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An Application of the Theory of Planned Behavior—A Randomized Controlled Food Safety Pilot Intervention for Young Adults

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Objective: Approximately 48 million Americans are affected by foodborne illness each year. Evidence suggests that the application of health psychology theory to food safety interventions can increase behaviors that reduce the incidence of illness such as adequately keeping hands, surfaces and equipment clean. This aim of this pilot study was to be the first to explore the effectiveness of a food safety intervention based on the Theory of Planned Behavior (TPB). ***Methods:*** Young adult participants (N = 45) were randomly allocated to intervention, general control or mere measurement control conditions. Food safety observations and TPB measures were taken at baseline and at 4-week follow-up. Within and between group differences on target variables were considered and regression analyses were conducted to determine the relationship between condition, behavior and the TPB intention constructs; attitude, subjective norm, perceived behavioral control (PBC). ***Results:*** TPB variables at baseline predicted observed food safety behaviors. At follow-up, the intervention led to significant increases in PBC (p = .024) and observed behaviors (p = .001) compared to both control conditions. Furthermore, correlations were found between observed and self-reported behaviors (p = .008). ***Conclusions:*** The pilot intervention supports the utility of the TPB as a method of improving food safety behavior. Changes in TPB cognitions appear to be best translated to behavior via behavioral intentions and PBC. Further research should be conducted to increase effectiveness of translating TPB variables to food safety behaviors. The additional finding of a correlation between self-reported and observed behavior also has implications for future research as it provides evidence toward the construct validity of self-reported behavioral measures.

Keywords: social cognition models, theory of planned behavior, behavior change, food safety

Food borne illness continues to be an international public health concern generating both clinical problems for the individual (Helms, Vastrup, Gerner-Smidt, & Molbak, 2003) and an economic burden for society (Scharff, 2010). Data reports from the United States of America estimate that the mean economic cost of food borne illness is approximately $152 billion annually (Scharff, 2010); with 48 million consumers affected by this preventable disease, resulting in 128,000 hospitalizations and 3,000 deaths (Centers for Disease Control & Prevention, 2011). The Centers for Disease Control and Prevention suggest that an effort to lower the occurrence of foodborne illness by 10% would equate to a decrease of approximately five million cases of illness annually (2011). A cohort that is of particular risk is the young adult population (18–29 years) and individuals with education beyond high school (Byrd-Bredbenner et al., 2007).

Several studies have concluded that consumer education, targeting prevention of food borne illness in the domestic environment, is necessary (Barrett, Penner, & Shanklin, 1996; Gorman, Bloomfield, & Adley, 2002; Li-Cohen & Bruhn, 2002; Medeiros, Kendall, Hillers, Chen, & DiMascola, 2001; Ropkins & Beck, 2000) as research has found many consumers do not practice adequate food safety in the home (Daniels, 1998; Medeiros et al., 2004; Medeiros, Hillers, Kendall, & Mason, 2001; Medeiros, Kendall et al., 2001; Ryan, Wall, Gilbert, Griffin, & Rowe, 1996). These key educational steps include washing and drying hands correctly for at least 20 seconds, keeping surfaces and equipment clean, separating raw and cooked food, cooking food thoroughly, keeping food at safe temperatures, and using safe water and raw materials (World Health Organization, 2006).

In spite of these recommendations, very few studies have focused on implementing and measuring effectiveness of interventions that have the objective of changing consumer's food safety behavior in the domestic environment. Calls have been made in the literature for food safety interventions to have a greater theoretical foundation through the use of social cognition models (SCM; Griffith, Mullan, & Price, 1995; Milton & Mullan, 2010). A recent systematic review found that only 10 published studies examining psychosocial food safety interventions had occurred in the developed world (Milton & Mullan, 2010). The review's overarching recommendations included the need for better defined outcome measures, more rigorous reporting of results and intervention design, the use of randomized controlled trial protocols, and utilizing SCM to provide a greater theoretical foundation and gain further insight into the constructs that improve food safety behaviors.

Previous use of SCM in the food safety literature focusing on behavior change has been parsimonious and somewhat conflicting. Research utilizing the Health Belief Model (HBM) to predict food

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safety behaviors have been generally successful (Hanson & Benedict, 2002; Roseman & Kurzynske, 2006; Schafer, Schafer, Bultena, & Hoiberg, 1993). However, a study by McArthur, Holbert, and Forsythe (2006), was unable to report the HBM as a effective tool for explaining food handling behavior in undergraduate university students. Other documented difficulties of the HBM include conceptualization of the relationship between the components of the model, failure to establish validity and reliability of measures and inconsistent measurement of constructs (Abraham & Sheeran, 2005). Furthermore, the HBM does not include any normative constructs that measure the influence that other people have on a person's behavior (Conner & Sparks, 2005), which may assume a significant role in how health related behaviors are performed (Quine, Rutter, & Arnold, 1998). Mullan and Wong's (2009) research study revealed that normative influences, found in Ajzen's (1991) Theory of Planned Behavior (TPB), were a key feature in safe food handling behaviors.

