Examining the predictive utility of an extended theory of planned behaviour model in the context of specific individual safe food-handling.

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Examining the predictive utility of an extended theory of planned behavior model in the context of specific individual safe food-handling.
Abstract

Background: In order to minimise the occurrence of food-borne illness, it is recommended that individuals perform safe food-handling behaviours, such as cooking food properly, cleaning hands and surfaces before preparing food, keeping food at the correct temperature, and avoiding unsafe foods. Previous research examining the determinants of safe food-handling behaviour has producing mixed results; however, this may be due to the fact that this research examined these behaviours as a totality, rather than considering the determinants of each behaviour separately. As such, the objective for the present study was to examine the predictors of the four aforementioned safe food-handling behaviours by applying an extended theory of planned behaviour to the prediction of each distinct behaviour. Method: Participants were 170 students who completed theory of planned behaviour measures, with the addition of moral norm and habit strength at time 1, and behaviour measures one week later.

Results: While the influence of injunctive and descriptive norm and perceived behavioural control differed between behaviours, it appeared that moral norm was an important predictor of intention to engage in each of the four behaviours. Similarly, habit strength was an important predictor of each of the behaviours and moderated the relationship between intention and behaviour for the behaviour of avoiding unsafe food.

Conclusion: The implication of these findings is that examining safe food-handling behaviours separately, rather than as a totality, may result in meaningful distinctions between the predictors of these behaviours.

Keywords: The theory of planned behaviour, food-handling behaviours, food safety, habit, moral norm
Introduction

Foodborne disease is a global problem (Kuchenmüller et al., 2009) that not only affects individual health and wellbeing, but also impacts upon society by way of extensive costs related to both sick leave and medical expenses (Hall et al., 2005; Mullan, 2009). Data from Australia and North America shows that approximately one quarter of the population will experience illness due to foodborne pathogens each year (McKercher, 2012; Scallan et al., 2011). It has, however, been suggested that this approximation underestimates the true rate of foodborne disease, as many individuals do not seek medical treatment, resulting in an underreporting of cases (Hall, Yohannes, Raupach, Becker, & Kirk, 2008; Majowicz et al., 2005). Additionally, recent data suggests that the incidence of foodborne disease is increasing (McKercher, 2012).

A substantial proportion of foodborne disease occurs in the home (Griffith, Mullan, & Price, 1995), with estimates ranging from 50% to 87% (Clayton, Griffith, & Price, 2003). Fortunately, many of these illnesses are preventable by safe food-handling behaviours exercised during all stages of food preparation and storage (Scharff, 2010). For example, early research suggested that correct temperature control, avoiding preparation of food too far in advance of cooking, and avoiding cross-contamination from other foods and utensils, can all reduce the risk of foodborne disease (Roberts, 1982; Bryan, 1988 as cited in Mullan, 2009). More recently, Azevedo, Albano, Silva, and Teixeira (2014) proposed that correct hand hygiene and taking precautions when cooking, storing, and preparing food, could also reduce this risk. Specifically in Australia, the National guidelines recommend that the following four behaviours should be performed in order to minimise the occurrence of foodborne disease: ‘cook food properly’, ‘clean hands and surfaces before preparing food’, ‘keep food at the correct temperature’, and ‘avoid unsafe foods’ (Food Safety and Regulatory Activities, 2011). Previous research attempting to predict and explain engagement in safe
food-handling behaviour has produced inconsistent results (for a review, see: Redmond & Griffith, 2003). This may be due to the fact that the majority of research to date has considered safe food-handling behaviours as a totality (Mullan, Wong, Davis, Todd, & Kothe, In Press), rather than considering the determinants of each of the different behaviours separately. Given the variety of behaviours corresponding to safe food-handling (Azevedo et al., 2014; Food Safety and Regulatory Activities, 2011), it is likely that individual safe food-handling behaviours are determined by different factors.

Various theoretical frameworks have been applied to the explanation and prediction of safe food-handling behaviours, including the Health Action Process Approach (Chow & Mullan, 2010), and the Health Belief Model (Bearth, Cousin, & Siegrist, 2014; Rimal, 2000). The model that appears to account for the most variance in behaviour is, however, the Theory of Planned Behaviour (TPB; Mari, Tiozzo, Capozza, & Ravarotto, 2012; Mullan & Wong, 2009; Mullan, Wong, & Kothe, 2013; Seaman & Eves, 2010; Shapiro, Porticella, Jiang, & Gravani, 2011), which has been applied to both overall safe food-handling behaviour, as well as specific behaviours including hand hygiene (Clayton & Griffith, 2008) and cooking food properly (Mari et al., 2012).

The TPB posits that the most proximal predictor of behaviour is one’s intention to perform that behaviour (Ajzen, 1991). Intention is in turn influenced by perceptions of the likely outcome of behaviour and an evaluation of these outcomes as positive or negative (attitudes), perceptions of pressure from significant others to perform the behaviour (subjective norm), and perceptions of confidence or self-efficacy in overcoming any barriers to the performance of the behaviour (perceived behavioural control; PBC). The TPB has been shown to be a valid model in the prediction of intentions and behaviour across a wide range of health-related behaviours (Armitage & Conner, 2001; McEachan, Conner, Taylor, & Lawton, 2011). Regarding safe food-handling behaviours, the TPB constructs of attitude,
subjective norm, and PBC have been shown to account for two thirds of the variance in
intention to perform safe food-handling behaviours, although only subjective norms and
PBC, not attitudes, were significant predictors (Mullan & Wong, 2009).

