PART II: THE EFFECT OF DATA ON WASTE BEHAVIOUR: THE SOUTH AFRICAN WASTE INFORMATION SYSTEM

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Abstract

Combining the process of learning and the theory of planned behaviour into a new theoretical framework provides an opportunity to explore the impact of data on waste behaviour, and consequently on waste management, in South Africa. Fitting the data to the theoretical framework shows that there are only three constructs which have a significant effect on behaviour, *viz* experience, knowledge, and perceived behavioural control (PBC). Knowledge has a significant influence on all three of the antecedents to behavioural intention (attitude, subjective norm and PBC). However, it is PBC, and not intention, that has the greatest influence on waste behaviour. While respondents may have an intention to act, this intention does not always manifest as actual waste behaviour, suggesting limited volitional control. The theoretical framework accounts for 53.7% of the variance in behaviour, suggesting significant external influences on behaviour not accounted for in the framework. While the theoretical model remains the same, respondents in public and private organisations represent two statistically significant sub-groups in the data set. The theoretical framework accounts for 47.8% of the variance in behaviour of respondents in public waste organisations and 57.6% of the variance in behaviour of respondents in private organisations. The results suggest that respondents in public and private waste organisations are subject to different structural forces that shape knowledge, intention, and resultant waste behaviour.

Keywords: waste behaviour, theory of planned behaviour, learning, waste information system

1. Introduction

The Department of Environmental Affairs (DEA) developed and implemented the South African Waste Information System (SAWIS) in 2006, as part of the National Waste Management Strategy Implementation (NWMSI) project. A project funded by the South African and Danish Governments. The Department requires certain public and private waste organisations to report to SAWIS on the monthly tonnages of waste that they landfill, treat, and reprocess.

An empirical study conducted by the lead author in 2006 (Godfrey & Scott, 2011) explored whether SAWIS could create opportunities beyond simply being a tool for data collection. The authors examined whether collecting data for SAWIS could also build the waste knowledge of those persons tasked with the responsibility of collecting and reporting the data. The authors posited that this new waste knowledge could lead to changes in personal behaviour and ultimately changes in the way organisations manage their waste. The 2006 study, which involved interviews with participant organisations, adopted a qualitative research design, based on an interpretive approach. A theoretical framework of learning (Miller & Morris, 1999) was used to guide the research, as it supported the empirical investigation into the role of data in building knowledge. However, while the theoretical framework provided a useful means of interpreting the interview findings, the results showed that knowledge is a necessary, but insufficient condition for resultant action (Godfrey & Scott, 2011). The theoretical framework was found to be overly simplistic for understanding the role of waste data in a developing country context such as South Africa, in that it did not account for all of the evidence gathered, particularly the existence of behavioural and situational influences (Godfrey & Scott, 2011).

The authors followed up this research from 2006, with a second empirical study in 2011. The aim of this second study is to build a more conceptually inclusive theoretical framework that supports the initial research findings and provides a basis to further explore the research question "*Can the collection of data for a national waste information system change the way waste is managed in South Africa, such that there is a noticeable improvement?*" The authors present an overview of two social-psychological theories with the aim of incrementally constructing a novel theoretical framework that links the collection of waste data with behaviour change. This framework is then applied to the empirical data collected in the 2011 study.   The paper focuses specifically on waste management in South Africa, a developing country in a process of social and political transformation, which faces many waste management challenges (Savage, 2009).

Given the wealth of findings from this second empirical study, the results are presented in two parts. The first paper (Godfrey *et al*., forthcoming) re-examines the relationship between data, theory, and experience in building waste knowledge in South Africa, in 2011. In this, the second paper, the

authors move beyond the role of waste data in building knowledge, to examining the influence of waste data on waste management behaviour.

2. Theoretical framework

2.1 Knowledge as a precursor to action

Environmental information disclosure, science communication and environmental education are three theoretical fields that have provided significant contributions to understanding the impact of environmental information on behaviour (Weiss, 2002; Denisov *et al*., 2005; Stephan *et al*., 2009).

Information strategies have been successfully used internationally as policy instruments to elicit desired policy outcomes by influencing human behaviour, either directly or indirectly (Weiss, 2002; Antweiler & Harrison, 2003; Kolominskas & Sullivan, 2004). According to Weiss (2002), information can influence people's knowledge and awareness of a behaviour. Policy makers then rely on people to use their newly acquired skills to change their behaviour so as to meet the required policy intention. The underlying assumptions of information-behaviour strategies is that people respond to information out of their own accord; that people have limitless capacity to absorb new information; that people have endless motivation to alter their behaviour based on what is considered optimal behaviour; and that knowledge is linked to action (Weiss, 2002). In this approach, agency is seen to be centred on rationality and knowledge.

Scientific opinions differ between those who suggest that making data and information available to individuals can influence actions (Denisov & Christoffersen, 2001; Denisov *et al*., 2005; Stephan *et al*., 2005), and those who believe that a tenuous relationship, if any, exists between knowing what to do and acting on that knowledge (Finger, 1994; Miller & Morris, 1999; Pfeffer & Sutton, 2000; Weiss, 2002; Barr, 2007). Empirical research has shown that in the South African context, the collection of waste data, although not the primary driver, does positively change the way waste is managed within organisations (Godfrey & Scott, 2011; Godfrey *et al*., forthcoming). This is what Denisov & Christoffersen (2001:4) refer to as "*changing patterns of behaviour through raising overall awareness*".

 "*Far more useful than information, and consequently far more difficult to obtain, is the right knowledge*" (Miller & Morris, 1999:75). Empirical evidence shows the importance of knowledge as a precursor to behavioural intention and resultant action for waste recycling, composting and reuse (Fransson & Gärling, 1999; Oom Do Valle, 2005; Barr, 2007; Mosler *et al*., 2008). However, very few behavioural studies have taken matters further to explore the way in which knowledge supports or

inhibits action. In fact, it is not clear from many studies whether the authors, when referring to knowledge, actually mean knowledge or whether they mean information. Often the two terms are used interchangeably, or reference is made to knowledge and the authors go on to discuss the importance of information campaigns or communication strategies (Mosler *et al*., 2008; Fudge & Peters, 2011). Information is not the same as knowledge (Miller & Morris, 1999; Moeletsi & Novella, 2004). Knowledge is created in individuals through the integration of information derived from data; theory that puts that information into the correct context; and experience of real world applications (**Figure 1**) (Allee, 1997; Miller & Morris, 1999; Poch *et al*., 2004; Godfrey *et al*., forthcoming).

The collection, interpretation and internalisation of data, can through a process of learning, raise awareness (Finger, 1994; Denisov & Christoffersen, 2001) and increase knowledge (Miller & Morris, 1999). Dominant frameworks in environmental education assume information to be the basis for generating knowledge, concern and resultant environmental awareness. When combined with value orientations, beliefs and attitudes, these have the potential to influence behaviour (Finger, 1994). The role of information in generating knowledge and raising awareness is seen as a means of changing human behaviour particularly in circumstances where environmental problems exist (McAndrew, 1993; Gardner & Stern, 1996; Denisov & Christoffersen, 2001; Jones, 2001; van Birgelen *et al*., 2009). Trudgill (1990) recognises the lack of knowledge as a barrier to action. According to Trudgill (1990), while a person may be willing to do something about an environmental problem, their knowledge base may be inadequate, with the result that they may not know what to do to overcome the problem.

While theorists suggest that it is knowledge (and not data or information) that directly influences action, some authorities, e.g. Bandura (1982) suggest that even knowledge is insufficient to accomplish action. The examination of the relationship between data, knowledge and behaviour forms the focus of this paper.

2.2 Action theories and their application in waste management

Many social-psychological theories, models and frameworks have been applied in evaluating and predicting environmental behaviour (Finger, 1994; Kollmuss and Agyeman, 2002; Payne, 2002; Oom Do Valle *et al*., 2005; Kurz *et al*., 2007; Montada *et al*., 2007; Wall *et al*., 2007; van Birgelen *et al*., 2009). Perhaps the most frequently applied and empirically proven action theory in environmental behavioural research, and certainly in understanding waste recycling behaviour, is Ajzen's (1985) theory of planned behaviour, (Oom Do Valle *et al*., 2005; Kurz *et al*., 2007; Mosler *et al*., 2008; van Birgelen *et al*., 2009). Kollmuss and Agyeman (2002:243) consider it to be "*the most influential*

attitude-behaviour model in social psychology". It has been used to examine behavioural change in various fields, from health studies (particularly behavioural change with respect to HIV/AIDs, see UNAIDS, 1999; Fishbein *et al*., 2001) to waste recycling studies (Barr, 2007; Knussen & Yule, 2008; Mosler *et al*., 2008).