The TPB (Ajzen, 1991) posits that intention is the main precursor to actual behavior. Intention is guided by three independent variables: perceived behavioral control (PBC), attitudes, and subjective norms. The PBC construct intends to explain a person's volitional control over a behavior and as such is seen as a reflection of the perceived ease or difficulty involved in performing the intended behavior. The variable of attitude illustrates the individual's positive or negative evaluation of the expected consequences resulting from performing an intended behavior. Lastly, subjective norm reflects the perceived normative expectations of others and the motivation to abide by these expectations.

A previous systematic review of various health interventions utilizing the TPB found that out of 30 studies, two thirds reported effectively changing behavior (Hardeman et al., 2002). Research topics associated with hygiene practices found that the TPB has significantly predicted 79% of intention and 87% of self-reported hand hygiene practices in hospitals (Jenner, Watson, Miller, Jones, & Scott, 2002) and has predicted 30% of the variance in hand hygiene malpractice in catering establishments (Clayton & Griffith, 2008). With regards to food safety studies, targeting young adult consumers, Mullan and Wong (2009) have shown the TPB to predict 66% of variance for intentions to prepare food safely and 21% of the variance in self-reported food safety behaviors. Overall, the research to date suggests that the TPB can be a useful tool in developing interventions which target increasing self-reported behavior. No studies, however, have looked at whether the TPB can assist in changing observable food safety behaviors of consumers. Previous research has suggested that observation may be a better measure of food safety behaviors (Clayton, Griffith, & Price, 2003) because the impact of social desirability bias in self-report measures is likely to lead to inflated reports of behavior.

Thus, the present pilot study has therefore examined the TPB as a predictor of food safety intentions and observed food safety behaviors. Following Mullan and Wong's (2009) research, it is expected that the TPB variables (attitude, subjective norm, and PBC) will account for a significant level of variance for behavioral intentions. Furthermore, this pilot study is first to implement and review an intervention based on the TPB that directly observes changes in young adult consumers' food handling behaviors, rather than solely relying on self-report data. Previously, however, a systematic review of TPB based interventions (Hardeman et al., 2002) found that out of 30 studies, two thirds reported effectively changing behavior. It is, therefore, hypothesized that at follow up the intervention group will show an increase in TPB variable scores and a greater improvement in observed food hygiene behaviors compared to both control groups.

Method

Participants

Participants consisted of 45 first year psychology students from an Australian University. Inclusion criteria stated that participants must prepare meals at home at a minimum of three times per week. No participants were excluded because of not meeting the selection criteria. Participants were advised that they could discontinue participating in the study at anytime. In the sample 82.2% were female with a mean age of 21.7 ($SD = 6.39$). The remaining 17.8% were male with a mean age of 20.5 ($SD = 2.07$). Almost half of the participants identified as of Australian-Caucasian decent (46.7%), 24.5% identified as Asian/Asian-Australian, 15.5% as European, 8.9% as Middle Eastern/North African, and 4.4% identified with other ethnic groups. Ethical approval was obtained from the University's Human Ethics Committee; the participants were voluntary and received course credit for participation.

Design

The pilot study utilized a simple computer-generated random allocation process was used at baseline to divide one third of the participants to an intervention condition, another third to a general control condition and the remaining third to a mere measurement control condition. (For mere measurement control rationale see Sandberg & Conner, 2009). Measures were taken at both baseline and follow-up by a researcher blind via an allocation concealment process.

Procedure

All baseline and follow-up data was collected over a one month period in March 2010. At baseline, all participants first completed an observational section of the study in a fully functioning kitchen located on the university campus. This was a self-contained kitchen available to staff working in that campus building. Participants were familiarized with the kitchen and all equipment that was available for use throughout the study. This familiarization procedure attempted to control for biases arising from working in an unfamiliar kitchen. Participants were subsequently asked to make a cold meat, cheese, and salad sandwich. All behavioral observations were completed prior to the food safety questionnaires to avoid changing food preparation behavior. Food safety behaviors were observed and recorded by a trained researcher. The researchers had completed an Australian qualification in observational assessment and also undertook preliminary observational training with an academic who hold expertise in food safety observations. Participants were blind to the occurrence of the observations as the researcher was not in sight of the participant. All food safety practices such as washing hands, vegetables, and equipment were timed to ensure that behaviors were performed appropriately.

After the observational section of the study, the 45 participants received a computer generated personal identification number that allocated them to one of three conditions (intervention, general control, and mere measurement control). Participants were blind to their allocated group and all completed online questionnaires. Participants in the intervention and general control group completed the demographic and TPB questionnaires. At this time, participants in the mere measurement control condition only completed the demographics questionnaire. After the questionnaires were complete participants in the intervention condition completed the TPB food safety intervention. Participants in the general control group and mere measurement control condition completed a distracter task (see Kellar & Abraham, 2005).

