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Video recorded participant behaviours: the association between food choices and observed behaviours from a web-based diet history interview

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Abstract

Automation of dietary assessments allow participant behaviour to be captured by video observation. They also allow clinicians to identify areas which effect reporting accuracy. This observational study describes the differences in behaviour according to the type of foods selected by participants using a dietary assessment website encompassing diet history methodology.

Keywords

choice behaviour, food, nutrition assessment, observation, video recording

Disciplines

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Background: Automation of dietary assessments allow participant behaviour to be captured by video observation. They also allow clinicians to identify areas which effect reporting accuracy. This observational study describes the differences in behaviour according to the type of foods selected by participants using a dietary assessment website encompassing diet history methodology.

Methods: Eleven free-living adults with type 2 diabetes mellitus were video-recorded while using a dietary assessment website in a laboratory setting. Significant observable events were identified using Transana software and matched for time of occurrence with grouped food item selections from the website. The frequency and proportion of behaviour types per food group were calculated and trends of associations between food groups and observed behaviour type were determined using weighted chi-square analyses.

Results: Sixteen categories of observed behaviour type were constructed from 7724 significant observable events. The food groups with the highest percentage of observed behaviour types were the savoury sauces (7.66%), takeaways (6.47%), sugary foods (6.27%), fats and oils (5.93%), alcoholic beverages (5.93%) - socially undesirable food groups. Self-touching of the face, head movement, postural movement, and movement in chair were observed significantly more often than other observed behaviour types across all food groups.

Conclusions: Behaviours related to the reporting of foods during a dietary assessment may have significant implications for dietary practice.

INTRODUCTION

It is common for individuals to categorise foods based on their reputation as either ‘good’ or ‘bad’ depending on specific food qualities, such as being low calorie, low fat, fresh, or high in vitamins (good); or fried, high in fat, sugar or cholesterol (bad) (Roefs and Jansen, 2002, Oaks and Slotterback, 2001). This presents itself as a potentially important source of systematic bias in dietary self reporting.

The extent to which an individual perceives societal value in the questions being asked and/or expects to be judged determines whether or not bias is expressed in a test situation. Social desirability has been shown to influence reporting accuracy (Tooze et al., 2004, Hebert et al., 2001, Hebert et al., 1997, Horner et al., 2002), and has been demonstrated to be more prevalent in women than in men (Hebert et al., 2001, Horner et al., 2002); and in dieters rather than non-dieters (Oaks and Slotterback, 2002). Overall, there is a greater tendency for individuals to underestimate caloric intake relative to energy requirements (Black et al., 1997, Seal, 1995) than to estimate accurately or overestimate, but this trend also varies with the demographic profile of the population group (Hebert et al., 2001).

In particular population groups (dieters, the obese, and women) the self-reporting of socially undesirable food types (takeaway, high fat, salt or sugar) may evoke feelings of discomfort, distress, worry, fear, shame, nervousness, guilt, anxiety, or stress. The communications literature links these feelings to behaviours, such as adopting a rigid posture, self touching (Argyle, 1988) – especially of the face and head (Eckman and Freisen, 1974), greater movement of the head and legs, aimless fidgeting, and shifting in a

chair when seated (Knapp and Kirk, 2003, Argyle, 1988). In contrast, healthier, more socially desirable foods may evoke less of these behaviours as they are thought to be less likely to bring about disapproval from the dietitian, and/or lead to weight gain/poor health. Moreover, people who are being deceptive or lying will tend to over control cues; they blink, and move the head and limbs less, touch the body more often (Argyle, 1988), and undertake more gaze and postural shifts (Zuckerman et al., 1981). However, to date the literature does not appear to report the use of behavioural responses associated with reporting certain foods.