Applications of the TPB to the prediction of safe food-handling behaviours do,
however, result in a finding that is common within the TPB literature; that is, that a
proportion of individuals fail to translate their positive intentions into behaviour, leaving
what is commonly referred to as the ‘intention-behaviour gap’ (Sheeran, 2002). For example,
Mullan and Wong (2009) found that intention only predicted 21 percent of the variance in
safe food-handling behaviour, leaving a significant proportion of the variance unexplained.
Consequently, the TPB, which is primarily a motivational rather than a volitional model, has
been criticised as being incomplete (Sniehotta, Presseau, & Araújo-Soares, 2014), and
numerous researchers have therefore included additional variables in attempts to improve the
prediction of behaviour and explain why some individuals fail to translate their (usually)
positive intentions into action (e.g., Reuter et al., 2010; Sainsbury, Mullan, & Sharpe, 2013;
Sniehotta, Scholz, & Schwarzer, 2005).

Moral norm is one variable that has been added to the standard TPB, both as a pre-
intentional predictor (Conner & Armitage, 1998; Manstead, 2000) and a direct predictor of
behaviour (Godin, Gagnon, Lambert, & Conner, 2005), as well as specifically to bridge the
gap between intentions and behaviour (Godin, Conner, & Sheeran, 2005). Moral norm refers
to the perceived moral correctness or incorrectness of a particular behaviour (Ajzen, 1991),
and is used to aid in the prediction of behaviours that have consequences beyond the
individual – for example, driving under the influence of alcohol (Moan & Rise, 2011) and
condom use (Godin, Gagnon, et al., 2005). Conner and Armitage (1998) reported an average
increase in the prediction of intention of four percent when moral norms were included in
addition to the standard TPB pre-intention variables (based on 11 studies).
Regarding the influence of moral norms on behaviour, Godin, Conner, et al. (2005) conducted a moderation analysis using data from five previously conducted studies and demonstrated that ‘morally-aligned intentions’ – intentions formed on the basis of the perceived moral correctness of a behaviour – were better predictors of behaviour than intentions that were formed based on the likely outcomes of a behaviour (‘attitudinally-aligned intentions’). Interestingly, despite evidence of an overall moderation effect, this was only significant for the behaviours of smoking, driving over the speed limit, and nurses’ use of universal precautions, all of which would be considered to have a moral component as such actions have the potential to impact other people. In contrast, in the two included studies that measured physical activity – a behaviour that only minimally involves or impacts other people – there was no evidence for a distinction between morally- or attitudinally-aligned intentions on behaviour (Godin, Conner, et al., 2005). Given that cooking and food preparation is an activity often performed for other people, the inclusion of a variable that accounts for whether individuals consider the moral consequences of their actions may be of particular value here (see Clayton & Griffith, 2008, for a relevant study investigating moral norm in hand hygiene behaviours for caterers).

Another variable that has been proposed in order to narrow and explain the intention-behaviour gap is habit strength (Gardner, de Bruijn, & Lally, 2011) – that is, the degree to which the performance of a particular behaviour has become habitual or automatised (Verplanken & Orbell, 2003). Habit strength represents another variable that may be of particular importance in determining safe food-handling behaviour because for many individuals food preparation is likely a repeatedly and routinely performed activity. Ouellette and Wood (1998) contend that behaviours that are performed consistently in stable conditions eventually become habitual and are executed without the need for conscious intention. Given that the context involved in safe food-handling behaviour is typically consistent (i.e., the
kitchen), it is likely that the enactment of certain safe food-handling behaviours have become habitual for many people. Indeed, Brennan, McCarthy and Ritson (2007) found that in relation to engaging in safe food-handling behaviours, habit and past experience were important predictors of future behaviour. Therefore, it may be useful to also account for the role of habit in addition to the TPB variables in the prediction of safe food-handling behaviour.

Study Aims and Hypotheses

The aim of this study was to employ an extended TPB model in an attempt to improve the prediction of the performance of specific safe food-handling behaviours. In particular, the variables of moral norm and habit strength were added to the model and applied to the prediction of four distinct safe food-handling behaviours in order to determine: (1) whether these elements would add to the prediction of intention and behaviour over and above the standard TPB; (2) whether the TPB and additional variables differentially predicted specific safe food-handling behaviours; and (3) whether the addition of habit in particular moderated the intention-behaviour gap. It was hypothesised that the TPB variables of attitude, subjective norm, and PBC would significantly predict the intention to perform each of the four safe food-handling behaviours, and that moral norm would add to the prediction when added after the standard TPB variables. Regarding behaviour, it was predicted that intention and PBC would significantly predict each of the four safe food-handling behaviours, and that habit strength would add to the prediction when added after the TPB variables. Finally, it was hypothesised that habit would interact with intention to predict behaviour, such that intention would not guide the behaviour of individuals with strong safe food-handling behaviour habits.

Method

Design
A prospective design was employed, in which the variables hypothesised to predict
intention and behaviour were measured at Time 1, and engagement in safe food-handling
behaviours was assessed one week later at Time 2.

