behavior. Experimental research has demonstrated there is a negative correlation ($r = -.53$) between time and the strength of the intention-behavior link[13], and that there is a stronger link between intention and self-reported behavior ($r = .56$) than objective measures of behavior ($r = .45$)[14]. The present research will explicitly model the time between the formation of the implementation intention and the behavioral outcome, and will use an objective measure of behavior to address these two variables.

Methods

At the time of this study, Southern Polytechnic State University (SPSU) was a special-purpose institution in the University System of Georgia with over 6000 students enrolled. Approximately 80 percent of the student body was male, and many of the students were nontraditional. The school's mission was to offer both traditional and nontraditional students bachelors and masters degrees and continuing professional development in the sciences, engineering, engineering technology, applied liberal arts, business, and professional programs. A large majority of students majored in STEM (science, technology, engineering, and mathematics) fields. In January of 2015, SPSU consolidated with Kennesaw State University, but all work related to this paper was conducted prior to the consolidation.

Approximately one month into Fall Semester 2014, the undergraduate research assistant visited ten math, science, and engineering technology classes on campus to collect data for the study. Beginning the study one month into the semester allowed students the ability to evaluate the importance of assignment completion in the particular course visited by the research assistant, as well as to accurately determine how to shape their requested goal for the semester. This also allowed the researchers to evaluate whether or not writing implementation intentions had an impact on the students' assignment completion. Overall, more than 150 usable responses were collected from eight of the ten courses visited. The instructor of the remaining two courses discontinued the assessment being studied, making that data unusable. Of these, 37 students (24.3%) indicated that their major fell within the School of Engineering Technology and Management.

Participating classes intentionally had small point value assignments that students often neglect to complete, such as homework assignments, quizzes, or discussion postings. A specific such assignment category was targeted for the study in each class, and will be referred to hereafter as "the assessment". Students who consented to the study were blindly split into three groups. "Group one" (oversampled at approximately 50%) wrote implementation intentions related to the assessment; the first control group, "group two" (approximately 15%) wrote less specific goals related to the assessment; and the second control group "group three" (approximately 35%) wrote a control statement about their semester in general. Written instructions were provided for the students (see Appendix), and the research assistant was available to answer questions.

Demographic information such as gender, ethnicity, age, and major were collected, as well as an assessment of the students' prior intention to do the work. Students also took a revised version of the UPPS Impulsive Behavior scale[15], UPPS-P, which assesses Positive Urgency, Negative Urgency, (lack of) Premeditation, (lack of) Perseverance, and Sensation Seeking – factors which might impact a students' likelihood to complete assignments.

The statements were reviewed by the researchers and students were moved to different study groups if necessary. For example, if a student assigned to the implementation intentions group did not follow instructions correctly and ended up writing a less specific goal, they were classified in group two for the analysis. Table 1 shows the resulting self-reported

demographics for each of the three groups, and Table 2 shows the same information for the Engineering Technology student subsample.

Table 1: Self-reported demographics for the three study groups

Demographics	**All (n=152)**	**Group 1 (n=77)**	**Group 2 (n=23)**	**Group 3 (n=52)**
Gender by %				
Male	87%	88%	83%	87%
Female	13%	12%	17%	13%
Ethnicity by %				
Caucasian	63%	57%	70%	67%
African American	13%	12%	17%	13%
Hispanic/Latino	11%	18%	4%	4%
Asian	8%	8%	4%	10%
Other	5%	4%	4%	6%
No Response	1%	1%	0%	0%
School				
Architecture and Construction Management	1%	0%	0%	2%
Computing and Software Engineering	11%	10%	4%	13%
Engineering Technology and Management	24%	22%	30%	25%
Engineering	59%	61%	61%	54%
Arts and Sciences	6%	6%	4%	6%
Classification				
Freshman	16%	13%	13%	21%
Sophomore	44%	45%	43%	42%
Junior	27%	29%	30%	23%
Senior	13%	13%	13%	13%
Age				
< 25	84%	86%	74%	85%
25 - 35	14%	14%	17%	13%
> 35	2%	0%	9%	2%

Table 2: Self-reported demographics for the three study groups, engineering technology subsample

Demographics	Group 1 (n=17)	Group 2 (n=7)	Group 3 (n=13)
Gender by %			
Male	94%	71%	85%
Female	6%	29%	15%
Ethnicity by %			
Caucasian	65%	43%	69%
African American	24%	43%	23%
Hispanic/Latino	6%	0%	8%
Asian	6%	14%	0%
Other	0%	0%	0%
Classification			
Freshman	0%	0%	0%
Sophomore	41%	14%	38%
Junior	29%	43%	31%
Senior	29%	43%	31%
Age			
< 25	82%	57%	77%
25 - 35	18%	29%	15%
> 35	0%	14%	8%

At the end of the term, the instructors of the participating courses provided the grade data and dates for the assessments for all of the participating students. All data was entered into Excel and Minitab for analysis.

