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# Developing Consumption Feedback Principles for Monthly Utility Bills informed by Behavioural Economics: Evidence from Controlled Experiments

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## ABSTRACT

Better feedback principles for the utility bills in South Africa need to be developed. Utility providers might be able to "nudge" consumers towards more desirable consumption patterns by delivering simpler and better feedback informed by applied behavioural sciences. Two sets of controlled experiments were conducted with over 1,500 subjects to identify bill design strategies that could overcome two major barriers to effective consumption feedback:

- the complexity of the utility bill, especially with regards to tariff calculations, and
- consumer's declining mindfulness of utility consumption between billing moments.

The "Utility Bill Redesign" experiment, using a randomised control trial, investigates how improving billing feedback design increases consumer's understanding of energy usage and costs. More than 1,300 participants are randomly assigned to different treatment groups and receive one of nine redesigned utility bills or the current standard bill. Thereafter, participant's understanding of the bill they received is tested through a questionnaire. We find that restructuring the bill in a logical order and displaying the amount of electricity consumed in each tariff block with separate bar graphs is a successful way to increase consumer understanding of the bill, especially with regards to the step tariff. Further, the results clearly show that consumers are unable to make sense of a utility bill that is not in their home language, even when adding utility specific symbols. We conclude that significant low-cost improvements can be made to utility bills to increase consumer comprehension.

In the "Attention Redirection" experiment, participants are assigned to different treatment groups and are given an online task that requires daily attention and effort in order to maximise pay-offs. We find that daily SMS reminders significantly redirect attention to the daily task. A blank graph, given to participants at the beginning of the experiment to assist them in self-managing their behaviour, has no effect on task adherence. The results illustrate how inattention routinely leads to sub-optimal behaviour in a specific task area and the resulting welfare loss. A purely bill-based strategy is rendered unsuccessful.

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# **1. Introduction and Rationale**

## **1.1 Increasing Energy Demand in South Africa**

World-wide energy use keeps on rising due to advances in technology, economic and demographic growth, and different institutional and cultural factors leading to the continuous depletion of the world's natural resources (Abrahamse et al., 2005; OECD, 2012). In developing countries, such as South Africa, economic growth is one of the major contributors to the increase in energy demand. Electricity demand in South Africa is expected to double in the next 20 years (Koen et al., 2015). A new consumer class and grid extension to remote areas that were previously not supplied with electricity contribute to the increase (Winkler, 2005). However, the demand increase has not always been met by corresponding increases in electricity supply leading to planned electricity blackouts, also referred to as 'load shedding'<sup>1</sup> schedules. Moreover, in comparison to other countries, South Africa's electricity generation process is very coal intensive; the environmental costs of electricity generation are therefore comparatively high (Winkler, 2005). To counteract the potential negative environmental effects that economic development entails, more ambitious energy policies need to be introduced. Demand side management is ecologically desirable because successfully reducing electricity demand would mean that less electricity generation is required. Since households have a considerable share in energy consumption, raising their consumption awareness and changing their consumption behaviour is a vital part of demand side management.

## **1.2 Behavioural Economics and Demand Side Management**

Historically, when thinking about demand side management, municipalities have relied upon pecuniary methods such as price increases or non-pecuniary methods such as consumer education campaigns, both informed by traditional economic models of rational choice. Over the last decade, municipalities, particularly in developed countries, have increasingly been using demand side management strategies informed by behavioural economics because the traditional tools have not been as successful as anticipated (Chetty et al., 2007; Olmstead et al., 2007; Nolan et al., 2008). Behavioural economics combines insights from psychology and

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<sup>1</sup> In South Africa, the term load shedding has been used to describe countrywide controlled blackouts of electricity power systems. Old power stations and infrastructure are used to full capacity. If demand on the system is greater than supply, controlled blackouts are administered in order to prevent a total blackout. Load shedding is only used in case of emergency conditions and is only in place for limited periods. It is usually implemented in two hour blocks and schedules are made available to the public to see what date and time their suburb is affected.

economics and challenges the assumptions of classic economic theory. It takes into account that individuals use mental short-cuts and make suboptimal choices due to lack of information, limited attention, or limited cognitive abilities (Kahneman, 2003; Gigerenzer and Gaissmaier, 2011). Behavioural insights are used to better understand the contexts in which people make decisions and to create policies that take true human decision-making into account. Achieving behavioural change through behavioural economics informed strategies is attractive for utility providers because, once created, behavioural interventions are inexpensive to run, scalable, and do not require a lot of administrative attention (Allcott and Mullainathan, 2010; Croson and Treich, 2014; Momsen and Stoerk, 2014).

### **1.3 The Need for Better Utility Consumption Feedback Principles**

The current study evolved out of a project by Davis, Smith and Visser (2012) who conducted focus group interviews throughout South Africa with individuals from different income groups to assess consumer understanding of billing practices. They concluded that there are substantial shortfalls in the current South African bill design and a number of ways to improve consumer understanding of the bill. Reviewing the status quo of interventions informed by behavioural science in South Africa, particularly in relation to utility bills, suggests that South Africa could benefit from such strategies that have shown to be successful in other parts of the world.

The overall objective of this study is to develop utility consumption feedback principles for monthly utility bills informed by behavioural economics. Consumer understanding and perception of the existing standard utility bill are assessed and solutions on how to improve it are provided. Two sets of controlled experiments are conducted with over 1,500 subjects. The experiments seek to identify bill design strategies that overcome two major barriers to more effective consumption feedback: (1) the complexity of the utility bill, especially with regards to tariff calculations, and (2) consumer's declining mindfulness of utility consumption between billing events. The "Utility Bill Redesign" experiment addresses the former barrier whereas the "Attention Redirection" experiment addresses the latter.

### **1.4 The "Utility Bill Redesign" Experiment**

The utility bill, as carrier of feedback information, is a highly cost-effective and readily available tool to make consumption more salient and to stimulate conservation. However, households are often unable to comprehend and interpret information about their consumption from the bill. The current invoices in South Africa are user-unfriendly and written in a

technical language that is particularly difficult to understand for non-native English speakers. Hence, consumers often struggle to find basic information on their invoices and have a hard time understanding the codes, units and abbreviations. The ineffective communication between consumers and their utility provider has an effect on consumer's consumption awareness, conservation efforts and their satisfaction with the service provider. Further, since consumers are often unable to understand what they are being billed for, 35% of households doubt that their municipal invoices are correct and are thus less willing to pay for the received services (Slabbert, 2010).

The way in which consumption feedback is presented on the bill needs to be improved to optimise it for consumer understanding and motivation. Information needs to be clear, understandable, and accessible in terms of language and design while adhering to invoice regulations. When testing feedback designs, researchers often make presumptions about consumer preferences and then compare a certain type of feedback display to no display at all (Roberts and Baker, 2003; Karjalainen, 2010). It is, however, important to find the most effective methods of presenting feedback information to consumers. In order to improve our understanding of how to optimise utility bill designs, in the first part of this paper, different treatments are developed that remove complexity and potentially increase comprehension of the overall billing information, the utility and service charges, and the tariff charges. The "Logic" and "Process" treatment groups receive bills that are reordered for logical flow whereby the logical process is further supported by including guiding comments before each section of the bill in the "Process" treatment. Four different treatments using various types of bar graphs are developed to assess how to clearly communicate consumption in each block of the step tariff. Another treatment group receives graphical math to break down the tariff calculations for each tariff block. Two treatments are written in a foreign, unfamiliar language to test how difficult it is for non-native English speakers to understand the currently used standard utility bill.

We find that restructuring the bill in a logical order and displaying the amount of electricity consumed in each tariff block with separate bar graphs is a successful way to increase consumer understanding of the bill, especially of the step tariff. Further, the results clearly show that consumers are unable to make sense of a utility bill that is not in their home language, even when adding utility specific symbols. In addition, participants that received the redesigned utility bills, except for the two foreign language treatments, felt significantly more satisfied with the way information is displayed than the group that received the current

standard utility bill. We conclude that significant low-cost improvements can be made to utility bills to increase consumer comprehension.

### **1.5 The “Attention Redirection” Experiment**

According to Taubinsky (2014), individuals will not perform an action that is not on their minds. Further research on attention suggests that inattention to regimes of a course of medical treatment, physical exercise or dieting may cause people to act sub-optimally (Calzolari and Nardotto, 2012; Vervloet et al., 2012). One such area may be energy consumption where a household needs to keep track of its usage in order to manage its energy consumption to an optimal level. Several aspects of typical energy consumption potentially act against this. Consumers perceive energy as an abstract commodity that is not an end product but is used to accomplish daily habits and routines (Burgess and Nye, 2008). Further, there are many incidents of usage every day while there is only one incident of expenditure per month: When the electricity bill arrives, it is difficult for consumers to connect an energy-using activity to expenditure (Gilbert and Graff Zivin, 2014). After receiving the bill, consumers initially reduce consumption levels but become increasingly inattentive and slide back into old habits until the next bill arrives (Allcott and Rogers, 2014). Providing people with continuous feedback about quantity consumed or costs, for example through real-time electricity meters, seems to counter this behaviour by creating a closer link between action and energy use (Abrahamse et al., 2005; Jessoe and Rapson, 2014). However, electronic “smart” meter reading needs technical preconditions such as high-speed internet connections that are often not available or would be too costly to implement, especially in South Africa (Burgess and Nye, 2008). Directing household’s attention to the target behaviour can also be achieved through reminders such as SMS or email (Ericson, 2014; Rogers and Frey, 2015; Karlan et al., 2016).

In the second part of this paper, the relationship between undirected and directed attention and welfare is tested through a self-management tool and SMS reminders respectively, when welfare is a function of tending to a task by short bursts of attention each day. We investigate the effectiveness of a bill-based strategy for raising attention to utility consumption and assess the magnitude of welfare loss due to inattention to consumption over a period of one month. Participants are assigned to different treatment groups and are given an online task that requires daily attention and effort in order to maximise pay-offs. We find that the groups that receive daily SMS reminders to complete the online task log on significantly more than the Control group or the Graph treatment group which, at the beginning of the experiment,

received a blank graph they could fill out themselves to track the amount owed to them each day as a result of their logons. The results render a purely bill-based strategy unsuccessful.

This paper is structured as follows: Chapter 2 presents a review of selected behavioural economics, consumption feedback design, information presentation, and step tariff literature. Chapter 3 focuses on the “Utility Bill Redesign” study. It discusses the choices made in designing the study as well as the methods and procedures used to conduct the experiment. It presents the results obtained from the econometric analysis of the data and each treatment group’s overall performance as well as performance in the basic, utility and tariff section of the questionnaire is analysed. Further, it is assessed if there are any additional benefits to adding conversational prompts to a bill that is already ordered in a logical way. It is also analysed which bar chart most successfully increases consumer understanding. Additionally, participant’s satisfaction with their respective utility bill is assessed. Chapter 4 focuses on the “Attention Redirection” study. The experimental design and procedure are explained. Further, the regression results as well as the robustness tests of the results are presented. A conclusion of the overall results and their implications are presented in Chapter 5.

## **2. Literature Review**

### **2.1 Consumption of an Invisible and Abstract Good: Electricity**

Electricity is a commodity, a basic human need or necessity, and an ecological resource (Sheldrick and Macgill, 1988). People receive utility from consuming energy services such as washing laundry or using the computer but they also receive moral utility from conserving energy (Allcott, 2011). Since there is no substitute good for electricity and because electricity consumption is only a small proportion of the overall household spending, price elasticity of electricity demand is inelastic. Households do not make conscious consumption decisions when switching lights on or when using a hairdryer (Hewitt and Hanemann, 1995; Arbues et al., 2003). Kamerschen and Porter (2004) find that residential customers are more price sensitive with price elasticities of demand from -0.85 to -0.94 than industrial customers showing price elasticities ranging from -0.34 to -0.55.

Energy is perceived as invisible and abstract by domestic users since most consumers are unable to understand how their daily activities are linked to their energy expenditure due to a lack of information transparency (Burgess and Nye, 2008). Since consumers are using electricity numerous times a day while only being billed once a month, most consumers are unaware of their electricity consumption (Jesso and Rapson, 2012; Gilbert and Graff Zivin, 2014; Sexton, 2015). Further, automatic bill payment programmes, where recurring bills are automatically paid for with a credit or debit card transaction, make it unnecessary for electricity consumers to read their bills and increase electricity consumption in the residential and commercial sector by 4 % and 8.1% respectively (Sexton, 2015).

### **2.2 Classic Economic Theory and Real Life Decision-Making**

Classic economic theory assumes that humans have complete knowledge of their choice set, can calculate each strategy's payoff, and make optimal consumption choices that maximise their utility (Jesso and Rapson, 2012). However, humans in real life rarely have an optimal amount of information and processing capabilities, stable preferences, or rational expectations. Humans often make suboptimal choices due to lack of information, limited attention, or limited cognitive abilities. People's cognitive abilities are finite (bounded rationality), they take decisions that are not in their long-term interest (bounded willpower) and they take selfless actions because they care about being treated fairly and treating others

fairly (bounded self-interest) (Jolls et al., 1998). These are all behaviours that are not predicted by standard economic models.

According to dual process theory, making decisions involves two separate cognitive systems: a fast, efficient, more intuitive process, often referred to as “System 1”, and a slower, more reflective and analytic process that needs more effort but is often more accurate, also referred to as “System 2” (Evans, 2003). Individuals use short-cut heuristics that ignore part of the information to make quicker decisions about daily tasks such as when reading the monthly utility bill (Gigerenzer and Gaissmaier, 2011). People take short-cuts to reduce their efforts for decisions that are not of great importance to them, especially when “costs of effort are higher than the gain in accuracy” (Gigerenzer and Gaissmaier, 2011, p. 457). Moreover, the way in which information is phrased or described (framing) can significantly influence consumer’s choice. Thereby, individuals focus on the emphasised aspects and ignore the presumably irrelevant rest. Behavioural economics integrates these bounds of rationality of economic agents.

### **2.3 Behavioural Economics and Energy Efficient Behaviour**

Recent field experiment findings support the use of nudges to alter household’s electricity and water consumption behaviours (Allcott and Mullainathan, 2010; Allcott, 2011; Ferraro and Price, 2011; Ayres et al., 2012; Allcott and Rogers, 2014). Nudges are non-price information treatments incentivising behavioural changes. These alternative low-cost persuasion strategies are easily scaled up and coercion free since households are still able to choose from the original choice set with the same relative prices. This makes nudges less controversial, less costly and consequentially more attractive than other policy tools such as price or tax increases. If a nudge is unsuccessful, it does not do any harm but household behaviour will simply stay the same as before the implementation of the nudge (Croson and Treich, 2014; Momsen and Stoerk, 2014).

#### ***2.3.1 Default Nudge***

One of the commonly used nudges is the “default nudge” which involves setting the default to a socially optimal decision because people often do not make active choices but rather stick to the option that is already selected for them (Allcott and Mullainathan, 2010). Individuals rarely change their default option due to procrastination, inertia, because they are biased towards what they already have (endowment effect) and because they try to avoid losses (loss aversion). Further, acquiring information about alternatives and changing options incurs

switching costs which makes it less likely that individuals deviate from the default option (Momsen and Stoerk, 2014). The “default nudge” has worked well in the case of enrolling employees automatically in 401(k) savings plans, which automatically pay a portion of the monthly salary into a savings account (Madrian and Shea, 2001). Madrian and Shea (2001) find that 401(k) participation is significantly higher when employees are automatically enrolled, even though none of the economic specifics of the savings plan changed. In terms of energy conservation policies, the default could be set to an energy efficient option. Policymakers could for example set the default energy contracts to 50% renewable energy and 50% conventionally produced energy and thereby increase energy efficiency (Pichert and Katsikopoulou, 2008).

### ***2.3.2 Framing as Loss***

Our risk perception changes whether an option is framed as disadvantage or advantage; individuals’ responses to losses are more extreme than responses to gains (Tversky and Kahneman, 1981). Tversky and Kahneman (1981) find that people are more risk-seeking when presented with a loss framing and more risk-averse when presented with a gain framing, when both conditions convey the same information. The value function for losses is steeper than the value function for gains because it is worse for people to lose than to gain. Altering the framing of an option changes individual’s perception of risk and consequently induces a change in behaviour. When utility providers give homeowners energy audits and provide them with information on how to increase their energy efficiency, they can formulate the improvements in terms of losses or in terms of gains. In the gain condition, electricity consumers would be told that they can save 10 Rand each day if they implement the suggested improvements whereby in the loss condition, consumers would be told that if they fail to implement the suggested improvements, they will lose 10 Rand each day. According to Tversky and Kahneman’s (1991) theory of loss aversion, responses are stronger when framed as loss than when potentially gaining something. Homeowners should hence be more likely to carry out the recommended energy efficiency improvement if told that they would continue to lose an average of 10 Rand per day instead of saving 10 Rand per day. Momsen and Stoerk (2014) provide participants in their study with information about the carbon dioxide emissions either framed as loss or as gain but they did not find any significant results.

