Metrics and measurement methods for the monitoring and evaluation of household food waste prevention interventions

Stine Bordier Høj

B. Commerce (Marketing)

Supervisors

Dr Anne Sharp
Professor Drew Dawson

Ehrenberg-Bass Institute for Marketing Science
University of South Australia

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University of South Australia, North Terrace, Adelaide 5001

Stine.Hoj@MarketingScience.info

Abstract

The amount of food wasted by households in developed countries has reached staggering proportions, with indications that up to a quarter of food brought into the home is subsequently discarded uneaten. In Australia alone, it is estimated that AU$5.2 billion worth of food (AU$616 per household) is thrown away by households each year(Baker et al., 2009). Representing a substantial proportion of total household waste, food waste carries a raft of economic, environmental and social consequences. Among these are the depletion of natural resources, emission of greenhouse gases, costs of municipal waste management, pressure on landfills, and the growing strain on global food systems.

While some degree of household food waste is inevitable, for example bones and hard vegetable peelings, theoretically the majority is avoidable. That is, most food waste can be avoided if more suitable practices in relation to food planning, purchasing, storage, and preparation are adopted. Social marketing techniques can be applied to induce modifications in householders' food management practices with the ultimate aim of achieving waste prevention outcomes. Accordingly, there is a requirement for consistently adopted measurement procedures, which can accurately capture and monitor the behavioural outcomes of social marketing efforts, in order to evaluate their effectiveness in meeting targets, prioritise spending, justify further budget provisions, and assist in planning for future strategy. When undertaken in a robust and consistent manner between studies, monitoring and evaluation activities present further benefits by developing a collated knowledge base on food waste prevention – identifying the strengths and weaknesses of available intervention techniques and allowing assessment of the conditions (e.g. targeted groups, behaviours, and waste materials, or incentives provided) that will demonstrate the greatest overall waste prevention impacts – helping to avoid research duplication and maximise the efficiency of limited resources.

Monitoring and evaluation procedures require two key components. First, the set of measures of effectiveness on which social marketing interventions are to be judged (suitable metrics) and second, a research design capable of capturing those metrics and isolating the role that an intervention has had in shifting them (suitable measurement methods). While some metrics must be tailored to strategy, reflecting specific targets and objectives, it is also necessary to adopt comparable metrics that provide some consistent and independent assessment of success across studies. Many waste prevention initiatives report genuine difficulties with monitoring and evaluation, which must be performed within the bounds of substantial resource limitations (budgetary, staff, and skill shortages) and collect information on a phenomenon that is not trivially measured. The 'invisibility' of waste prevention, combined with the fact that many householders do not know what behaviours waste prevention comprises, breeds difficulties in defining appropriate metrics and complicates the collection of data (measurement) for those metrics. The expense or impossibility of collecting observational data means that measurement is often undertaken using householder self-reports, the limitations of which are widely acknowledged. This thesis addresses significant gaps in the waste prevention literature by developing new, empirically based knowledge to expand the evidence base against which food waste interventions are selected and judged. The findings are of great practical significance to both academics and social marketers working in this area.

The thesis adopts the view that a 'hybrid' approach to the monitoring evaluation of food waste prevention initiatives is required and that this involves tracking (1) the level of food waste arisings, i.e. the amount of food discarded in households and (2) survey-based metrics, such as the performance of behaviours that underlie food waste prevention (Read et al., 2009; WRAP, 2010b; Sharp et al., 2010b). Such an approach shows not only *how much* levels of waste have changed, but also *why and what are the barriers to further change*. On this basis, this thesis presents two distinct studies, each of which addresses one component of the 'hybrid' approach. The first study addresses the problem of achieving accurate quantifications of the level of household food waste arisings, while the second study develops a set of behavioural metrics for use in survey-based tracking studies.