The theory of reasoned action (Fishbein & Ajzen, 1975), a precursor to the theory of planned behaviour, suggests that action, represented by means of behavioural *intention*, is a function of two factors, one personal (*attitude toward the behaviour* or *behavioural beliefs*), the other social (*subjective norms* or *normative beliefs*). A person's *attitude* towards a specific behaviour is seen as a function of the perceived positive or negative consequences of performing the behaviour and the desirability of these consequences. A high correlation has been found between attitude and behaviour where there is a high awareness of consequence (Fransson & Gärling, 1999). The subjective norms relate to the social environment or social pressures, i.e. the person's perception that an individual or group important to them expects them to perform the given act. This is influenced by the person's motivation or desire to comply with the perceived expectations of that reference group or the reference group's perceived power or authority over the person (Ajzen & Fishbein, 1973; Weiss, 2002; Oom Do Valle, 2005). According to Ajzen (1985:12), "*generally speaking, people intend to perform a behaviour when they evaluate it positively and when they believe that important others think they should perform it*".

The theory of reasoned action maps out the causal links from personal and social beliefs, through attitudes and intentions to overt behaviour, i.e. behaviour over which a person has full control or the power of determining outcome. The theory proposes that a person's intention to perform a behaviour immediately precedes the action. Therefore, with the exception of unforeseen events, people are expected to behave in line with their intentions. Pfeffer & Sutton (2000:157) refer to this as an atomistic view, which assumes that "*individual outcomes and individual behaviour are under the control and discretion of those individuals, so that results and decisions can be reasonably attributed to individuals*".

Research has shown however, that while actions are controlled by behavioural intentions, intentions may not always manifest as action, even if the willingness is there (Ajzen & Fishbein, 1973; Ajzen, 1985; Chung & Leung, 2007). This was evident in the piloting of the SAWIS, where intentions to change the way waste is managed often did not materialise as action (Godfrey & Scott, 2011). A number of factors impact upon the manifestation of intention as behaviour; these include broadly, *changes in intention* and degree of *volitional control* (Ajzen, 1985). According to Ajzen (1985), people are more likely to succeed in performing a behaviour if they have control over that behaviour. Where a person lacks the required skills, knowledge or ability, a poor correlation may be found

between behavioural intention and action. While internal influences on behaviour are perhaps easy to manage, through acquiring new skills or information, external societal factors may be outside a person's control. When a behaviour is dependent upon other people, it is likely that the person will not have full control over the implementation of the behavioural intent. Pfeffer & Sutton (2000:158) acknowledge that intentions and behaviour are highly interdependent.

Since many behaviours are not under the complete volitional control of the individual, Ajzen put forward an extension of the theory of reasoned action, namely the theory of planned behaviour (Ajzen, 1985; Ajzen, 1991), which includes a third antecedent to intention, that of perceived behavioural control (*control beliefs*) (**Figure 1**). Perceived behavioural control (PBC) has been described as the ease with which the behaviour can be performed, a person's perception of the difficulty of performing a behaviour (self-efficacy), or the presence and extent of factors that either facilitate or hinder performance (controllability). PC is a person's beliefs about available resources, opportunities, and specific knowledge (Ajzen, 1991; Eagly & Chaiken, 1993; Oom Do Valle et al., 2005). Francis *et al.* (2004:9) refer to this as the "*power of both situational and internal factors*" that influence behaviour, while van Birgelen *et al*. (2009:130) refers to the "*extent to which a person thinks his or her own actions will have an impact on the situation as a whole*".

A person is more likely to act if they are confident in their *ability* to perform the action or if strong *barriers* are removed (Ajzen, 1991; Gardner & Stern, 1996). DeYoung (1993, in Gardner & Stern, 1996), in a study of waste recycling initiatives, found that while both participants and non-participants of recycling programmes had strong, positive attitudes towards recycling, non-participants considered there to be greater barriers to recycling than did participants, highlighting the importance of perceived control over behaviours. Perceived behavioural control bears strong similarities to what Bandura (1982), refers to as self-efficacy in his social cognitive theory. Self-efficacy is seen as a person's belief or confidence in their ability to perform a given behaviour (Gist, 1987; Ajzen, 1991). Many studies have reported significant correlations between self-efficacy and subsequent task performance (Bandura, 1977; Bandura & Adams, 1977; Bandura, 1982). According to Bandura (1989:59), the "*self-efficacy mechanism plays a central role in human agency*".

The five most widely accepted theories for understanding, predicting and changing human behaviour[1] recognise the importance of a person's skills or ability as one of three factors necessary for producing any behaviour (Fishbein *et al*., 2001; Gielen & Sleet, 2003). A strong positive intention to perform the behaviour, coupled with the removal of environmental barriers that inhibit the behaviour, and the

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[1] Behavioural theories evaluated by the National Institute of Mental Health (cited in Gielen & Sleet, 2003): the *health belief model* (Becker, 1974); the *social cognitive theory* (Bandura, 1986); the *theory of reasoned action* (Fishbein & Ajzen, 1975); the *theory of self-regulation and self-control* (Kanfer, 1970); and the *theory of subjective culture and interpersonal relations* (Triandis, 1972).

possession of the necessary skills to perform the behaviour, are therefore held to be necessary for producing a behaviour (Fishbein *et al.*, 2001).

The value of the theory of planned behaviour is that it provides a structured framework within which to gauge the influence of data on behaviour. From this theory, the authors posit that data can influence and alter behavioural intentions, by influencing behavioural beliefs, normative beliefs and control beliefs (Ajzen, 1985; Finger, 1994; Gardner & Stern, 1996). New information may raise a person's awareness regarding the outcomes or consequences of a behaviour (or non-behaviour), thereby altering the person's attitude towards the behaviour. New information may alter a referent's awareness regarding the outcome of a behaviour, thereby placing more or less pressure on the person conducting the behaviour (change of subjective norms). A manager, for example, may be informed by new information that may alter his or her expectations regarding a subordinate's behaviour. Finally, new information can be used to increase a person's knowledge (through a process of learning), making them more capable of completing the behaviour and giving them more control over their behaviour. The theory of planned behaviour therefore suggests that data/information has the ability to influence intentions and resultant behaviour.

2.3 Hypotheses

This paper builds on the research by Godfrey & Scott (2011) and Godfrey *et al*., (forthcoming), by expanding the theoretical framework of learning to also include a behavioural component, represented by the theory of planned behaviour (**Figure 2**). This combined theoretical framework allows the authors to explore the influence of data directly on waste behaviour, by examining the contribution of data and resultant knowledge to each of the three constructs of behavioural intention (attitude, subjective norm and PBC) and the influence of intention on behaviour. This relationship between data and behaviour is explored by examining the following 10 hypotheses (Figure 2).

H1. Personal waste experience has a positive effect on knowledge
H2. Waste data (and information) have a positive effect on knowledge
H3. Waste theory has a positive effect on knowledge
H4. Knowledge has a positive effect on perceived behavioural control
H5. Knowledge has a positive effect on subjective norms
H6. Knowledge has a positive effect on attitude
H7. Attitude has a positive effect on good waste management practice intention
H8. Subjective norm has a positive effect on good waste management practice intention
H9. Perceived behavioural control has a positive effect on good waste management practice intention
H10. Intention has a positive effect on actual waste management practice

H11. Perceived behavioural control has a positive effect on actual waste management practice

Since participating organisations have already assimilated their waste data into waste information by the time of submitting to the SAWIS, data and information are treated as a single construct for the purposes of this research.

3. Method

3.1 Participants

Participants in the research were limited to those organisations that had submitted data to the SAWIS in 2009 and 2010. Two main types of organisations report data to SAWIS, namely public organisations (municipalities), and private organisations (itself of two types: industrial and private waste companies). Only 32 organisations in South Africa reported to SAWIS in both 2009 and 2010. In addition, two organisations reported only in 2009, and six organisations only in 2010, giving 40 unique organisations (14 municipal, 26 private). Because of the small population size (n=40), sampling was felt to be unnecessary and all organisations were approached to participate in the research.