Participants
Participants were recruited via the University research participation pool scheme, and
those who chose to volunteer were provided with course credit for participation. Eligibility
requirements included that participants had to regularly handle and cook food. It was made
clear to students enrolled in the scheme that participation was entirely voluntary. The
University’s Human Research Ethics Committee approved the study, and all participants gave
informed consent prior to participation.

Materials

Demographics
Participants reported their gender, age, living situation, and ethnicity.

Theory of Planned Behaviour
Attitudes, subjective norm, PBC, and intention were measured using previously
validated questionnaire items, modified to assess each of four distinct safe food-handling
behaviours: (1) Cooking food properly; (2) Cleaning hands and surfaces before preparing
food; (3) Keeping food at the correct temperature; (4) Avoiding unsafe foods. All items were
modified in line with the TPB guidelines (Ajzen, 2002; Francis et al., 2004).

Attitudes were assessed as the mean of six semantic differential scales for each
behaviour (“For me, cooking food properly/cleaning hands and surfaces before preparing
food/keeping food at the correct temperature/avoiding unsafe foods every time I prepare food
over the next week would be: very bad – very good, very unnecessary – very necessary, very
unpleasant – very pleasant, very unenjoyable – very enjoyable, very beneficial – very
harmful, very foolish – very wise”). Participants rated these items on a scale from 1–7 with a
higher score indicating a more positive attitude. The following internal consistency estimates were obtained in this sample (cook food properly: $\alpha = .882$; wash hands/clean surfaces: $\alpha = .848$; correct temperature: $\alpha = .878$; avoid unsafe foods: $\alpha = .856$).

Subjective Norm was divided into injunctive norm (“Most people who are important to me would want me to cook food properly/clean my hands and surfaces before preparing food/keep food at the correct temperature/avoid unsafe foods every time I prepare food over the next week”) and descriptive norm (“Most people who are important to me will cook food properly/clean hands and surfaces before preparing food/keep food at the correct temperature/avoid unsafe foods every time they prepare food over the next week”), for each behaviour. Participants rated each item on a seven-point scale (1 = strongly disagree; 7 = strongly agree), with higher scores indicating higher perceptions of normative pressure. The decision to use separate scores for injunctive and descriptive norms, rather than use a composite subjective norm score, was based on low internal consistency estimates when the scores were combined.

PBC was assessed as the mean of three items for each behaviour (e.g., “If I wanted to, I could easily cook food properly/clean hands and surfaces before preparing food/keep food at the correct temperature/avoid unsafe foods every time I prepare food over the next week”), rated on a seven-point scale (1 = strongly disagree; 7 = strongly agree), with higher scores indicating greater perceived control over the behaviours. The following internal consistency estimates were obtained in this sample (cook food properly: $\alpha = .766$; wash hands/clean surfaces: $\alpha = .805$; correct temperature: $\alpha = .764$; avoid unsafe foods: $\alpha = .749$).

Behavioural Intention was assessed using two items for each behaviour (e.g., “I intend to cook food properly/clean hands and surfaces before preparing food/keep food at the correct temperature/avoid unsafe foods every time I prepare food over the next week”), rated on a seven-point scale (1 = strongly disagree; 7 = strongly agree), with higher scores indicating
greater intention to perform safe food-handling behaviours. The following internal
consistency estimates were obtained in this sample (cook food properly: $\alpha = .906$; wash
hands/clean surfaces: $\alpha = .875$; correct temperature: $\alpha = .900$; avoid unsafe foods: $\alpha = .914$).

Behaviour was measured by a self-report item in which participants were asked to
indicate their engagement in each of the four safe food-handling behaviours over the previous
week ("How many times over the past week did you prepare food? Of these how many times
did you cook food properly/clean hands and surfaces before preparing food/keep food at the
correct temperature/avoid unsafe foods?"). The total number of times each participant had
prepared food over the week (maximum = 28; based on breakfast, lunch, dinner, and snacks
over the course of a 7-day week) was then calculated and formed the denominator of each
ratio; the total number of times each participant had prepared food hygienically by engaging
in each of the four specific safe food-handling behaviours was also calculated and formed the
numerator for each ratio. The final behavioural outcome variables reflected the proportion of
times (%) that participants had prepared food hygienically using each of the four specified
behaviours.

*Moral Norm*

Moral norm was measured as the mean of four items, assessed separately for each of
the four behaviours (e.g., "It is within my principles to cook food properly/clean my hands
and surfaces before preparing food/keep food at the correct temperature/avoid unsafe foods
every time I prepare food over the next week"). Participants rated items on a seven-point
scale (1 = strongly disagree; 7 = strongly agree), with higher scores indicating greater
perceived moral correctness of safe food-handling behaviour. The following internal
consistency estimates were obtained in this sample (cook food properly: $\alpha = .695$; wash
hands/clean surfaces: $\alpha = .778$; correct temperature: $\alpha = .779$; avoid unsafe foods: $\alpha = .712$).

*Habit Strength*
Habit strength of each behaviour was measured using the 4-item self-report behavioural automaticity index (Gardner, Abraham, Lally, & de Bruijn, 2012). Participants indicated on a seven-point scale (1 = strongly disagree – 7 = strongly agree) the extent to which each behaviour was something: “I do automatically”; “I do without having to consciously remember”, “I do without thinking”, “I start doing before I realise I’m doing”. Total automaticity scores range from 1 to 7 (weighted sum of four items) and higher scores indicate greater habit strength. The following internal consistency estimates were obtained (cook food properly: \( \alpha = .937 \); wash hands/clean surfaces: \( \alpha = .977 \); correct temperature: \( \alpha = .948 \); avoid unsafe foods: \( \alpha = .959 \)).

