Using the Theory of Planned Behaviour to design a food hygiene intervention

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A R T I C L E   I N F O

Article history:
Received 15 February 2010
Received in revised form 25 March 2010
Accepted 3 April 2010

Keywords:
Food safety
Theory of Planned Behaviour
Interventions

A B S T R A C T

Twenty percent of food poisoning annually in Australia is believed to result from consumer food handling behaviour. Research advocates the use of social cognition theories in designing food hygiene interventions, however very few studies have actually done so. Thus, this study investigated the efficacy of a food hygiene intervention based on the Theory of Planned Behaviour (TPB). One hundred and eighty-four participants completed a TPB questionnaire, including questions regarding past behaviour and food hygiene knowledge, and then were randomly allocated to a knowledge and implementation intention group, a combined knowledge/implementation intention/PBC group, or a control group. Behaviour was measured 4 weeks later. The TPB predicted a high proportion of variance in both intentions and behaviour, but neither intervention improved participants’ food hygiene behaviours. However, knowledge and PBC were significantly increased in the PBC group. The implications of this for future research are explored.

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1. Introduction

The number of reported cases of foodborne disease in Australia has increased over the past 10 years (National Health, 2003) and approximately a quarter of the population of many developed countries experience foodborne illness annually (Mead et al., 1999; The Food Safety Information Council, 2008). In Australia this is an estimated 5.4 million cases per year and in the United States an estimated 76 million cases. Further, as many cases of food poisoning go unreported, data on foodborne disease is believed to consistently underestimate their true incidence (Cerer, Dalton, Longbottom, & Kraa, 1996). As a result of the increasing occurrence, both within Australia and worldwide, foodborne disease poses a significant public health problem (Desmarchelier, 1996).

Correct handling of food during all stages of its preparation and storage is vital in reducing the incidence of foodborne illness (NHMRC, 2003). However, between 10% and 20% of foodborne illness both in Australia and the United Kingdom is estimated to be as a result of consumer food handling behaviour (Food Authority NSW, 2008; Ryan, Wall, Gilbert, Griffin, & Rowe, 1996). A systematic review of food safety studies identified that consumers commonly implement unsafe food-handling behaviours during domestic food preparation (Redmond & Griffith, 2003). In 2002, the USA ‘Home Food Safety... It’s in Your Hands’ survey on consumer food hygiene knowledge, found that consumers have large gaps in their knowledge regarding what factors affected foodborne disease and that they were unaware of specific recommendations to prevent foodborne illness (Cody & Hogue, 2003). Therefore increasing knowledge of correct food hygiene practices may be an important factor in changing behaviour. People may believe they are already implementing hygienic behaviours when in fact they are not.

Research in Australia and the USA has suggested that young adults aged 18–29 in particular have less knowledge about food safety and are more likely to engage in risky food hygiene behaviours than other groups (Altekruse, Yang, Timbo, & Angulo, 1999; Byrd-Bredbenner et al., 2008; The Food Safety Information Council, 2008). An observation study carried out on undergraduate university students found that participants performed less than 50% of the food safety behaviours recommended to prevent foodborne illness (Byrd-Bredbenner, Maurer, Wheatley, Cottone, & Clancy, 2007). Approximately 20% of the Australian population are enrolled in tertiary education, and approximately 60% of school leavers go onto some form of higher education (Australian Bureau of Statistics, 2009). Consequently young adults are at high risk yet there is a paucity of research in this group. In addition, a previous study investigating food hygiene in Australian undergraduate students found that almost half reported preparing food everyday over a 4 week period indicating that this group are also regular food handlers (Mullan & Wong, 2009).