At follow-up four weeks later, all participants completed the same food safety observation by the same research that remained blind to the participants' allocated condition. All participants subsequently relogged in to a computer using their personal identification number and completed the follow-up TPB questionnaire.

Outcome Measures

Observed Food Safety Measure

Participant's food safety malpractices and correct behaviors were recorded by a trained observer on a detailed observational checklist adapted from both Mullan's (2009) and Redmond and Griffith's (2006) observational studies. The food safety behavioral observations targeted the WHO food safety recommendations specifically in relation to keeping hands, surfaces, and equipment clean and avoiding cross contamination (World Health Organization, 2006). An example checklist item includes "wash hands with soap and hot water for 20 seconds before commencing food preparation".

Theory of Planned Behavior Questionnaire

A Theory of Planned Behavior (TPB) questionnaire was utilized which included previously validated indirect measures of TPB variables from Mullan and Wong's (2009) and Mullan's (2009) studies. The questionnaire examined six components including attitudes, subjective norm, PBC and intention. Attitudes were measured as the mean of six semantic differential scales (e.g., preparing food hygienically every meal would be: bad−good, unpleasant−pleasant). Participants responded on a scale of 1–7 with a higher score indicating a more positive attitude. An alpha coefficient of 0.83 ($M = 37.2$, $SD = 5.2$) was obtained. Subjective norm was assessed by two items for example, "people who are important to me think I should prepare food hygienically every meal over the next week″ (unlikely—likely), scored 1–7 with a higher score indicating more normative pressure. An alpha coefficient of 0.78 ($M = 12.3$, $SD = 1.7$) was obtained. PBC was assessed as the mean of four, seven-point (1–7) items including two items for controllability and two for self-efficacy. This is because the internal reliability of PBC items has frequently been found to be low (e.g., Ajzen, 2002; Sparks, 1994); therefore, more than one measure of controllability is now recommended. For this variable an alpha coefficient of 0.70 ($M = 12.4$, $SD = 1.4$) was calculated. Intention was assessed by a seven-point scale with higher scores indicating a greater intention: "Over the next seven days, I intend to make an effort to prepare food hygienically every meal" (strongly disagree-strongly agree). For intention the alpha coefficient was 0.91 ($M = 25.16$, $SD = 6.96$).

Theory of Planned Behavior Intervention

The intervention design was a computer task which was based on a computer based TPB food safety intervention which has previously been found to improve knowledge, self-reported behavior, and TPB variables (Mullan & Wong, 2010). The TPB intervention utilized behavior change techniques commonly applied in behavior change interventions (Abraham, Kok, Schaalma, & Luszczynska, 2010). The intervention's change targets and change techniques included: (a) changing affective and cognitive (or instrumental) attitudes by providing general information on behavior-health link, the material consequences and the affective consequences; (b) changing risk perception by providing information about personal susceptibility to negative consequences; (c) changing normative beliefs by providing information about others' behavior and others' approval; (d) utilizing techniques designed to change PBC and intentions via goal setting and motivation which consisted of prompting intentions and goal formation, prompting specific planning and goal setting, and prompt barrier identification; (d) enhancing PBC via self efficacy and self regulation through the provision of instruction and using arguments to bolster self efficacy.

Follow-Up Theory of Planned Behavior Questionnaire

The follow-up questionnaire examined the four components of the TPB including attitudes, subjective norm, PBC and intention. The follow-up questionnaire asked the same questions as baseline, however, they were phrased in past tense and intention was not measured. Additionally, behavior was measured by asking participants how many times they prepared food hygienically in the past seven days.

Statistical Analysis

Data was analyzed using SPSS 18.0 for Windows. Descriptive and exploratory analysis of TPB components, food safety behaviors and knowledge were performed between and within groups. Correlation and multiple regression analyses were also conducted to test consistency with the research hypotheses. A sample size of only 45 participants was used due to budgetary restraints. It is acknowledged that the relatively small sample size dilutes the power of the analyses conducted and can contribute to noise within the analysis. Nevertheless, there is evidence to suggest that the sample size was reasonable for the purposes of the analyses used (Virtanen, Kairisto, & Uusipaikka, 1998; Wilson VanVoorhis & Morgan, 2007).

Results

Participant Characteristics and Flow

Demographic characteristics are represented in Table 1.

Participant flow is represented in a 2010 CONSORT flow diagram in Figure 1.