### **2.3.3 Social Norms**

Studies have found that messages that appeal to normative behaviour by providing feedback information on household's own consumption compared to that of the average for the neighbourhood, have a more positive influence on environmental friendly behaviour than appeals to save the environment or be socially responsible (Schultz et al., 2007; Nolan et al., 2008). According to Festinger's (1954) social comparison theory, individuals judge themselves in relation to others, especially in relation to the ones that are closer to them in terms of gender, age, social status, or educational level. One of the largest randomised field experiments which uses social comparisons is the Opower home energy report programme with 600,000 US households receiving feedback on monthly energy consumption, social comparison with neighbours, and personalised tips on how to save energy (Allcott and Mullainathan, 2010; Allcott, 2011; Ayres et al., 2012; Allcott and Rogers, 2014). The programme led to an average electricity consumption decline of 2%, which is equivalent to a short-run electricity price increase of 11 to 20% or a long run price increase of 5% (Allcott, 2011). The results of the study show that non-price interventions can have effects on electricity demand that are comparable to large price changes. Households did not habituate to the intervention even after two years of receiving the home energy reports. Being part of the treatment group reduced the speed of backsliding into old habits even after two years of treatment (Allcott and Rogers, 2014).

### **2.4 Utility Consumption Feedback Designs**

Energy consumption is largely invisible to consumers making it difficult for them to understand how much electricity is used for the various household activities and what effect changes in technology or behaviour could have on the monthly electricity bill. The importance of energy conservation is commonly known but only few can link it to their own personal usage behaviour (Darby, 2006). In order to map consumption behaviour to billing costs, and to increase consumption awareness as well as conservation efforts, consumers need transparent and frequent feedback information. There are three factors stopping the mapping of behaviour to outcomes: information complexity, lack of information transparency, and infrequency or delay of feedback (Kahneman, 2003; Thaler and Sunstein, 2008). The more complex and less transparent information and consumption, the less likely individuals are to perceive the correct mapping between actions and outcomes. The greater the time gap between consumption and feedback, the less likely consumers are to remember specific actions and hence the less likely they are to link their actions to consumption correctly.

Feedback can be provided directly, from the meter or a separate display device, indirectly via billing, or inadvertently. Direct feedback, the most successful form of feedback with average energy savings of more than 5%, is given to consumers through attractive, user-friendly displays of energy consumption, through interactive feedback via PC, through smart meters, or through prepaid/pay-as-you-go meters. Often, electricity suppliers encourage energy users to read their own electricity meters and send their numbers to the supplier (self-meter reading). Since people rarely consult their meters, simply engaging them with the meter more and making them convert their meter readings into useful information raises awareness and consequentially reduces electricity consumption (Darby, 2001).

Many of the direct feedback techniques such as electronic “smart” meter reading need technical preconditions such as high-speed internet connections that are often unavailable or would be too costly to implement (Burgess and Nye, 2008). Previous research (Darby, 2001; Darby, 2006) shows that even though indirect feedback designs cannot induce the same level of energy conservation as direct feedback systems, they can still have a significantly positive effect and hence be a considerable low-cost alternative to advanced metering technologies. Indirect feedback refers to feedback that has been processed by the utility provider before being sent to the consumer. It is usually given through frequent billing or bills with historical, normative, or disaggregate feedback where consumers obtain information on consumption of the different end-use devices. Indirect feedback designs induce comparatively low savings varying from 0-5% depending on the context and quality of information (Darby, 2001).

Inadvertent feedback happens unintentionally or non-consciously for example when novel technologies such as solar panels or photovoltaic systems are installed in a private house and the household learns more about their energy use resulting in a change of their perception and thinking. Social learning during energy conservation projects with an emphasis on participation and learning in a community is another example of inadvertent feedback.

## **2.5 Increasing Attention through SMS Reminders**

When incentivising household behavioural changes through feedback designs, problems occur if there is an intervention-behaviour lag, a time gap between the administration of the intervention and the target behaviour. Instruments that help bridging this time gap need to be good at addressing the issues caused by inattention and forgetfulness as well as time inconsistent preferences (Rogers and Frey, 2015). Such instruments need to help people redirect their attention to the specific behaviour at the relevant time. Short time gaps can be

overcome by directing household's attention towards the target behaviour through SMS or email reminders (Ericson, 2014; Taubinsky, 2014; Rogers and Frey, 2015; Karlan et al., 2016).

According to Taubinsky (2014), there are two factors that determine attention: cues and rehearsal. Taubinsky (2014) suggests that, contrary to information processing models, individuals form behavioural intentions and then do not take certain actions because it is not on top of their mind, not due to cognitive limitations. Households might have intentions to save electricity but they are no longer top of mind due to daily stress and new in-coming tasks. Cues such as SMS or emails redirect people's attention towards the target behaviour making its execution more likely. Repeated performance of the desired action (rehearsal) also makes it more likely that individuals are attentive towards the behaviour in the future ("accessibility bias"). Recent engagement with the target behaviour such as thinking or performing the action makes it more likely that it rises back to the top of mind (Taubinsky, 2014).

Karlan et al. (2016) find that sending monthly reminder messages via SMS or letters to bank clients who recently opened up a savings account significantly increased their levels of savings. Different framing of the messages such as loss framing rather than gain framing did not have any significant effects. Verloet et al. (2012) have shown that electronic reminders via SMS, audio and visual reminders from electronic reminder devices, or reminders sent to pager systems have shown to increase patient's adherence to taking chronic medication in the short-term whereby long-term effects are unknown. Further, according to Calzolari and Nardotto (2012), sending weekly email reminders to gym members over the course of six months can have a significant impact on monthly gym attendance figures. The amount of monthly gym attendances of treatment and control group slowly converged after the reminders were no longer sent. However, the treatment group went to the gym more often than the control group for up to three months after the experiment. The email reminders were able to increase monthly gym attendances and formed a habit that enabled the participants to see the benefits of regular exercise.

Over the course of a year, Gleerup et al. (2010) test whether SMS and email feedback has a positive impact on overall household electricity consumption in Denmark using three treatment groups: (1) feedback is sent every day/week/month, (2) feedback is sent if current consumption deviates a certain percentage from consumption in the previous period, (3) feedback is sent if the current consumption is among the highest/lowest of the previous

periods. Glerup et al.'s (2010) treatment produced average consumption savings of 3% per year when informing households about their extreme consumption periods, for example their highest week of electricity use. Results are not robust but the researchers suggest that it could have a higher effect in other countries than Denmark because Danish households face some of the highest marginal electricity prices in the world and are therefore comparatively mindful about their consumption already.

## **2.6 What Features make a User-friendly Electricity Bill?**

Electricity bill design plays a vital role in catching individual's attention to energy consumption and in encouraging households to make more sustainable decisions. Improved billing feedback design can hence increase consumer's awareness and salience of energy usage (Wilhite and Ling, 1995). Since daily decisions are taken quickly, informed by information that is salient and on top of mind, more salient information will have a stronger impact on household behaviour (Chartrand et al., 2008; Sela and Shiv, 2009; LeBoeuf et al., 2010).

Experiments on choice overload show that increasing the amount of information consumers receive does not make them better informed but often has quite the opposite effect. Consumers experiencing information overload make less informed choices, are less likely to be satisfied with their choices and are even less likely to make a choice at all (Huffman and Kahn, 1998; Lee and Lee, 2004; Lurie, 2004; Diehl, 2005; Scheibehenne et al., 2010). In such situations, decision-makers are unable to process all the given information due to limited cognitive abilities and are consequently unsatisfied with their choices. The cognitive burden of processing information thus needs to be lowered. Lurie (2004) found that information structure has an impact on the acquisition of new information, processing of information, as well as, decision strategies and quality. Clearly categorising information reduces the risk of choice overload and makes information easier to navigate and understand (Russo, 1997; Huffman and Kahn, 1998; Diehl et al., 2003; Diehl, 2005).

The display form of information influences cognitive demands on attention and memory and consequently has an impact on individuals' decision processes (Kleinmuntz and Schkade, 1993). Billing information should be presented in a simple way, preferably reinforced with text, diagrams, and tables whereas none of them should stand alone but they should always complement each other (Roberts and Baker, 2003). Visualising information makes certain information more salient and allows people to easily see patterns in the data, compare

information, and process information more intuitively (Lurie and Mason, 2007). Visual representations change how information is processed and evaluated – they enable faster, automatic decision-making because the cognitive load is processed by the perceptual system (Ancker et al., 2006; Lurie and Mason, 2007). Thereby, consumer’s attention is drawn to salient attributes that stand out from the rest (Bordalo et al., 2013).

Graphic information influences inferences more than information presented in text format. Depending on the type of information that people are supposed to extract from the graph, different types of graphs should be used to make information processing and evaluation easier (Zacks and Tversky, 1999). When people are supposed to assess trends in the data, line graphs should be used to visualise the data, bar graphs should be used when discrete comparison judgements between data points need to be made, and pie charts when proportion judgments are required (Simkin and Hastie, 1987; Zacks and Tversky, 1999).

## **2.7 The Misunderstanding of the Step Tariff**

Another aim of the electricity bill redesign is to facilitate understanding of the step tariff. According to economic theory, individuals are well informed and equate costs and benefits at the margin to maximise their utility (Shin, 1985). However, marginal prices are costly to calculate because they change with the quantity consumed. Utility companies sell electricity in block prices at increasing marginal costs to induce a reduction in electricity consumption (Taylor, 1975; Arbues et al., 2003). Some empirical evidence shows that consumers respond to average prices rather than marginal prices (Shin, 1985; Carter and Milon, 2005). Average prices are easier to attain than marginal prices since households just need to compare the ratio of total cost to consumption ex post (Foster and Beattie, 1981; de Bartolome, 1995). If a household wants to know how much it costs them to use their toaster, they need to read the electricity meter before and after using the toaster while holding the use of all other household appliances constant. The marginal use of electricity then needs to be multiplied with the cost of electricity. If the benefits of calculating marginal prices are not large enough to outweigh the costs, consumers will be imperfectly informed and unaware of real electricity prices. However, as Carter and Milon (2005) state, Households need to have knowledge about the step tariff in order to respond adequately and change their behaviour as intended by policy makers.

## **2.8 Minimum Standards for South African Invoices**

The redesigned electricity bill needs to conform to all standards for South African utility bills. According to Clause 22 of the Consumer Protection Act 2008, South African customers have the right to attain information about products and services in plain and understandable language. Ordinary consumers (the target audience) with average literacy skills should be able to understand the content and importance of the given information without any big efforts. This requires that the comprehensiveness and consistency as well as the form and style of the information is clear and that the vocabulary and sentence structure is easy to understand.

The clauses 108, 109, and 110 of the National Credit Act 34 of 2005 determine that the statements of consumers' accounts have to be issued monthly without charge to the consumer and that they need to display the opening and closing balance. Any amounts credited or debited since the last bill need to be reflected on the invoice including the date of transaction. Additionally, any amounts overdue and any amounts currently payable need to be stated.

The Consumer Protection Act of 2008 (clause 26) further specifies what information needs to be provided on an invoice. It needs to show the full name or registered business name, the VAT registration number (if available) and address of the supplier as well as the recipient of the good and the date of transaction. Further, it needs to specify the name, unit price, and quantity of the good supplied, the total price before taxes, the amount of tax payable and the total price of the transaction including any taxes that need to be added. Also, the tariff structure needs to be made clear and it needs to be stated when the amount is payable.

## **2.9 Customer Satisfaction**

Besides increasing consumer understanding of the utility bill, it is also aimed to increase their satisfaction regarding the feedback that they receive from their utility provider. Customer satisfaction is often used as criterion to diagnose the performance of a service or a product (Anderson and Sullivan, 1993). The relationships between customers and firms are vital for firm success and survival. Satisfaction with previous experiences (due to kept promises) and a positive attitude towards a service provider is linked to higher trust in the service provider, customer retention, and higher loyalty (Andreassen and Lindestad, 1998). Quality below consumer's expectation has a greater impact on consumer's satisfaction than quality exceeding consumer's expectations (Anderson and Sullivan, 1993).

Households maintain the relationship with their service provider due to constraints (they do not have any alternatives or believe that it is impossible to exit the relationship due to economic/social/psychological costs) or because of dedication (they want to stay in the relationship). When households are in a constraint-based relationship their level of dedication to the relationship can be low and their level of constraints high. However, if only the constraints stop consumers from leaving their relationship with a service provider this relationship will no longer last when the conditions change and the constraints no longer exist. Further, higher switching costs occur when the satisfaction level with a service provider is high because there is a risk that the new provider delivers less satisfactory services. The quality of the relationship between the service provider and the household thus needs to be strengthened. It is therefore important to test participant's satisfaction with the current standard utility bill as well as their satisfaction with the redesigned bills (Bendapudi and Berry, 1997).

### 3. “Utility Bill Redesign” Study

#### 3.1 Research Objectives

The first controlled experiment, the “Utility Bill Redesign” experiment, identifies bill design strategies that could overcome the first one of the two major barriers to effective consumption feedback: the complexity of the utility bill, especially with regards to tariff calculations. The aim of the “Utility Bill Redesign” study is to assess how to increase people’s understanding of the monthly invoices they receive from their utility providers, in particular the different sections of the bill: the basic, utility and tariff information. The overall research question of the “Utility Bill Redesign” study therefore is the following:

*What visual, formatting or cognitively simplifying changes can be made to the current utility bill to increase consumer understanding?*

Based on prior literature and an evaluation of utility bills from overseas and South African municipalities, the current bill is redesigned to improve consumer understanding. Information needs to be clear, understandable, and accessible in terms of language and design while adhering to South African regulations.

In order to map consumption behaviour to billing costs consumers need transparent feedback information (Kahneman, 2003; Thaler and Sunstein, 2008). Information structure has a significant impact on the acquisition of new information, processing of information, as well as decision strategy and quality (Lurie, 2004). According to literature, the clearer information is structured and categorised, the easier it is to understand (Russo, 1997; Huffman and Kahn, 1998; Diehl et al., 2003; Diehl, 2005). Information load and complexity needs to be reduced to decrease the cognitive burden of processing billing information and to make consumers more informed and satisfied. It is therefore hypothesised that reordering the utility bill to make its structure inherently more logical will increase understanding of the bill measured by participant’s total number of correct answers in the questionnaire.

*H<sub>1</sub>: Reordering the bill for logical flow increases understanding of the bill.*

Due to limited cognitive abilities, decision-makers are unable to process all information they are given (Gigerenzer and Gaissmaier, 2011). As previous research indicates (Kleinmuntz and Schkade, 1993), the display form of information significantly influences cognitive demands on attention and memory and consequently has an impact on individuals’ decision processes. The cognitive burden of information processing can be reduced when structures are

cognitively simplified (Lurie, 2004). It is hypothesised that the processing of information is facilitated and the understanding of information is increased when information is not only ordered in a logical way but conversational prompts are added to guide the reader through the billing information.

*H<sub>2</sub>: Adding conversational prompts to support the logical flow of the billing information increases understanding of the bill.*

Daily decisions are taken quickly, informed by salient information (Chartrand et al. 2008; Sela and Shiv, 2009; LeBoeuf et al., 2010). Thus, consumers need to be able to grasp billing information quickly. The more salient the billing information is to consumers, the stronger will be the impact on their consumption behaviour. Consumer's attention is drawn to salient attributes that stand out from the rest (Bordalo et al., 2013), a process driven by their fast unreflective system. Since the display form of information influences information salience and the ease of information processing, it is expected that visual representations of billing information enables faster decision-making and increases understanding; expectations that are in line with previous findings by Lurie and Mason (2007) as well as Ancker et al. (2006). A graphical breakdown of the billing information, in form of different types of bar graphs, is predicted to increase participant's understanding of the tariff charges. Bar graphs are chosen because participants need to make discrete comparison judgements between data points (Simkin and Hastie, 1987; Zacks and Tversky, 1999). The bar graphs are expected to increase participant's understanding of the various tariff rates, the pricing structure and where their consumption lies within the different tariff blocks. It is expected that participants will be better informed and more aware of the utility step tariffs, measured by the number of correct answers in the tariff section of the questionnaire.

*H<sub>3</sub>: Presenting the billing information in form of bar graphs improves understanding of the step tariff.*

A treatment with separate bars was designed to test whether people would better understand that there are different rates for each block and how much they consumed in each block. However, this design could make consumers less aware that their consumption and costs have a cumulative relationship. Therefore, another treatment group was developed in which the bars were stacked on top of each other. The "Bar" and "Stacked Bar" treatment groups have classic separate and stacked bars respectively, while the "Utility Bar" and "Utility Stacked Bar" treatment groups received unconventional separate and stacked bars using utility

appropriate shapes such as lightning for electricity consumption and water-drops for water as bars.

Additionally, it is hypothesised that showing customers what exactly they are being billed for through graphical representations increases their understanding of the billing calculations. Since graphic information influences inferences more than information presented in text format (Zacks and Tversky, 1999), it is expected that breaking down each step of the calculations and enhancing them visually increases understanding. As a result it is hypothesised that breaking down the tariff calculations with graphical math will make participants better informed about the tariff calculations, measured by the number of correct answers in the tariff section of the questionnaire.

*H4: Breaking down the tariff calculations with graphical maths increases understanding of the step tariff.*

In South Africa, utility bills are predominantly written in English, even though the majority of consumers are speaking a different home language and might not be able to fully understand an English bill. Structuring and categorising information in a clearer way as well as adding visual representations of billing information is expected to facilitate understanding of the bill (Diehl et al., 2003; Diehl, 2005; Lurie and Mason; 2007). It is hypothesised that adding non-language visual cues to a foreign language utility bill helps participants to better understand the billing information.

*H5: Non-language visual cues help consumers to better understand a bill written in a foreign language.*

Experiments on choice overload have shown that consumers are less satisfied with their choices and their overall experience if the presented information is overwhelming (Huffman and Kahn, 1998; Lee and Lee, 2004; Lurie, 2004; Diehl, 2005; Scheibehenne et al., 2010). Simplifying the current utility bill through formatting, logical, and visual changes should therefore not only increase consumer understanding but also consumer satisfaction with the bill. Hence, we hypothesise that participants that receive a redesigned utility bill will overall be more satisfied with the bill that they receive than participants that receive the current standard utility bill.