For each organisation, the respondent was identified as the registered system user or person responsible for capturing and submitting the waste data to SAWIS. Of the 40 participating organisations, two were no longer contactable and seven organisations did not make themselves available to participate in the study. In certain organisations, capturing the data and uploading the data to SAWIS, has been assigned to different persons. In these cases, both persons were approached for interviews. From the 31 available organisations, 44 respondents participated in the study (15 municipal, 29 private).

3.2 The target behaviour

According to Ajzen (2006), the behaviour of interest must be defined in terms of target, action, context and time elements. This is to ensure that all constructs relate to the same behaviour, thereby ensuring the principle of compatibility (Francis *et al*., 2004). For the purposes of this research, the behaviour under investigation was defined as '*good waste management practice'*, in the day-to-day handling of waste, at facilities owned or operated by public and private waste organisations within South Africa. Although a widely used term in the waste field, a search of local and international literature could not provide a definition for "good waste management practice". A definition is proposed here, building on concepts put forward in the literature (DWAF, 1998; Environmental

Agency, 2001; WRAP, 2007; Republic of South Africa, 2009). Good waste management practice, as a normative concept, is defined as: "*waste activities that are compliant with waste and environmental legislation; that promote the waste hierarchy and support waste avoidance, minimisation, reuse, and recycling; and that minimise the impact of waste and possible associated pollution on the environment and human health*".

The use of the term "good" in relation to the target behaviour, does raise concerns around the potential for social desirability bias (Timlett & Williams, 2008), or the tendency for respondents to reply to a question in a manner that is viewed favourably by others. It was considered that the target behaviour be changed to "sustainable waste management practices" which is also widely used within the waste field, and for which a definition was equally elusive. However, "sustainable" similarly provides the same risk of social desirability bias.

3.3 Research design

The research adopts a mixed methods design, combining both quantitative and qualitative research methods in a one-phase or parallel design (Gelo *et al*., 2008; Teddlie & Tashakkori, 2009). While many theorists recognise the incompatibility of positivist and interpretive philosophical paradigms in mixed methods research (Guba & Lincoln, 1994), this research adopts a pragmatist paradigm (Gelo *et al.*, 2008; Teddlie & Tashakkori, 2009). The pragmatic approach rejects the either/or philosophy of the positivist and interpretive theorists, instead adopting a context-driven approach where the research method is chosen based on the research question and purpose (Gelo *et al*., 2008; Teddlie & Tashakkori, 2009). In so doing, proponents of mixed methods research acknowledge that quantitative and qualitative research methods exist along an interactive continuum (Newman *et al*., 2003; Teddlie & Tashakkori, 2009).

A mixed methods research design was adopted for this research for a number of reasons. First, it is appropriate given the research question and purpose – to seek understanding of the influence of waste data on good waste management practice in South Africa (Godfrey & Scott, 2011). Second, a single influence on behaviour, amongst a multitude of influences, such as the case of data on behaviour, is difficult to observe and to quantify (Denisov and Christoffersen, 2001, Jones 2001). Third, the theoretical framework (**Figure 2**) includes two causal positivist theories – the process of learning and the theory of planned behavioural. As a linear action theory, the theory of planned behaviour has typically been applied within a positivist, quantitative approach. To place this research in context in terms of international literature, a quantitative analysis is necessary. However, quantitative methods have their limitations in this study, given the small population size (n=40) and the resultant limitations in statistical analysis. By adopting a mixed-methods research design, the authors aim to explore the

relationships between the theoretical constructs by means of quantitative data (and associated statistical analysis), while at the same time seeking a deeper understanding in these relationships through the rich qualitative data. In this way, a fuller picture is obtained as to the role of data in changing waste behaviour in South Africa. Mosler *et al.* (2008) found a mixed research method particularly appropriate in exploring factors influencing waste behaviour in the developing country of Cuba.

Data were collected by means of one-hour, semi-structured interviews, during which time a questionnaire was administered. The questionnaire consisted of two parts, Part 1 being a questionnaire of 57 closed questions and Part II being an interview schedule of 11 open questions to guide the discussion. All responses were obtained by means of self-reports. Empirical studies using the theory of planned behaviour have typically relied on self-reported behaviour, despite evidence to suggest the vulnerability of data to self-presentational biases (Armitage & Connor, 2001). Exaggerated self-reports have been found in numerous studies where the tested behaviour is seen as being socially desirable, as in the case of waste recycling (Tonglet et al., 2004; Kurz et al., 2007; Timlett & Williams, 2008). Given the nature of the target behaviour in this study, the possibility exists for social desirability bias in responses. While responses are self-reported, utilising a mixed-methods approach creates the opportunity for convergence triangulation and corroboration of results through the independent analysis and interpretation of the quantitative and qualitative data (Gelo et al. 2008).

3.4 Statistical measures

All constructs were measured by means of a seven point semantic differential scale, ranging from 1 to 7 (strongly disagree/strongly agree). Positive and negative adjective endpoints were, where possible, swopped to reduce pattern developed responses (Ajzen, 2006). Questions assessing the same construct were interspersed with those of other constructs to ensure a non-systematic order to the questions, thereby reducing the chance for response bias on sets of questions (Ajzen, 2006).

The reliability of each set of questions (i.e. instrument) was assessed using Dillon and Goldstein's rho (ρ) as recommended by Tenenhaus *et al.* (2005), Henseler *et al.* (2009) and Vinzi *et al.* (2010). Dillon and Goldstein's rho is a composite measure of internal consistency reliability that is well-suited to the partial least squares path modelling method of analysis used here. For exploratory work, ρ should be equal to or greater than 0.7 (Vinzi *et al.*, 2010). Dimensionality was assessed using the size of the first eigenvalue relative to the second. Instruments are considered to be unidimensional if the first eigenvalue is greater than one, and the second eigenvalue less than one; or if the first eigenvalue

is much greater than the second. Although it is no longer considered to be a good measure of reliability (Sijtsma, 2009), Cronbach's alpha (α) is also reported, since it is still widely used.

3.4.1 Learning theory

The three constructs of knowledge, namely data, theory, and experience were each measured by means of two items. All three instruments are shown to be unidimensional (**Table 2**). The internal consistency reliability for the construct '*experience*' is adequate to good, for '*theory*' is excellent, and for '*information*' is good to very good (**Table 2**).

Five items were used to measure the influence of '*knowledge*' on attitude, subjective norms and perceived behavioural control. The instrument is unidimensional and internal consistency reliability is very good (**Table 2**).

3.4.2 Theory of planned behaviour

Three items were used to measure *attitude*, two instrumental and the third making use of the good-bad adjective pairs, noted by Ajzen (2006) to give a good overall evaluation of attitude. Including experiential questions was not felt to be appropriate given the target behaviour under consideration.

Five questions were used to measure *subjective norm*, two injunctive ($\bar{x}$ = 5.94; SD = 1.40) and three descriptive ($\bar{x}$ = 5.72; SD = 1.31). There has been a move, in the literature, towards including descriptive subjective norm questions as they are felt to give a better indication of subjective norms (Dohnke *et al*., 2011). While internal consistency reliability of the construct is good (ρ = 0.876), there is a likelihood that an element of multidimensionality exists in this instrument (even after sharpening), given the very nature of the questions and the existence of a duality in the management of waste in South Africa. Descriptive and injunctive norms influence behaviour based on different motives (Klein & Boster, 2006). When asked "*whether people important to you think you should*" respondents generally look internally as to what constitutes morally approved conduct (Klein & Boster, 2006). When asked "*the people who are important to me implement*" or "*other organisations like mine implement*" respondents look externally and see evidence that other waste professionals or other waste companies are not implementing good waste management practice in the country. This is likely to result in injunctive and descriptive social norms measuring different things and hence a multidimensionality to the construct. This is summed up in the response by Respondent 4: "*if you want an example of how a solid waste site should be run, then come and visit* [our site] *and if you want an example of how something should NOT be done, then go and look at* [the municipal] *solid waste site*."