A systematic review of food safety interventions (Milton & Mullan, in press) found that they have been predominantly educational, using persuasive messages and targeting knowledge, for example the ‘Fight Bac’ intervention (www.fightbac.org, 2002) and ‘Now You’re Cooking... using a Food Thermometer’ (Takeuchi, Hillers, Edwards, Edlefsen, & McCurdy, 2005). The Fight Bac intervention was successful at increasing knowledge of food hygiene...
compared to non-exposed counterparts, however it only increased actual behaviours, such as defrosting meat in the refrigerator, by approximately 7% (Dharod, Pérez-Escamilla, Bermúdez-Millán, Segura-Pérez, & Damio, 2004). Few of these previous interventions have based their outcome measures on constructs from theoretical models, which weaken their methodological strength and foundations. In addition, there has been little support that knowledge alone can change behaviour, although the research does suggest that increasing knowledge can make it possible for the consumer to make more informed choices with regard to changing behaviour. Although there have been numerous calls for the development of interventions based on social cognition theory in the area of food safety (Griffith, Mullan, & Price, 1995; Seaman & Eves, 2010), there have in fact been very few theory based studies with the goal of changing consumer's behaviour. One intervention that did target changing behaviour was an observational study by Redmond and Griffith (2006). The authors used a social marketing intervention (leaflets, posters, TV documentary, and newspaper articles) with the target behaviours including adequate hand washing and changing/washing chopping boards between preparation of raw chicken. Although the intervention was effectively immediately after the implementation, food safety behaviours had decreased at follow-up 4–6 weeks later. This supports the idea that increasing knowledge alone is not enough to change and maintain desired behaviours. Kretzer and Larson (1998) recommended that when planning a theoretically based intervention for improving infection control practices, factors that have been shown to consistently predict or influence behaviour need to be incorporated into the design, in order to increase the likelihood of success. As such, it is important to choose a theoretical model that has been successful in predicting the target behaviour (Kretzer & Larson, 1998), however only very few studies have taken this into consideration (e.g. Seaman, 2010; Seaman & Eves, 2010). One such model, the Theory of Planned Behaviour (TPB), has received much attention in the health domain and has been previously shown to successfully predict food hygiene behaviour.

The TPB (Ajzen, 1991) is an extension of the earlier Theory of Reasoned Action (TRA) which posits that behaviour is proximally determined by behavioural intention. Intention to act is assumed to capture the motivational factors that influence a behaviour and are indications of how much of an effort an individual is planning to exert, in order to perform the behaviour (Ajzen, 1991). In turn, intention is predicted by three variables – attitude, the overall evaluation of the behaviour; subjective norm, which represents the perceived pressure from significant others to perform the behaviour; and perceived behavioural control (PBC). PBC is a component that represents the individual’s perceptions of the ease or difficulty of performing the behaviour of interest. Ajzen (1991) contended that PBC directly influences both intention and behaviour for behaviours that are under volitional control.

Meta-analyses of the TPB (Armitage & Connor, 2001) have found the model to predict 39% of the variance in behavioural intention, and 27% of the variance in behaviour for a variety of different behaviours. The predictive validity of the model has led to an interest in developing TPB based interventions that target intentions, which will then lead to behaviour change. A systematic review of TPB based interventions (Hardeman et al., 2002) found that although the studies had many limitations, out of 30 studies, half were effective in changing intentions and two-thirds in changing behaviour.

In the area of hygiene, the TPB has been used to predict 79% of intention and 87% of self reported hand hygiene practice in hospitals (Jenner, Watson, Miller, Jones, & Scott, 2002) and 34% of hand hygiene malpractices in catering establishments (Clayton & Griffith, 2008). Mullan and Wong (2009) found that the TPB predicted 66% of the variance in intention to handle food hygienically in a population of undergraduate students who cooked at home, and 21% of the variance in behaviour over a 4 week period. PBC was found to be the strongest predictor of intention to handle food hygienically; however, it did not directly predict behaviour.