**Procedure**

Participants completed two online questionnaires spaced one week apart. After signing up to the study and providing informed consent, participants were directed to a survey that firstly included descriptions of the four safe food-handling behaviours and what each involved. Participants then completed demographic measures, TPB variables (attitudes, subjective norms, perceived behavioural control, and intention), and measures of moral norm and habit. At time two, participants reported their safe food-handling behaviours over the past week and were then fully debriefed.

**Data Analysis**

A series of hierarchical regression analyses were used to determine the significant predictors of intention to perform each of the following safe food-handling behaviours: (1) Cook food properly; (2) Wash hands and clean cooking surfaces before food preparation; (3) Keep food at the correct temperature; and (4) Avoid unsafe foods. In each case, attitude, injunctive and descriptive norms, and PBC were added at step 1, followed by moral norm at step 2.
A series of hierarchical regression analyses were also used to determine the significant predictors of the four safe food-handling behaviours. In each case, intention and PBC were entered at step 1, followed by habit at step 3, and the intention x habit interaction term at step 3. Simple slopes analyses were used to determine the significance and direction of any significant moderation effects.

**Results**

**Sample characteristics**

One hundred and eighty-eight participants, (77.1% female; age: $M = 19.8, SD = 4.39$, range 17-47), completed the time one questionnaires. The majority of the sample was single, (89.4%), and lived with their parents, (70.7%). Five participants (2.7%), reported that they had children. Of these, 170 also completed the time 2 behaviour measures.

**Descriptive statistics**

Participants reported preparing between 1 and 28 meals in the previous week ($M = 11.8, SD = 4.9$). As shown in Table 1, rates of each of the four safe food-handling behaviours were reasonably high, 77-90%. There were no gender differences in the rates of performance of each of the behaviours, all $p > .05$, and nor was age correlated with any of the behaviours, all $p > .05$. Regarding the TPB and additional variables, participants appeared to hold reasonably positive beliefs and intentions towards safe food-handling, and such behaviours also appeared to have become reasonably habitual (see Table 1).
Table 1. Means, standard deviations (SD), and range for all measured variables

<table>
<thead>
<tr>
<th></th>
<th>Cook food properly</th>
<th>Wash hands/clean surfaces</th>
<th>Correct temperature</th>
<th>Avoid unsafe foods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td>Intention</td>
<td>5.34</td>
<td>0.70</td>
<td>3–6</td>
<td>5.28</td>
</tr>
<tr>
<td>Attitude</td>
<td>6.08</td>
<td>0.85</td>
<td>1–7</td>
<td>5.85</td>
</tr>
<tr>
<td>Injunctive norm</td>
<td>6.25</td>
<td>0.86</td>
<td>3–7</td>
<td>6.23</td>
</tr>
<tr>
<td>Descriptive norm</td>
<td>5.94</td>
<td>1.03</td>
<td>2–7</td>
<td>5.51</td>
</tr>
<tr>
<td>PBC</td>
<td>6.30</td>
<td>0.75</td>
<td>3.33–7</td>
<td>6.42</td>
</tr>
<tr>
<td>Moral norm</td>
<td>6.04</td>
<td>0.80</td>
<td>2.5–7</td>
<td>5.95</td>
</tr>
<tr>
<td>Habit</td>
<td>5.77</td>
<td>1.10</td>
<td>2–7</td>
<td>5.61</td>
</tr>
<tr>
<td>Behaviour (%)</td>
<td>87.72</td>
<td>24.72</td>
<td>0–100</td>
<td>77.13</td>
</tr>
</tbody>
</table>

Note: PBC = perceived behavioural control
As can be seen in Tables 2 – 5, strong positive inter-correlations were observed between the TPB variables for each of the four behaviours, as well as between TPB variables and habit. The relationships with behaviour were more variable – none of the TPB or additional variables was significantly related to cooking food properly. Regarding washing hands and cleaning surfaces, all variables with the exception of injunctive norms were significantly positively correlated with behaviour. Regarding keeping food at the correct temperature, all variables except intention and descriptive norms were related to behaviour. Finally, regarding avoiding unsafe food, higher rates of behaviour were significantly related to intention, attitude, moral norms, and habit. Strong positive correlations were also observed across behaviours for each of intention, attitude, descriptive, injunctive, and moral norms, PBC, and habit, all $p < .001$; not shown.
Table 2. Correlations between TPB and additional variables: Cook food properly