The level of waste arisings is arguably an easily definable metric, operationalised simply as some unit of measurement (e.g. weight) of the amount of household food waste produced. Collecting this data, however, is not so straightforward, and although a number of published works have sought to quantify household food waste arisings there has been little consistency in the measurement method adopted. A variety of approaches are taken to derive quantitative estimates, spanning both observational (e.g.

compositional analysis of garbage) and self-report methods (e.g. household waste diaries, questionnaires requiring recall of specific waste events, or broader generalisations about the amount wasted). Although the limitations of self-report data are well documented, and the accuracy with which self-report methods can quantify waste is questionable, they are commonly used in place of the more objective compositional analysis method. Often this is driven out of necessity; under limited evaluation budgets the expense of undertaking compositional analysis, which involves separating food items from other waste left out by households for municipal collection, can preclude it from consideration entirely.

The waste diary method – which requires the respondent to keep a record of all food discarded in their household during a seven-day period – is the most commonly used self-report method for quantifying waste arisings. In comparison with observational methods, the diary method is cost-effective and can be used to collect a rich depth of information that is unattainable from the analysis of trace elements in garbage. Reliance on the householder to collect data over an extended period of time allows the researcher to capture waste to all disposal routes, the reasons for food disposal, and other relevant information such as food purchases made during or prior to the measurement period. This information is of great managerial benefit in understanding the underlying drivers of waste and designing interventions on this basis. While there are indications that the diary method will provide a representative record of the actual amount of food that is discarded during the measurement period (Van Garde and Woodburn, 1987), it is also expected that behavioural reactivity to performing the task – whether conscious or unconscious – will lead to abnormal food usage and disposal patterns. This means that the amount of food discarded during the measurement period may be lower than what is typical for the household (Dowler, 1977; Wenlock et al., 1980; Rathje, 1984b; Van Garde and Woodburn, 1987; Schneider, 2007; WRAP, 2007g). Omissions of waste events from the record, arising for example from a loss of enthusiasm for the task, forgetting to fill in the diary, or concerns of social desirability, may also lead to an underestimation of the quantity of food wasted (Langley et al., 2010). Despite these postulations, no research has yet attempted to empirically quantify the extent to which quantifications of waste from a diary method can be expected to represent typical levels of household food waste arisings.

The first research question in this thesis addresses that research gap. Comparing the quantities of food waste reported in a set of 284 seven-day waste diaries with those observed through compositional analysis of 2138 households' garbage, it finds that – as a general rule of thumb – the diary method returns waste estimates that are only around 60% of the typical amount of household food waste. The main driver of this method bias appears to be underreporting on avoidable waste (that is, food items that are inherently edible and could have been consumed had they been managed better in the household). Not only does the diary significantly underestimate the quantity of avoidable waste produced, but also this category represents two thirds of all waste produced in a household and so divergences in its measurement carry the greatest overall influence over total waste quantifications. On the other hand, diary participants recorded quantities of unavoidable (inedible) waste that were equivalent to those collected using compositional analysis, indicating that there is no method bias for this category of waste.

There are several important implications of these findings. First and foremost, whether compositional analysis is excluded from consideration due to its expense, or a diary method is chosen for its informational benefits, those in charge of diary implementation and interpretation must be aware that waste quantification estimates from this method will not reflect the typical or objectively measured weight of waste that would ordinarily be created in participating households. Secondly, the fact that the diary method bias applies only to food discards that have some inherent level of avoidability and not to inedible or unavoidable byproducts indicates a real sensitivity to food waste issues on the part of householders. This thesis provides the first empirical confirmation of suggestions in the literature that diary respondents will react behaviourally to their participation in the research and / or misreport their discards with reference to conceptions of what is 'socially desirable'. In doing so, this thesis indicates that an important distinction exists between the use of a food waste diary as a pure measurement tool (an impartial or objective indicator of the amount of waste produced) and its use as a mechanism for behavioural change. Where the self-recording of waste is *intended* to have a minimising effect on the amount of food discarded – as a social marketing intervention in itself – the reactivity effect is desirable. While waste estimates from a diary method must be interpreted with caution, the method should be considered as an option for inducing reductions in household food waste.

The second broad research question in this thesis concerns the latter component of a 'hybrid' monitoring and evaluation approach, namely the need for survey-based metrics for household food waste. This component of the monitoring procedure presents greater difficulty not in measurement, but in terms of the actual selection and definition of the set of metrics to track.