*H6: Participants that receive a redesigned utility bill will be more satisfied with their bill than participants that receive the standard utility bill.*

## **3.2 Methods**

### ***3.2.1 Participants***

A total of 1,325 students from the University of Cape Town who are mainly in their first three years of study (77%) participated in this research project. Respondents were recruited through the university's online communication and administration platform Vula and had to fill out a recruitment questionnaire before taking part in the study.

### ***3.2.2 Materials***

The aim of this experiment is to assess how changing the visual appearance, formatting the text, or simplifying the graphs in a utility bill improves the comprehension of it. Utility bills from overseas and from various South African municipalities were analysed to determine common features such as wording, font, and graphics that could help to increase consumer's understanding of the billing information.

Utility providers in cities such as London (EDF Energy), Wellington (Mercury Energy), Berlin (Vattenfall) and New York (NYSEG) already make use of graphs, mostly separate bar graphs, to give their customers historical consumption comparisons or consumption comparisons with similar households in the neighbourhood. Vattenfall furthermore uses pie charts to show how total energy costs are composed. British Gas, the largest UK energy and home services company, uses logical order and utility appropriate shaped separate bar graphs in their bills. They also add conversational prompts to guide consumers through the multiple sections of the bill. Graphical math is for example used by Scottish Power, the German energy provider GASAG, and the Australian energy provider Synergy. Each bill was rated in the categories (1) general information, (2) format, and (3) charges which were divided into several sub-categories. As to the general information, it was checked if the provider gives an account summary, the opening and closing charges, and a line item summary. Concerning the format of the bills, it was analysed if any graphics or pictures are used, whether the bill is divided into separate sections, and how many pages the bill is in total. Finally, it was analysed how variable, fixed, and VAT charges are presented, for example if the utility provider gives a tariff break down, the amount consumed, or the price per Kilo Watt.

The current standard South African utility bill was used as control, the (1) "Status Quo" bill, and nine different designs were developed from it to assess how to make it easier to find and process information on the bill with greater speed. An overview of all treatment groups is

given in Table 1 and the utility bill for each treatment group can be found in Appendix A, Figure 2A to Figure 11A.

Simpler layouts and larger font sizes were used to develop the (2) “Logic” bill which is based on the existing bill and was reordered for logical flow starting with general information such as total amount owed and total amount consumed and continuing with more specific information about how these total amounts were calculated. The (3) “Process” bill, which is also based on the existing bill, was likewise reordered for logical flow and additionally obtained conversational prompts (speech bubbles) to guide consumer’s thought process.

**Table 1.** Description of all treatment groups.

<b>Experimental Group</b>	<b>Description of the Treatment</b>
<b>Status Quo</b>	Existing standard bill
<b>Logic</b>	Existing standard bill reordered for logical flow
<b>Process</b>	Logic bill with conversational prompts
<b>Bar</b>	Process bill & consumption in each tariff step represented as a labelled bar graph
<b>Stacked Bar</b>	Process bill & consumption in each tariff step represented as a labelled stacked bar graph
<b>Utility Bar</b>	Process bill & consumption in each tariff step represented as a labelled bar graph with each bar in the shape of the relevant utility service
<b>Utility Stacked Bar</b>	Process bill & consumption in each tariff step represented as a labelled stacked bar graph with each bar in the shape of the relevant utility service
<b>Graphical Math</b>	Logic bill & graphical math
<b>Foreign Language</b>	Process bill in Spanish
<b>Symbols &amp; Foreign Language</b>	Process bill in Spanish & utility specific symbols for each section of the bill

Five different treatments were developed to assess how to make it easier for consumers to understand the step tariff. The first four of these treatments (4-7) are based on the “Process” bill whereas the last one (8) is based on the “Logic” bill. To test if people better understand that there are different rates for each tariff block and how much they consumed in each tariff block, a graph treatment with separate bars was designed. Since consumption and costs have a cumulative relationship, another treatment group was developed in which the bars were stacked on top of each other to assess if this information presentation makes it easier for consumers to understand the step tariff. The (4) “Bar” and (5) “Stacked Bar” treatment groups have classic separate and stacked bars respectively, while the (6) “Utility Bar” and (7) “Utility Stacked Bar” treatment groups received unconventional separate and stacked bars using utility

appropriate shapes such as lightning for electricity consumption and water-drops for water as bars. The (8) “Graphical Math” bill design is based on the “Logic” bill but was extended to test whether clarifying the tariff calculations by breaking down each step of the calculation helps customers to better understand how the final billable sum was determined.

In South Africa, a country with 11 official languages, English is used as lingua franca even though it is not the most predominant mother tongue. Thus, utility bills are mostly written in English even though the majority of consumers are speaking a different home language and might not be able to fully understand the English bill. To test to what extent non-native speakers understand a foreign bill, two treatments (9) “Foreign Language” and (10) “Symbols & Foreign Language” were developed. The two bills were written in Spanish since Spanish is one of the least spoken languages at UCT. This made it unlikely that any of the participants would be familiar with the Spanish language to a proficient extent. Both of these bill designs used the “Process” bill as status quo and non-language utility symbols were added in the “Symbols & Foreign Language” treatment.

### ***3.2.3 Experimental Procedure***

Before being randomly assigned to any of the treatment groups, the participants had to fill out an online questionnaire giving details about their demographics, educational background, and electricity consumption habits. Also, they were informed that each participant is remunerated a fixed amount of R120 for their participation irrespective of their performance.

Participants were told a specific date and time that they had to log onto the experimental website to participate in the study. At the beginning of the study, they were asked to open a utility bill and they received the bill specific to their treatment (see Appendix A, Figure 1A, for experiment instructions). Participants were furthermore told that they are not able to go back in the questionnaire to complete questions that they skipped or to change their answers. The participants were then given 12 minutes to read through the bill and answer a total of 27 questions: (1) 7 basic billing information questions, (2) 11 questions related to utility charges for water, electricity, and refuse, and (3) 9 questions pertaining to step tariff charges. For a detailed description of the various basic, utility and tariff questions, see Table 2.

**Table 2.** List of all basic, utility and tariff questions

Questionnaire Section	Questions
<b>Basic Billing Questions</b>	<ol style="list-style-type: none"> <li>1. To whom is the bill addressed?</li> <li>2. How much do they owe on this bill as a whole?</li> <li>3. Did they have any debt to the municipality at the time of this bill?</li> <li>4. On what day of the month is the debt due?</li> <li>5. What month of the year is the debt due?</li> <li>6. How much VAT is charged overall on this bill in Rand?</li> <li>7. What is the VAT rate they are charged on this bill?</li> </ol>
<b>Utility questions</b>	<ol style="list-style-type: none"> <li>1. What is the unit of consumption for electricity?</li> <li>2. What is the unit of consumption for water?</li> <li>3. What is the unit of consumption for refuse?</li> <li>4. How much water consumption are they being billed for overall, as measured in Kiloliters?</li> <li>5. How much electricity consumption are they being billed for overall, measured in Kilowatt per hour (kWh)?</li> <li>6. What is their property value at the time of getting this bill?</li> <li>7. During which month was their electricity meter last read?</li> <li>8. On what day of the month was their electricity meter last read?</li> <li>9. During which month was their water meter last read?</li> <li>10. On what day of the month was their water meter last read?</li> <li>11. What type of property is this person being billed for?</li> </ol>
<b>Tariff Questions</b>	<ol style="list-style-type: none"> <li>1. How many possible different price bands (blocks) does their electricity tariff have?</li> <li>2. How much electricity, in kWh, did they consume in the lowest electricity price band?</li> <li>3. How much water, KL, did they consume in the middle water price band?</li> <li>4. How much electricity, in kWh, did they consume in the highest electricity price band?</li> <li>5. For how many electricity price bands did this person consume more than zero amounts of electricity?</li> <li>6. What is the price per unit of consumption in the lowest electricity band, in Rand per kWh?</li> <li>7. What is the price per unit of consumption in the middle electricity band, in Rand per kWh?</li> <li>8. What is the price per unit of consumption in the highest electricity price band, in Rand per kWh?</li> <li>9. What is the price per unit for refuse removal?</li> </ol>

Participants were advised to take no longer than two minutes to read through the utility bill that they were given and to take the remaining 10 minutes to answer the questions assessing their understanding of the different parts of the bill. The strict time constraint was chosen to simulate the real life situation of reading a utility bill because people rarely have a lot of time to deeply engage with it. However, it turned out that the time constraint made it impossible for participants to finish all the questions and lead to a lot of non-responses, especially regarding the tariff questions which were the last part of the questionnaire. In a second session, the questions about basic information and the questions regarding the tariff calculations were reversed in order.

At the end of the session, participants were asked to answer a questionnaire about their satisfaction with the bill that they received. They were given statements about their experience with the bill and were asked to rate how much they agree or disagree with the statements. They had to rate their level of satisfaction on a 10 point satisfaction scale where 1 means "Very dissatisfied" and 10 means "Very satisfied" and their level of agreement on a 7 point agree-disagree scale where 1="Totally Disagree", 2="Strongly Disagree", 3="Disagree", 4="Neither agree nor Disagree", 5="Agree", 6="Strongly Agree", and 7= "Totally Agree".

### **3.3 Analysis and Results**

#### ***3.3.1 Demographic Characteristics of Respondents***

There are a total of 1,325 participants in the final dataset, 627 participants in the first session and 698 in the second session. Each treatment group has around 130 participants and the observable characteristics such as cultural background, gender, and age are approximately evenly distributed across them as shown in Table 3. One-way analysis-of-variance (ANOVA) models show that treatments are balanced i.e. there is no significant difference of the observable characteristics among the treatment groups, except for the income groups which are significantly different between the “Bar” group and the “Utility Bar” group. The results of the ANOVA tests can be found in Appendix B, Table 1.1B to Table 1.4B.

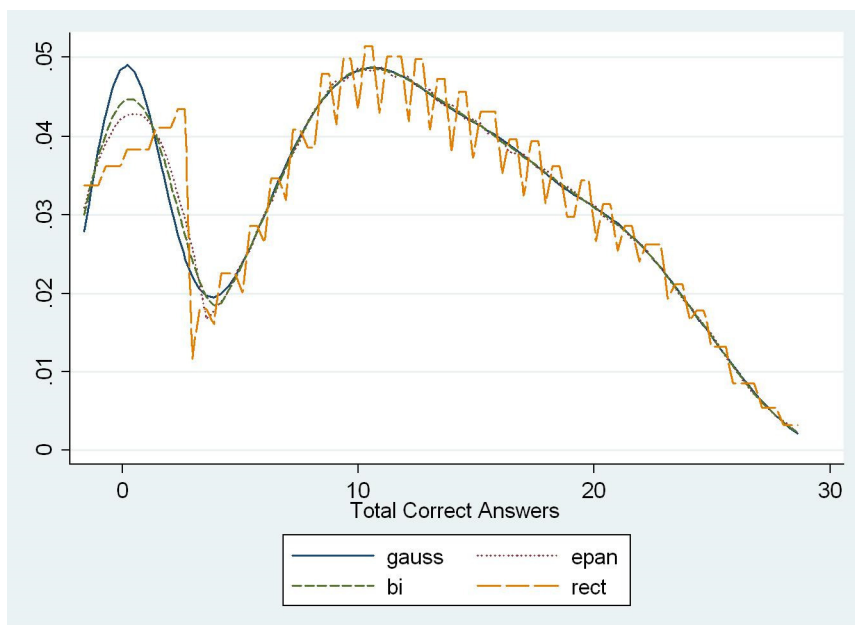
**Table 3.** Demographic characteristics per treatment group

	Control	Logic	Process	Bar	SBar	UBar	USBar	GM	FL	SFL	Total
<b>Gender (in %)</b>											
Female	55.83	51.18	48.84	51.59	55.81	53.49	55.91	54.62	59.23	48.06	53.45
<b>Age (in years)</b>											
mean	20.92	20.97	20.98	21.11	21.01	20.88	21.14	21.19	20.84	20.95	20.99
stdv	2.7	2.32	2.74	2.33	2.38	2.44	2.51	2.55	2.71	2.48	2.51
min	17	18	18	18	17	17	18	18	18	18	17
max	35	32	33	31	32	35	30	33	33	34	35
<b>Race (in %)</b>											
Black	56.90	53.28	50.39	55.08	54.03	50.88	56.78	50.79	54.03	48.41	53.00
Coloured	11.21	9.02	14.96	11.86	8.87	8.77	10.17	13.49	8.06	9.52	10.62
Indian	5.17	6.56	3.94	9.32	8.06	8.77	7.63	11.9	8.87	6.35	7.65
Asian	2.59	1.64	0.79	2.54	0.81	1.75	1.69	0.00	0.00	0.00	1.15
White	21.55	27.05	27.56	19.49	25.81	28.95	22.88	21.43	27.42	35.71	25.84
Other	2.59	2.46	2.36	1.69	2.42	0.88	0.85	2.38	1.61	0.00	1.73
<b>Income Group (in %)</b>											
Low	38.14	30.95	30.47	40.65	34.11	27.56	30.89	31.25	35.66	29.13	32.83
Medium	56.78	62.70	60.94	55.28	50.39	55.91	62.60	60.16	56.59	61.42	58.27
High	5.08	6.35	8.59	4.07	15.50	16.54	6.50	8.59	7.75	9.45	8.90

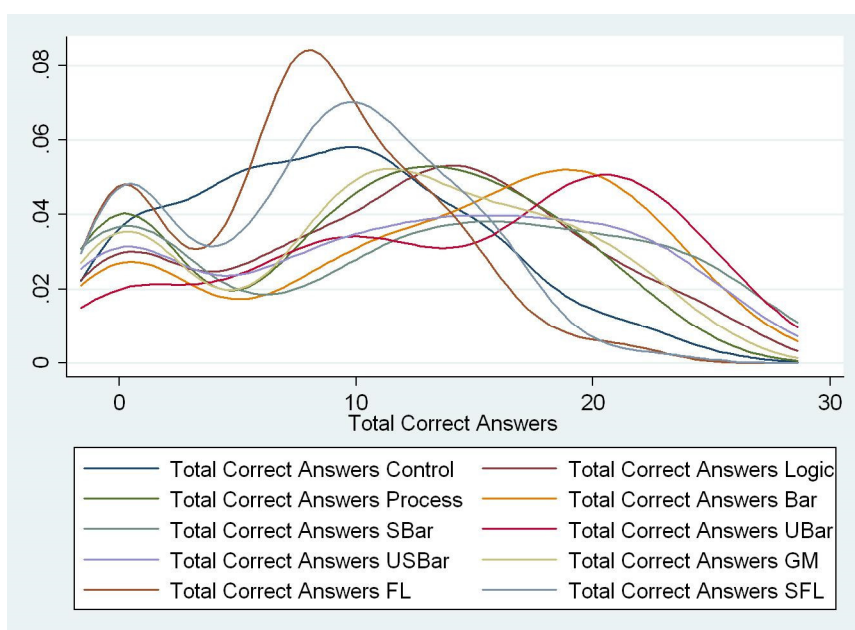
The median age is 20 years (average is 21) with the lowest age being 17 and the highest 35. There are 53.5% female participants and most participants say that they belong to the medium income group (58.27%) or the low income group (32.83%). Only 8.90% feel that they are part of the high income class. Most participants consider English (45.09%), Xhosa (17.28%) or Zulu (8.96%) their home language.

### 3.3.2 Distribution of Correct Answers

The median of participants' total correct answers is 11 and the distribution is skewed to the right by 0.034 and has a kurtosis of 2.01. Looking at the distribution of the total amount of correct answers in Figure 1 makes clear that the dependent variable is not normally distributed. A Gaussian kernel, 100 grid points, and the default bandwidth are used to estimate the density function of total correct answers for each treatment group and they are overlaid on one graph in Figure 2. It can be seen that the "Bar" and "Utility Bar" treatment groups both have more density at higher amounts of correct answers and less density at lower amounts of correct answers than the "Status Quo" bill group or the two foreign language treatment groups.



**Figure 1.** Distribution of total correct answers

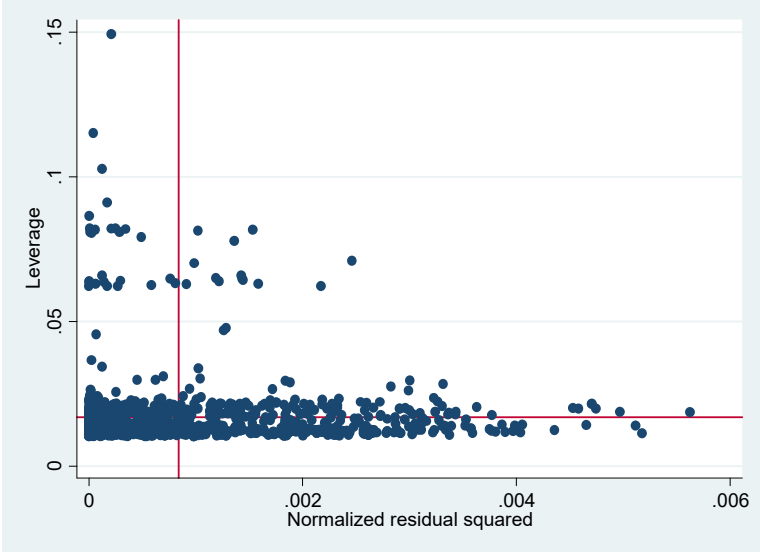


**Figure 2.** Distribution of total correct answers per treatment group

### 3.3.3 Testing the Regression Assumptions

Analysing the distribution of total correct answers above showed that the dependent variable, the amount of total correct answers, is not normally distributed. Testing for the normality of residuals shows that the residuals are not close to a normal distribution. However, a robust estimator should be efficient if the errors do not follow a normal distribution. A robust test for equality of variances (Levene's test of homogeneity) between the treatment groups makes clear that the variances are not equal. A Breusch-Pagan/Cook-Weisberg test which tests the

null hypothesis that the variance of the residuals is homogenous shows that the p-value is very small; correction for heteroscedasticity is thus needed. Heteroscedasticity consistent standard errors (robust regression) will be used because otherwise the estimates of the covariance matrix would be biased and inconsistent. There are no problems with multicollinearity since there are no high variance inflation factor values which means that none of the control variables are possibly redundant. High degrees of collinearity would cause standard errors to be inflated. However, there is a significant collinearity between age and age squared which can be expected and does not require any corrective measures.