<table>
<thead>
<tr>
<th></th>
<th>Attitude</th>
<th>DN</th>
<th>IN</th>
<th>PBC</th>
<th>MN</th>
<th>Habit</th>
<th>Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention</td>
<td>.370***</td>
<td>.310***</td>
<td>.554***</td>
<td>.681***</td>
<td>.550***</td>
<td>.405***</td>
<td>-.020</td>
</tr>
<tr>
<td>Attitude</td>
<td>-</td>
<td>.298***</td>
<td>.481***</td>
<td>.536***</td>
<td>.596***</td>
<td>.321***</td>
<td>-.001</td>
</tr>
<tr>
<td>DN</td>
<td>-</td>
<td>.425***</td>
<td>.370***</td>
<td>.373***</td>
<td>.305***</td>
<td>-.069</td>
<td></td>
</tr>
<tr>
<td>IN</td>
<td>-</td>
<td>.626***</td>
<td>.580***</td>
<td>.321***</td>
<td>-.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBC</td>
<td>-</td>
<td>.649***</td>
<td>.442***</td>
<td>.113</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MN</td>
<td>-</td>
<td>.497***</td>
<td>.042</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Habit</td>
<td>-</td>
<td></td>
<td>.044</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behaviour</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: DN = descriptive norm; IN = injunctive norm; PBC = perceived behavioural control; MN = moral norm, ***p < .001
### Table 3. Correlations between TPB and additional variables: Wash hands and clean surfaces

<table>
<thead>
<tr>
<th></th>
<th>Attitude</th>
<th>DN</th>
<th>IN</th>
<th>PBC</th>
<th>MN</th>
<th>Habit</th>
<th>Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention</td>
<td>.448***</td>
<td>.251***</td>
<td>.534***</td>
<td>.640***</td>
<td>.607***</td>
<td>.499***</td>
<td>.204**</td>
</tr>
<tr>
<td>Attitude</td>
<td>-</td>
<td>.276***</td>
<td>.429***</td>
<td>.447***</td>
<td>.610***</td>
<td>.416***</td>
<td>.201**</td>
</tr>
<tr>
<td>DN</td>
<td>-</td>
<td>-</td>
<td>.397***</td>
<td>.249**</td>
<td>.411***</td>
<td>.399***</td>
<td>.152*</td>
</tr>
<tr>
<td>IN</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.646***</td>
<td>.512***</td>
<td>.467***</td>
<td>.071</td>
</tr>
<tr>
<td>PBC</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.572***</td>
<td>.472***</td>
<td>.183*</td>
</tr>
<tr>
<td>MN</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.664***</td>
<td>.272***</td>
</tr>
<tr>
<td>Habit</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.338***</td>
</tr>
</tbody>
</table>

Note: DN = descriptive norm; IN = injunctive norm; PBC = perceived behavioural control; MN = moral norm, ***p < .001, **p < .01, *p < .05.
Table 4. Correlations between TPB and additional variables: Keep food at the correct temperature

<table>
<thead>
<tr>
<th></th>
<th>Attitude</th>
<th>DN</th>
<th>IN</th>
<th>PBC</th>
<th>MN</th>
<th>Habit</th>
<th>Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention</td>
<td>.481***</td>
<td>.254***</td>
<td>.531***</td>
<td>.643***</td>
<td>.539***</td>
<td>.365***</td>
<td>.097</td>
</tr>
<tr>
<td>Attitude</td>
<td>.325***</td>
<td>.536***</td>
<td>.562***</td>
<td>.525***</td>
<td>.340***</td>
<td>.150*</td>
<td></td>
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<td>DN</td>
<td></td>
<td>.396***</td>
<td>.319***</td>
<td>.465***</td>
<td>.329***</td>
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<td></td>
</tr>
<tr>
<td>IN</td>
<td></td>
<td></td>
<td>.651***</td>
<td>.493***</td>
<td>.252***</td>
<td>.158*</td>
<td></td>
</tr>
<tr>
<td>PBC</td>
<td></td>
<td></td>
<td></td>
<td>.581***</td>
<td>.319***</td>
<td>.187*</td>
<td></td>
</tr>
<tr>
<td>MN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.582***</td>
<td>.190*</td>
<td></td>
</tr>
<tr>
<td>Habit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.278***</td>
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<tr>
<td>Behaviour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: DN = descriptive norm; IN = injunctive norm; PBC = perceived behavioural control; MN = moral norm, ***p < .001, *p < .05
Table 5. Correlations between TPB and additional variables: Avoid unsafe foods

<table>
<thead>
<tr>
<th></th>
<th>Attitude</th>
<th>DN</th>
<th>IN</th>
<th>PBC</th>
<th>MN</th>
<th>Habit</th>
<th>Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention</td>
<td>.463***</td>
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<td>.480***</td>
<td>.571***</td>
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<tr>
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<td>MN</td>
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Note: DN = descriptive norm; IN = injunctive norm; PBC = perceived behavioural control; MN = moral norm, ***p < .001, **p < .01, *p < .05.

Predicting intention and behaviour

Cooking food properly

Intention: At step 1, the TPB variables of attitude, injunctive and descriptive norms, and PBC accounted for 49.2% of the variance in intention to cook food properly, $F(4, 183) = 44.4, p < .001$. Injunctive norm, $\beta = .212, p < .01$, and PBC, $\beta = .61, p < .001$ were the only significant predictors. At step 2, the addition of moral norm furthered the prediction by 1.3%, $p < .05$; $R^2 = .505, F(5, 182) = 37.17, p < .001$. At this step, injunctive norm, $\beta = .180, p < .05$; PBC, $\beta = .504, p < .001$, and moral norm, $\beta = .167, p < .05$, were significant predictors, all other $p > .05$.

Behaviour: None of the included variables (intention, PBC, habit, intention x habit interaction) were significant predictors of the rates of cooking food properly.
over the past week, all $p > .05$. The amount of variance accounted for was very low
and non-significant at each step, final step: $R^2 = .033$, $F(4, 167) = 1.44$, $p = .223$.
Despite the overall model failing to reach significance, PBC was a significant
predictor at all three steps, final step: $\beta = .245$, $p < .05$.