The literature presents very conflicting results on the relationship between injunctive and descriptive norms and behavioural intention; and whether they measure the same or different things (Klein & Boster, 2006; Dohnke et al., 2011). "*The data raise the point that descriptive norms may not be correlated strongly with behaviour. Instead, the data indicate that injunctive norms are strong predictors of behaviour.*" (Klein & Boster, 2006; 22). Dohnke *et al*., (2011) however, found the opposite to be true, where "*the descriptive norm had a higher predictive value than the subjective norm, suggesting that perceiving others' behaviour is of greater importance for the formation of an intention than perceiving their expectations.*" (Dohnke *et al*., 2011:287). However, over which there does appear to be agreement, is that measuring for both provides a broader conceptualisation of social norms and increases variability in its measure. Since they can potentially measure different things, one must be vigilant for possible attenuation of conflicting scores.

Eight items were used to measure *PBC*, three questions measuring capability ($\bar{x}$ = 5.95; SD = 1.14) and five questions measuring controllability ($\bar{x}$ = 5.70; SD = 1.44). The instrument is unidimensional and internal consistency reliability is very good (ρ = 0.912) (**Table 2**).

Intention was measured using two items and *behaviour* using three items. Both instruments are unidimensional and internal consistency reliability is good to very good (ρ = 0.905; ρ = 0.899) (**Table 2**).

3.5 Analysis and interpretation

3.5.1 Quantitative data

Traditional structural equation modelling (SEM), often applied to the analysis of the theory of planned behaviour, is a large-sample method, requiring in this case a minimum of 480 respondents (Stevens, 2009; Henseler et al., 2009). Due to the small population size of this study (n=40), partial least squares (PLS) was instead used to analyse the data, using the *plspm* package (Sanchez & Trinchera, 2010). Traditional SEM makes strong distributional assumptions, while the PLS method, in contrast, makes few assumptions and is suitable for use with small to very small data sets (Henseler *et al*., 2009). PLS path modelling is component-based whereas SEM is covariance-based; however, the results of the two methods are often similar (Tenenhaus, 2005; Vinzi *et al*., 2010). The results of the PLS structural model were validated using the bootstrap to derive standard errors (SEs) and confidence intervals (CIs). The confidence intervals effectively allow one, notably, to determine whether the model coefficients are significantly different from zero. Overall, there was good to very good agreement between the estimated coefficients and the bootstrapped coefficients. The authors are therefore confident in the quality of the measuring instruments and the method of analysis used. The

method of analysis advocated by Francis *et al*. (2004), in which the latent variables are estimated by taking the mean value of the manifest (or measurement) variables, gave results similar to those of the PLS analysis.

During the interviews, it became apparent that there could be significant differences in responses by respondents from the two types of organisations, i.e. public and private. To test whether this was so, a segmentation-tree analysis (Sanchez, 2009) was carried out. Segmentation trees are a type of classification and regression tree, specifically adapted for use with the PLS path modelling method. Type of organisation (whether municipal or private) was found to provide the basis for a significant split in the data set ($p = 0.0008$). What this means is that, although the structural/theoretical model in the two parts is the same, the path or regression coefficients (or some of them) that index how the latent variables influence each other are different (at the 5% level of significance), based on a modified F-test. Hence, there are different forces and intensities at work in the two types of waste organisations. In particular, the coefficients for K, PBC, S, I, were all found to be significantly different at the 10% level (the first three, at the 5% level). This distinction between organisational type is shown to be significant in the analysis of the data. Partial least squares path models were fitted to the two parts of the data set identified above, giving rise to two local models, one for municipal organisations, the other for private organisations.

3.5.2 Qualitative data

The interpretation of the qualitative involved a number of stages. All interviews were transcribed, providing a large body of qualitative data, which were then coded and categorized into a small set of pertinent themes (Leedy and Ormond, 2005). These themes were derived from the objectives of the study, as well as through an inductive and highly interpretive process of seeking meaning in the data. Content analysis (Whitley, 2002; Henning, 2004) was applied in interpreting the data, which allowed the authors to delve into the understanding and beliefs of respondents. The results of the qualitative data analysis are presented in a discussion section, following the statistical results. This allows for the results of the qualitative data analysis (presented as statistics, narrative, and themes), to be woven into a discussion together with the results of the quantitative data analysis.

4. Results

4.1 Statistical analysis of quantitative data

4.1.1 Global model

The statistics related to the fitted structural model are given in **Tables 2** and **3**. A relative goodness of fit (GoF) of ≥ 0.9 in considered by Vinzi *et al.* (2010) to indicate a reasonably well supported model. The overall assessment is that the structural model presented here is sound. Dillon-Goldstein's ρ_{dg} which is preferred to Cronbach's α for assessing internal consistency reliability (Sijtsma, 2009), is good to very good across all latent variables, with all variables having values of well above 0.7, considered by Vinzi *et al.* (2010) to be indicative of homogeneous instruments.

If we consider total effects (direct plus indirect effects) (**Table 3**), it is evident that there are only three regressors or constructs that have coefficients that are significantly different from zero (5% level), namely experience, knowledge, and perceived behavioural control. These are the only constructs that have a significant effect on behaviour, with total effects of 0.285 (experience), 0.611 (knowledge) and 0.649 (perceived behavioural control). Of these three constructs, only perceived behavioural control has a direct effect.

The structural model shows that of the three antecedents to knowledge, experience (*β = 0.466*) has the greatest influence on waste knowledge creation (**H₁**), with minor influences from information (*β = 0.250*) and theory (*β = 0.141*). Together the three variables account for 54.1% of the variance in knowledge (R^2=0.541). Knowledge has a significant influence on all three of the antecedents to behavioural intention (**H₄, H₅, H₆**) – attitude, subjective norm and most of all, perceived behavioural control. Knowledge accounts for 69.5% of the variance in PBC, relating to the aspect of capability within this variable.

The three belief constructs (A, SN, PBC) account for 64.7% of the variance in behavioural intention. This is higher than that typically found in other empirical studies. Meta-analyses and specific studies, referenced in the literature, have shown the theory of planned behaviour constructs to account for significant variances in behavioural intention, from 49.7% (Nigbur *et al.*, 2004); 39% (Armitage & Conner, 2001); 32% (Perugini & Bagozzi, 2004); to as low as 26% (Tonglet *et al.*, 2004). While intention and PBC show a reasonable correlation with behaviour they account for only 53.7% of actual waste management behaviour, suggesting significant additional influences on behaviour not accounted for in this theoretical framework.

However, from the structural model, it is evident that it is PBC and not intention that has the greatest influence on behaviour, with PBC having more than two-and-a-half times the influence on behaviour as behavioural intention. So while respondents may have an intention to act, this intention is not manifest as actual waste behaviour. Instead, the statistics suggest that capability and controllability, the two components of PBC, have the greatest influence on actual waste management behaviour in

this case study. Since experience is shown to have the greatest influence in the development of knowledge or capability, it resultantly has a significant influence on ultimate waste management behaviour.

Waste data does not have any significant influence directly on behaviour (β=0.499), with data explaining only 24.9% of the variance in observed behaviour (**Figure 4**). This is supported by Godfrey *et al*., (forthcoming), who found that while collecting waste data has a positive impact on the way organisations manage their waste, it is not the data that causes the operational response in organisations, but rather resultant waste knowledge.

4.1.2   Local models

The pathmox algorithm reveals that there are two sub-groups in the data set (**Figures 5 and 6**), and that these two sub-groups are subject to significantly different influences, impulses and behaviours. Given the small population size, and even smaller sub-population size, validation of these results should be undertaken in future research when the population of respondents submitting data to SAWIS has significantly increased.

The *Municipal* local model (**Figure 5**) shows that knowledge is influenced mostly by theory and information, with 49.5% of the variance in knowledge explained by learning theory. Knowledge has a strong influence on all three theory of planned behaviour beliefs, however only PBC has a significant influence on both intention and behaviour, twice the influence on behaviour as behavioural intention. Only 47.8% of the variance in behaviour can be explained by the combined theoretical framework.

The *Private* local model (**Figure 6**) shows that knowledge is influenced mostly by experience, with 77.9% of the variance in knowledge explained by learning theory. Knowledge has a strong influence on all three theory of planned behaviour beliefs, however only attitude and subjective norms have an influence on intention. PBC has a direct impact on behaviour, more than twice the influence on behaviour as behavioural intention. While more of the variance in waste management behaviour in private organisations can be explained by the combined theoretical framework, this accounts for only 57.6% of the variance.