As aforementioned, PBC was the most significant predictor of safe food handling intention (Mullan & Wong, 2009) and a significant predictor of intention for hand hygiene practices (Clayton & Griffith, 2008). This suggests that food handling behaviour is not wholly within volitional control and people perceive that there are salient barriers which prevent them from achieving the behaviour. Similarly, studies using the Health Action Process Approach model found that action self-efficacy was the strongest predictor of intentions to perform hygienic food practices (Chow & Mullan, 2010; Mullan, Wong, & O’Moore, in press). There is evidence that an individual's self-efficacy beliefs are positively related to the goals they set and their commitment to engage in the intended behaviour, even if failure occurs (Schwarzer, 1992). An intervention that targeted self-efficacy in increasing fruit and vegetable consumption showed that the group which increased self-efficacy alone benefited equally from the intervention compared to the group that also made plans to increase behaviour (Luszczynska, Tryburcy, & Schwarzer, 2007). Change in self-efficacy was able to predict change in behaviour at a 6 month follow-up, which indicates that enhancing perceptions of control may result in long term behaviour change. Therefore, interventions aimed at increasing PBC, which includes both a self-efficacy and a controllability component, may assist in increasing both intentions and safe food handling behaviour.

Although the TPB can be utilised to develop interventions that target intention, the fact remains that not all intentions are translated into behaviour. This leaves what is often termed the ‘intention-behaviour gap’ and Ajzen (1991) supported the contention that additional predictors could be included in the model to increase the prediction of behaviour. Past behaviour is often included as a variable as it has often been found to be the strongest predictor of future behaviour. Frequency of past behaviour is often thought to be a measure of habit, as well practiced behaviours that are repeatedly performed in a stable context eventually become automatic (Ouellette & Wood, 1998). In previous research, past behaviour was found to explain an additional 18% of the variance in safe food handling behaviour (Mullan & Wong, 2009) and was the strongest predictor of behaviour, suggesting that hygienic food handling may be habitual. There is evidence to suggest that undesirable habits can be changed by using implementation intentions or plans to create specific links between cues in the environment and individual responses (Gollwitzer, 1999), or by using positive reinforcement to strengthen the association between the behaviour and health benefits (Honkanen, Olsen, & Verplanken, 2005).

A TPB intervention aimed at increasing children's fruit and vegetable consumption found that attempting to change behaviour by developing implementation intentions to assist in planning out the behaviour, significantly increased fruit and vegetable intake compared to a control group (Gratton, Povey, & Clark-Carter, 2007). The implementation intention group was also more successful in increasing behaviour than the group that only targeted salient beliefs about fruit and vegetable consumption. Additionally in other research, implementation intentions have been shown to successfully increase exercise behaviours, cancer screening behaviours and dental flossing (Brickell, Chatzisarantis, & Pretty, 2006a; Lavin & Groarke, 2005; Steadman & Quine, 2004). The research suggests that implementation intentions may assist in translating intentions into behaviour through creating cues in a stable environment or facilitating retrieval of intentions in memory (Gollwitzer, 1999). Once these plans are formed, they no longer require conscious control which eventually leads to behaviour becoming habitual (Ouellette & Wood, 1998).
The aim of the current study was to determine if either of two different interventions would lead to an increase in safe food-handling behaviours, relative to a control group. The first intervention involved a combination of increasing knowledge and creating implementation intentions, and the second was the same but also involved increasing PBC.

2. Method

2.1. Participants

At time one, 195 participants signed up to the study; 11 participants dropped out or did not complete the study. One hundred and eighty-four undergraduate students with a mean age of 19.9 years (range 17–46, SD = 4.1) completed the follow-up at time two. Ethical approval was obtained from the University's Human Ethics Committee.

2.2. Design

A 3 × 2 design was utilised where participants were randomly allocated into Intervention A (n = 61), Intervention B (n = 63) or a control group (n = 60) and behaviour was measured at two separate times, spaced 4 weeks apart. Participants also completed questions on the TPB variables and knowledge of food hygiene.

2.3. Procedure

At time one, participants completed questions related to demographic information and TPB variables, including attitudes, PBC, subjective norms, intention and past behaviour. To investigate baseline knowledge, participants were also required to report what they believed to be the six most important food hygiene rules to keep them safe from foodborne disease when cooking at home. The questionnaire was based on the direct TPB measures used in previous research investigating food hygiene (Mullan & Wong, 2009).