Table 1
Demographic Characteristics of Sample at Baseline

	Intervention		Control (General)		Control (Mere measurement)				
	Mean	*SD*	Mean	*SD*	Mean	*SD*	*F*	*df*	*p*
Age	20.9	5.05	23.2	7.36	20.4	4.88	.931	44	.402
	N	%	*N*	%	*N*	%	χ^2	*df*	*p*
Ethnicity							2.143[a1]	2	.343
Australian	7	46.7	5	33.3	9	60.0			
Other	8	53.3	10	66.7	6	40.0			
Living Situation							2.340[a2]	2	.310
With Parents	9	60.0	6	40.0	10	66.7			
Other	6	40.0	9	60.0	5	33.4			
Occupation of Head of household							5.431[a3]	2	.066
Professional	9	60.0	7	46.7	13	86.7			
Other	6	40.0	6	53.3	2	13.3			
Gender									
Female	12	80.0	12	80.0	13	86.7			
Male	3	20.0	3	20.0	2	13.3			

[a1] Yates continuity correction used. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7. [a2] Yates continuity correction used. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.67. [a3] Yates continuity correction used. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.33.

TPB Model as a Predictor of Intentions

At baseline, participants reported that they prepared food an average of 13.8 times out of a possible 21 times consisting of breakfast, lunch, and dinner throughout a 7 day week. During these instances, they prepared food hygienically an average of 76.4% of the time. With regards to participants overall behavior, Pearson's correlations revealed that self-reported behavior and observed behavior were significantly correlated, $r(30) = .478$, $p = .008$.

Thirty participants completed the TPB questionnaire baseline; the remaining 15 were blind to this part of the study. All 45 participants completed the TPB questionnaire concerning food safety behavior at follow-up.

Pearson's product correlation matrix between TPB variables, intention and observed food safety behaviors were calculated. Subjective norm and attitude were significantly correlated, $r(30) = .395$, $p = .031$. Both variables were not, however, correlated with any other variable including PBC, intention and observed behavior. PBC was significantly correlated with intention, $r(30) = .500$, $p = .005$, and observed behavior, $r(30) = .436$, $p = .016$.

Attitude, subjective norm and PBC were examined via a multiple hierarchical regression analysis in order to evaluate each variables unique contribution to predicting intention to perform hygienic food handling behaviors. The overall analysis showed significance, $R^2 = .263$, $F(2, 26) = 3.092$, $p = .044$, with all three variables accounting for 26.3% of the variance in intentions. The only variable displaying stand alone significance in predicting intentions was PBC, $b = .487$, $t = 2.77$, $p = .01$.

TPB Model as a Predictor of Behavior

Participant's intentions to perform food safety behaviors were a significant predictor of observed behavior. Pearson's correlations revealed an intention- observed behavior association, $r(30) = .528$, $p = .003$. Furthermore, a regression analysis indicated that intentions accounted for 27.9% of variance in behavior, $\beta = .528$; $t = 3.294$; $p = .003$. Results showed that when controlling for the effects of intention on observed behavior. PBC was not an additional significant predictor of behavior, PBC accounted for 4% of the additional variance over intention which was not a significant R^2 change from 27.9% to 31.9%. The variance for intention and PBC together was 32% ($p = .032$) Figure 2 displays a complete summary of the model.

Effects of the Intervention on TPB Variables, Intention, and Behavior

To investigate the effect of the interventions on each component of the TPB, both within group and between group analyses were conducted for the variables attitude, subjective norm, PBC, and behavior. Paired sample *t* tests were performed for each of these variables so as to compare baseline and follow-up scores by condition (see Table 2).

An analysis of variance (ANOVA) was conducted for behavior as it was measured for all three groups at baseline and follow-up. For the remaining variables, independent sample *t* tests were conducted using difference scores from baseline to follow-up to compare the size and magnitude of change over the course of the intervention between groups (see Table 3).

Behavior

Baseline observational data revealed that out of a possible 13 instances for safe food hygiene practices when preparing food, participants in the intervention group averaged 5.4 ($SD = 2.35$) correct behaviors, the general control group averaged 4.13 ($SD = 1.6$) correct behaviors and the mere measurement control made 7.3 ($SD = 2.37$) correct behaviors. At follow-up, participants in the intervention group made an average of 9.2 ($SD = 2.14$) correct