To date, the Waste and Resources Action Programme (WRAP)'s 'Committed Food Waste Reducer' (CFWR) metric, a key performance indicator for that organisation since 2006, is the only survey metric that has been consistently adopted, worldwide in the public domain and across time, for the monitoring and evaluation of waste prevention interventions. Collection of the metric is suggested as standard procedure for local UK authorities implementing a food waste intervention (WRAP, 2010c), and in this manner CFWR represents a significant advancement in achieving some comparability between many smaller-scale studies. Furthermore, distinctions between households based on their classification as CFWR (or not) have been shown to reflect real differences in the amount of waste produced, allowing its use as a proxy for changes in waste arisings across a population. CFWR is, however, largely attitudinally based and lacks diagnostic power in identifying the underlying behavioural changes that correspond to changes in waste arisings. Furthermore, although the proportion of UK households classified as CFWR rose steadily from 8% in November 2006 to 17% in October 2008, it remained at 17% in February 2009 and, despite significant investment in food waste campaigns, actually dropped in 2010 (Quested, 2010). This has raised concerns about the sensitivity of the metric and its ability to provide monitoring data that accurately captures population changes in relation to food waste over time.

It is considered in this thesis that the planning and evaluation of social marketing interventions should maintain a strong behavioural focus, and that there are numerous potential benefits from developing a new class of behavioural metrics for monitoring and evaluation. The thesis nominates as candidate metrics ten food management behaviours that are expected, based on the existing literature, to have waste prevention outcomes (relating to food planning, shopping, storage, etc), devising their operationalisation on an individual basis as well as their amalgamation into an overall Behavioural Food Waste Prevention (BFWP) score – a composite metric calculated based on the respondent's performance across the set of behavioural metrics – which can be used for monitoring and segmentation purposes. The second study then assesses whether each of the nominated behaviours does in fact represent a means of waste prevention (and is therefore appropriate for inclusion in the set of metrics) and also whether the overall BFWP metric provides useful distinctions between households that exhibit differing degrees of waste prevention.

The findings indicate that seven of the ten nominated behaviours are appropriate for inclusion in the set of metrics because, considered individually, they are indicative of differences in the amount of food waste produced between households. These behaviours include: checking food in the house before shopping; planning meals in advance; ensuring one knows what to buy before going shopping; avoiding unplanned purchases when shopping; controlling portion sizes; placing left over food into cold storage; and consuming food that is left over after meals. Three of the ten behaviours are excluded from further consideration because their performance shows no relationship with the amount of food wasted in a household. These are: using the refrigerator to extend the shelf life of fruit and vegetables; discarding food on the basis of use-by and best-before dates; and using the freezer to extend the shelf life of food.

An overall BFWP score is calculated for each respondent according to his or her responses to the seven individual metrics deemed suitable for tracking, such that a higher score indicates more desirable food management behaviours across the board. Results show that use of this BFWP metric as a segmentation variable creates useful and meaningful distinctions between households that exhibit differing levels of household food waste, whereby segments of respondents with better BFWP scores discard markedly less food than those with worse BFWP scores. Furthermore, by establishing a discrete distribution of possible scores ranging from 0 to 16 points, the BFWP metric provides a more refined segmentation scheme and greater discriminatory power than is possible under the dichotomous Committed Food Waste Reducer metric. While CFWR successfully isolates a small group of respondents who waste very little food, it only worked to separate around one in 10 respondents from all other householders. In other words, the metric identifies the very best respondents but fails to discriminate between the vast numbers who do not satisfy the CFWR classification. Results under the BFWP segmentation scheme illustrate clearly the shortcomings of that approach by demonstrating that there are in fact differing degrees of waste prevention proficiency between householders who are not classified as the 'best' in this regard. It follows that the BFWP metric, which is able to illustrate movement of the population across a greater number of segments, where each segment that performs better on the metric produces less waste than the last, may consequently provide a more accurate proxy measure for changes in waste tonnages than can a dichotomous metric such as CFWR.