Attitudes were assessed as the mean of six semantic differential scales, e.g. (preparing food hygienically every meal would be: bad–good, unnecessary–necessary, unpleasant–pleasant, unenjoyable–enjoyable, beneficial–harmful, foolish–wise). Participants rated on a scale of 1–7 with a higher score indicating a more positive attitude. An alpha coefficient of .72 (M = 6.39, SD = .63) was reported.

Subjective Norm was assessed by a single item “people who are important to me think I should prepare food hygienically every meal over the next 4 weeks” (unlikely–likely), scored 1–7 with a higher score indicating more normative pressure (M = 6.16, SD = 1.40).

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 PBC is now recommended.

For this variable an alpha coefficient of .76 (M = 5.79, SD = .89) was reported.

Behavioural intention was measured as a single item on a seven-point scale “I intend to prepare food hygienically every meal over the next 4 weeks” – strongly disagree to strongly agree (M = 6.25, SD = 1.26).

Past behaviour was measured by participants indicating how many meals in the week preceding the study they had prepared food hygienically (M = 9.33; range 2–21; SD = 4.63). To account for how many meals a week participants typically cooked, they were also asked “over the last week think about how many times you have prepared food for yourself or others at home” (M = 11.23; range 2–21; SD = 4.63). A past behaviour proportion was then calculated by dividing the number of times participants prepared the meal hygienically by the number of meals cooked (M = 0.82, SD = 0.22). This measure was also used as the baseline behaviour score. In between the two past behaviour questions participants were asked to write down six food hygiene rules to assist them in remembering if they had used such rules whilst preparing their meals.

Behaviour was measured 4 weeks later at time two using the format described above for past behaviour, giving the proportion of meals prepared hygienically (M = 0.85, SD = 0.20).

Knowledge of food hygiene was measured by asking participants to list the six most important rules they should follow to prepare food hygienically in order to prevent foodborne disease and keep food safe to eat.

After completing the questionnaire at time one, participants were then randomly allocated to one of three conditions: Intervention A received a fact sheet providing knowledge of correct food hygiene rules, and an implementation intention planning guide where they were informed how to make specific plans about where, when, what and how they would perform hygienic food handling. Participants were asked to develop their own implementation intentions and make their own plans as to how they would achieve the behaviour. Participants in Intervention B received exactly the same information as group A, but were also given information on PBC and how self-efficacy and PBC can help to increase desired behaviours. This was based on the self-efficacy intervention used in Luszczynska, Sobczyk, and Abraham (2007), but also included ways to overcome perceived barriers to performing correct food hygiene when preparing meals. The control group completed a questionnaire regarding what they thought the study was about.

Four weeks later, all participants completed a follow-up questionnaire that measured behaviour and PBC, and were again asked to provide six rules for hygienic food handling. They were also asked if they had made any specific plans over the past 4 weeks to implement safe food handling when cooking at home.

2.4. Analysis

Data were analysed using SPSS version 15. To investigate the success of the model, two hierarchical regression analyses were run. The first tested attitude, subjective norm, PBC and past behaviour as predictors of intention. In the second, intention, PBC and past behaviour were entered as predictors with 4-week behaviour as the dependent variable. To explore the efficacy of the interventions, analyses of variance (ANOVA) were conducted on the difference between baseline and follow-up scores to see if there were any differences in behaviour and PBC across the conditions. Bonferroni post hoc analyses were used when necessary. Lastly a qualitative exploration on the six hygiene rules participants listed was carried out, and ANOVAs on the baseline and follow-up knowledge scores were performed to investigate any increases in knowledge between the conditions.

3. Results

3.1. Description of sample

There were 195 participants (148 females), of whom 125 were living at home with their parents (64%), 49 were living with relatives, or with a partner (25%), eight were in colleges (4%), six owned their own homes (3%) and the remainder classed their living situation as ‘other’ (which included living with relatives, or with a partner). In terms of
ethnicty, the sample consisted mainly of Australian-Caucasians (45%), Asians (33%), Europeans (10%), and those of Middle Eastern descent (4%), with the remainder collapsed into ‘other’ (8%). Approximately one third (36%) of the participants were classified as upper middle class, 27% as middle class, 16% as working class, 4% lower class and due to the nature of the population of interest a separate class of ‘student’ (17%) was included.