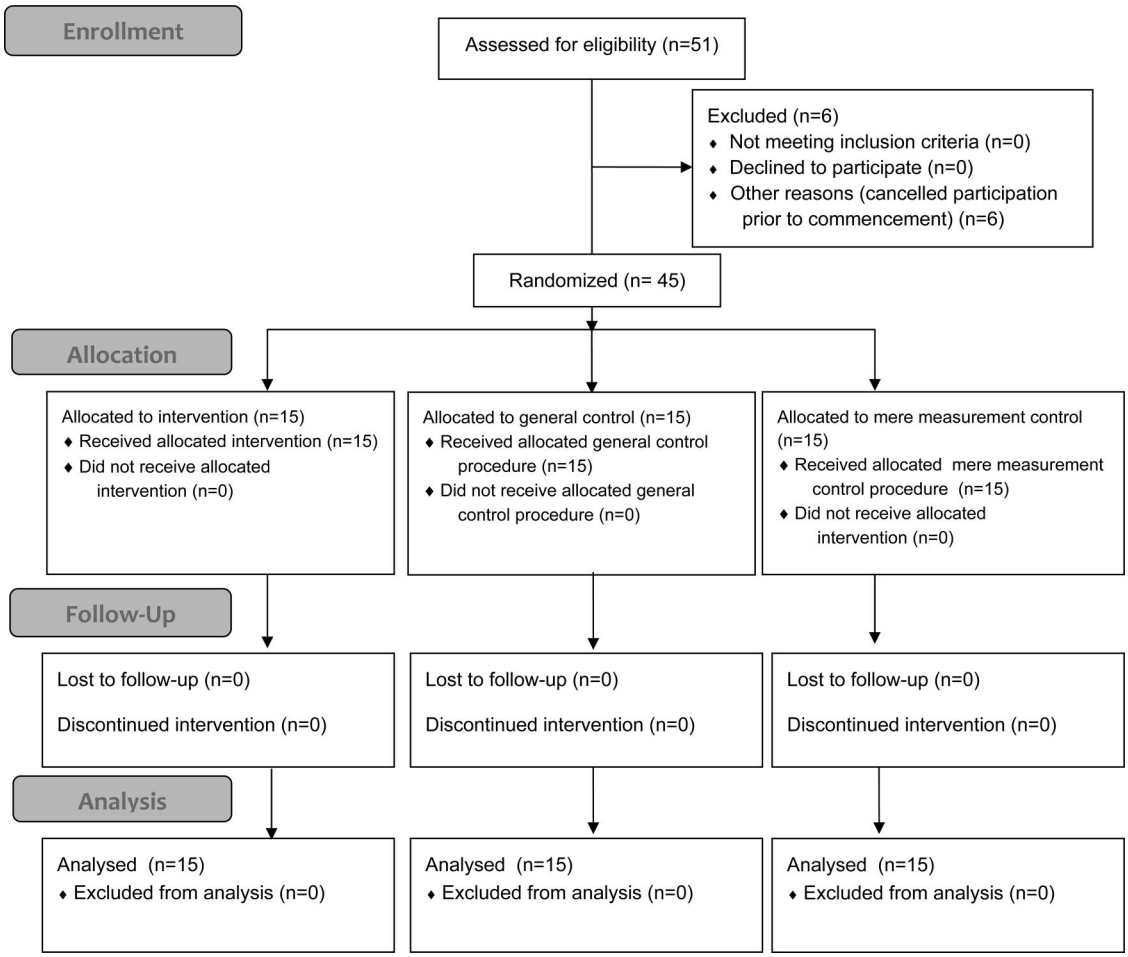

Figure 1. Participant flow.

behaviors, the general control group made 5.2 ($SD = 2.31$) correct behaviors and the mere measurement control averaged 4.73 ($SD = 1.83$) correct behaviors. When examining the frequency of hygienic food preparation, the difference between baseline and follow-up was significant in the intervention group, $t(15) = -5.99$, $p < .001$, and the mere measurement control group, $t(15) = 6.52$, $p < .001$, but not for the general control group. As shown in Figure 3, the intervention group's behavior change was in a positive direction from baseline to follow-up; whereas the mere measurement control group was in a negative direction over time. Furthermore, the difference in change in hygienic food preparation behaviors between the intervention, mere measurement control and control group was also significant. As shown in Table 3, significant difference were found between the conditions at a 99% level of confidence, $F(3, 44) = 29.29$, $p = <.001$. Tukey's post hoc comparisons revealed that significant differences were present between all groups.

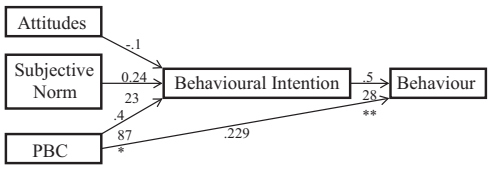

Figure 2. Model 1 with standardized regression coefficients (β). (*Note:* $^{*}p < .05$. $^{**}p < .01$.)

TPB Constructs: Attitudes, Subjective Norm, and Perceived Behavioral Control

Paired samples *t* tests were conducted to compare baseline and follow-up attitude, subjective norm and PBC scores for both the intervention and the general control group. Neither group experienced a significant change in their attitude toward food safety, nor their reported subjective norm influenced over the course of the intervention. In terms of PBC, the general control group did not experience significant change in PBC toward food safety over the course of the intervention; however, a significant increase in PBC was found for the intervention group, $t(14) = -2.61$, $p = .021$, as represented in Figure 4.