In face to face dietary assessments, the ability of a dietitian to recognise non-verbal behaviour may potentially aid in minimising social desirability bias. Recognising that a client is shifting in the chair, touching their face, or moving their head around when asked about dessert for example, could assist in determining the appropriate types of questions being asked, how they are asked, and whether or not to ask additional probing questions in order to gain more detail. If a dietitian is successfully able to recognise that a client is feeling uncomfortable, anxious or even being deceitful through their non-verbal behaviour when asked about particular food groups they may wish to offer additional counselling to the client. They could be made aware of the questions that may trigger negative reactions and in turn find more appropriate ways of obtaining valid information without causing anxiety or triggering a deceit response. Such an approach would also allow dietitians to plan ahead when talking to specific population groups.

When selecting or reporting foods during a dietary assessment, the social desirability of a particular food may influence client behaviour; although, neither face to face nor self-recorded dietary assessments allow this behaviour to be captured. Automated dietary assessments allow for ease of manipulation of the data, improved standardisation of the analysis and the ability to incorporate audio and visual data into the assessment with minimal interference. Automated dietary assessments enable body movement and facial expression to be captured at the time of food reporting via video recording.

Automation of the diet history interview has occurred using grouped foods, Australian nutrient data and a multiple pass web-based user interface. The foods were grouped using a combination of iterative statistical analyses of the National Nutrition Survey data of Australia and professional judgement. A prototype of this program (a website) was created for think-aloud usability testing with potential end-users (Probst and Tapsell, 2007). This usability testing was video recorded (Probst et al., 2005) to allow the researchers to determine potential links between website function and food item selection. The aim of this study is to describe the differences in the observed behaviours according to the type of foods selected by participants using a prototype version of the web-based dietary assessment.

METHODS

The web-based dietary assessment method

The website follows the sequence of questioning that a dietitian would take with a client when conducting a diet history interview but through a self-administered format. The first

part of the website asks the user on-screen questions about themselves. These questions include demographic information and food pattern information i.e. meals eaten per day and how often these meals are eaten per week. The remainder of the website is divided into three sequential sections (passes). The first pass asks broad level questions about groups of foods that the user may consume during an average week. These foods relate only to the meals that the user has selected in the food pattern section. The second pass then asks more detail about each of the food groups selected by the user and the final pass requires the user to recall the portion size and frequency of consumption of the foods that they consume.

Participants

Adults with type 2 diabetes mellitus from University staff and previous clinical trials were recruited for usability testing by convenience sampling. Participants who were not literate in English were excluded. Further detail about participant recruitment has been reported elsewhere (Probst and Tapsell, 2007). All participants provided informed consent prior to participation in the study and ethics approval was provided by the University of Wollongong Human Research Ethics Committee. This study uses data from n=11 participants of phase one of the usability testing of the website for which video data was available (Probst et al., 2007).

Design

Participants were asked to think out aloud while using the website. For use of the website (approximately 60 minutes) participants worked individually in a laboratory setting under researcher observation to recall one week of their dietary intake using a combination of diet

history and food frequency questionnaire methodology. The combined approach was required as a computer is unable to converse as a dietitian would do in a diet history interview, hence the added food frequency components. All participants were videorecorded while using the website using two different camera angles to monitor observed behavioural responses to the program. Two angles were required to capture both the facial and bodily movements of the participants. When using the website, participants logged on using a unique identifier code. The website automatically logged user interactions with the website and created a log file for each participant.

Video analysis

The original footage was recorded on mini-DV tapes. The data from the individual mini-DV tapes was captured in real time into mpeg2 format using Pinnacle Studio (version 9, Pinnacle Systems International) and then edited using Pinnacle Studio 9. Camera 1 footage was reduced in size by approximately 60% and overlaid over the camera 2 footage, to give a picture in picture effect (Figure 1). The two views were synchronized to begin at the same time point using the sound files as both cameras could not be started at the exact same time point. This synchronisation ensured the correct facial movements corresponded with the bodily movements. Once complete, the files were converted to MP3. Audio data was transcribed using Microsoft Word (2000 edition, Microsoft Corporation, USA) and checked for accuracy. Video files were further converted to mpeg1 360x240 format using TMPEnc resulting in approximately 2GB per 60min video footage. The final files were then burnt to DVD.