**Figure 3.** Leverage plot of total correct answers

A quick way of checking potentially influential data points and outliers in the study is to use a `lvr2plot` in Stata. It looks at the leverage and relative square of the residuals and shows if there are any observations that are particularly influential. Data points in the top left corner are small residuals but high in leverage and points in the top right corner are high in leverage as well as high in the absolute of residuals. Data points that are the most influential on the estimates of the regression coefficients are the ones that have both a large residual and a high leverage. Figure 3 shows that there are some data points in the top left of the leverage plot meaning that they have high leverage but their squared residuals are comparatively small and hence do not raise any concern.

### 3.3.4 Regression Results

Table 4 presents the results from the ordinary least squares (OLS) regressions estimating the following model:

$$\text{Overall Performance} = \alpha + \beta[\text{treatment}] + \gamma[\text{race}] + \delta[\text{female}] + \varepsilon[\text{age}] + \zeta[\text{age}]^2 + \eta[\text{income}] + \theta[\text{wave}] + \iota \quad (3.1)$$

where the dependent variable is how many questions overall and in the three different sections of the questionnaire (basic questions, utility questions, and tariff questions) the participants in each treatment group answered correctly on average. Thereby, non-responses and incorrect answers were treated the same since non-responses give an indication for how complex the bill is. If participants were unable to answer the last part of the questionnaire (the tariff questions) because they took too much time answering the basic and the utility questions, it indicates that they had trouble to quickly retrieve information from the bill.

The treatment variable is a categorical variable from 1 to 10 with 1 being the “Status Quo” bill, 2 the “Logic” bill, 3 the “Process” bill and so forth. The other variables are ethnical background (using “Black” as baseline), the dummy variable female that takes the value 0 for male participants and 1 for female participants, age, age squared, a categorical variable for low, medium and high income, a variable controlling for whether the participant was part of the first or the second session, hence controlling for the order of the questionnaire, and a standard error term. Home language was not added as control variable to the regression because including it did not have a significant effect and hence did not change the regression outputs. The main regression is estimated separately for the three different sections of the questionnaire (basic, utility, and tariff) and for the overall performance. Two specifications – one with control variables, one without control variables – are run for each of the four models (total correct answers, basic questions, utility questions, tariff questions) resulting in a total of eight regressions.

**Table 4.** Comparison between all treatment groups overall/basic/utility/tariff performance

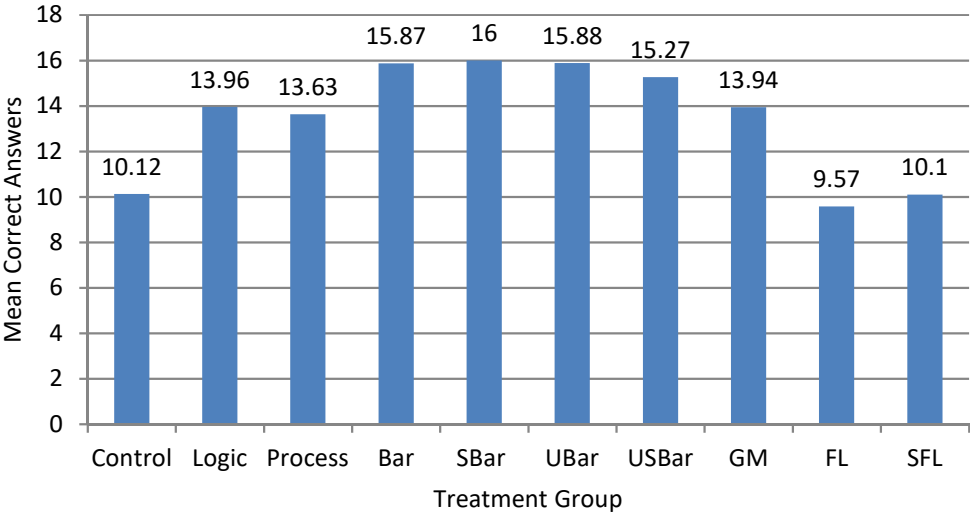
VARIABLES	(1) Total Correct Answers		(2) Basic Questions		(3) Utility Questions		(4) Tariff Questions	
	1	2	3	4	5	6	7	8
<b>Logic</b>	2.837*** (0.840)	2.852*** (0.807)	0.686*** (0.261)	0.600** (0.252)	1.627*** (0.400)	1.634*** (0.362)	0.524 (0.337)	0.617* (0.343)
<b>Process</b>	1.721** (0.826)	1.582** (0.795)	0.536* (0.283)	0.417 (0.277)	0.960** (0.376)	0.934*** (0.348)	0.226 (0.323)	0.231 (0.324)
<b>Bar</b>	4.659*** (0.882)	4.414*** (0.882)	1.087*** (0.269)	0.963*** (0.271)	2.014*** (0.403)	1.892*** (0.376)	1.558*** (0.374)	1.559*** (0.387)
<b>Stacked Bar</b>	3.393*** (0.952)	3.005*** (0.906)	0.513* (0.293)	0.390 (0.294)	1.624*** (0.426)	1.468*** (0.380)	1.256*** (0.381)	1.148*** (0.379)
<b>Utility Bar</b>	5.453*** (0.886)	5.356*** (0.836)	1.332*** (0.250)	1.284*** (0.241)	2.495*** (0.420)	2.521*** (0.373)	1.627*** (0.387)	1.550*** (0.389)
<b>Utility Stacked Bar</b>	3.446*** (0.907)	3.517*** (0.912)	0.690** (0.278)	0.641** (0.279)	1.609*** (0.414)	1.582*** (0.391)	1.146*** (0.380)	1.294*** (0.394)
<b>Graphical Math</b>	2.296*** (0.835)	2.051** (0.806)	0.737*** (0.276)	0.566** (0.271)	1.296*** (0.394)	1.152*** (0.351)	0.263 (0.333)	0.333 (0.331)
<b>Foreign Language</b>	-1.065 (0.709)	-1.089 (0.678)	0.0421 (0.261)	-0.0141 (0.261)	-0.108 (0.337)	-0.131 (0.300)	-0.999*** (0.278)	-0.944*** (0.278)
<b>Symbols &amp; Foreign Language</b>	-0.517 (0.722)	-1.125 (0.706)	-0.0336 (0.259)	-0.207 (0.262)	0.297 (0.349)	-0.0138 (0.319)	-0.781*** (0.282)	-0.903*** (0.289)
<b>Coloured</b>		0.918 (0.678)		0.136 (0.232)		0.0803 (0.306)		0.702*** (0.255)
<b>Indian</b>		2.035** (0.876)		-0.0899 (0.273)		0.679* (0.395)		1.446*** (0.328)
<b>White</b>		2.287*** (0.523)		0.0723 (0.167)		0.765*** (0.224)		1.450*** (0.208)
<b>Female</b>		-0.944** (0.414)		-0.243* (0.135)		-0.264 (0.185)		-0.438*** (0.158)
<b>Age</b>		1.845** (0.749)		0.563** (0.260)		0.908*** (0.327)		0.374 (0.296)
<b>Age Squared</b>		-0.0369** (0.0157)		-0.0112** (0.00550)		-0.0179*** (0.00680)		-0.00775 (0.00628)
<b>Medium Income</b>		1.916*** (0.446)		0.614*** (0.151)		0.747*** (0.200)		0.555*** (0.167)
<b>High Income</b>		2.599*** (0.901)		0.735*** (0.280)		0.735* (0.381)		1.129*** (0.356)
<b>Wave</b>		-3.230*** (0.424)		-1.192*** (0.138)		-2.812*** (0.190)		0.773*** (0.167)
<b>Constant</b>	8.906*** (0.540)	-9.767 (8.694)	3.890*** (0.168)	-1.234 (3.012)	3.055*** (0.252)	-4.186 (3.811)	1.961*** (0.241)	-4.347 (3.405)
<b>Observations</b>	1,325	1,157	1,325	1,157	1,325	1,157	1,325	1,157
<b>R-squared</b>	0.075	0.175	0.032	0.111	0.056	0.242	0.089	0.200

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

**3.3.4.1 Overall Performance of All Treatment Groups**

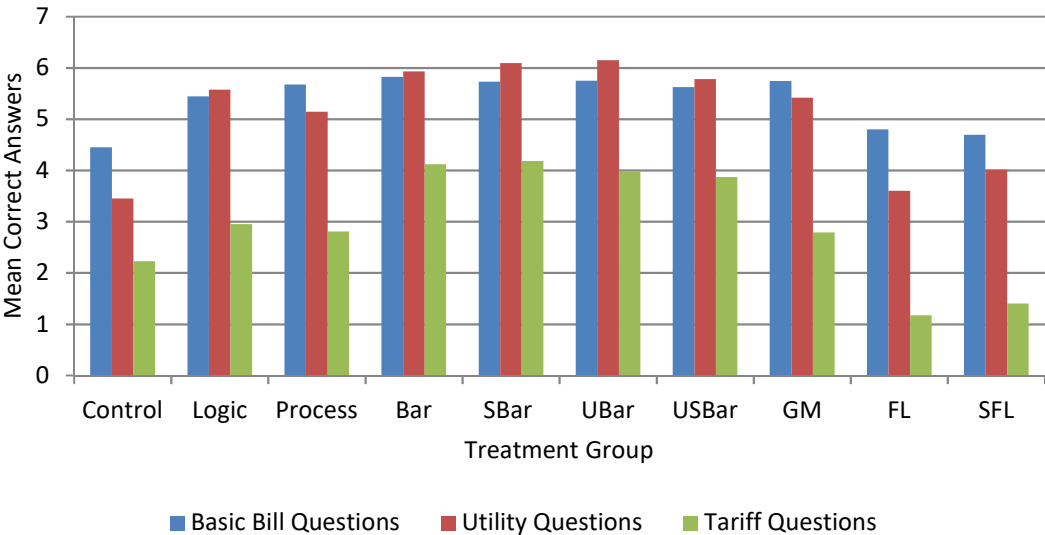
When looking at the average number of total questions that participants in each treatment group answered correctly in Figure 4, it can be seen that the group that received the utility bill, currently used as standard bill in South Africa, is part of the three treatment groups with the worst performance. The “Foreign Language” and “Symbols & Foreign Language” bill designs seem to perform equally as poorly as the current standard bill when looking at Table 4. The regression output in Table 4, panel 1, column 1 and 2, supports these impressions and shows that there is no significant difference between the two foreign language bills and the bill currently used as standard monthly utility bill in South Africa. These results are in line with Slabbert’s (2010) findings that the current South African invoices are user-unfriendly and written in a technical language that is very difficult to understand – even for native English speakers. Table 4, panel 1, column 1 and 2 shows that all other groups achieved a significantly higher overall score than the “Status Quo” bill at a 1% level, except for the “Process” bill which is significantly different at a 5% level. When controlling for confounding variables, the significance level of the “Graphical Math” treatment decreases from 1% to 5% (Table 4, panel 1, column 1 and 2). Overall, the results indicate that reordering the bill for logical flow increases understanding of the billing information;  $H_0(1)$  is thus rejected in favour of  $H_1$ . This effect can clearly be observed in Figure 4 below when comparing the bar of the Control group (10.12) to the bar of the “Logic” treatment group (13.96).



**Figure 4.** Total mean correct answers per treatment group

**3.3.4.2 Performance of the Different Treatment Groups in the Basic, Utility and Tariff Section of the Questionnaire**

The amount of mean correct answers of all treatment groups in the different sections of the questionnaire can be found in Figure 5. As it can be seen in Table 4, column 2, panel 3 and 4, the “Logic”, “Bar”, “Utility Bar”, “Utility Stacked Bar” and “Graphical Math” treatment groups performed significantly better than the “Status Quo” bill on the *basic questions* at a 5% level of significance (with and without controlling for observable characteristics). As to the *utility questions*, all treatment groups, except the foreign language bill treatments, performed significantly better at a 1% level than the “Status Quo” bill (Table 4, column 3, panel 5 and 6). On the *tariff questions*, the two foreign language treatments performed significantly worse than the “Status Quo” bill at a 1% level. This result is also very apparent in Figure 5.



**Figure 5.** Mean correct answers basic / utility / tariff questions per treatment group

Further analysis of the data for Figure 5 shows that 80 (out of 132) individuals in the “Foreign Language” treatment and 78 (out of 139) individuals in the “Symbols & Foreign Language” treatment had zero answers correct in the *tariff section* of the questionnaire, compared to 73 (out of 127) in the Control. Moreover, additional analysis shows that there is no significant difference in performance on any of the questionnaire sections between the two foreign language treatments (see Appendix B, Table 2B). Non-language visual cues thus do not help consumers to better understand a foreign language bill;  $H_0(5)$  cannot be rejected in favour of  $H_5$ .

Participants in the “Bar”, “Stacked Bar”, “Utility Bar”, and “Utility Stacked Bar” treatments performed significantly better on a 1% level on the *tariff questions* as shown in Table 4, column 4, panel 7 and 8. Moreover, all of these treatment groups had much less zero answers compared to the Control group and the two foreign language groups. This study hence shows that using bar graphs improves understanding of the step tariff and there consequently is enough evidence to reject  $H_0(3)$  in favour of  $H_3$ .

Previous studies, for example Shin (1985) or Carter and Milon (2005), which find that it is difficult for consumers to understand a step tariff when presented in a conventional way, are supported. The change in billing information design has a significantly positive effect on participant’s understanding of the step tariff. Visualising tariff information in form of graphs allows people to process and understand information faster, which is in line with previous findings by Ancker et al. (2006) as well as Lurie and Mason (2007). However, the “Graphical Math” treatment was not successful in making the step tariff easier to understand: the treatment group did not have a significantly different average tariff comprehension score from the control group.  $H_0(4)$  can thus not be rejected in favour of the alternative hypothesis  $H_4$ . These results do not change when analysing the incremental impact of the “Graphical Math” treatment from the “Process” bill (see Appendix B, Table 3B).

### **3.3.4.3 Is there a Difference between the “Logic” and the “Process” Bill?**

Assessing the regression output whether including speech bubbles into the bill to guide consumers through the calculations has a significant effect on performance shows that there is no significant difference (with and without controlling for confounding variables) between the “Logic” and the “Process” groups in terms of how they perform in any part of the questionnaire (see Appendix B, Table 4B). In other words, making the design more logical was the key to increase participant’s understanding of the utility bill. Adding conversational prompts did not have an additional positive effect and  $H_0(2)$  can therefore not be rejected in favour of  $H_2$ .

### **3.3.4.4 Which Bar Graph Treatment Performs Best?**

The regression output in Table 4 shows that all bar graph treatments are significantly different from the “Status Quo” bill. In order to understand the incremental impact that each additional modification to the bill yields, the bar graph treatment groups, which are based on the “Process” bill design, will be assessed in comparison to the “Process” bill. The results are shown in Table 5.