3.2. Theory of Planned Behaviour

Using the TPB as a guide, a hierarchical regression was conducted. As seen in Table 1, attitudes, subjective norm and PBC made a significant contribution to the prediction of intention. The TPB predicted 32.8% of the variance in intention to prepare food hygienically. Past behaviour predicted an additional 5.6% of the variance in intention, which was a significant increase.

In predicting behaviour, Table 2 shows that intention and PBC predicted 14.5% of the variance in behaviour. Only intention was a significant predictor of behaviour. Past behaviour accounted for an extra 3.6% of variance in behaviour a small but significant increase.

3.3. Interventions

Table 3 shows the mean behaviour and PBC scores before and after interventions over the three conditions. A one-way ANOVA was conducted. As seen in Table 1, attitudes, subjective norm and PBC made a significant contribution to the prediction of intention. The TPB predicted 32.8% of the variance in intention to prepare food hygienically. Past behaviour predicted an additional 5.6% of the variance in intention, which was a significant increase.

In predicting behaviour, Table 2 shows that intention and PBC predicted 14.5% of the variance in behaviour. Only intention was a significant predictor of behaviour. Past behaviour accounted for an extra 3.6% of variance in behaviour a small but significant increase.

3.4. Knowledge

A qualitative analysis on the food hygiene knowledge was carried out. Answers were scored out of 6 and participants were given one point if their response was one of the following:

1. Wash hands.
2. Avoid cross contamination, e.g. change cutting boards between meat and vegetables.
3. Clean cooking utensils.
5. Store appropriate foods in fridge/freezer.
6. Check expiry dates.
7. Cook meat thoroughly.

Table 4 shows a summary of the results. Both the interventions increased in knowledge scores at follow-up, whereas the control group stayed the same. An analysis of variance showed that there was a highly significant difference between conditions in increasing knowledge $F_{2,182} = 7.09, p = .001$. Bonferroni post hoc analyses revealed that participants in the intervention B group significantly increased their knowledge scores at time two compared to the control group ($p = .001$).

4. Discussion

The current study investigated whether theory based interventions drawn from previous literature would increase the occurrence of hygienic food handling behaviour when preparing and cooking meals. The Theory of Planned Behaviour was fairly successful at predicting intention, explaining 33% of the variance. This is comparable but slightly lower than the proportion reported in a meta-analysis of studies using the TPB (Armitage & Connor, 2001).

### Table 1
Hierarchical regression of attitudes, subjective norm, PBC and past behaviour into intention.

<table>
<thead>
<tr>
<th></th>
<th>$\beta$</th>
<th>t</th>
<th>$R^2$</th>
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<tbody>
<tr>
<td><strong>Step 1:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes</td>
<td>.259</td>
<td>4.03**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subjective norm</td>
<td>.135</td>
<td>2.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBC</td>
<td>.366</td>
<td>5.65**</td>
<td>.328</td>
<td>31.10**</td>
</tr>
<tr>
<td><strong>Step 2:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes</td>
<td>.216</td>
<td>3.45**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subjective norm</td>
<td>.173</td>
<td>2.86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBC</td>
<td>.286</td>
<td>4.40**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Past behaviour</td>
<td>.245</td>
<td>3.93**</td>
<td>.384</td>
<td>29.58**</td>
</tr>
</tbody>
</table>

$^{*} p < .05$.  
$^{**} p < .01$.  

### Table 2
Hierarchical regression of TPB and past behaviour into behaviour.

<table>
<thead>
<tr>
<th></th>
<th>$\beta$</th>
<th>t</th>
<th>$R^2$</th>
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<tbody>
<tr>
<td><strong>Step 1:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention</td>
<td>.294</td>
<td>3.73**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBC</td>
<td>.139</td>
<td>1.76</td>
<td>0.145</td>
<td>15.93**</td>
</tr>
<tr>
<td><strong>Step 2:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention</td>
<td>.233</td>
<td>2.91**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBC</td>
<td>.099</td>
<td>1.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Past behaviour</td>
<td>.209</td>
<td>2.12**</td>
<td>0.181</td>
<td>13.29**</td>
</tr>
</tbody>
</table>

$^{*} p < .05$.  
$^{**} p < .01$.  