Given the mixed-methods research design, the qualitative data provides increased confidence in the findings of the statistical analysis. However, since our research interest is in understanding the relationships between data, knowledge, and behaviour and not simply in predicting behaviour, the

qualitative data provides further insights into, and deeper understanding of these relationships, providing reasons for the patterns not explained through the quantitative data.

4.2 Qualitative analysis of beliefs, intention and behaviour

4.2.1 Knowledge

The role of data, theory and experience in the creation of waste knowledge is discussed in some detail by Godfrey *et al*. (forthcoming). Content analysis of the qualitative data shows that 67.7% of all first responses to the open question on means of learning favour experience, 25.8% favour theory and 6.5% favour data/information. While theory and data are less significant in building knowledge from both the quantitative and qualitative data analysis, their order of significance differs between the methods of analysis, with the qualitative data showing a greater influence of theory on respondent's learning than data/information. Experience is the dominant means of learning for both private (73.7% responses) and municipal (58.3%) respondents, while theory has a greater influence for municipal respondents (33.3%) than for private respondents (21.1%). Data/information plays a minor role for both municipal and private respondents, at 8.3% and 5.3% respectively.

4.2.2 Attitude

Attitude is seen in the global model (**Figure 3**) to have a strong influence on behavioural intention, supporting hypothesis H_7. However, the local models show marked differences in the attitude of respondents towards good waste management practice in public and private organisations, with attitude playing an insignificant role in the behavioural intention of municipal respondents. This finding is supported by the content analysis of the qualitative data. A factor that relates to both attitude in terms of perceived consequence, and subjective norms in terms of social pressure, is the mindset of respondents regarding consequence or compliance.

In interviewing respondents, it became very clear that issues of legal compliance were part of the vocabulary of respondents from private organisations when compared to public respondents (i.e. a compliance discourse was evident). This was assessed by counting the number of times a respondent, without prompting, made mention to one of the following words in the interview transcript – compliance/comply; permit/licence; legal; audit; Green Scorpions[2]; and legislation. It was found that on average, respondents from municipalities referred to these compliance terms only six times in an

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[2] The Green Scorpions, as they are popularly known, are environment enforcement officers, mandated to monitor compliance with, and enforce of, environmental legislation in South Africa.

interview, respondents from private industries on average 10 times, and respondents from private waste companies on average 14 times.

Respondents from private companies appear to be more concerned about, and under greater pressure to ensure legal compliance of waste operations. The private sector made reference to the Green Scorpions 10 times, whereas the municipalities did not make reference to them at all. This supports a growing concern within the private sector that government and the Green Scorpions are targeting private waste facilities at the near neglect of municipal facilities, creating inconsistencies in enforcement and dual enforcement standards for public and private waste facilities (Bosman and Boyd, 2008; Engledow and Groeners, 2008). This focus by regulators on the private sector is well summed up by Respondents 22 and 33: "*They generally pick on industry, but when it comes to municipalities there's no action taken, they just carry on. So, it makes us rather despondent because we feel that there's both an environmental need as well as a financial implication to managing waste correctly, but it only seems to apply to industry*" (Respondent 33). "*I think lack of enforcement, I can't say in* [our] *case because we've been audited to death. But a lack of enforcement with other companies and municipalities definitely; I think they just carry on and do their own little thing*" (Respondent 22).

This compliance discourse within the private waste sector creates a strong organisational culture and attitude towards implementing good waste management practice. As noted by Respondent 22 "*There's a very strong compliance message within the group. You can't not be compliant in this. We've got such a culture of compliance in the company at the moment, that's all I can say.*"

4.2.3 Subjective norms

In the application of the theory of planned behaviour, subjective norms are often found to hold the weakest relationship with behavioural intention (Armitage & Connor, 2001; Klein & Boster, 2006; Dohnke *et al*., 2011). Personal beliefs are therefore considered to overshadow normative beliefs, or perceived social pressure, in the formation of behavioural intentions (Ajzen, 1991). A meta-analysis of the theory of planned behaviour shows subjective norms to be less predictive of intention than both attitude and perceived behavioural control (Dohnke *et al*., 2011).

Subjective norms have a very weak influence on behavioural intention in both the global and local models. An analysis of the subjective norm closed questions shows a noticeable difference between responses from municipal respondents ($\bar{x}$ = 5.31; SD = 1.46) and private respondents ($\bar{x}$ = 6.07; SD = 1.21). Municipal respondents only slightly agree that 'important others' think they should implement

good waste management practice. We also see a greater variation in municipal responses, with more municipal respondents strongly disagreeing that 'important others' think they should implement good waste management practice. This differs from private respondents who on average have a greater sense that 'important others' think good waste management practice is important.

This difference between public and private organisations is also evident in the responses to the open-ended question: "*People who are important to me think that I should implement good waste management practices in my organisation*". Certain municipal respondents feel that there is no sense from 'important others' that good waste management practice should be implemented in the municipality (Respondent 6, 15). "*There's no pressure from colleagues to implement good waste management practice*" (Respondent 6). "*Nobody worries about waste, nobody is interested in it. They don't give you the support, you're on your own*" (Respondent 15).

Some municipal respondents feel that Council and senior management in the municipality expect good waste management practice to be implemented, but do not provide staff with the resources or authority to do so. So long as waste is removed from the streets and there are no incidences, such as illegal dumping, strikes, non-collection, etc, waste receives little priority. "*The executive directors they expect that you should implement as per legislation. It's an expectation that they don't fulfil because they don't give you the tools to implement that. I strongly agree with implementing* [good waste management practice] *but it goes hand in hand with the means for you to be able to achieve that*" (Respondent 9). We see the three constructs of the theory of planned behaviour within this single statement of Respondent 9. A strong attitude to want to implement good waste management practice, and a sense from those important to him that good waste management practice should be implemented. However, converting intention to action is constrained in terms of perceived behavioural control, and in particular, controllability. This is evident in a number of statements made by respondents in municipalities:

"*They feel like it's a normal operation. So long as* [waste management is] *done, it's ok, even if sometimes it's not done up to standards*" (Respondent 13).

"*Oh yes, they want a fully nice excellent service, for sure they want it, council and the people, both. They want it, but they do not provide sufficient resources*" (Respondent 14).

"*As long as* [waste is] *taken away from our streets, it's taken away from our house. They don't give you the support. You're on your own*" (Respondent 15).

"*Everybody theoretically agrees that legislation must be applied and the place must be clean. However, the same people who require that service to be rendered take the decision not to fund those services. And then I think there's a conflict of interest, where people are sending signals that they require this top grade service, yet they don't send the funding that actually ensures that you can do that*" (Respondent 18).

"*I think the people that we work with do feel that we should implement good waste management practice, and they actually sometimes think we do, although I don't think so*" (Respondent 19).

This is different to what is evident in private industry and private waste companies where there appears to be a strong organisational culture of implementing good waste management practice driven from the highest levels of management.

"*I don't think its pressure, I think it's a common responsibility that we all feel towards it and I think we all feel obligated to do the right thing. It's more a cultural issue. I'm talking of the CEO, so from that level you have the support and it trickles down all over the organisation*" (Respondent 3).

"*Having that good waste management is a culture that's been entrenched in the company and I also see it's something that gets driven from the top down. You should be trying to implement good waste practices, it's important. It's something that's being discussed at management meetings, and discussed above us at board level*" (Respondent 8).

This organisational culture is often found in response to the compliance discourse (Respondent 3, 5, 22, 36), but also in response to maintaining certain organisational ratings, e.g. ISO certification (Respondent 5, 22), or environmental rating systems (Respondent 16). The organisations public image, e.g. Stock Exchange listings (Respondent 4), or business sustainability and profitability (Respondent 4, 25) are also seen as strong drivers of organisational pressure to implement good waste management practice. "*If the company is a Johannesburg Stock Exchange listed company, something in the public eye, then yes I would strongly agree,* [good waste management practice] *is something that's driven very, very hard within industry*" (Respondent 4).