Analysis of all the videos was conducted separately by two researchers using Transana analysis software (version 2.05, Wisconsin Centre for Educational Research www.transana.com). Both researchers were unaware of the aims of the present study and the analysis task was performed before any food-related data was downloaded from the website. To reduce error, both of the researchers were asked to analyse a subset of the same videos and their results were compared upon completion. Keywords were created in the program by the researchers to describe non-verbal aspects of communication: for example, frowning, leaning forward in the chair, tapping the desk (significant observable movements). These keywords were updated as new descriptions were required. Episodes (locations for uploading video information) were created for each participant. Video files were attached to these episodes and transcripts were then uploaded individually for each participant in .rtf format. Time stamps were added to the transcript to link the transcript with the video footage and keywords were then assigned to the transcript. Clips (pieces of the video files) were created as snippets of each episode in which significant movements (defined by the keywords) were observed. Finally collections (groups of similarly themed clips) were created, indicating changes in the non-verbal communication of the participant as seen in the video (Figure 2). Keyword reports were generated for each researcher.

Grouping food items

The participant log files tracked participant progress through the website from login to logout. The log files were cleaned to include only food related events. Food entries from the website were then grouped and coded (Commonwealth Department of Health and Aged Care, 1998) by the researchers. The food groups were based on the Australian Guide to

Healthy Eating. Additional food groups were constructed for non-alcoholic beverages; and sauces, spreads and condiments. Foods listed in newly constructed groups were based on nutrient or conceptual similarities (Wheeler, 2003). “Occasional foods” were grouped as takeaway foods (commercially available and high in fat); sugary foods (foods high in sugar such as cakes, biscuits, confectionary and desserts); fats and oils; and alcohol. These “occasional foods” were also considered to be the least socially desirable food groups (Worsley et al., 1984, Johanssona et al., 2001) and therefore reporting of their component foods would be expected to be linked with different observed behaviours than compared to the more socially desirable food groups.

Linking foods and observed behaviours

The creation of individual clips within each of the episodes allowed links to be created between the clips and the significant observable event (keywords) listed for that clip in the Transana summary reports. Individual observable events were grouped into observable behaviours and coded based on related aspects pertaining to four major categories of behaviour: body movement, facial expression, environmental interaction (interaction with objects within the laboratory setting) or noise. Sub-groups (observed behaviour types) were created for each of these four categories to specify particular types of behaviours depending on what-with or how the movement, interaction or noise was made as described in the communications literature (Manninen, 2003, Argyle, 1988, Sundaram and Webster, 2000, Gabbott and Hogg, 2000).

Food events (items) from the log file and observed behaviour types from Transana were matched for time of occurrence using the start and end times for each clip and the times of website entry from the participant log files. The food items, matched observed behaviour type and their respective behavioural categories were then entered into a Microsoft Excel spreadsheet showing time of occurrence of each food item selection within the clip.

Matched food and grouped behaviour data was transferred into SPSS for Windows (Version 12.0.1, 2003: SPSS Incorporated, Chicago, USA) for analysis. The frequency and proportion of observed behaviour types (%) per food group were calculated. Given the total number of observed behaviour types per food group differed depending on total number of food entries per group, the proportion of observed behaviour types (%) per food group was calculated as a percentage of the total number of entries for that food group. Trends in the proportion and frequency of observed behaviour type between food groups were analysed using weighted chi-square analyses using the non parametric chi-square option command in SPSS. A value of $p < 0.05$ was considered significant. The time taken to complete website entries in the log files were also summed to give a cumulative time per interaction. An analysis for trend using a non parametric test (an extension of the Wilcoxon rank-sum test) (Cuzick, 1985) was conducted. The food groups were ranked from least to most socially desirable using the proportion of times reported. The test for trend then determined whether this ranking was significant at $p < 0.05$ (trend for ranks of across ordered groups). The analysis was performed on STATA using the nptrend command (v 7.0 May 2002: STATA Corporation, College Station, TX USA).