### Table 3
Mean baseline and 4 week follow-up knowledge scores.

<table>
<thead>
<tr>
<th></th>
<th>Pre score M (SD)</th>
<th>Post score M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention A</td>
<td>3.49 (1.08)</td>
<td>3.80 (1.05)</td>
</tr>
<tr>
<td>Intervention B</td>
<td>2.67 (1.13)</td>
<td>3.52 (1.03)</td>
</tr>
<tr>
<td>Control</td>
<td>2.70 (.90)</td>
<td>2.67 (1.00)</td>
</tr>
<tr>
<td>Total</td>
<td>2.95 (1.10)</td>
<td>3.33 (1.13)</td>
</tr>
</tbody>
</table>

### Table 4
Mean baseline and 4 week follow-up behaviour proportion and PBC scores.

<table>
<thead>
<tr>
<th></th>
<th>Baseline meals</th>
<th>4 week meals</th>
<th>Baseline beh prop</th>
<th>4 week beh prop</th>
<th>Baseline PBC</th>
<th>4 week PBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention A</td>
<td>9.558</td>
<td>9.951</td>
<td>.815</td>
<td>.823</td>
<td>5.723</td>
<td>5.648</td>
</tr>
<tr>
<td>Intervention B</td>
<td>8.849</td>
<td>10.096</td>
<td>.823</td>
<td>.835</td>
<td>5.712</td>
<td>6.464</td>
</tr>
<tr>
<td>Control</td>
<td>9.578</td>
<td>10.55</td>
<td>.834</td>
<td>.895</td>
<td>5.945</td>
<td>6.171</td>
</tr>
<tr>
<td>Total</td>
<td>9.333</td>
<td>10.196</td>
<td>.824</td>
<td>.891</td>
<td>5.792</td>
<td>6.098</td>
</tr>
</tbody>
</table>
PBC was the most significant predictor of intention confirming the importance of creating interventions aimed at increasing PBC. Similarly to previous research using the TPB, the model was less successful at predicting behaviour 4 weeks later, predicting only 15% of behaviour. Past behaviour was found to only slightly increase the proportion of variance predicted in behaviour. The results of the current study are likely to be more conservative as the behaviour measure used in the current study was more precise. Compared to the previous TPB study (Mullan & Wong, 2009) that measured how many days per week participants prepared food hygienically, the current study asked how many meals per week the behaviour was performed (out of 21) and then calculated a proportion of how many meals were prepared hygienically over how many meals were actually cooked during that week. These results demonstrate the applicability of the TPB to this behavioural arena, however future research could consider such factors as moral norms (for example, it may be that cooking food for other people has a moral component that impacts upon people's behaviour) and affective beliefs (for example, it may be that aspects of food hygiene elicit strong emotional responses such as disgust, which impact on the prediction of behaviour) (Conner & Armitage, 1998).

The interventions were designed to increase knowledge and implementation intentions (Intervention A) and knowledge, implementation intentions and PBC (Intervention B). The PBC intervention was effective at changing PBC, and this provides fruitful avenues for future research. However, despite this neither of the interventions was found to significantly increase behaviour at time two. This is in contrast to previous studies that have found implementation intentions to increase behaviour for a number of different health behaviours (Brickell, Chatzisarantis, & Pretty, 2006b; Gratton et al., 2007; Luszczynska et al., 2007). In the case of food hygiene behaviours however, it could be the case that participants did not actively want to change their behaviour as they already believed they were performing the correct behaviours. For example, participants may state that they are washing their hands before preparing food, however they may not be doing so correctly (i.e. wet hands, lather for at least 10 s, rinse and dry thoroughly). As well, interventions using implementation intentions have usually targeted a group that intended to change their behaviour (Luszczynska, Tryburcy et al., 2007). Across all groups there was a high baseline percentage (48.7%) of participants indicating that they prepared food hygienically every time they cooked a meal, and on average participants reported that they were preparing food hygienically 80% of the time in the previous week. Thus participants appeared to believe they were already performing good hygiene behaviours. This however is contradicted by their knowledge scores which indicated that participants knew less than three out of six correct food hygiene rules, when assessed at time one.