Furthermore, an independent samples *T* test using difference scores was used to compare the magnitude and direction of the change for TPB construct scores between participants in the intervention and the general control group. As Table 3 indicates, a significant difference in the size of the change in PBC scores was found between

Table 2
Paired Sample T-Tests: Within Group Differences in TPB Components and Behavior

	Baseline	Follow-up	Paired sample *T*-test		
	Mean ± *SD*	Mean ± *SD*	*t*	*df*	*p*
Intervention					
Behavior	5.40 ± 2.35	9.20 ± 2.14	−5.99	14	<.001**
Attitude	36.73 ± 5.50	37.80 ± 4.54	−.55	14	.592
Subjective Norm	12.73 ± 1.62	12.46 ± 2.23	.60	14	.556
PBC	12.53 ± 1.25	13.46 ± 0.51	−2.61	14	.021*
General Control					
Behavior	4.13 ± 1.6	5.20 ± 2.31	−1.54	14	.146
Attitude	37.67 ± 4.94	34.73 ± 7.70	1.27	14	.225
Subjective Norm	11.93 ± 1.75	11.20 ± 2.54	.81	14	.430
PBC	11.93 ± 1.44	11.26 ± 1.44	1.17	14	2.59
Mere measurement Control					
Behavior	7.27 ± 2.37	4.73 ± 1.83	6.52	14	<.001**

* Denotes statistical significance at the .05 level. ** Denotes statistical significance at the .01 level.

baseline and follow-up when comparing intervention and the general control group, $t(28) = -2.39, p = .024$. This indicates that the change between baseline and follow-up was larger in the intervention group than it was in the general control group.

Predicting Change in Behavior

Regression analyses were performed to determine the predictive value of condition on change in attitudes, change in subjective norm and change in PBC. Only PBC change from baseline to follow-up was significant, $\beta = .411$; $t = 2.38$; $p = .024$. A multiple regression analysis was subsequently completed to establish the effect of change in the TPB variables on change in observed behavior when controlling for condition. Condition significantly accounted for 23.2% of the variance in predicting observed food safety behaviors, $B = .482$; $t = 2.91$; $p = .007$. When including both condition and the TPB variables into the second part of the analysis, it was found that the change in attitudes, change in subjective norm and change in PBC accounted for 13.4% of variance in change in food hygiene behavior when controlling for condition ($R^2 = .366$) which was not significant. When controlling for condition, none of the TPB variables represented a significant proportion of variability in change in food safety behaviors between baseline and follow-up. PBC showed a trend in predicting change in behavior; however, this was not significant, $B = .383$; $t = 2.04$; $p = .052$.

Discussion

Two central aims were explored in the present study. First, the TPB model was applied to predict the social–cognitive determinants of intention and observed food safety. Second, the study

Table 3
ANOVA and Independent Samples T-Tests: Between Group Differences in TPB Components, Intention and Behavior

	Mean ± *SD*	*F*	*df*	*p*
Behavioral Change		29.29	44	<.001**
Intervention	3.80 ± 2.46			
General Control	1.07 ± 2.68			
Mere measurement Control	−2.53 ± 1.51			
	Mean ± *SD*	*t*	*df*	*p*
Attitude Change		−1.33	28	.196
Intervention	1.06 ± 7.53			
General Control	−2.93 ± 8.95			
Subjective Norm Change		−.47	28	.646
Intervention	−.27 ± 1.71			
General Control	−.73 ± 3.49			
PBC Change		−2.39	28	.024*
Intervention	.93 ± 1.39			
General Control	−.67 ± 2.19			
Intention		−.136	0	.184
Intervention	5.87 ± 1.25			
General Control	5.27 ± 1.16			

* Denotes statistical significance at the .05 level. ** Denotes statistical significance at the .01 level.

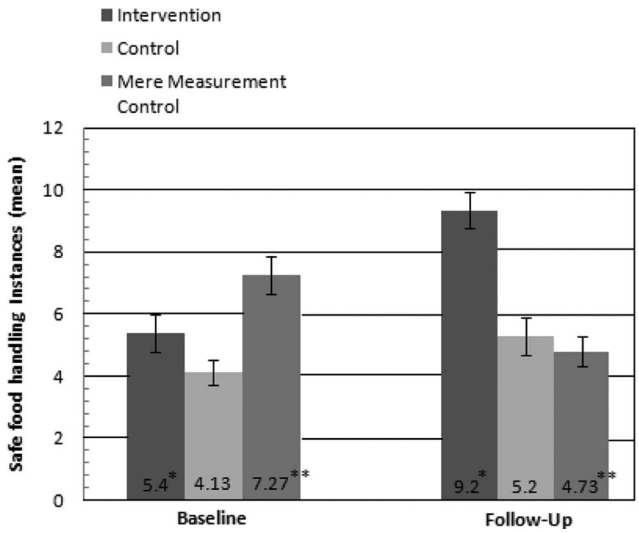

Figure 3. Mean score of safe food handling instances by observation and group. *Note:* * denotes significant Intervention group baseline to follow-up observed behavior change, $p < .001$; ** denotes significant Mere-Measurement control group baseline to follow-up observed behavior change, $p < .001$.

examined the effect of a theoretically derived food safety intervention on TPB variables, intention and observed behavior from baseline to follow-up.