RESULTS

Participants

Analysed video data was available for n=11 subjects. Participants had a mean age of 56.7 ± 8.6 years and included 10 (90.9%) males and one (9.1%) female. Nine (81.9%) participants owned a computer and seven (63.6%) were advanced users. Two (18.2%) were intermediate, and two (18.2%) were beginner computer users, or had never used a computer before. Participants reported being either very comfortable (six, 54.5%) or comfortable (five, 45.5%) when using a computer. Eight (72.7%) of participants were Australian born, with seven (63.6%) in full time work and six (54.5%) having a university level education.

Food groups

Eleven food groups were constructed from 1755 website food entries identified in the log files. Mixed food dishes that contained ingredients from more than one food group were grouped based on professional judgment about which ingredient was contained in largest proportion. For example, pasta with meat sauce was included with the breads, cereals, rice and pasta group as pasta was considered to be the main ingredient. The largest number of food entries were seen for the core food group items - Bread, cereals, rice, pasta, noodles; Vegetables and foods where vegetables were the main ingredient; Fruit and foods where fruit was the main ingredient; Dairy products (milk, yoghurt, cheese and cream); and Meat, seafood, eggs, poultry, nuts and alternatives (Table 1) (Commonwealth Department of Health and Aged Care, 1998).

Behaviour groups

A total of 7724 observable events were identified in the Transana analysis. Auditory changes were considered an event for this count. Four primary behaviour groups and sixteen sub-groups (observed behaviour types) were constructed from 155 observed events identified in the videos. The 16 observed behaviour types were:

Head movement	Mouth movement
Postural movement	Eyebrow movement
Self-touching face	Facial movement
Self-touching body	Non-computer interaction
Hand movement	Computer interaction
Arm movement	Bodily noises
Gaze/eye movement	Breath noise
Movement in chair	Voice noise

Voice alteration (21%) was in the most commonly observed event, followed by head movement (15.5%), self touching of the face (15.3%), and movement in chair (13.4%).

Voice noise also ranked in the top two most commonly observed behaviour types across all food groups. Mumbling - one of the observable events within this observed behaviour type - was the most commonly observed event overall. This justifies the subjects' requirement to talk out aloud while navigating through the website; a technique used for the website usability testing. As voice noise technically represents a form of verbal communication rather than a non-verbal observed behaviour type; subsequent analyses omit voice noise.

The eyebrow movement, facial movement, and mouth movement observed behaviour types were also grouped together as facial movement due to their low frequencies.

Trends

Food groups with the most observable behaviour types were the meat, seafood and alternatives (2126); breads, cereals, rice and pasta (1380); and the vegetables groups (1042). Although, when expressed relative to the total number of food group entries, the highest percentage of observable behaviour types were seen in the socially undesirable food groups. They were the savoury sauces (7.66%), takeaways (6.47%), sugary foods (6.27%), fats and oils (5.93%), alcoholic beverages (5.93%) groups. After removing voice noise, the most commonly observed behaviour type was non-computer interaction (touching items on the desk or on themselves such as glasses) in the savoury sauces (14.0%) group; self touching of the face in the sugary food (20.2%), and fats and oils (16.9%) groups; shifting in the chair in the takeaway food (20.2%) group; and head movement in the alcoholic beverages (21.6%) group (Table 2).

Chi-square analyses revealed that the three food groups with higher overall frequency of observed behaviour types – the savoury sauces, takeaway food, and sugary foods – also all had either non-computer interactions (14.0%) or postural movement (12.8% and 15.2%) in the top three most observed behaviours types (Table 2). The top two most prevalent observed behaviour types for each food group were seen significantly more often in all food groups except takeaway food and the beverages groups.