*Washing hands/cleaning surfaces*

Intention: At step 1, the TPB variables of attitude, injunctive and descriptive
norms, and PBC accounted for 46.5% of the variance in the model, $F(4, 183) = 39.84$,
$p < .001$, with attitude, $\beta = .196$, $p < .01$, injunctive norm, $\beta = .149$, $p = .05$, and PBC,
$\beta = .450$, $p < .001$, but not descriptive norm, $p > .05$, making significant independent
contributions to the model. At step 2, the addition of moral norm furthered the
prediction by 4.4%, $p < .001$; $R^2 = .509$, $F(5, 182) = 37.73$, $p < .001$. At this step,
PBC, $\beta = .358$, $p < .001$, and moral norm, $\beta = .304$, $p < .001$, were significant
predictors, while the influence of attitude, $p = .246$, and injunctive norm, $p = .081$,
were reduced to non-significance.

Behaviour: At step 1, intention, $\beta = .148$, $p = .154$, and PBC, $\beta = .082$, $p = .429$,
accounted for 4.5% of the variance, $F(2, 169) = 3.98$, $p < .05$, although neither
variable was independently significant. The addition of habit at step 2 added a further
7.1% to the model, $R^2 = .116$, $p < .001$; $F(3, 168) = 7.38$, $p < .001$, and was the only
significant predictor, $\beta = .313$, $p < .001$. At step 3, the intention x habit interaction
accounted for a further 1.3% of the variance but was not significant, $p > .05$; $R^2 = .130$, $F(4, 167) = 6.23$, $p < .001$.

*Correct temperature*

Intention: At step 1, the TPB variables of attitude, subjective norm, and PBC
accounted for 44.7% of the variance in intention to keep food at the correct
temperature during preparation, $F(4, 183) = 36.96$, $p < .001$, with attitude, $\beta = .137$, $p$
= .05, injunctive norm, $\beta = .155$, $p < .05$, and PBC, $\beta = .465$, $p < .001$, as significant predictors. At step 2, the addition of moral norm furthered the prediction by 2.7%, $p < .01$; $R^2 = .474$, $F(5, 182) = 32.81$, $p < .001$. At this step, PBC, $\beta = .388$, $p < .001$, and moral norm, $\beta = .225$, $p < .01$, were significant predictors. Behaviour: At step 1, intention and PBC accounted for 3.6% of the variance in the rate of keeping food at the right temperature over the past week, $F(2, 169) = 3.19$, $p < .05$, although only PBC, $\beta = .220$, $p < .05$, made a significant contribution to the model. The addition of habit at step 2 accounted for a further 5.8% of the variance, $p < .01$; $R^2 = .095$, $F(3, 168) = 5.86$, $p < .01$. At this step habit was the only significant predictor, $\beta = .260$, $p < .01$. The intention x habit interaction term did not contribute significantly to the model at step 3, $p = .998$.

Avoid unsafe foods

Intention: At step 1, the TPB variables of attitude, descriptive and injunctive norms, and PBC accounted for 37.8% of the variance in intention to avoid unsafe foods, $F(4, 183) = 27.81$, $p < .001$; injunctive norm, $\beta = .177$, $p < .05$; and PBC, $\beta = .386$, $p < .001$, were significant predictors. At step 2, the addition of moral norm furthered the prediction by 4.5%, $p < .001$; $R^2 = .423$, $F(5, 182) = 26.64$, $p < .001$. At this step, injunctive norm, $\beta = .190$, $p < .05$; PBC, $\beta = .277$, $p = .001$; and moral norm, $\beta = .290$, $p < .001$, were significant predictors.

Behaviour: At step 1, intention and PBC accounted for 2.9% of the variance in rates of avoiding unsafe food, but this was not significant, $F(2, 169) = 2.52$, $p = .084$. The addition of habit at step 2 accounted for a further 3.3% of the variance, $p < .05$; $R^2 = .062$, $F(3, 168) = 3.70$, $p < .05$; habit was the only significant predictor, $\beta = .198$, $p < .05$. At step 3, the intention x habit interaction term was also significant and added a further 2.7% to the model, $p < .05$; $R^2 = .089$, $F(4, 167) = 4.06$, $p < .01$, with both
habit, $\beta = .180, p < .05$, and the interaction term, $\beta = -.170, p < .05$, making significant independent contributions.

Simple slope analyses revealed that for low levels of habit (1 SD below the mean) the gradient of the slope, $\beta = 9.667$, was significant, $t(171) = 2.451, p = .015$, indicating that intention predicted behaviour within individuals whose habit strength regarding avoiding unsafe foods was low. For high levels of habit (1 SD above the mean) the gradient of slope, $\beta = -.613$, was not significant, $t(171) = .163, p = .871$, indicating that for those who were avoiding unsafe foods habitually, intention did not predict behaviour (see Figure 1).