Results of the study found that the TPB constructs of attitude, subjective norm, and PBC significantly predicted 26% of the participants' intention to prepare food hygienically. This finding was consistent with research examining hand hygiene practices in catering establishments (19%; Clayton & Griffith, 2008), but not as considerable, as a self-report food safety study which could account for a third of the variance in consumers intentions to undertake safe practices when preparing food (66%; Mullan & Wong, 2009).

PBC was the only variable that significantly predicted intention independently. This provides further support to the proposal that an intention to perform safe food handling behaviors is not considered to be wholly within a consumer's volitional control (Mullan & Wong, 2009). Unlike the two above mentioned food safety studies, the present pilot study did not find subjective norm to be a significant predictor of intention. In the literature, it has been noted that the normative component of the TPB has been reported as the weakest predictor of intention and behavior (Armitage & Conner, 2001; Godin & Kok, 1996).

In terms of behavior, 28% of the variance was explained by intentions. When including PBC, 32% of variance could significantly be accounted for to predict behavior; however, this additionally 4% R^2 Change was not independently significant. This level of variance in behavior explained by intention and PBC is comparable to the self-reported food safety study findings of 21%, the results from the hand hygiene study in catering establishment of 30%, and also a meta-analysis of meta-analyses which found intention and PBC accounted for 26% of the variance in behavior (Conner & Spark, 2005).

In general, the present study's findings still supported their results and ultimately the overall conceptualization of Ajzen's (1991) TPB model. Overall, the results of the present study add further evidence to suggest that the TPB is a useful framework for food safety and address the many calls in the literature that have been campaigning for such theoretical underpinnings (Griffith et al., 1995; Milton & Mullan, 2010).

In the present study, a significant positive increase in PBC for the intervention condition, but not the general control condition from baseline to follow-up, was found. Furthermore, when measuring between group differences PBC change scores showed that the change from baseline to follow-up was significantly larger for the intervention than the control condition. When controlling for Condition PBC showed a trend toward explaining behavior, but this was not significant ($p = .052$) and must be interpreted cautiously due the small sample sizes in each group. Overall, however, the intervention's efficacy was promising as results revealed that the intervention promoted significant change in participants' PBC and behavior. This finding signifies that young adult consumers' perceived control over their food safety behaviors are susceptible to change via the influence of TPB health messages. Furthermore, this may be indicative that if consumers hold the belief that they have volitional control over performing a behavior, this may translate into actually performing the behavior correctly.

Multiple regression analysis indicated that condition significantly accounted for 23% of the variance in food hygiene behavior change. This provided support the Ajzen's (1991) suggestion that theoretical change in TPB variables should predict change in behavior, mediated by change in intention. Overall, it was found that the intervention group's food safety behaviors increased significantly, the general control group showed a slight increase in food safety behavior but this was not significant, and the mere measurement control group's food safety behaviors decreased significantly. This shows that in terms of the intervention, the salience of food safety was important. That is, as participants in the intervention and the general control group were thinking about food safety, their actual behaviors improved, unlike the mere measurement control participants who were not thinking about food safety. It must be acknowledged that part of the positive change in behavior may be due to a "halo effect" as documented by Redmond and Griffith (2006), that is, the known target behavior influences the outcome. Nevertheless, due to the rigorous controls embedded in the

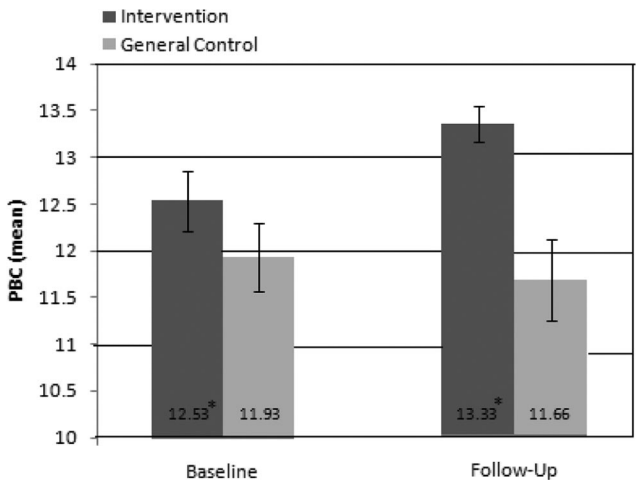

Figure 4. Mean score of PBC by observation and group. *Note:* * denotes significant Intervention group baseline to follow-up PBC change, $p = .021$.

interventions design, the intervention itself can be deemed a success; as observed food safety behaviors improved significantly for the intervention group compared to the general control group who were also aware of the food safety element to the study. This shows that increased levels of food safety salience for the intervention group did assist with increasing behavior change.