4.2.4 Perceived behavioural control (PBC)

Azjen's theory of planned behaviour posits that the stronger the intention to act, the more likely the intention will translate into actual behaviour (Ajzen, 1991). There is considerable doubt amongst social psychologists as to whether intentions are consistent with behaviour (Bell *et al*., 1990; Fishbein *et al*., 2001). Ajzen (1991) qualifies this position in that intention is manifest as behaviour only where the behaviour is under volitional control (Ajzen, 1991). Both motivation (intention) and ability (behavioural control) are required for action (Ajzen, 1991). According to the theory, PBC will become increasingly important as volitional control over the behaviour decreases (Ajzen, 1991). Similarly, the correlation between intention and PBC and actual behaviour is shown by Ajzen (1991) to decrease as volitional control decreases. This 'discrepancy' between intention and behaviour, seen in many environmental behaviour studies, is often referred to as the value-action gap (Chung & Leung, 2007, Burgess *et al*., 2005, cited in Barr, 2007).

In the global model, PBC is the dominant influence on behavioural intention and behaviour (**Table 3**). As with the other constructs of the theory of planned behaviour, differences are evident in the effect of PBC in the local models. While PBC is the dominant influence on both behavioural intention and behaviour for municipal respondents, for private respondents PBC has little influence on intention, its dominant influence being on behaviour.

The theory of planned behaviour has been criticised for not making adequate allowance for the effect of past behaviour on current behaviour (Ajzen & Fishbein, 2005; Norman, 2011). Norman & Smith (1995, cited in Ajzen & Fishbein, 2005) showed that by including past behaviour as a separate predictor of current behaviour, variance in behaviour could be increased from 41% to 54%, considered to be significant by Ajzen & Fishbein (2005). Ajzen (1985) also suggested that past performance of a behaviour influences current behaviour independently of intention, attitude and subjective norms. By combining the two theoretical frameworks, this research suggests that past behaviour is already accommodated. Past behaviour can be considered to build experience (experiential learning), which we see in this case study to be the most significant contributor to building knowledge. Knowledge has a significant effect on PBC, and PBC a significant effect on waste behaviour. Past behaviour and experience therefore has a significant influence on behaviour via the knowledge and PBC constructs.

In terms of the two components of PBC, capability and controllability, Godfrey et al., (forthcoming) show the strong influence of knowledge (capability) on PBC and waste behaviour (**Table 3**). However, from the qualitative data, there is evidence that controllability also appears to have a significant influence on behaviour. The influence of controllability is captured in these statements by respondents:

> "*the control over implementing good waste management practice is a function of how high you are in the organisation, it's not a function of the amount of knowledge that you have. You're in a food chain, your ability to do something is only determined by your rank in the food chain*" (Respondent 4).

> "*Sometimes it's challenging because your boss must give you a go ahead to do something. So you cannot just do things on your own. The powers to make final decisions, we must discuss first. We make decisions on the ground and then we've got to elevate them to be ratified. So we cannot just make final decisions. Unless they're minor issues which we've been given powers to*" (Respondent 28).

4.2.5 Intention

The results, for both the global and local models, show a weak relationship between intention and behaviour. Good waste management intention is therefore not always being translated into actual waste management practice in this case study. As per Ajzen (1991) these results suggest that good waste management practice is not completely under the volitional control of those tasked with its implementation, in both public and private organisations.

The correlation between intention and behaviour (r = 0.63) is somewhat higher than that found in other studies. Meta-analyses covering diverse behaviours report mean intention-behaviour correlations of 0.62 (van den Putte, 1993); 0.44 to 0.56 (Albarracín, Johnson, Fishbein,& Muellerleile, 2001; Godin & Kok, 1996; Hausenblas, Carron, & Mack, 1997; Sheeran & Orbell, 1998); 0.53 (Shepherd, Hartwick, & Warshaw, 1988); 0.53 (Sheeran, 2002); 0.47 (Armitage & Conner, 2001; Notani, 1998); and 0.45 (Randall & Wolff, 1994) *(all cited in Ajzen & Fishbein, 2005).*

4.2.6 Direct influence of data on behaviour

The statistical results provide evidence of a weak direct relationship between data and behaviour. The relationship between data and behaviour was explored in this study by means of two closed and two open questions. Closed questions, measured on a seven point semantic differential scale, included: "*Collecting waste data within my organisation has had a positive impact on the way we manage waste*" and "*Collecting waste data, specifically for reporting to the SAWIS, has a positive impact on the way our organisation manages waste*". The two open-ended questions were: "*In your opinion, has anything changed in the way your organisation manages its waste because of data collection, and more specifically data collection for SAWIS?*" and "*Why do you (agree/disagree) that collecting data within your organisation has a positive impact on the way your waste is managed?*"

A statistical analysis of the two closed questions measuring the direct impact of data on behaviour shows that respondents, on average, slightly agree that data has had a positive impact on the way they manage waste ($\bar{x}$ = 5.33; SD = 1.67). When asked in the open questions whether respondents felt if anything had changed in the organisation because of waste data collection, 37.5% of respondents felt that data had resulted in both an impact and a change, 18.8% felt there had been neither an impact nor a change, while 43.8% of respondents felt that data had had an impact, but that nothing had changed in the organisation. There are therefore mixed responses as to whether data has in fact led to a direct behavioural response in the way waste is managed in the organisation (Respondent 31, 38). Most respondents felt that the impact of the data was in simply 'knowing' the quantities and types of waste received (Respondents 6, 8, 13, 15, 16, 19, 29), in supporting planning and management of waste (Respondents 7, 17, 24), or in monitoring of waste (Respondents 14, 18). The influence of data can

therefore be understood as part of knowledge building, which, when combined with experience and theory, is applied to the management of waste.

5. Conclusions

Combining the process of learning and the theory of planned behaviour into a refined theoretical framework, provides an opportunity to further explore the research question "*Can the collection of data for a national waste information system change the way waste is managed in South Africa, such that there is a noticeable improvement?*" Fitting the data to this theoretical framework shows that there are only three regressors that have a significant effect on behaviour, namely experience, knowledge and perceived behavioural control. Experience is shown to have the greatest influence on building waste knowledge in this case study, with minor influences from information and theory. Together the three variables account for 54.1% of the variance in knowledge.

Knowledge has a significant influence on all three of the antecedents to behavioural intention – attitude, subjective norm and most of all, perceived behavioural control. From the structural model, it is evident that it is perceived behavioural control and not intention that has the greatest influence on waste behaviour. So while respondents may have an intention to act, this intention does not always manifest as actual waste behaviour. The results suggest that capability and controllability, the two components of perceived behavioural control, have the greatest influence on actual waste management behaviour in the case study. Since experience is shown to have the greatest influence in the development of knowledge or capability, it resultantly has a significant influence on actual waste management behaviour. The structural model supports hypotheses H_1, H_4, H_5, H_6, H_9 and H_{11}, namely, that personal waste experience has a positive effect on knowledge; knowledge has a positive effect on perceived behavioural control; knowledge has a positive effect on subjective norms; knowledge has a positive effect on attitude; perceived behavioural control has a positive effect on good waste management practice intention; and perceived behavioural control has a positive effect on actual waste management practice.

Municipal and private organisations are shown to represent two statistically significant sub-groups in the data set. For the municipal local model, knowledge is influenced mainly by theory and information, with 49.5% of the variance in knowledge explained by learning theory. Knowledge has a strong influence on all three belief constructs, however only perceived behavioural control has a significant influence on both intention and behaviour. Perceived behavioural control has twice the influence on behaviour as that of intention. Only 47.8% of the variance in behaviour in the municipal local model can be explained by the combined theoretical framework. For the private local model, knowledge is influenced mainly by experience, with 77.9% of the variance in knowledge explained by

learning theory. Knowledge has a strong influence on all three belief constructs, however only attitude and subjective norms have an influence on intention. Perceived behavioural control has a direct influence on behaviour, more than twice the influence on behaviour as that of intention. Only 57.6% of the variance in behaviour in the private local model can be explained by the combined theoretical framework. The main findings of the statistical analysis are supported by the qualitative data. Content analysis shows that 67.7% of all responses to the open question on means of learning, favour experience, 25.8% theory and 6.5% data/information.