Results

Despite the incredibly promising results from the health literature, the results from this pilot study do not support the benefit of implementation intentions in improving grades for low-point value assessments in the university setting. Summary results provided below indicate that the performance of the group that wrote implementation intentions was no better than, and in some cases worse than, the control groups. This is true for the engineering technology subsample as

well. Detailed results and hypothesis test results are not included in this paper since they do not support the use of implementation intentions, but they are available from the authors upon request.

The first two columns of Table 3 include summary results of the grades for the assessment for the remaining portion of the semester after the intervention. The second control group had the highest average, followed by the implementation intentions group. The next two columns include the same data, but for the engineering technology student subsample. For that subsample, the group that wrote implementation intentions performed the worst.

As noted above, the literature indicates that implementation intentions work best when the person intends to complete the task. For that reason, we also looked at the subset of students who replied "yes" to the question, "Do you believe it is worthwhile to do your [assessments] in this class this term?" That data is included in the final two columns of Table 3. While the implementation intentions group performed the best in that subsample, it was not statistically significant.

Table 3: Assessment grades for the three study groups

	Grade after intervention (full sample)	n (full sample)	Grade after intervention (ET subsample)	n (ET subsample)	Grade after intervention ("important" subsample)	n ("important" subsample)
Group 1 - Implementation intentions	65.0%	77	72.2%	17	64.7%	72
Group 2 - Control, wrote related goal	54.5%	23	79.1%	6	53.0%	20
Group 3 - Control, wrote unrelated statement	66.9%	52	77.1%	12	63.1%	44

Because of the negative correlation found between time and the strength of the intention-behavior link, we also looked at the grades for various time periods following the intervention. Table 4 includes the student average grades on the assessment before the intervention, on their first assignment after the intervention, for the two weeks following the intervention, and for the entire term following the intervention. The final column also includes the percentage change in grade for the first assessment after the intervention, compared to the grade prior to the intervention. Note that in some cases there was only one assessment in the two weeks following the intervention, so the same data point in those instances was used for both the first assessment and the two weeks average. One instructor did not have any grades prior to the intervention, and another did not have any in the two week period following the intervention, so this reduced our sample to 100 students in Table 4. Again, the implementation intentions group did not perform better than the control groups.

Table 4: Assessment grades for various time periods for the three study groups (subsample of students who completed assessments in each time period; n=100)

	Grade before intervention	Grade 1st assessment after intervention	Average grade for 2 weeks after intervention	Average grade for remainder of term after intervention	Difference in grade from before intervention and first assessment thereafter
Group 1 - Implementation intentions (n=53)	77.8%	65.2%	67.3%	62.4%	-16.2%
Group 2 - Control, wrote related goal (n=16)	69.4%	61.3%	57.4%	62.4%	-11.6%
Group 3 - Control, wrote unrelated statement (n=31)	74.7%	73.3%	67.9%	63.0%	-1.9%

We did similar analysis for various demographics, including gender, ethnicity, grade level classification, and age and found no statistically significant benefits of implementation intentions among those groups. In addition, we analyzed across the different groups from the UPPS Impulsive Behavior scale and did not find implementation intentions to have a statistically significant benefit for any of those subgroups either.

Conclusions and Future Work

The results of this study do not support the use of implementation intentions as a way to improve homework completion rates. However, these results are entirely inconsistent with those achieved in health-related areas, and as such, the outcome is very surprising. The authors will be conducting a small additional study in Spring Semester 2015 in the hopes that the results may be more promising.

It is possible that there is some fundamental difference between health-related behaviors and homework completion that renders implementation intentions ineffective in an academic setting. However, we should note that there were some weaknesses in the study that may help to explain the poor outcome. First and foremost, the loss of data from the ET courses due the professor's change in assessment policy made it difficult to draw meaningful conclusions regarding students in courses that are in their major. We hypothesize that students would have stronger intentions to complete assignments in their major courses. If so, then the health-related literature suggests that these stronger goal intentions would increase the positive impact of the implementation intentions.