**Table 5.** Comparison between the bar graph treatments' overall/basic/utility/tariff performance

VARIABLES	(1) Total Correct Answers		(2) Basic Questions		(3) Utility Questions		(4) Tariff Questions	
	1	2	3	4	5	6	7	8
	<b>Bar</b>	2.938*** (0.937)	2.797*** (0.973)	0.552* (0.309)	0.526* (0.316)	1.054** (0.421)	0.937** (0.425)	1.333*** (0.359)
<b>Stacked Bar</b>	1.672* (1.003)	1.397 (0.994)	-0.0224 (0.331)	-0.0510 (0.334)	0.664 (0.443)	0.534 (0.431)	1.030*** (0.366)	0.913** (0.363)
<b>Utility Bar</b>	3.732*** (0.940)	3.713*** (0.926)	0.796*** (0.294)	0.835*** (0.291)	1.535*** (0.437)	1.576*** (0.421)	1.401*** (0.373)	1.302*** (0.369)
<b>Utility Stacked Bar</b>	1.724* (0.960)	1.907* (1.000)	0.155 (0.318)	0.207 (0.321)	0.649 (0.431)	0.629 (0.439)	0.920** (0.365)	1.071*** (0.379)
<b>Coloured</b>		1.190 (1.068)		0.178 (0.346)		0.135 (0.480)		0.877** (0.393)
<b>Indian</b>		3.200** (1.325)		0.275 (0.367)		1.107* (0.593)		1.819*** (0.564)
<b>White</b>		2.038** (0.842)		-0.0427 (0.252)		0.668* (0.354)		1.413*** (0.340)
<b>Female</b>		-1.063 (0.663)		-0.178 (0.202)		-0.241 (0.289)		-0.644** (0.263)
<b>Age</b>		2.462** (1.229)		0.819* (0.444)		1.071** (0.518)		0.572 (0.503)
<b>Age Squared</b>		-0.0510* (0.0262)		-0.0172* (0.00963)		-0.0216** (0.0108)		-0.0122 (0.0108)
<b>Medium Income</b>		2.603*** (0.735)		0.855*** (0.232)		1.006*** (0.319)		0.742*** (0.283)
<b>High Income</b>		3.508*** (1.318)		1.101*** (0.375)		0.861 (0.565)		1.546*** (0.535)
<b>Wave</b>		-3.047*** (0.659)		-1.095*** (0.201)		-2.885*** (0.290)		0.933*** (0.266)
<b>Constant</b>	10.63*** (0.625)	-15.55 (14.19)	4.425*** (0.228)	-3.837 (5.061)	4.015*** (0.280)	-5.099 (6.054)	2.187*** (0.216)	-6.618 (5.761)
<b>Observations</b>	661	571	661	571	661	571	661	571
<b>R-squared</b>	0.024	0.129	0.017	0.106	0.019	0.206	0.024	0.144

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

In terms of overall scores, shown in Table 5, panel 1, column 1 and 2, the “Bar” group and the “Utility Bar” group performed significantly better than the treatment group which received the “Process” bill (at a 1% significance level both with and without controlling for demographics). Results for the “Stacked Bar” and the “Utility Stacked Bar” are rather weak: the “Stacked Bar” treatment becomes insignificant when adding control variables and the “Utility Stacked Bar” treatment is only significant at the 10% level with and without controls. Concerning the *basic questions*, only the “Utility Bar” treatment group answered significantly more questions correctly than the “Process” group, at the 1% level. The “Bar” treatment is only significant at the 10% level. The “Bar” treatment and the “Utility Bar” treatment group

are also the only two groups that have significant results regarding the *utility section* of the questionnaire. All bar graph treatment groups have significantly more correct answers in the *tariff section* of the questionnaire than the “Process” bill treatment group.

#### **3.3.4.5 Should Utility Providers use Standard or Stacked Bar Graphs?**

The results indicate that utility providers should rather use bar graphs that are not stacked. Even though no significant difference between the “Bar” and “Stacked Bar” treatments is found in the *overall, utility, or tariff question* performance, the “Stacked Bar” treatment group performed worse at a 10% significance level on the *basic questions* (see Appendix B, Table 5B). The “Utility Stacked Bar” treatment performed significantly worse than the “Utility Bar” *overall* as well as on the *basic and utility questions*. However, there is no significant difference between the two treatments when it comes to the *tariff questions* (see Appendix B, Table 6B).

#### **3.3.4.6 Participant’s Satisfaction with their Utility Bill**

At the end of the study, participants were asked to answer a questionnaire about their satisfaction with the bill they received. All the regression results can be found in Appendix B, Table 7B. Firstly, they were asked to rate how they feel about the bill overall. Participants that were in the “Status Quo” group gave on average 5 points out of 10 and all other treatment groups, except for the two Spanish bills, gave an average score that is significantly higher. The two Spanish treatment groups were significantly less satisfied than the control bill with an average score of 3.9. The “Stacked Bar” and “Bar” treatment groups reported the highest average scores regarding how they felt about the way in which electricity/water was displayed in the bill. The lowest average scores were achieved by the treatment groups which received the “Status Quo” bill or any of the two Spanish bills.

Further, participants who received any of the two Spanish bills were more likely than the “Status Quo” group to report that they perceived the bill as silly, especially the “Symbols & Foreign Language” treatment group which is significant at the 1% level. All of the bar treatment groups found the bill significantly less silly compared to the “Status Quo” group. It could have been expected that participants find the electricity shaped graphs silly because previous research found that a utility bill that used small houses for illustration purposes was perceived as childish (Wilhite et al., 1999).

The two Spanish treatments do not have significantly different average scores than the “Status Quo” group on the questions regarding to what extent they agree that the bill is too cluttered, that there was no logical flow in the bill, and that it was hard to find information on the bill. All the other treatment groups, however, report satisfaction scores that are significantly different from the “Status Quo” group. Similar results are found regarding the statement “This bill was too complex for me to understand in the time available”: all treatment groups except for the two Spanish treatment groups are significantly less likely to find the bill too hard to understand than the “Status Quo” group.

Further, participants that were part of any of the bar treatment groups felt significantly less angry about the bill whereby the “Logic” and “Process” group treatments as well as the “Foreign Language” treatment groups did not feel significantly different from the “Status Quo” group. The “Symbols & Foreign Language” treatment group was significantly more likely at a 10% level to feel angry about the bill. The “Graphical Math” treatment group on the contrary was less likely to feel angry at a 10% level. None of the treatment groups felt significantly different than the “Status Quo” group about the bill making them feel bored. Participants on average gave 3.1 points on a 7 point agree-disagree scale where 1 means “Totally Disagree” and 7 “Totally Agree”. All treatment groups, except for the Spanish treatment groups, were more likely to say that the bill they received is a bill that has everything they wish for in a bill than the “Status Quo” group.

The results show that not all redesigned utility bills significantly increased participant’s satisfaction with their bill. The two Spanish bills did not perform significantly better than the current standard utility bill on most questions related to satisfaction and overall performance of the bill. There consequently is not enough empirical evidence to reject  $H_0(6)$  in favour of  $H_6$ . However, most redesigned bills made participants significantly more satisfied.

### ***3.3.5 Calculating and Reporting Effect Sizes***

The p-values from the regression results in Table 4 and Table 5 do not report the size of the effect of the different treatment designs, but only whether there is an effect or not. Statistical significance does not tell us anything about the magnitude of the effect i.e. how much a certain utility bill redesign affects participant’s understanding of the bill. Effect sizes for all treatments thus need to be calculated to interpret the effectiveness of the different utility bill redesigns. When interpreting the effect of an intervention, the general guideline is to evaluate a Cohen’s  $d$  (1977) of 0.2 as small, 0.5 as medium and 0.8 as large effect (Cashen and Geiger,

2004). While the “Logic”, “Bar”, “Utility Bar”, “Foreign Language”, and the “Symbols & Foreign Language” treatment groups all have medium effect sizes (around 0.4), the “Process”, “Stacked Bar”, and “Utility Stacked Bar” treatment groups have small effect sizes (around 0.2). However, it needs to be taken into account that the billing redesign treatments should be evaluated in comparison to other similar interventions that also aim to increase consumer understanding of billing information. Further, if a small low-cost improvement to the billing design increases understanding with a small effect size, it can still be effective taking costs and (long-run) benefits into account.

### ***3.3.6 Conclusion***

Building on existing literature, this study was conducted to test different strategies how to improve utility bill design to reduce information complexity and increase consumer understanding of the billing information. A randomised control experiment amongst over 1,000 students was used to test nine different utility bill redesigns. In each case, the bill design builds on the previous improving logical flow and adding conversational prompts and graphical representations of the different charges through graphs or graphical maths. Participant’s understanding of the bill is tested through a questionnaire with basic billing, utility, and tariff questions.

The results clearly indicate that restructuring the utility bill in a logical order and displaying the amount of electricity and water consumed in each tariff block with separate bar graphs is a successful way to increase consumer understanding of the bill. The two treatment groups with the best overall performance are the “Bar” treatment group which displays bar graphs using separate bars and the “Utility Bar” treatment group which uses bar graphs with separate bars in utility appropriate shapes such as lightning for electricity consumption and water-drops for water. The “Bar” and “Utility Bar” treatment group both had on average more than 40% more correct answers than the “Status Quo” bill group, which received the current standard South African utility bill. Moreover, participants that received the redesigned utility bills, except for the foreign language treatment groups, felt significantly more satisfied with the way information was displayed than the group that received the current standard utility bill. This study further shows how difficult it is to understand utility bills that are not in your home language, even when utility specific symbols for each section of the bill are added. The foreign language bills performed the worst of all treatment designs. These results have particularly strong policy implications because most households in South Africa receive a utility bill that is not in their home language.

## 4. “Attention Redirection” Study

### 4.1 Research Objectives

Standard information processing models suggest that when consumers receive information, they update their knowledge and permanently optimise their consumption behaviour accordingly (Allcott and Rogers, 2014). However, when households receive a utility bill, they initially reduce their consumption levels but become increasingly inattentive and slide back into old habits until the next bill arrives (Allcott and Rogers, 2014; Gilbert and Graff Zivin, 2014). As time from the billing moment passes, attentiveness to electricity and water consumption decreases. The aim of the “Attention Redirection” study is to assess the evolution of the lack of mindfulness over time and to test a bill-based strategy for increasing the involvement of consumers and thereby their mindfulness of consumption. The overall research question of the “Attention Redirection” study hence is the following:

*Is there a way to use the utility bill to increase attentiveness towards consumption during the period between billing events?*

Participants in this study are assigned to different treatment groups and are given an online task that requires daily attention and effort in order to maximise pay-offs. A bill-based strategy to increase the involvement of participants is tested. A commonly used non-pecuniary way of drawing consumer’s attention to utility conservation is to provide them with information on how to save water and/or energy or with self-management tools that encourage self-monitoring of consumption patterns. We test a bill-based self-management tool, a blank graph that participants receive at the first day of the experiment to fill out themselves to track the amount owed to them each day. Participant’s task adherence is expected to be positively influenced by the graph.

*H<sub>1</sub>: Providing participants with a blank graph to assist them in self-managing their behaviour has a positive effect on task adherence.*

When incentivising household behavioural changes through feedback designs, problems occur if there is an intervention-behaviour lag, a time gap between the administration of the intervention and the target behaviour. Reminders via email or SMS are found to successfully address this issue caused by inattention and forgetfulness, shown for example by Calzolari and Nardotto (2012), Verloet et al. (2012), Ericson (2014), Taubinsky (2014), Rogers and Frey (2015) and Karlan et al. (2016). Cues such as SMS or emails redirect individual’s

attention towards the target behaviour making the behaviour top of mind again and its execution consequently more likely (Taubinsky, 2014). SMS and email feedback would therefore be expected to have a positive impact on overall household electricity consumption. The daily SMS reminders used in this study are predicted to help participants redirect their attention to the online task at the relevant time.

*H<sub>2</sub>: Daily SMS reminders have a positive effect on task adherence.*

## **4.2 Methods**

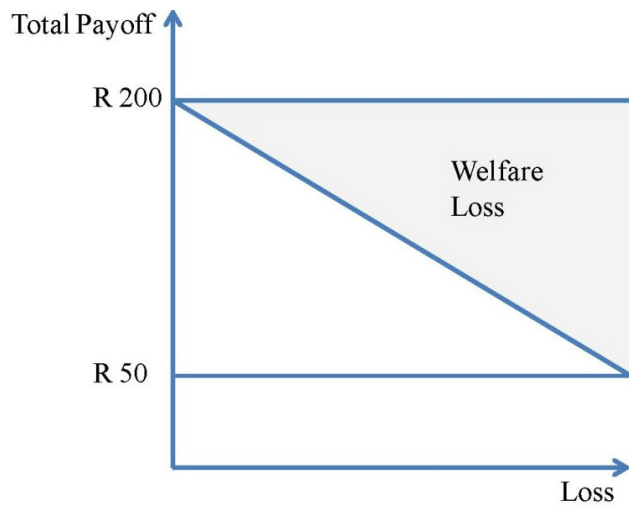
### **4.2.1 Participants**

Participants in this study consist of 417 students from the University of Cape Town who are mainly in their first three years of study (78%). Just like in the “Utility Bill Redesign” study, respondents were recruited through the university’s online communication and administration platform Vula and had to fill out a questionnaire before taking part in the study.

### **4.2.2 Experimental Design**

In order to apply the results of this research to tasks with payoffs that only become salient in the future but which require consistent tending to in the present, the experiment was conducted for 30 days from the 10<sup>th</sup> of December 2014 until the 8<sup>th</sup> of January 2015. To ensure a low salience context for the participating students, the experiment took place during semester holidays, a time with typically low salience for university matters.

As shown in Figure 6, the experimental payoff design was framed as loss where *Total Payoff* = *endowment of R200* - *R5 × number of days participant did not log on*. Hence, welfare loss is calculated by =  $\frac{R150 \times R5 \times \text{number of days participant did not log on}}{2}$ . According to Tversky and Kahneman’s (1991) theory of loss aversion, responses are stronger when framed as loss than when potentially gaining something. Participants should hence be more likely to log onto the experimental website if told that they would continue to lose an average of 5 Rand per day instead of saving 5 Rand per day.



**Figure 6.** Experimental payoff design

The welfare loss from suboptimal consumption due to inattention will be assessed leaving aside rational inattention. If attention is a scarce resource that needs to be rationed, inattention to consumption might be a rational choice because the savings in attention that can be achieved due to inattention possibly offset the costs of overconsumption (Sexton, 2015). Consumers would then choose to make decisions with incomplete information rather than acquiring additional information to be perfectly informed (Sallee, 2014). If consumers rationally choose not to pay attention to electricity prices, overconsumption cannot be interpreted as welfare loss. However, it seems unlikely that average consumers make rational decisions to over-consume electricity in order to save attentional resources for other areas in their life.

#### **4.2.3 Materials**

Participants had to fill out a questionnaire before taking part in the study which, besides general information, asked respondents to report "how satisfied are you with your life as a whole right now" on a ten point scale ranging from "(1) very dissatisfied" to "(10) very satisfied". This was done because organising, progressing and achieving goals is positively related with well-being (Romero et al., 2009). Participants with high levels of life satisfaction are thus expected to perform better on the task. Additionally, each participant completed a Five-Factor personality test which is commonly used for personality assessment and consists of five dimensions (Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness) under which all personality traits can be classified (Digman, 1990; McCrae and John, 1992). Individuals with high conscientiousness scores commonly have high levels of self-control and motivation to accomplish tasks and are hence expected to log onto

the experiment website more often (Spielberger, 2004; Romero et al., 2009). Since a priori testing of the psychological traits showed that only conscientiousness is significant to predict participants' number of submissions, it was the only trait included in the regression (see Appendix D, Table 1D).

#### 4.2.4 Experimental Procedure

The participants were randomly assigned to one of three possible treatment groups or the control group. Table 6 provides an overview of the treatment received by each experimental group. All participants had the task to log onto the experiment website daily to answer four simple questions whereby the answers were irrelevant but only the logon behaviour as measure of attention was of interest. Before the start of the experiment, the participants were told that the payment owed to them at the end of the study is R200 and that they lose R5 every day they do not log onto the website (see Appendix C, Figure 1C, for experiment instructions).

**Table 6.** Description of all treatment groups

<b>Experimental Group</b>	<b>Description of the Treatment</b>
<b>Control</b>	Received explanation of the experimental task and payoff structure
<b>SMS</b>	Received a daily SMS reminding them to log onto the website
<b>Graph</b>	Received a blank graph that they could fill out themselves to track the amount owed to them each day as a result of their logons
<b>SMS&amp;Graph</b>	Received the graph as well as the daily SMS

The control group only received the explanation of the experimental task and the payoff structure resembling the usual passive billing procedure where the consumer only obtains a monthly utility bill. The first treatment group (SMS group) additionally received a daily SMS reminding them to log onto the website (SMS text: "Remember to log on to Vula today and complete your Online Update task."). The presence or absence of the SMS reminder did not change the participants' incentives in terms of monetary payoffs hence it should not change behaviour if participants are only optimising their payoffs. SMS reminders do however direct attention to the task. The second treatment group (Graph group) received a blank graph at the first day of the experiment that they could fill out themselves to track the amount owed to them each day as a result of their logons (Appendix C, Figure 2C). Participants may become relatively inattentive over the course of the task if they lack tools to help them self-manage

their behaviour. The blank graph was provided electronically, as pdf, to this group as a self-management tool at the start of the study and could be downloaded and printed at any time. As it could not be observed how intensively a participant used the graph, this treatment was an intention to treat. However, it has applicability since self-management resources are dispensed in this fashion in other fields that require consumer's daily attention. The third treatment group (SMS&Graph group), which received the daily SMS reminder as well as the graph, was added to the experiment in order to check for interaction effects between the SMS reminder and the graph since it was considered possible that an SMS reminder would induce participants to use the graph more often.

### **4.3 Analysis and Results**

#### ***4.3.1 Demographic Characteristics of Respondents***

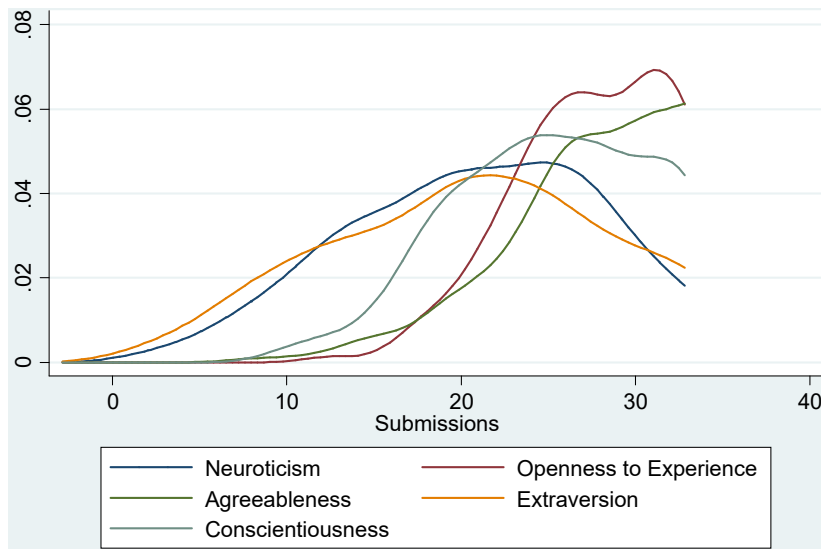
There are 417 participants in the experiment with 105 participants in each treatment group except for the SMS&Graph group which has 102 participants. The recruited students are mainly from the Faculty of Commerce (37.86%) but students from the Humanities Faculty (19.06%), as well as the Faculty of Engineering & the Built Environment (16.71%) participated as well. The majority of the participants are in their first three years of university study (78%).