Repeated chi-square analyses for within observed behaviour type trends revealed significant differences existing for the proportion of observable events within the socially desirable and socially undesirable food groups, across most observable behaviour types except mouth movement and facial movement (data not shown). Savoury sauces, takeaway food and alcoholic beverages shared the largest percentages of observed behaviour types across all food groups, relative to the number of website entries for that group. The analysis of trends test indicated a significant linear trend $z=2.88$, $p<0.001$.

DISCUSSION

Social desirability in food type selection appears to have an influence on the observed behaviours types of participants with type 2 diabetes mellitus during an automated diet history assessment. Observed behaviour types appeared to be influenced by food type when comparing the proportion of observed behaviour types per food group. The social desirability of the food did not appear to influence the type of observed behaviour type, only the frequency of the observations. Head movement, self-touching of the face, and movement in chair were the top three most observed behaviour types overall and rated in the top three groups of observed behaviour types in eight out of eleven food groups and at least two of the top three most observed behaviour types were observed significantly more often for all food groups. This suggests that all food groups may stimulate similar types of observed behaviours types, in different ratios.

Self-touching, especially of the head or face; aimless fidgeting and greater movements of the head and legs are commonly associated with feelings of discomfort, distress, worry,

fear, shame, nervousness, guilt, anxiety, or stress (Argyle, 1988, Eckman and Freisen, 1974). Given these movements/events made up the most commonly observed behaviour types overall, it may be said that all food types evoke feelings of discomfort/anxiety to some degree or perhaps the act of self-reporting dietary intake regardless of food type may bring about some degree of anxiety in people with diabetes. Fidgeting may also be related to the order of the foods. Food selected later in the assessment may be related to more fidgeting by the participants as their focus begins to decline.

Food groups exhibiting the most deceit cues appeared to have a tendency to be seen as 'bad' foods. Deceit has been associated with less head and body movement and more postural and gaze shifts (Zuckerman et al., 1981, Argyle, 1988). Overall decreased body movement was found to be related to the socially desirable food groups. This finding was most likely an association with the social desirability of the food rather than a deceit behaviour, as these groups also displayed proportionally less postural movement and gaze/eye movement observed behaviour types. The alcoholic beverages and savoury sauces groups both had large proportions of postural shifts observed events, although eye/gaze shifting events were only more apparent in the alcoholic beverages group. The finding that individuals show signs of deceit in reporting alcohol intake may also relate to alcohol being frequently underreported (Klatsky et al., 2006, Searles et al., 2002) though this would require a further testing.

The small sample size is a primary limitation of the study and therefore the results should be considered as a case study into the behavioural influence of food selection for a group of

people with diabetes. These subjects were well suited to the study as they were likely to have strong perceptions of 'good' and 'bad' foods. Having diabetes may have meant that they already had a lower intake of socially undesirable food (these foods were less frequently reported).

It cannot be said whether the behaviours observed during human computer interactions are the same and mean the same as they do in face-to-face interaction. Moreover, the meaning of a behaviour may not be singular. The behaviours may be the result of the human-computer interaction rather than a reaction to the food items being reported, however this would require further testing. Furthermore, the need to group the food items may have limited the full extent of observed behaviours types with single foods items within the food groups potentially having more influence on observed behaviour type on their own.

CONCLUSION

Foods have the potential to influence behaviour during dietary assessments. The findings from this study show that there may be a relationship between increased observable behaviour types and the selection of socially undesirable food groups. A larger, more representative and more targeted study would need to be conducted to determine whether a direct association between observed behaviour and specific foods exist. This finding would enable dietitians to better recognise where social desirability bias may be impacting on the information they are collecting during face-to face interviews, Specific associations between foods and behaviours could significantly influence day-to-day dietary practice.

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