While good waste management practice is generally supported by all respondents, attitudinal differences are apparent between municipal and private respondents. Respondents from private organisations appear to be more concerned, and under greater pressure, to ensure legal compliance of waste operations. This compliance discourse within the private waste sector creates a strong organisational culture towards implementing good waste management practice, which is also evident in the normative beliefs of respondents in this sector. Subjective norms are referred to in the literature as having the weakest influence on behavioural intention, and this is evident in both the global and local models. Differences in normative beliefs are also evident in responses from municipal respondents, with some feeling that there is no organisational pressure to implement good waste management practice and others reporting that while Council and senior management expect good waste management practice to be implemented, they are given neither the resources nor the authority to do so. This is different to what we see in private organisations where there is a strong organisational culture to implement good waste management practice driven from the highest levels of management. This organisational culture in private organisations is driven by a strong compliance discourse, maintaining organisational environmental rating systems and public image, and in supporting business sustainability and profitability.

Results show a weak relationship between intention and behaviour, with perceived behavioural control having a greater effect on waste behaviour than intention. As volitional control decreases, so the translation of intention to behaviour decreases and perceived behavioural control plays a more fundamental role in predicting behaviour. The results suggest that good waste management practice is not under the volitional control of those tasked with its implementation. While intention and perceived behavioural control show a reasonable correlation with behaviour, they account for only around a half of actual waste management behaviour (53.7%), suggesting that there must be significant additional influences on behaviour that are not accounted for in this theoretical framework. These additional influences on behaviour, which might lie outside the theoretical framework, should be explored through further research.

It is recognised that the relative weights of beliefs vary from one person to another and across behaviours and situations (Ajzen, 1985; Ajzen, 1991), however results show that there are significant differences at the organisational level in the way the two sub-populations build knowledge, and construct intentions and behaviour, given the same target behaviour and situation. According to Ajzen (1991:206) "*it is at the level of beliefs that we can learn about the unique factors that induce one person to engage in the behaviour of interest and to prompt another to follow a different course of action*". The results raise questions as to the nature of these forces that appear to collectively shape personal beliefs and cause structural differences between public and private organisations. Similarly, it raises questions as to the apparent lack of volitional control of those tasked with the management of waste, particularly respondents with public organisations in South Africa. These questions need to be further explored.

6. Acknowledgements

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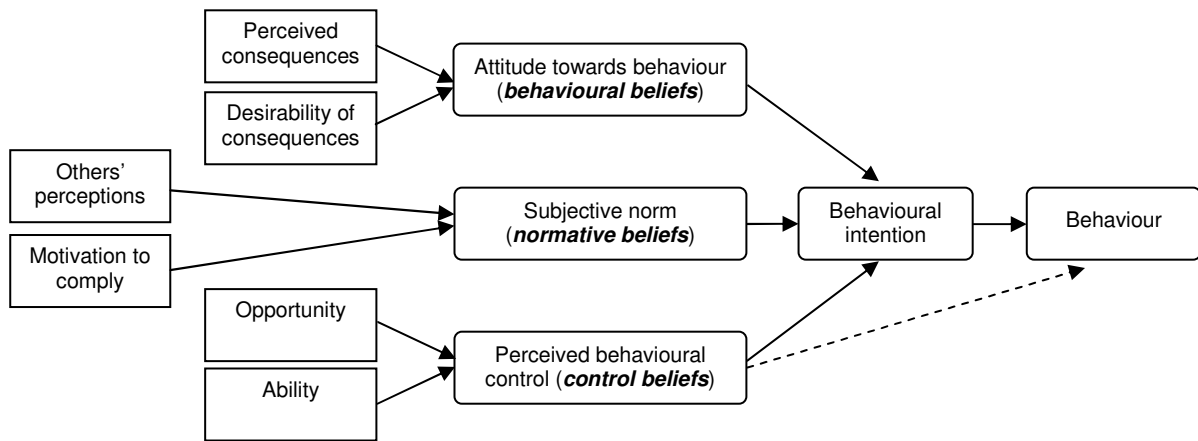
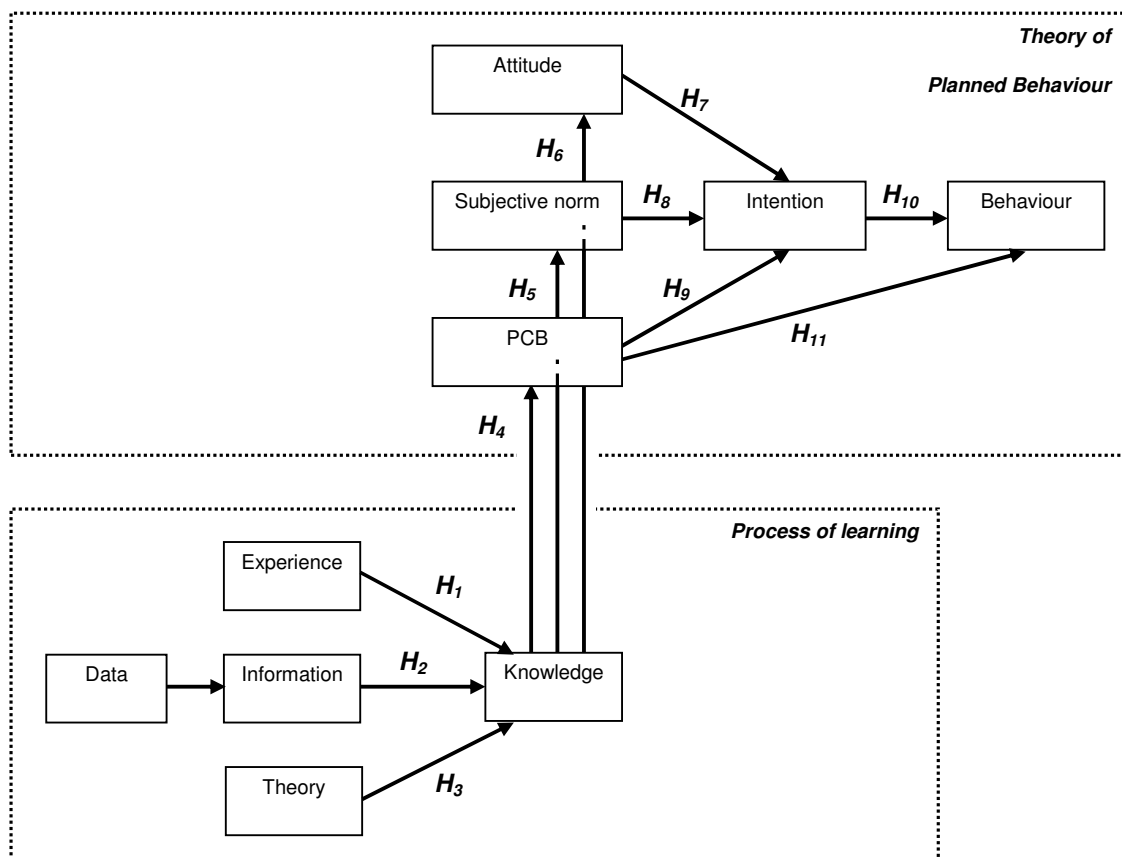**Figure 1. Theory of Planned Behaviour (from Ajzen, 1985; Ajzen, 1991)**

Figure 2.   Theoretical framework of learning and the influence of knowledge on behaviour
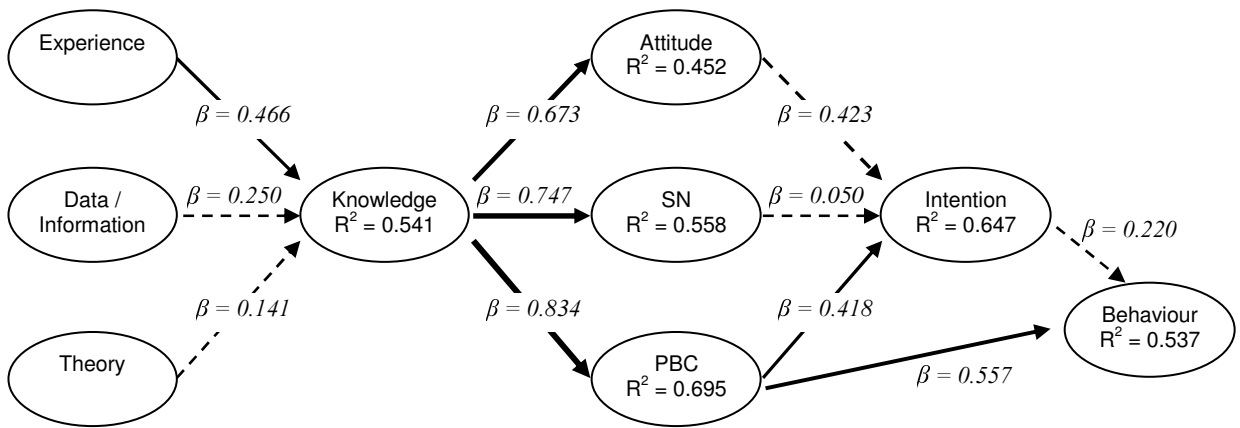
Figure 3. Path diagram for the global model, fitted to the imputed data set using sharpened instruments.