Before analysing the data, it is tested whether observable characteristics such as age, gender, ethnicity, and income background are evenly distributed across treatment groups. The results are presented in Table 7. One-way ANOVA tests show that none of the control variables are significantly different between treatment groups (Appendix D, Table 2.1D to 2.6D). Most participants are between 18 and 21 years old with the youngest respondent being 18 years old and the oldest 36 years. The median age is 20 years and the mean is 21.07 years. There are slightly more female than male participants in all treatment groups except for the SMS&Graph group. The racial/ethnic groups are equally distributed across treatment groups with most of the participants being Black (37%), White (33%) and Coloured (15%). The majority of participants are from a medium income background (62%) and 29% are from a low income background. Only 9% say that they belong to the high income class. The median as well as average well-being score is 7 (out of 10) meaning that on average people are satisfied with their life at the moment.

**Table 7.** Demographic characteristics per treatment group

	Treatment Groups				
	Control	SMS	Graph	SMS&Graph	Total
<b>Gender (in %)</b>					
Female	59.38	65.22	52.04	49.49	56.36
<b>Age (in years)</b>					
Mean	21.13	20.91	21.36	20.86	21.07
Stdv	2.79	2.69	2.7	2.47	2.66
Min	18	18	18	18	18
Max	36	33	35	32	36
<b>Race (in %)</b>					
Black	34.41	37.5	35.11	41.11	36.99
Coloured	13.98	17.05	17.02	12.22	15.07
Indian	10.75	10.23	13.83	13.33	12.05
Asian	1.08	0	1.06	2.22	1.1
White	37.63	32.95	30.85	30	32.88
Other	2.15	2.27	2.13	1.11	1.92
<b>Income (in %)</b>					
Low	21.05	33.33	29.17	31.63	28.8
Medium	71.58	58.06	57.29	60.2	61.78
High	7.37	8.6	13.54	8.16	9.42
<b>Well-being score</b>					
Mean	7.13	6.81	6.86	6.86	6.92
Stdv	1.65	1.77	1.76	1.9	1.77
Min	1	1	2	1	1
Max	10	10	10	10	10
<b>Conscientiousness score</b>					
Mean	25.04	25.81	27.16	26.54	26.14
Stdv	6.77	6.24	6.08	6.23	6.36
Min	10	12	11	10	10
Max	40	40	40	38	40

Further, there is no imbalance between treatment groups in terms of personality traits. The distribution of each Five-Factor personality trait (Neuroticism, Openness to Experience, Agreeableness, Extraversion, Conscientiousness) can be seen in Figure 7.



**Figure 7.** Distribution of personality traits

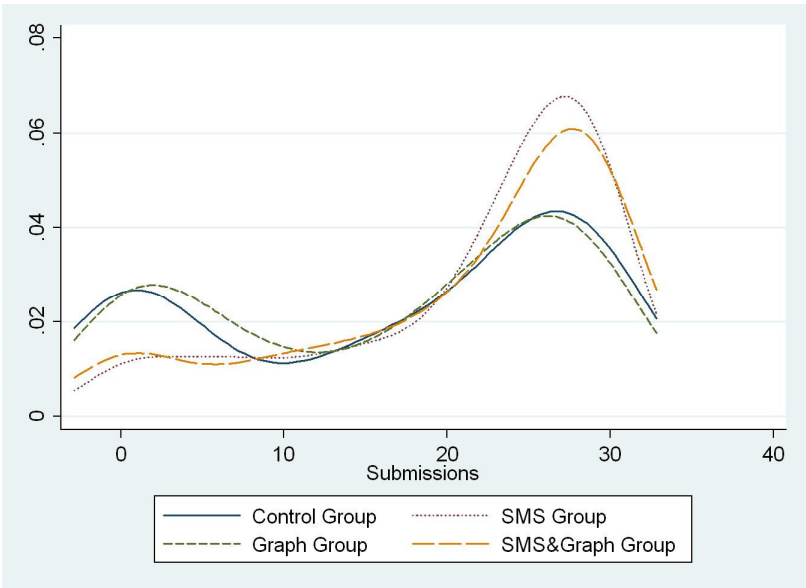
Special attention needs to be paid to the conscientiousness scores since they are most important to the amount of submissions made by participants and one can see in Table 7 above that the Graph group has the highest ones. However, a one-way ANOVA test shows that there is no significant difference regarding the conscientiousness scores between the different treatment groups (Appendix D, Table 2.6D). The “enrollment\_pers” variable indicates whether the participant will be enrolled at UCT in 2015 so whether they are a returning student or not. A total of 18 participants in this study (Control 8, SMS 1, Graph 4, SMS&Graph 5) will not be enrolled at UCT in 2015. One could argue that their enrolment in 2015 could have an effect on their motivation to take the experiment seriously because they will have to make extra efforts to receive the payment for their participation in this study. However, further analysis shows that whether participants are returning students in 2015 or not does not have an effect on the amount of participant’s submissions (Appendix D, Table 3D). The “enrollment\_pers” variable is therefore not included as control variable in the main regression.

#### **4.3.2 Distribution of Submissions**

The smallest amount of submissions is 0 and the largest value is 30 thus there were some participants that never submitted and some that submitted every day of the month long study. The median of overall submissions is 24 and the mean is 19.05. The Control and the Graph treatment groups have a median amount of submissions of 22 and 20 respectively while the SMS and the SMS&Graph groups have median submissions of 25 each. The mean amount of submissions are 17.15 and 16.71 for the Control and the Graph treatment group respectively

while the mean amount of submissions for the SMS and the SMS&Graph treatment groups are 21.34 and 21.04 respectively.

As the overall skewness coefficient is negative (-0.74), the median is higher than the mean and the distribution is skewed to the left. The negative skew indicates that the distribution's tail on the left side (lower amount of submissions) is longer or fatter than on the right side (higher amount of submissions). The distribution of submissions has a kurtosis of 2.04 meaning that it is light-tailed and produces less outliers than the normal distribution, which has a skewness of 0 and a kurtosis of 3. Overall, the standard deviation is rather large with 10.58.

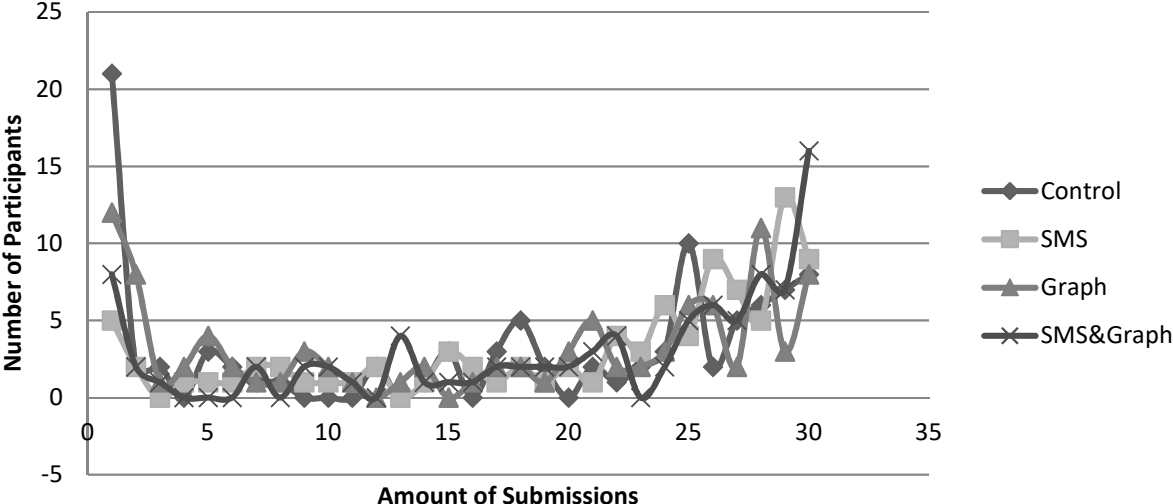


**Figure 8.** Distribution of submissions per treatment group

Figure 8 reports the distribution of submissions per treatment group and shows that the density function is non-symmetric for all groups whereby the SMS and SMS&Graph groups have more density at higher amounts of submissions and less density at lower amounts of submissions than the Control and the Graph group. Thus, densities differ at the extremes of the distribution whereby all treatment groups have roughly the same density of subjects achieving a total amount of logons between 10 and 20.

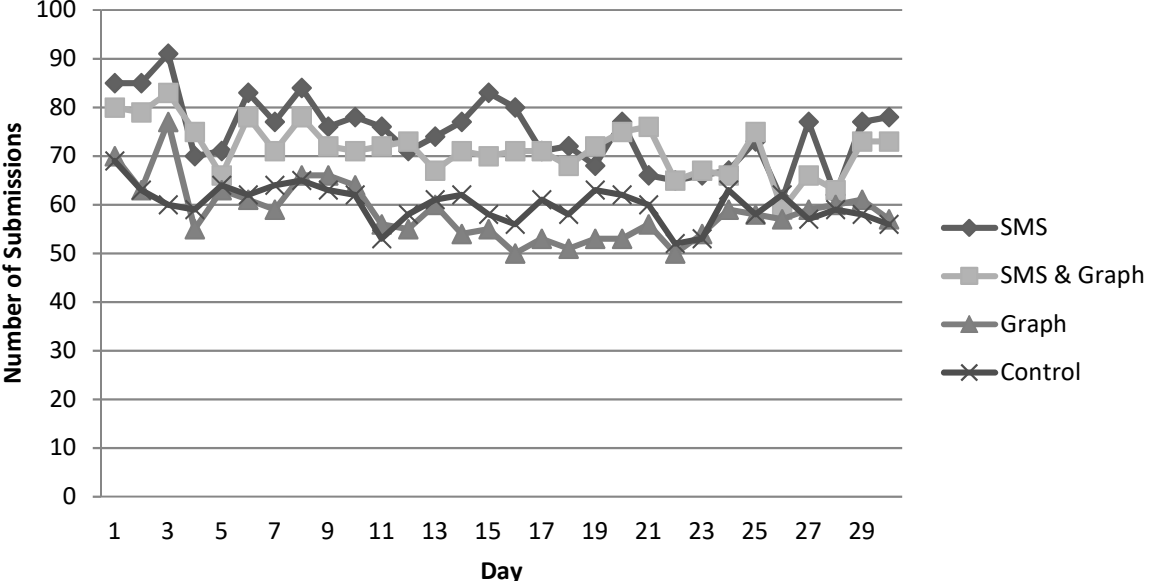
Looking at the total amount of submissions per treatment group in Figure 9, it can be seen that there is a very large number of participants that log onto the experimental website very few times. Particularly the Control group has many participants that only log on one or two times, or never. The SMS and the SMS&Graph group both have fewer people that log on very little and perform better in the higher amounts of submissions. In fact, there are 21 individuals in

the Control group that never logged on, 5 individuals in the SMS group, 12 in the Graph group and 8 individuals in the SMS&Graph group. All treatments thus were particularly strong in reducing zeroes, especially the SMS and the SMS&Graph group.



**Figure 9.** Total amount of submissions per treatment group

Figure 10 shows the amount of submissions per treatment group each day over the course of the experiment. Similar to the graph above, Figure 10 shows that the SMS as well as the SMS&Graph group both have higher numbers of submission than the Graph and the Control group over the entire duration of the behavioural experiment.



**Figure 10.** Submissions per treatment group over time



#### 4.3.4 Pre-Regression Analysis

To detect any systematic differences between the different treatment groups two-sample Wilcoxon rank-sum (Mann-Whitney) tests are conducted (see Appendix D, Table 4.1D to 4.6D for detailed results). This test is chosen because it is a non-parametric analog to the independent samples t-test that can be used when the dependent variable is not a normally distributed interval variable (UCLA: Statistical Consulting Group). For this test it only needs to be assumed that the variable is at least ordinal. It is a test of the null hypothesis that two samples come from the same population against an alternative hypothesis, especially that a particular population tends to have larger values than the other. The comparisons show that there is no significant difference between the Control and the Graph group ( $z=0.224$ ,  $p=0.8224$ ) but that the Control and the SMS group ( $z=-2.438$ ,  $p=0.0148$ ) as well as the Control and the SMS&Graph group ( $z=-2.459$ ,  $p=0.0139$ ) are significantly different at the 5% level. Further, there is no significant difference between the SMS and the SMS&Graph treatment group ( $z=-0.185$ ,  $p=0.8532$ ).

#### 4.3.5 Regression Results

The robust ordinary least squares regression results are presented in Table 8 estimating the following model:

$$\begin{aligned} \text{Total Amount of Submissions} = & \alpha + \beta[\text{treatment}] + \gamma[\text{female}] + \delta[\text{age}] + \\ & \varepsilon[\text{race}] + \zeta[\text{income}] + \eta[\text{well} - \text{being}] + \theta[\text{conscientiousness}] + \iota \end{aligned} \quad (4.1)$$

where the dependent variable is the total number of times a participant submitted their answers to the daily task on the experimental website. The treatment variable is a categorical variable ranging from 1 to 4 with 1 being the Control group, 2 the SMS group, 3 the Graph group, and 4 the SMS&Graph group. Other variables included as controls in the estimation are the dummy variable female that takes the value 0 for male participants and 1 for female participants, age, ethnical background (using “Black” as baseline), a categorical variable for low, medium and high income, the participant’s well-being as well as conscientiousness score, and a standard error term. Four different models are estimated. Table 8, column 1, shows the first estimation which does not include any control variables. Column 2 shows model 2 which includes control variables such as gender, age, and race. Model 3 in column 3 additionally includes income as control variable. The final model in Table 8, column 4, includes all control variables (gender, age, race, income, well-being, conscientiousness).

The robust ordinary least squares regression, presented in Table 8, column 4, shows that the SMS group on average logged on 4.1 times more than the Control group and that the SMS&Graph group logged on 3.61 times more often. Both findings are at least significant at the 5% level meaning that there is enough evidence to reject  $H_0(2)$  in favour of  $H_2$ . However, there is no significant difference between the Control group and the Graph group;  $H_0(1)$  can thus not be rejected in favour of  $H_1$ . Looking at the control variables it can be seen that having higher scores of conscientiousness makes people more likely to log onto the experimental website.

**Table 8.** Standard linear regression estimates and control variables.

Submissions	(1)	(2)	(3)	(4)
Treatment: SMS	4.190*** (1.435)	3.903** (1.516)	4.106*** (1.511)	4.100*** (1.543)
Graph	-0.438 (1.435)	-0.397 (1.619)	-0.0118 (1.656)	-0.362 (1.702)
SMS & Graph	3.887*** (1.446)	3.165** (1.567)	3.346** (1.604)	3.613** (1.628)
Female		-1.685 (1.089)	-1.514 (1.100)	-1.804 (1.096)
Age		-0.136 (0.191)	-0.150 (0.194)	-0.227 (0.190)
Race: Coloured		2.100 (1.716)	2.127 (1.739)	2.014 (1.741)
Indian		2.689 (1.889)	2.440 (1.930)	1.803 (2.009)
Asian		12.86*** (1.852)	12.67*** (1.934)	13.02*** (2.501)
White		2.707** (1.261)	3.136** (1.346)	2.349* (1.400)
Other		2.328 (3.898)	2.754 (4.016)	2.552 (4.013)
Income: Medium			0.659 (1.284)	1.450 (1.297)
High			-2.319 (2.218)	-1.778 (2.189)
Well-being				0.149 (0.346)
Conscientiousness				0.250*** (0.0922)
Constant	17.15*** (1.015)	19.90*** (4.364)	19.55*** (4.596)	13.62*** (5.250)
Observations	417	362	359	345
R-squared	0.041	0.064	0.070	0.106

Standard errors in parentheses

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

The robustness of the results is tested by turning the total number of submissions variable into a categorical variable of low, medium and high amounts of submissions (low\_subs=1 if submissions<=9, med\_subs=1 if submissions>9 & submissions<21, high\_subs=1 if submissions>=21) and running a robust ordered logit and probit using the same explanatory variables as in the previous regression. The results are presented in Table 9, column 1 and 2.