![Graph showing intention-habit interaction effect for avoiding unsafe food](image)

**Figure 1.** Intention-habit interaction effect for avoiding unsafe food

**Discussion**

The aim of this study was to examine whether an extended TPB model, which included moral norm and habit strength, could predict four distinct safe food-handling behaviours: cooking food properly, washing hands and cleaning surfaces, keeping food at the correct temperature, and avoiding unsafe food. Consistent with
expectations, the extended TPB predicted between 42 and 51 percent of the variance in intentions for all four behaviours. Previous research using the TPB found that the model could accounted for 66 per cent of the variance in intention (Mullan & Wong, 2009). The lower proportion of variance accounted for here may reflect a discrepancy between an individual’s overall intention to engage in a general set of behaviours (i.e., safe food-handling), and their motivation to actually carry out specific behaviours required to enact that intention. That is, while an individual may hold positive overall beliefs about the importance of safe food-handling, their motivation to perform specific behaviours, which could be perceived as time consuming and requiring conscious effort, may be more limited, meaning that their prediction from such beliefs is also limited. In contrast, another TPB study found that 48 percent of the variance in safe food-handling intentions was accounted for by attitudes, subjective norms, and PBC. This study was, however, conducted on people working in the food industry, 60 percent of whom had undergone safe food-handling training, and as such may have led to different results compared to an untrained sample from the general population.

Although not directly compared here, a similar pattern of results was found in a recently conducted TPB-based study of motivation to recover from anorexia nervosa (Dawson, Mullan, & Sainsbury). Specifically, it was found that while individuals reported strong motivation for recovery in general, they were less motivated to eat normally and gain weight (i.e., the specific behaviours required to achieve recovery). Further, the TPB was found to predict a greater proportion of general recovery-related intentions than behaviour-specific intentions (i.e., eat normally/gain weight). The discrepancy in findings when measuring general versus behaviour-specific intentions is likely to have important implications for measurement in future predictive research, as well as when designing interventions to improve safe food-handling behaviour.
While the extended TPB model was significant in the prediction of intentions across behaviours, subtle differences in the pattern and magnitude of significant predictors for each of the four target behaviours were observed. In line with expectations, normative influences – either injunctive, moral or both – were important predictors of intentions. This was consistent with previous research, whereby moral norm has been shown to be a strong predictor of intentions for behaviours that have consequences beyond the individual (Clayton & Griffith, 2008; Conner & Armitage, 1998; Manstead, 2000). In the cases of washing hands/cleaning surfaces and keeping food at the correct temperature, injunctive norm was significant in the first step, but reduced to non-significance when moral norm was included at step two, whereas for the other two behaviours both moral and injunctive norms were important. It was also interesting to note that participants’ perceptions of what other people actually did (i.e., descriptive norms) were not a significant predictor of intention to perform any behaviour.

Subjective norm has been found to be the weakest predictor of intention across a wide range of behaviours (Armitage & Conner, 2001). The results of the present study, in which descriptive norm did not influence intention to perform any of the behaviours, and the significance of injunctive norm was reduced by the addition of moral norm, reiterate these results. The current results instead suggest that moral norm is a useful predictor of intention to perform safe food-handling behaviours. Thus, it appears that for behaviours that involve or impact upon other people, compared to more individually focused behaviours, intention is more likely to be influenced by moral norm than subjective norm.

Attitudes were significant in the prediction of intentions to wash hands/clean surfaces, keep food at the correct temperature, and avoid unsafe foods \( (p = .051) \) at
step one, but in all cases were reduced to non-significance when moral norms were
added to the model at step two. This is consistent with previous safe food-handling
research, where it was found that attitudes represented the weakest, and in some cases
a non-significant, predictor of intentions after subjective norm and PBC (Fulham &
Mullan, 2011; Mullan & Wong, 2009; Seaman & Eves, 2010). Although a moderation
analysis according to morally- vs. attitudinally-aligned intentions, as was conducted
by Godin, Conner, et al. (2005), was not possible in this study, this finding indirectly
supports the idea that moral norms are an important consideration when examining
behaviours that have consequences beyond the individual, and may influence the
likelihood of translating positive intentions into behaviour. This is important for
designing safe food-handling interventions, as it may be that people are more inclined
to modify their behaviour if it is perceived to also benefit others, compared to
behaviours perceived to only benefit the individual.
Consistent with previous research (Fulham & Mullan, 2011; Mullan & Wong,
2009; Seaman & Eves, 2010), PBC was an important predictor of the intention to
perform all four safe food-handling behaviours. This suggests that interventions
targeting PBC are likely to be of benefit to consumers. Indeed, an intervention
conducted by Milton and Mullan (2012) was successful in improving both PBC and
safe food-handling behaviour (see however, Clayton et al., 2003, for a discrepant
finding). Further, after controlling for condition, the change in PBC accounted for
significant variance (trend level: \( p = .052 \)) in the change in behaviour from baseline to
post-intervention. More research is needed to design and evaluate cost-efficient means
of improving safe food-handling behaviour. The current, and previous research,
would suggest that targeting PBC (which has positive flow-on effects to both
intention and behaviour) is likely to be effective.
The amount of variance accounted for in the actual performance of these food hygiene behaviours was generally low (3-12%), with none of the TPB predictors showing consistent relationships with behaviour. This was contrary to previous research using the TPB, where it was found that, although lower than the prediction of intention, the TPB accounted for between 16 and 21 percent of the variance in safe food-handling behaviour (Fulham & Mullan, 2011; Mullan & Wong, 2009). Again, the lower proportion of variance accounted for here may suggest that individuals are prone to overestimating their performance of safe food-handling behaviour when asked about overall/general behaviour. In contrast, when asked about specific and distinct behaviours, it appears that individuals are better able to accurately recall and provide a temporally relevant estimate of their behaviour, which although lower, is more reflective of the disjunct between relevant cognitions and intentions, and actual behaviour. Further, in a study of hand hygiene that also asked about specific behaviours, less of the variance in intention was explained than in the present study (Clayton & Griffith, 2008). The differences found may be due to the fact that their study was conducted on commercial food handlers as opposed to people preparing food for themselves and others in their household.