*) Where β represents the regression coefficients and R^2 the coefficients of determination. Line weight is proportional to effect-size and to the degree of confidence in the link; broken lines indicate no influence (insufficient evidence to reject the null hypothesis that the coefficient is zero, i.e. $H_0 : \omega = 0$ at the **5%** level of significance). Line weight for unbroken paths is proportional to the lower bound of the associated confidence interval.
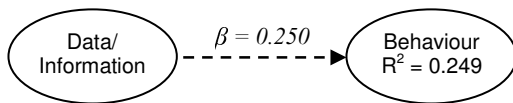

Figure 4. Path diagram for the structural model showing effect of data directly on behaviour.

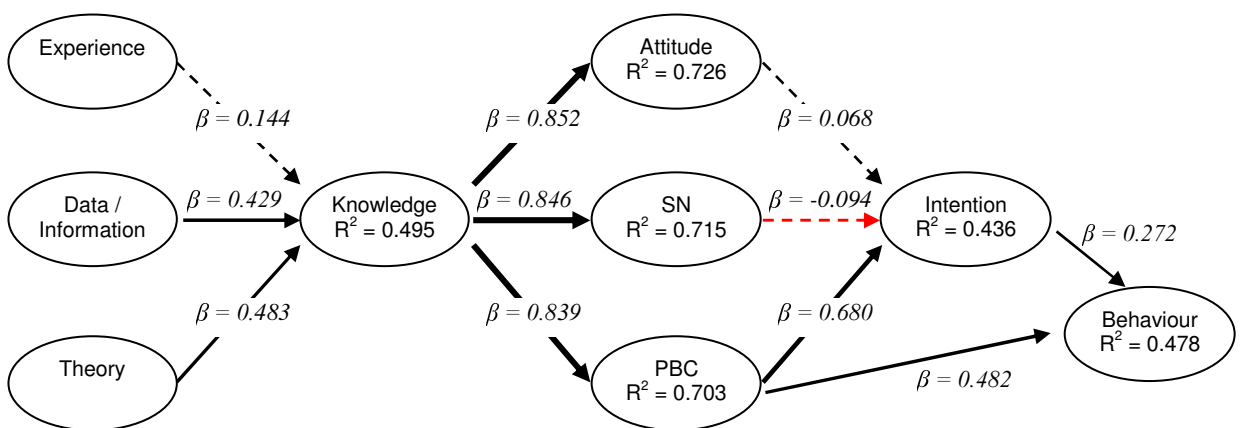
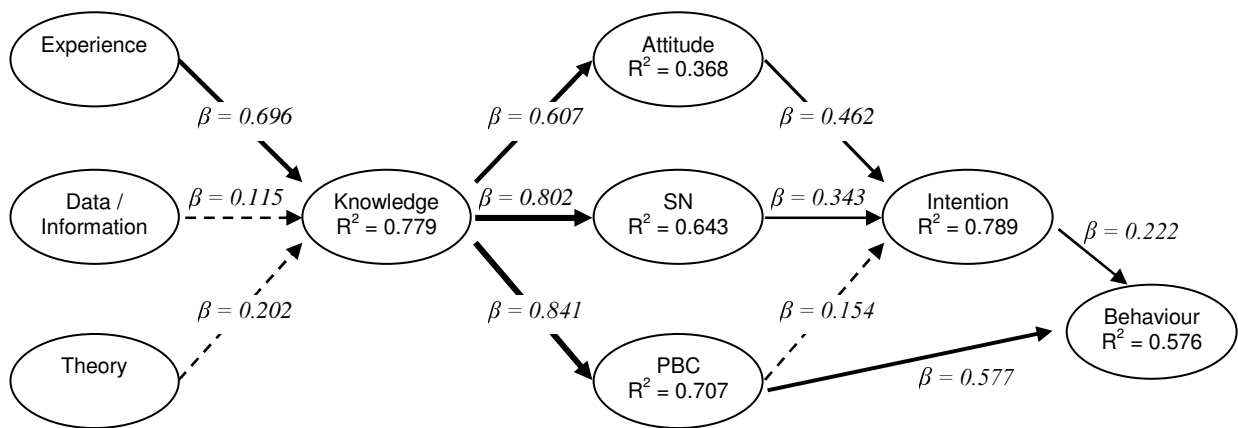**Figure 5. Path diagram for the *Municipal* local model, fitted to the imputed data set using sharpened instruments.**

Figure 6. **Path diagram for the** *Private* **local model, fitted to the imputed data set using sharpened instruments.**

Table 1. Number of organisations reporting data to SAWIS in 2009 and 2010

Reporting year	Reporting organisations
2009	34
2010	38

Table 2. Summary statistics and quality indices for the Partial Least Squares Path Model

			Summary of Inner Model				Reliability / Dimensionality			
LV (ξ)	LV-type	MVs	R^2	$TotEff_B$	Av.C	Av.R	α	ρ	Eig.1st	Eig.2nd
E	Exogen.R	2	na	0.2850	0.6704	na	0.530	0.810	1.360	0.640
D/IN	Exogen.R	2	na	0.1527	0.8428	na	0.816	0.916	1.689	0.311
T	Exogen.R	2	na	0.0860	0.8736	na	0.862	0.935	1.757	0.243
K	Endogen.R	5	0.5407	0.6114	0.6736	0.3642	0.877	0.912	3.378	0.834
A	Endogen.R	3	0.4523	0.0930	0.7129	0.3224	0.799	0.882	2.143	0.531
PBC	Endogen.R	8	0.6948	0.6486	0.5668	0.3938	0.887	0.912	4.537	1.069
S	Endogen.R	5	0.5578	0.0110	0.5914	0.3299	0.819	0.876	2.959	0.869
I	Endogen.R	2	0.6468	0.2201	0.8269	0.5348	0.791	0.905	1.654	0.346
B	Endogen.R	3	0.5370	na	0.7474	0.4014	0.832	0.899	2.245	0.439

Model of Goodness of Fit (GoF)	Value
Absolute	0.6221
Relative	0.8880
Outer model	0.9984
Inner model	0.8894

Abbreviations: LV = latent variable/construct; MV = measurement variable; Exogen.R = Exogenous, Reflective; Endogen.R = Endogenous, Reflective; MVs give the number of MVs (items/indicators/measurement-variables) in the construct/LV; R^2 is the coefficient of determination or variance explained; $TotEff_B$ is the total effect on B (sum of direct and indirect effects); Av.C is the average communality (communality index) and is the same as the average variance extracted (AVE, not shown separately); Av.R is the average redundancy (redundancy index); α_{std} is Cronbach's alpha (standardized); ρ_{dg} is Dillon-Goldstein's (or Jöreskog's) rho (aka composite reliability); Eig.1st/Eig.2nd are the first and second eigenvalues from a principal component analysis of the standardized manifest variables (*i.e.* items/indicators of the construct).

Table 3. Total effects (β) and R^2 (structural model) from a partial least squares path model of factors that influence waste management behaviour.

Influencing construct	Influenced Construct								
	E	IF	T	K	A	PBC	SN	I	B
E				0.4661	0.3135	0.3885	0.3481	0.3121	**0.2850**
D/IN				0.2497	0.1679	0.2081	0.1865	0.1672	0.1527
T				0.1407	0.0946	0.1173	0.1051	0.0942	0.0860
K					0.6726	0.8335	0.7469	0.6697	**0.6114**
A								0.4228	0.0930
PBC								0.4177	**0.6486**
SN								0.0498	0.0110
I									0.2201
R^2				0.5407	0.4523	0.6948	0.5578	0.6468	0.5370

[*)] Where R^2, the coefficients of determination, is the variance explained.