Secondly, participation in the study was optional. Many students elected not to participate, imposing an unavoidable selection bias onto the sample. Anecdotally, the student assistant observed that students who sat in the rear of the classroom were less likely to participate in the study. We have no information regarding why students elected not to participate – whether they were concerned about the authors accessing their grade data, or whether they just preferred

to leave class early rather than stay and participate in the study. Participation rates were higher in classes where the instructor strongly encouraged participation. For the spring study, we have faculty participating who are willing to provide that encouragement.

Thirdly, due to the demographic breakdown of the students at our institution, women were significantly undersampled in the study. The results when restricted to the female population did not appear to be better than the overall results, but the number of females participating was too small to draw meaningful conclusions.

Finally, the study design should have focused more on the timing of the intervention. In several of the courses, there was no assessment due during the week following the intervention. The health-related literature has not pinned down a specific duration for which the creation of implementation intentions is effective, but there are indications that it may be relatively short. When we repeat the study in Spring Semester 2015, we will ensure the intervention is scheduled a few days before an assessment deadline.

Overall, we believe that based on the health-related literature, the use of implementation intentions should increase homework completion rates, particularly among students who truly to intend to complete their assignments. If so, since writing implementation intentions would take only a few minutes of class time, employing them could have a significant impact on student success. Based on this, we hope that other researchers will undertake studies in this area.

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Appendix

Below are the forms used by the students to write implementation intentions or controls. Students were each given one form, and it did not include the label at the top. Text in square brackets was replaced by the correct terminology for the class being surveyed.

GROUP 1 - IMPLEMENTATION INTENTIONS FORM

1. Do you believe it is worthwhile to do your [homework assignments] in this class this term?

   Yes No

2. On a scale of 1 to 5 where 1 represents not at all committed and 5 represents extremely committed, how committed are you to completing your [homework assignments] in this class this term?

   1 2 3 4 5

3. Please take a moment and make a plan for when you will do those assignments. Think about times it is most likely to fit into your schedule. Be specific, and think of times that you are most likely to be successful! (*ex: right after my 10AM Tuesday class; after Sunday night dinner*)

   a. When will you work on your assignments? _____

   Now think about where you will work on those assignments and best be able to focus on them. Again, be specific. (*ex: the library, my desk at home*)

   b. Where will you work on your assignments? _____

   Now think about how you will work on those assignments. Again, be specific. (*ex: until they are finished, for 30 minutes*)

   c. How will you work on your assignments? _____

   Finally, write these plans in the form of one "if-then" statement on the lines below.

   Examples of good statements:

   If it is right after my 10AM class on Tuesdays, then I will go to the library and work on my [assignments] for 30 minutes.

   If I have just finished Sunday night dinner, then I will go to my desk and complete my [assignments].

_____

_____

_____

GROUP 2 - GOAL FORM

1. Do you believe it is worthwhile to do your [homework assignments] in this class this term?

   Yes No

2. On a scale of 1 to 5 where 1 represents not at all committed and 5 represents extremely committed, how committed are you to completing your [homework assignments] in this class this term?

   1 2 3 4 5

3. Please take a moment and think about those assignments.
   a. What is the primary reason that you want to be successful on them? Be specific. (*ex: It will help me in my future career; so I don't fail the course*)

      _____

   b. Finally, write a statement of your goal for [the assignment] on the line below. Start your sentence with, "My goal is to…".

   Example of goal statements:

   My goal is to complete the [assignments] and submit them on time.

   My goal is to give my best effort on the [assignments].

_____

_____

_____

GROUP 3 - CONTROL FORM

1. Do you believe it is worthwhile to do your [homework assignments] in this class this term?

   Yes No

2. On a scale of 1 to 5 where 1 represents not at all committed and 5 represents extremely committed, how committed are you to completing your [homework assignments] in this class this term?

   1 2 3 4 5

3. Please take a moment and think about this semester.

   a. Which course is the most stressful for you?
   _____

   b. Which outside activity is the most importation to you? (ex: club, hobby, job)
   _____

   Finally, write your most important plan for this semester. Start your sentence with, "I plan to...", and be specific.

   Examples of good plan statements:

   My plan is to join the Student Government Association.

   My plan is to find a part-time job close to campus.

   My plan is to earn at least a 3.0 GPA this semester.

_____

_____

_____