**Table 9.** Ordered logit/probit of the “Submissions” and “Paygroup” variable

Submissions	(1) Logit Submissions	(2) Probit Submissions	(3) Logit Paygroup	(4) Probit Paygroup
Treatment: SMS	0.840*** (0.319)	0.530*** (0.189)	0.642** (0.285)	0.437*** (0.169)
Graph	-0.184 (0.323)	-0.103 (0.192)	-0.173 (0.311)	-0.0819 (0.181)
SMS & Graph	0.586* (0.329)	0.357* (0.195)	0.648** (0.311)	0.425** (0.182)
Female	-0.408* (0.232)	-0.250* (0.136)	-0.237 (0.204)	-0.153 (0.121)
Age	-0.0522 (0.0400)	-0.0290 (0.0248)	-0.0454 (0.0349)	-0.0241 (0.0218)
Race: Coloured	0.587 (0.375)	0.335 (0.219)	0.482 (0.349)	0.259 (0.202)
Indian	0.443 (0.448)	0.209 (0.251)	0.487 (0.397)	0.253 (0.224)
Asian	14.31*** (0.619)	5.277*** (0.228)	16.68*** (0.608)	5.539*** (0.216)
White	0.488* (0.292)	0.290* (0.173)	0.370 (0.259)	0.219 (0.154)
Other	0.437 (0.715)	0.238 (0.453)	0.618 (0.666)	0.347 (0.422)
Income: Medium	0.285 (0.275)	0.192 (0.162)	0.271 (0.256)	0.152 (0.147)
High	-0.423 (0.433)	-0.243 (0.261)	-0.373 (0.407)	-0.222 (0.240)
Well-being	0.0268 (0.0672)	0.0160 (0.0402)	0.0426 (0.0628)	0.0249 (0.0370)
Conscientiousness	0.0587*** (0.0204)	0.0351*** (0.0118)	0.0475*** (0.0177)	0.0288*** (0.0103)
Constant cut1	-0.161 (1.101)	-0.0488 (0.672)	-0.512 (0.950)	-0.242 (0.581)
Constant cut2	0.703 (1.101)	0.468 (0.672)	-0.0880 (0.945)	0.00345 (0.579)
Constant cut3			0.216 (0.943)	0.184 (0.579)
Constant cut4			0.706 (0.942)	0.482 (0.578)
Constant cut5			1.601* (0.944)	1.034* (0.579)
Observations	345	345	345	345

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Overall, the results did not change much; however, the SMS&Graph group became slightly less significant since the significance level changed from 5% to 10%. There are two cut points (constant cut 1, constant cut 2) for the logit/probit of the submissions variable because there are three ordered categories (low, medium, high). In order to divide the curve into three sections, two cut points are needed.

A second ordered logit and ordered probit test is done with the paygroup variable which is created by turning the amount owed to each participant into different categories. If the amount owed to a participant is between R50 and R75 they are assigned to paygroup 1. The participants are assigned to paygroup 2 if the amount owed to them is "R76–R100", to 3 if "R101–R125", 4 if "R126–R150", 5 if "R151–R175", and 6 if "R176–R200". The results of the ordered logit and probit with the paygroup variable are presented in Table 9, column 3 and 4. The results remain the same as the results from the main regression, except that in the logit model the SMS treatment group is slightly less significant because the significance level changed from 0.008 to 0.024. There are five cut points for the paygroup variable because there are six different categories (paygroup 1 “R50–R75” to paygroup 6 "R176–R200"). Thus, in order to divide the curve into six different sections, five cut points are needed.

#### ***4.3.6 Calculating and Reporting Effect Sizes***

In order to evaluate the results of the “Attention Redirection” study, not only the statistical significance (p-values) but also the substantive significance (effect size) needs to be reported. The level of statistical significance does not indicate the effect size or if the implementation of an intervention is justified. Effect sizes, as measure of true significance of the difference between treatment groups, are calculated. Effect sizes for the test statistics of the two-sample Wilcoxon rank-sum (Mann-Whitney) tests are calculated according to Rosenthal (1994) using the following formula:  $r = \frac{z}{\sqrt{N}}$ . While the SMS and SMS&Graph groups both have small effect sizes (around 0.2), the Graph treatment group has an effect size close to zero. The magnitude of the difference between treatment groups and control group in this study is relatively small. However, according to Cohen (1977), even though a small effect of 0.2 is considerably smaller than a medium effect of 0.5, it is not so small as to be trivial. It can be concluded that the SMS and SMS&Graph treatments were much more effective than the Graph treatment.

#### ***4.3.7 Conclusion***

The “Attention Redirection” study sought to understand the role of attention in realising welfare gains for tasks that require repetitive bursts of attention. Actively directing the attention of participants in this task helped them lock in welfare gains beyond those achieved by groups who were left to self-manage. This study finds that there is a significant welfare loss in terms of monetary payoff due to inattention. Daily SMS reminders significantly increase individuals’ monetary payoffs and seem to have directed attention to the task and made its execution more likely. The provision of a graph to encourage self-management had no discernible effect upon monetary payoffs.

## **5. Conclusions and Discussion**

Over the last decade, insights from behavioural economics have increasingly been used to design public policies. Individuals are “nudged” into behaviours that are self-beneficial but would not have been adopted otherwise. Utility providers might be able to “nudge” consumers towards more desirable consumption patterns by delivering simpler and better feedback informed by applied behavioural sciences. Two sets of controlled experiments were conducted with over 1,500 subjects to identify bill design strategies that could overcome two major barriers to effective utility consumption feedback:

- the complexity of the utility bill, especially with regards to tariff calculations, and
- consumer’s declining mindfulness of utility consumption between billing events.

### **5.1 “Utility Bill Redesign” Conclusion and Discussion**

The monthly utility bill is an important low-cost carrier of feedback information and commonly used as tool to make households aware of their consumption. It can cost-effectively increase energy conservation without changing consumer choices or increasing prices. Therefore, bill design plays a vital role in catching individual’s attention to utility consumption and in encouraging households to make more sustainable decisions. According to Wilhite and Ling (1995), improved billing feedback design can increase consumer’s awareness and salience of energy usage. Unfortunately, consumers are often unable to understand the billing information, especially the step tariff calculations. A more effective communication between consumers and their utility provider has the purpose of increasing household’s energy and water conservation efforts as well as their overall satisfaction with their utility provider. Previous research shows that billing information needs to be presented in a simple way, preferably reinforced with graphs or tables, and that an increase in information does not necessarily increase understanding. Since people make quick daily decisions to reduce their efforts for unimportant tasks, the bill design needs to catch people’s attention and enable them to understand the content quickly. Thereby, consumer’s attention is drawn to salient attributes that stand out from the rest.

The “Utility Bill Redesign” study was conducted to test nine different strategies how to improve utility bill design to reduce information complexity and increase consumer understanding of the billing information. A randomised controlled experiment was conducted amongst 1000+ students to test nine different utility bill designs. Each bill design builds on

the previous improving logical flow and adding conversational prompts and graphical representations of the different charges through graphs or graphical maths. Participant's understanding of the bill was tested through a questionnaire with basic billing, utility, and tariff questions.

Restructuring the utility bill in a logical order and displaying the amount of electricity consumed in each tariff block with separate bar graphs is shown to be a successful way to increase consumer understanding. The "Bar" treatment group which displays bar graphs using separate bars and the "Utility Bar" treatment group which uses bar graphs with separate bars in utility appropriate shapes such as lightning for electricity consumption and water-drops for water are the two treatment groups with the best overall performance. The "Bar" and "Utility Bar" treatment group both have on average more than 40% more correct answers than the "Status Quo" bill group, which received the utility bill currently used as standard in South Africa. Furthermore, all treatment groups, except for the foreign language treatment groups, feel significantly more satisfied with the utility bill they received than the group that received the current standard utility bill. Participants who received a redesigned utility bill, except for the foreign language treatment groups, are on average more satisfied with the way that information is displayed on the bill, find the bill less cluttered, are more likely to think that there is logical flow in the billing information and that it was generally easy to find information. The "Utility Bill Redesign" study further shows how difficult it is to understand a utility bill that is not in your home language, even when adding utility specific symbols for each section of the bill. The foreign language bills performed the worst of all treatment designs which has a particularly strong policy implication because most households in South Africa receive a utility bill that is not in their home language.

Adding speech bubbles into the bill to guide the reader through the calculations did not have a significant effect on participant's understanding of the utility bill. The way in which "process" was presented (through speech bubbles) was thus not effective. Other ways to design bills with the aim to improve information processing need to be assessed, for example, the bill could be designed in a way that resembles a dialogue.

Since the "Utility Bill Redesign" study purely looks into the understanding of the utility bill information, it is unclear whether households will actually change their consumption behaviour when better informed about their electricity usage. This study is therefore unable to provide any prognosis for potential electricity conservation efforts. However, Lynham et al. (2016) find that better knowledge about electricity consumption does increase energy

conservation efforts. Increasing people's understanding of consumption is hence seen as important step towards energy conservation. However, other studies have found that knowing the personal level of consumption does not always decrease consumption. Moreover, it needs to be considered that the size of such an effect may be quite different amongst a particular sub-population, such as university students, than in the population at large.

If households learn that they use less energy than expected, they are likely to increase their consumption ("boomerang effect") (Schultz et al., 2007). As next step, utility providers need to increase household's knowledge of effective ways to reduce utility consumption. When thinking about the most effective ways to save energy, people rather think about *curtailment actions* such as switching off their lights when leaving the room than *efficiency improvements* such as installing fluorescent lights (Attari et al., 2010). Curtailment actions can be done with less effort since they are easy and cheap to implement because they do not require any upfront costs or acquisition of additional information but they have a comparatively low impact and are only conserving energy but not changing efficiency.

Future research should evaluate the effectiveness of providing a graphical breakdown of household consumption in form of separate bar graphs in combination with a page of water/electricity saving tips on actual utility conservation. In fact, researchers from the Environmental Policy Research Unit at the School of Economics, University of Cape Town, in collaboration with the City of Cape Town and the Water Research Commission, are currently running a randomised control trial of 400,000 households to test the effectiveness of several behavioural messages, sent as inserts with the monthly municipal utility bill, on water consumption. One of their treatment groups receives an insert that provides a graphical breakdown of the billing information, using separate bar graphs, to clarify the pricing structure, the tariff charges and where a household's consumption is situated within the block tariff structure. This treatment group further receives a one-page insert providing information on ways to reduce water consumption through curtailment actions and efficiency improvements. The results of this still ongoing study will show how effective graphical breakdowns of tariff calculations in combination with information inserts are in a real world setting.

## 5.2 “Attention Redirection” Conclusion and Discussion

The “Attention Redirection” study was conducted in order to understand the role of attention in realising welfare gains for tasks that require repetitive bursts of attention. Actively directing participant’s attention towards the daily online update task enabled them to achieve higher welfare gains than the group who had to self-manage their behaviour. We find that there is a significant welfare loss in terms of monetary payoff due to inattention. Daily SMS reminders significantly increase individuals’ monetary payoffs and seem to have directed attention to the task and made its execution more likely. Providing a graph to encourage self-management did not have an effect.

SMS reminders make desired actions such as adherence to diets, gym attendance, or attention to electricity consumption top of mind again and do not even need to be sent daily, as in this study, since habituation causes marginal effects to decrease (Allcott, 2011; Allcott and Rogers, 2014). However, as Taubinsky (2014) points out: returns to additional messages are not converging to zero and, as this study also indicates, frequent reminders make it more likely that individuals will remain attentive towards desired behaviour in the future. The SMS treatment in this study actively directed individual’s attention to logging in online. However, cues such as SMS are imperfect since they are not always reaching the target person. Individuals do not check their phones, delete SMS before reading them, or do not receive the SMS at the time the target behaviour needs to be performed. Participants potentially did not have internet access when receiving the SMS, could not immediately log onto the experimental website and forgot about the task before they had internet access again. Rogers and Frey (2014) found that if only incomplete changes in behaviour are achieved, there will be marginal benefits to continued treatments. If the intervals between sending the reminder messages are long, desensitisation and habituation are less likely to occur and the stimulus will sufficiently redirect individual’s attention towards the desired actions. If stimuli are provided at different intervals and in different ways (SMS, email, letter), marginal benefits to continuing the treatment are higher (Rogers and Frey, 2014).

Future research should assess which aspects of personalised messages are most effective in changing household energy consumption patterns. Different framings should be tested in a randomised control trial in the field. The study, mentioned above, run by researchers from the Environmental Policy Research Unit in collaboration with the City of Cape Town and the Water Research Council, aims to assess which message prompts are most effective to encourage behavioural change. Even though their study uses inserts focusing on household

water consumption, sent with the monthly municipal utility bill, the results will have general implications for the framing of consumption feedback messages such as SMS, emails, or letters. The study will show if household consumption is more likely to be reduced when addressing informational failures with regards to price and household usage or when using social incentives or appeals to the public good in the messages.

The provision of a graph to encourage self-management did not significantly increase individuals' monetary payoffs and seems to have not directed attention to the task. The results hence do not support the use of a low-cost bill-based strategy to increase electricity consumption salience. For feedback to work, it needs to be easily accessible and give clear, transparent, and specific information. In the "Attention Redirection" study, however, feedback had to be self-created by the participants. The results suggest that the mapping of behaviour to outcomes was not facilitated by the graph treatment. If participants had been given the possibility to self-read their pay-offs every time they log in online, their attention to the task could potentially have increased. Direct feedback designs that have an interactive component (such as daily meter self-reading) have been shown to have a positive impact on consumption behaviour. Indirect feedback via billing that has been more successful includes frequent billing with comparative historical consumption feedback (Wilhite and Ling, 1995) or frequent billing with normative feedback giving social comparisons with similar neighbouring households often in combination with tips on how to save energy (Allcott and Mullainathan, 2010; Allcott, 2011; Ayres et al., 2012; Allcott and Rogers, 2014).

### **5.3 Further Research Limitations**

Running the experiment in an online setting has practical advantages, however it needs to be considered that it can also create bias since participants might have had varying internet speeds which would enable some participants to load the experimental pages faster than others. In addition, we do not know if participants fully understood the study since they did not have the possibility to ask questions as in lab-based studies. Further, it is not possible to control the environment the participant is in during the experiment which means that participants could have had different levels of concentration. Even though self-reported data on questions such as income and well-being is relatively easy and inexpensive to obtain, participants can be motivated to bias their response (self-report bias). Donaldson and Grant-Vallone (2002) find that people over- or under- report behaviours that are seen as socially desirable and make errors in self-observation.

Using students for the two experiments is appropriate because the identified behavioural blockages arise due to cognitive and behavioural processes which are common to humans in general and are observed across socioeconomic class, education, gender, and race. However, it can be expected that university students' cognitive abilities are higher than the cognitive abilities of an average individual in the general population. The results found in the two studies are therefore expected to be an upper bound and further testing for external validity in the broader population is needed.

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## 7. Appendices

### Appendix A. Experiment Instructions and Utility Bill Design for Each Experimental Group

#### Figure 1A. Experiment instructions

### **IT IS IMPORTANT THAT YOU READ THESE INSTRUCTIONS**

This **Quiz is Timed** with the time starting as soon as you click begin assessment.

On the **SECOND** question there is an **attachment**. Download it and refer to it continuously throughout the quiz.

In order to successfully complete this quiz, please download the **attached bill** under the first question and spend a brief moment studying it.

This quiz has a time limit of **12 minutes** which includes the time taken to study the bill. We advise that you take no more than **2 minutes** to study the bill and then immediately start with the quiz for which you will have **10 minutes**.

The third and fourth questions on the quiz relates to the Consent Policy and Renumeration Policy and need to be understood and answered in order to complete the quiz.

### **PLEASE DOWNLOAD THE ATTACHMENT NOW AND BEGIN THE QUIZ**

At the end of the quiz you will be paid R 120 if completed successfully. You will receive an online slip for the cashiers office at UCT. Please take this slip to the cashiers office in order to be paid.

This research has been approved by the Commerce Faculty Ethics in Research Committee. Your participation in this research is voluntary. You can choose to withdraw from the research at any time; however non-completion of the comprehension test will result in you not receiving any payment for this task. Only people who successfully complete the quiz will be paid.

You will not be requested to supply any identifiable information, ensuring anonymity of your responses.