The current study clearly showed that knowledge of correct food hygiene was fairly low in this population. The most common correct answer was washing hands (45%), followed by cleaning kitchen utensils (23%) and avoiding cross contamination (e.g. change or wash chopping boards for preparing meat and vegetables) (22%). Only 3% of participants said to store appropriate or left-over foods in fridge or freezer, 4% reported that checking expiry dates was important, and 3% to cook meat thoroughly. Only two people (1%) said that changing or washing the dishcloth was an important food hygiene rule. Incorrect answers included 'clean chopping board every month', 'don't sit on the bench', 'keep an eye on the food so nothing gets in'. At time two, knowledge had clearly increased with 92% of participants reporting that washing hands was important, 73% reporting that utensils should be clean, 64% reporting that cross contamination of foods should be avoided, 28% that expiry dates should be checked, 47% that foods should be stored in the fridge/freezer, 8% that dishcloths should be washed or changed and 18% that foods should be heated correctly. In particular, the participants in intervention B scored significantly higher than controls at follow-up indicating that they had retained some of the information provided to them in the intervention.

This research thus demonstrates the importance of food hygiene interventions which target not only social cognitive determinants of behaviour, but also knowledge. Additionally, psychological theory has long argued that knowledge alone is not sufficient to change behaviour, but it can also be contended form this research that behaviour change without knowledge is equally unlikely.

In conducting this study, a number of limitations became apparent, which must be taken into account when considering the results obtained. Firstly, the results may have been affected by social desirability bias, in that asking participants to state their intentions, in terms of performing hygienic food-handling behaviours, may have led to participants being more likely to subsequently implement this behaviour than they may otherwise have been. This is problematic in that the level of hygienic food handling behaviour recorded may be an overestimation. However, as all study groups would have been equally affected by this bias, any differences between the groups could still be attributed to the interventions, which was the primary aim of the current study.

Additionally, recent research (Sandberg & Conner, 2008) has demonstrated that purely measuring the components of the TPB at time one is sufficient to change behaviour at time two. It is suggested that the pathway to behaviour change in this instance relates to making the particular behaviour salient. Thus, future research needs to have a control group where PBC variables are not measured at time one.

A second consideration is that the behaviour of participants may have changed over the 4 week duration of the study. For example, participants may have immediately acted upon their intentions and prepared all meals hygienically for the first 2 weeks of the study, but then failed to maintain this behaviour into the third and fourth week. Only the final week of the study was examined to obtain a behaviour score, thus this score may not have been representative of participants overall behaviour. Taking this into account, future research could perhaps assess behaviour weekly over the study period, which would provide a more accurate representation of behaviour, and may prevent distorted recall. In this way, future studies could also assess if one intervention produced more stable behaviour than the other, or than the control group.

Given the high rate of incidence of foodborne illness and thus its status as a significant public health problem, it is important that further research be conducted in the domain of food hygiene. Future studies could perhaps employ an observational method when assessing the effectiveness of food hygiene interventions, in order to avoid problems often associated with self-report, such as distorted recall and social desirability bias. However, observational studies are often more expensive and difficult to conduct, requiring video systems and trained coders, which is a drawback to this type of study. Further research could also consider strengthening the intervention used in the current study, perhaps through increasing the amount of information provided, or varying the medium through which the material was presented.

5. Conclusion

In conclusion, the TPB model was found to be a reliable model for predicting food hygiene behaviours, providing further support for the utility of the TPB in this health domain. Additionally, the interventions devised for this study were shown to be effective in terms of increasing PBC, and increasing knowledge. Although food hygiene behaviours were not significantly improved as a result of either intervention, these results provide a platform from which to conduct future research into theory driven interventions.
References