Despite the low proportion of variance accounted for across behaviours, a fairly consistent finding was that habit was a significant predictor, such that those with stronger habits were more likely to engage in safe food-handling behaviours (all bar cooking food properly). This is consistent with previous research, which has suggested that for behaviours that are performed repetitively and routinely in stable environments, habit is likely to be a significant predictor of behaviour (Lally, van Jaarsveld, Potts, & Wardle, 2010). Although not previously studied in the context of safe food-handling behaviour, this finding is similar to previous research that found
that past behaviour was the most significant predictor of safe food-handling
behaviour, adding 26 percent over and above the standard TPB variables (Fulham &
Mullan, 2011). Presumably the more that an individual performs a particular
behaviour, the more habitual it will be become, suggesting that both habit and past
behaviour are likely to be important in this area.

Further, regarding the behaviour of avoiding unsafe foods, results revealed a
significant interaction between habit and intention, whereby intention was only an
important predictor for individuals who did not have strong habits. This is consistent
with previous studies that have examined such an interaction, with most finding that
when a behaviour has become habitual, it is likely to be executed without the need for
This finding also has important implications for the design of interventions.
Specifically, it is likely that improving intentions to perform safe food-handling
behaviours will only go part of the way to improving actual behaviour. Instead, what
appears to be needed is the provision of behaviour change techniques to prompt
behaviour and the formation of safe food-handling habits. In this way, the influence or
need for a positive intention is reduced as, once habitual; behaviour is no longer
dependent on conscious motivation. Indeed, a recently published safe food-handling
intervention, which included behaviour change techniques such as providing a cue to
action and reminders (linked to habit formation), was found to be effective in
improving the performance of safe food-handling behaviours relative to an active
control group (Mullan, Allom, Fayn, & Johnston). In addition, a mediator analysis
revealed that the mechanism responsible for change in behaviour was change in habit
strength.

Limitations and Conclusion
This study had some limitations that should be considered when interpreting the results. Firstly, safe food-handling behaviour was measured using self-report, which may have led to an over- or under-estimation of the rates of actual behaviour. Milton and Mullan (2012), however, found that self-reports of safe food-handling behaviour correlated well with objective observations, suggesting that individuals are able to provide a reasonably accurate estimate of their safe food-handling behaviour.

Secondly, the study was conducted on a sample of undergraduate university students, and as such the results may not generalise to other populations. Indeed, previous research has found that young adults are particularly bad at performing safe food-handling behaviours (Byrd-Bredbenner et al., 2007). In addition, as 71% of participants indicated they lived with their parents, this means it is likely that participants are not always responsible for food preparation. Further, previous research has also revealed differences in the utility of the TPB according to age, such that intention and PBC were predictive of safe food-handling behaviour amongst young adults, but were not shown to be predictive amongst older adults (Mari et al., 2012). It may therefore be the case that different predictors are relevant for different age groups. More research is needed to replicate the findings across populations of different ages, as any differences will have important implications for the design of effective, theory-based interventions to improve safe food-handling behaviour and reduce the incidence of foodborne illness. Further, analyses such as SEM may be useful in future studies to consider the relationships between the constructs in more detail. Another potential limitation relates to the fact that while norms were considered, participants were not given the opportunity to specify who the important people are that could influence their behaviour. Perhaps the findings may be different if the salient people were specified. Finally, future research may benefit from
measuring the extent to which individuals view safe food-handling behaviours to be a moral issue, in order to determine whether morally-aligned intentions, versus attitudinally-aligned intentions, better predict behaviours that are perceived to be a moral issue (Godin, Conner, et al., 2005).

There are several important implications of this study, for future research as well as for the design of theory-based interventions to improve safe food-handling behaviour. Firstly, comparing the results of this study with similar previous research, it appears that measurement of general safe food-handling behaviour may lead to an overestimation of intention and behaviour. It is therefore important in future research to examine the prediction of specific safe food-handling behaviours, as it may be that participants are able to more accurately estimate such behaviours. This may also have implications when designing interventions to improve safe food-handling, as it may be that base line levels of behaviours are lower than previous studies have demonstrated and maybe measuring specific behaviours will lead to clearer indications as to efficacy of interventions. Further support for this idea comes from evidence that the translation of intentions into actual behaviour is improved when participants are clear on what, when, and how they are to change their behaviour (e.g., implementation intentions; Gollwitzer, 1999).
References


Dawson, L., Mullan, B., & Sainsbury, K. Using the theory of planned behaviour to measure motivation for recovery in anorexia nervosa. Submitted to *Appetite.*


Highlights

- The TPB predicted each of the four distinct target food hygiene behaviours
- Moral norm was also an important predictor of food hygiene intentions
- Habit strength added to the prediction of behaviour over and above the TPB
- Habit moderated the intention-behaviour gap for avoiding unsafe foods