A genuine strength of the study was the incorporation of the overarching recommendations from Milton and Mullan's (2010) systematic review. These suggestions included the need for better defined outcome measures, more rigorous reporting of results and intervention design, the use of randomized controlled trial protocols, and utilizing health models to have a greater theoretical underpinning to the studies. Furthermore, by implementing two control arms (general and mere measurement control) the study enabled a greater insight into the interventions efficacy. By having a general control group that compared TPB change, and a mere measurement control group that avoided questions that had the potential to change behavior, we can better account for the recommendations from Sandberg and Conner's (2009) research.

A limitation of the study was that due to the time consuming and expensive nature of observation, a sample size of only 45 participants was used and additional longer term follow-up could not be explored. It is therefore recommended that any further interpretation from these findings is treated with the full understanding that this is a pilot study. It is acknowledged that the relatively small sample size dilutes the power of the analyses conducted. Nevertheless, the literature does suggest that the sample size was reasonable for the purposes of the analyses used (Wilson VanVoorhis & Morgan, 2007). With regard to regression analysis, research has shown that standard deviation and coefficient of variation remain rather static after the sample size passes 30 (Virtanen et al., 1998). In relation to the short follow-up time frame of 4 weeks, a systematic review of published TPB interventions found that follow-up was often quite short, with 7 study a having a follow-up of 4 weeks or less and only 16 having more than 4 weeks at follow-up (Hardeman et al., 2002). Further, Ajzen (1988) argues that if the duration between intention and timing of the behavior is short then it is more likely that the behavior will be performed. Another limitation relates to the potentially biased sample of university students. However, this cohort prepares food regularly and previous research has shown that they are a group that is at high risk of food poisoning (Byrd-Bredbenner et al., 2007). It is recommended that this is taken into account in terms of generalizing findings to the wider population. Despite these matters, this pilot study does present promising and significant findings. However, it is strongly recommended that future research continues down this avenue of exploration to provide further endorsement to these recent findings.

A strength of the study was its uniqueness compared with other research, as no research to date has investigated whether the TPB is a good predictor of observed food safety behavior pre and post a psychosocial food safety intervention. From this unique standpoint, a particularly noteworthy finding arose as both observational and self-reported behavioral data was collected and the relationship between them was explored. Results suggested that at baseline overall self-reported behavior and overall observed food safety behaviors did correlate significantly in a positive direction ($r = .47$, $p = .01$). Previous research has suggested that observation may be a better measure of food hygiene behaviors (Clayton et al., 2003) because the impact of social desirability bias is likely to lead to inflated reports of behavior. The present study's finding of a positive linear relationship between consumer's self-reported and observed food safety behaviors, however, helps address these concerns. The finding also has significant overarching implications for future research as it adds weight to the argument that self-report is a suitable way of gathering data to make inferences about consumer behavior.

It is recommended that future research explore for the lack of significant change in attitudes and subjective norm, as this result may be due to the high scores across time and condition. For example, for attitudes out of a possible positive score of 42, the control and intervention group mean was between 37 and 38 at baseline. This trend of people reporting positive attitudes toward food safety has been found in previous research. Redmond and Griffith (2005) reported that the majority (90–97%) of consumers held positive attitudes toward the use of adequately washed and dried utensils/separate utensils for raw and ready-to-eat foods. Other research findings also propose that consumers' actual behavior may be inconsistent with their reported attitudes (Rimal, Fletcher, McWatters, Misra, & Deodhar, 2001); which appears to hold true for the current study. An explanation for this inconsistency between very positive attitudes and actual food safety behaviors could potentially be due a social desirability bias occurring or because of the attitudes not translating directly into actual behaviors via intention. As the present study only gauged attitudes and the other TPB variables via self-report, future research should consider also controlling for social desirability bias via measures such as the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1960).

In terms of subjective norm, future research may consider increasing the number of constructs that measure subjective norm. This would allow for an increased variety of consumer responses leading to a greater range of subjective norm scores. Including more variables related to subjective norm may also be of value. For instance, Mullan and Wong (2009) have suggested social pressure and social concern could be explored as they may provide insight into consumers' underlying motivation to abide by others expectations; for example, the level of fear a consumer has about giving others food poisoning may be a motivating factor to prepare food safely. Further to this, Clayton and Griffith (2008) have found that perceptions of others' actions, termed "descriptive norms", adds to the prediction of hand hygiene intentions in addition to TPB variables. These additional constructs regarding a consumers' social concerns, beliefs about social pressures, perceptions of others actions and their subjective norms (i.e., the perception of important others' attitudes toward that behavior) may provide a more comprehensive insight into explaining intention to prepare food safely.

Overall, the TPB was found to be a useful framework for predicting observed food safety behaviors. Additionally, the TPB food safety intervention was shown to be effective in terms of significantly increasing PBC and observed food safety behaviors of young adult consumers. A final noteworthy finding was the significant correlation between self-reported and observed behavior, which gives weight to the construct validity of self-report when measuring behavior. Taken as a whole, the present study has addressed the appeals in the literature for theory driven food safety interventions, and lays the foundation for future research in this relatively uncharted area of food safety.

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