Should you have any questions regarding the research please feel free to contact the researcher at [experimentsuct@gmail.com](mailto:experimentsuct@gmail.com)

Figure 2A. Experimental group 1 – “Status Quo” bill

# Billing

BILLING HOLDING LIMITED REG NO  
1204/215275/05  
VAT REG NO 8920582049

Western Cape Region  
PO Box BELVILLE 23

**CONTACT CENTRE:** (084) 092 9843  
**Fax NO:** (021) 092 2934  
**E-MAIL:** info@billing.co.za  
**WEB:** www.billing.co.za



# Billing

**TEL:** 08600 37834  
**SMS:** 083 325 23053  
084 903 23453  
082 328 48393

CUSTOMER SERVICE WEBSITE  
WWW.BILLING.CO.ZA/CUSTOMER

YOUR ACCOUNT NO	185 395 325
SECURITY HELD	6036.23
BILLING DATE	2014-10-22
TAX INVOICE NO	44697822
ACCOUNT MONTH	OCTOBER 2014
CURRENT DUE DATE	2014-11-19
VAT REG NO	NOT SUPPLIED

Western Cape Region  
PO Box BELVILLE 23

**DIRECT DESOPIT DETAIL**  
BANK: GHT  
BRANCH CODE: 372

## TAX INVOICE

EMAIL: youremail@email.co.za

ACC NO/REFERENCE NO:

185 395 325

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Your next reading will be on 2014/11/12  
CONSUMPTION SUMMARY FOR PERIOD

Electricity Reading	Water Reading	Property type	Stand number	Refuse	
Actual	Actual	Residential	558748	4 collections	

NAME

Mr. W.K.M. Brown

<b>SE ID NUMBER</b>	185 395 325	<b>TARIFF NAME:</b> Plan K
House 32, Lovers Walk, Rosebank		
Electricity: Meter 2591446		
208kWh (R0x50kWh)+(R1.75x158kWh)+(R2.75x0kWh)		
2014/9/13-2014/10/11	[458984kWh-459192kWh]	R 276.50
Water: Meter 5487161		
333KL (R0x100KL)+(R0.75x233KL)+(R1.56x0KL)		
2014/9/13-2014/10/11	[5646108KL -5646441KL]	R 174.75
Rates : 1355771x0.0089/365x30		
Refuse: R88.41x4		
VAT: 14%		

<b>TOTAL CHARGES</b>	R 2 089.66
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<b>ACCOUNT SUMMARY FOR SEPTEMBER 2014</b>	
BALANCE BROUGHT FORWARD (Due Date 2014-11-23)	R 264.42
PAYMENTS RECEIVED	R -217.42
TOTAL CHARGES FOR BILLING PERIOD	R 2 042.66

Arrears				TOTAL AMOUNT DUE	R 2 089.66
>90 DAYS	51-90 DAYS	31-51 DAYS	CURRENT		
0.00	0.00	0.00	R47.00		

TOTAL AMOUNT DUE

R 2 089.66



Figure 3A. Experimental group 2 – “Logic” bill

# Billing

BILLING HOLDING LIMITED REG NO  
1204/215275/05  
VAT REG NO 8920582049

Western Cape Region  
PO Box BELVILLE 23

**CONTACT CENTRE:** (084) 092 9843  
**Fax NO:** (021) 092 2934  
**E-MAIL:** info@billing.co.za  
**WEB:** www.billing.co.za



# Billing

TEL: 08600 37834  
SMS: 083 325 23053  
084 903 23453  
082 328 48393

CUSTOMER SERVICE WEBSITE  
WWW.BILLING.CO.ZA/CUSTOMER

DTo: Mr Brown  
11 Lover's Walk  
Rondebosch

Total Amount Owed on Account: R2 089.66

### Account Information:

Account Holder's Name:	Mr. W.K.M. Brown
Account Number:	185 395 325
Tax Invoice:	154321

### Your Account Summary is:

Opening Balance:	R 264.42
Payments:	R 217.42
Charges for Billing period:	R2 042.66
Closing Balance:	R2 089.66

### Charges for Billing Period Breakdown:

Electricity:	R 276.50
Water:	R 174.75
Rates	R 988.00
Refuse:	R 352.56
VAT:	R 250.85
Charges for Billing period:	R2 042.66

Please Turn Over to find out



### Payment Information



DIRECT DESOPIT DETAILS  
BANK: GHT  
BRANCH CODE: 372



**Your Electricity Charges were Calculated as follows:**

Tariff 1 (0- 50kWh) : R0/kWh x 50kWh R0.00  
Tariff 2 (50- 350kWh): R1.75/kWh x 158kWh R276.50  
Tariff 3 (350kWh+) : R2.10/kWh x 0kWh R0.00

Total for Electricity: R276.50

**Additional Information**

- Your Meter Number is: 2591446
- The Current Reading is: 459192kWh
- The Previous Reading is: 458984kWh
- Your Total Consumption: 208 kWh
- The Type of Reading was : *Actual*
- Reading Dates were: 2014/9/13-2014/10/11

**Your Water Charges were Calculated as follows:**

Tariff 1 (0- 100KL): R0/KL x 100KL R0.00  
Tariff 2 (100-400 KL) : R0.75/KL x 233KL R174.75  
Tariff 3 (400KL+) : R1.56/KL x 0KL R0.00

Total for Water: R174.75

**Additional Information**

- Your Meter Number is: 5487161
- The Current Reading is: 5646441
- The Previous Reading is: 5646108
- Your Total Consumption: 333KL
- The Type of Reading was : *Actual*
- Reading Dates were: 2014/9/13-2014/10/11

**Your Property Rates were Calculated as follows:**

Stand Number: 558748

Total for Rates: R988

**Additional Information**

- Your Property Type is: Residential
- Property Value : 1 355 771
- Tariff rate: 0.89%
- Period: 2014/09/11-2014/10/11

**Your Refuse Charges were Calculated as follows:**

Stand Number: 558748

Total for Refuse: R352.56

**Additional Information**

- Your Property Type is: Residential
- No. of collections: 4
- Tariff: R88.41

**VAT**

Charged at 14%:

R250.85

**Giving us the Total Charge for this bill of:**

**R 2 042.66**

**Your Account Information:**

The name of your account holder is: Mr. W.K.M. Brown  
Your account number is: 185 395 325  
The tax invoice number of this bill is: 44697822  
And it is due by: 2014/11/30

Figure 4A. Experimental group 3 – “Process” bill

<h1>Billing</h1> <p>BILLING HOLDING LIMITED REG NO 1204/215275/05 VAT REG NO 8920582049</p>	<p>Western Cape Region PO Box BELVILLE 23</p> <p><b>CONTACT CENTRE:</b> (084) 092 9843 <b>Fax NO:</b> (021) 092 2934 <b>E-MAIL:</b> info@billing.co.za <b>WEB:</b> www.billing.co.za</p>	 <p>TEL: 08600 37834 SMS: 083 325 23053 084 903 23453 082 328 48393</p> <p><small>CUSTOMER SERVICE WEBSITE WWW.BILLING.CO.ZA/CUSTOMER</small></p>
---	--	--

Dear Mr W.K.M Brown  
From 11 Lover’s Walk, Rondebosch

You owe a Total of: **R2089.66**  
For your electricity, water, refuse, rates, unpaid amounts and taxes. Here are the details of the charges:

Your Account Summary is:

You had previously owed:	R264.42
But you paid:	R217.42
And owe for this period:	R2 042.66
So, you owe a Total of:	R2.089.66

But where do these charges come from?

Your bill can be broken down as follows:

Your Electricity for the period was:	R265.50
Your Water for the period was:	R174.75
Your Rates and Taxes for the period were:	R988.00
Your Refuse for the period was:	R352.56
VAT	R 250.85
Adding up to the total you owe of:	R2 042.66

But how were these charges calculated?

Please Turn Over to find out



Payment Information



DIRECT DESOPIT DETAILS  
BANK: GHT  
BRANCH CODE: 372



**Your Electricity Charges were Calculated as follows:**

Tariff 1 (0- 50kWh) : R0/kWh x 50kWh R0.00  
Tariff 2 (50- 350kWh): R1.75/kWh x 158kWh R276.50  
Tariff 3 (350kWh+) : R2.10/kWh x 0kWh R0.00

Total for Electricity: R276.50

Additional Information  
Meter Number: 25491446  
Current Reading: 459192kWh  
Previous Reading: 458984kWh  
Total Consumption: 208  
Reading Type: Actual  
Reading Dates: 2014/9/13-  
2014/10/11

**Your Water Charges were Calculated as follows:**

Tariff 1 (0- 100KL): R0/KL x 100KL R0.00  
Tariff 2 (100-400 KL) : R0.75/KL x 233KL R174.75  
Tariff 3 (400KL+) : R1.56/KL x 0KL R0.00

Total for Water: R174.75

Additional Information  
Meter Number: 5487161  
Current Reading: 5646441  
Previous Reading: 5646108  
Total Consumption: 333  
Reading Type: Actual  
Reading Date: 2014/9/13 -  
2014/10/11

**Your Property Rates were Calculated as follows:**

Stand Number: 558748

Total for Rates: R988

Additional Information  
Property: Residential  
Property Value: 1 355 771  
Tariff rate: 0.89%  
Period: 2014/09/11 -  
2014/10/11

**Your Refuse Charges were Calculated as follows:**

Stand Number: 558748

Total for Refuse: R352.56

Additional Information  
Property: Residential  
No. of Collections: 4  
Tariff: R88.14

**VAT**

Charged at 14%:

R250.85

Giving us the Total Charge for this bill of:

R 2 042.66

**Your Account Information:**

The name of your account holder is:  
Your account number is:  
The tax invoice number of this bill is:  
And it is due by:

Mr. W.K.M. Brown  
185 395 325  
44697822  
2014/11/30

Figure 5A. Experimental group 4 – “Bar” bill

# Billing

BILLING HOLDING LIMITED REG NO  
1204/215275/05  
VAT REG NO 8920582049

Western Cape Region  
PO Box BELVILLE 23

**CONTACT CENTRE:** (084) 092 9843  
**Fax NO:** (021) 092 2934  
**E-MAIL:** info@billing.co.za  
**WEB:** www.billing.co.za



# Billing

TEL: 08600 37834  
SMS: 083 325 23053  
084 903 23453  
082 328 48393

CUSTOMER SERVICE WEBSITE  
WWW.BILLING.CO.ZA/CUSTOMER

Dear Mr W.K.M Brown  
From 11 Lover's Walk, Rondebosch

You owe a Total of: **R2089.66**  
For your electricity, water, refuse, rates, unpaid amounts and taxes. Here are the details of the charges:

### Your Account Summary is:

You had previously owed:	R264.42
But you paid:	R217.42
And owe for this period:	R2 042.66
So, you owe a Total of:	R2.089.66

But where do these charges come from?

### Your bill can be broken down as follows:

Your Electricity for the period was:	R265.50
Your Water for the period was:	R174.75
Your Rates and Taxes for the period were:	R988.00
Your Refuse for the period was:	R352.56
VAT	R 250.85
Adding up to the total you owe of:	R2 042.66

But how were these charges calculated?

Please Turn Over to find out



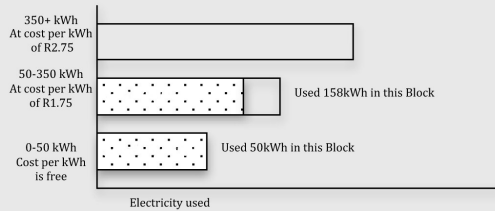
### Payment Information



DIRECT DESPOSIT DETAILS  
BANK: GHT  
BRANCH CODE: 372



**Your Electricity Charges were Calculated as follows:**

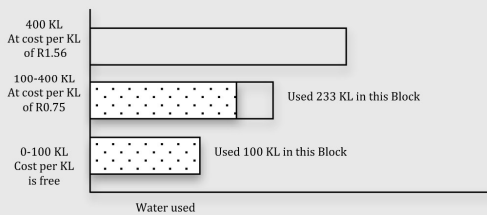


**Additional Information**

- Your Meter Number is: 2591446
- The Current Reading is: 459192kWh
- The Previous Reading is: 458984kWh
- Your Total Consumption: 208 kWh
- The Type of Reading was : *Actual*
- Reading Dates were: 2014/9/13-2014/10/11

**Total: R 276.50**

**Your Water Charges were Calculated as follows:**



**Additional Information**

- Your Meter Number is: 5487161
- The Current Reading is: 5646441
- The Previous Reading is: 5646108
- Your Total Consumption: 333KL
- The Type of Reading was : *Actual*
- Reading Dates were: 2014/9/13-2014/10/11

**Total: R 174.75**

**Your Property Rates were Calculated as follows:**

**Stand Number: 558748**

**Total for Rates: R988**

**Additional Information**

- Your Property Type is: Residential
- Property Value : 1 355 771
- Tariff rate: 0.89%
- Period: 2014/09/11-2014/10/11

**Your Refuse Charges were Calculated as follows:**

**Stand Number: 558748**

**Total for Refuse: R352.56**

**Additional Information**

- Your Property Type is: Residential
- No. of collections: 4
- Tariff: R88.41

**VAT**

**Charged at 14%:**

**R250.85**

**Giving us the Total Charge for this bill of:**

**R 2 042.66**

**Your Account Information:**

The name of your account holder is:  
Your account number is:  
The tax invoice number of this bill is:  
And it is due by:

**Mr. W.K.M. Brown**  
**185 395 325**  
**44697822**  
**2014/11/30**

Figure 6A. Experimental group 5 – “Stacked Bar” bill

# Billing

BILLING HOLDING LIMITED REG NO  
1204/215275/05  
VAT REG NO 8920582049

Western Cape Region  
PO Box BELVILLE 23

**CONTACT CENTRE:** (084) 092 9843  
**Fax NO:** (021) 092 2934  
**E-MAIL:** info@billing.co.za  
**WEB:** www.billing.co.za



# Billing

TEL: 08600 37834  
SMS: 083 325 23053  
084 903 23453  
082 328 48393

CUSTOMER SERVICE WEBSITE  
WWW.BILLING.CO.ZA/CUSTOMER

Dear Mr W.K.M Brown  
From 11 Lover's Walk, Rondebosch

You owe a Total of: **R2089.66**  
For your electricity, water, refuse, rates, unpaid amounts and taxes. Here are the details of the charges:

### Your Account Summary is:

You had previously owed:	R264.42
But you paid:	R217.42
And owe for this period:	R2 042.66
So, you owe a Total of:	R2.089.66

But where do these charges come from?

### Your bill can be broken down as follows:

Your Electricity for the period was:	R265.50
Your Water for the period was:	R174.75
Your Rates and Taxes for the period were:	R988.00
Your Refuse for the period was:	R352.56
VAT	R 250.85
Adding up to the total you owe of:	R2 042.66

But how were these charges calculated?

Please Turn Over to find out



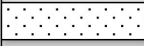
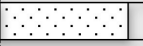

### Payment Information



DIRECT DESPOSIT DETAILS  
BANK: GHT  
BRANCH CODE: 372



**Your Electricity Charges were Calculated as follows:**

Used 50kWh in this Block	Used 158 kWh in this Block	
		
0-50 kWh Cost per kWh is free	50-350 kWh At cost per kWh of R1.75	350+ kWh At cost per kWh of R2.75




Electricity used

Total: R 276.50

**Additional Information**

- Your Meter Number is: 2591446
- The Current Reading is: 459192kWh
- The Previous Reading is: 458984kWh
- Your Total Consumption: **208 kWh**
- The Type of Reading was: *Actual*
- Reading Dates were: 2014/9/13-2014/10/11

**Your Water Charges were Calculated as follows:**

Used 100kWh in this Block	Used 233 KL in this Block	
		
0-100 KL Cost per KL is free	100-400 KL At cost per KL of R0.75	400+ KL At cost per KL of R1.56

Water used

Total 174.75

**Additional Information**

- Your Meter Number is: 5487161
- The Current Reading is: 5646441
- The Previous Reading is: 5646108
- Your Total Consumption: **333KL**
- The Type of Reading was: *Actual*
- Reading Dates were: 2014/9/13-2014/10/11

**Your Property Rates were Calculated as follows:**

Stand Number: 558748

Total for Rates: R988

**Additional Information**

- Your Property Type is: Residential
- Property Value : 1 355 771
- Tariff rate: 0.89%
- Period: 2014/09/11-2014/10/11

**Your Refuse Charges were Calculated as follows:**

Stand Number: 558748

Total for Refuse: R352.56

**Additional Information**

- Your Property Type is: Residential
- No. of collections: 4
- Tariff: R88.41

**VAT**

Charged at 14%:

R250.85

Giving us the Total Charge for this bill of:

R 2 042.66

**Your Account Information:**

The name of your account holder is:

Mr. W.K.M. Brown

Your account number is:

185 395 325

The tax invoice number of this bill is:

44697822

And it is due by:

2014/11/30

Figure 7A. Experimental group 6 – “Utility Bar” bill

# Billing

BILLING HOLDING LIMITED REG NO  
1204/215275/05  
VAT REG NO 8920582049

Western Cape Region  
PO Box BELVILLE 23

**CONTACT CENTRE:** (084) 092 9843  
**Fax NO:** (021) 092 2934  
**E-MAIL:** info@billing.co.za  
**WEB:** www.billing.co.za



# Billing

TEL: 08600 37834  
SMS: 083 325 23053  
084 903 23453  
082 328 48393

CUSTOMER SERVICE WEBSITE  
WWW.BILLING.CO.ZA/CUSTOMER

Dear Mr W.K.M Brown  
From 11 Lover's Walk, Rondebosch

You owe a Total of: **R2089.66**  
For your electricity, water, refuse, rates, unpaid amounts and taxes. Here are the details of the charges:

### Your Account Summary is:

You had previously owed:	R264.42
But you paid:	R217.42
And owe for this period:	R2 042.66
So, you owe a Total of:	R2.089.66

But where do these charges come from?

### Your bill can be broken down as follows:

Your Electricity for the period was:	R265.50
Your Water for the period was:	R174.75
Your Rates and Taxes for the period were:	R988.00
Your Refuse for the period was:	R352.56
VAT	R 250.85
Adding up to the total you owe of:	R2 042.66

But how were these charges calculated?

Please Turn Over to find out



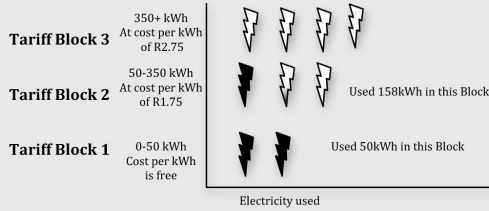
### Payment Information



DIRECT DESPOSIT DETAILS  
BANK: GHT  
BRANCH CODE: 372



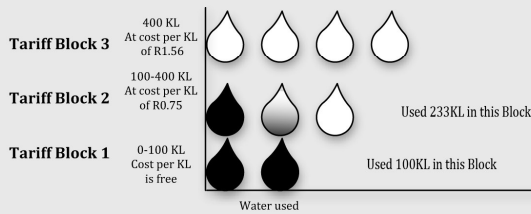
**Your Electricity Charges were Calculated as follows:**



**Additional Information**

- Your Meter Number is: 2591446
  - The Current Reading is: 459192kWh
  - The Previous Reading is: 458984kWh
  - Your Total Consumption: 208 kWh
  - The Type of Reading was: *Actual*
  - Reading Dates were: 2014/9/13-2014/10/11
- Total: R 276.50**

**Your Water Charges were Calculated as follows:**



**Additional Information**

- Your Meter Number is: 5487161
  - The Current Reading is: 5646441
  - The Previous Reading is: 5646108
  - Your Total Consumption: 333KL
  - The Type of Reading was: *Actual*
  - Reading Dates were: 2014/9/13-2014/10/11
- Total: R 174.75**

**Your Property Rates were Calculated as follows:**

**Stand Number: 558748**

**Total for Rates: R988**

**Additional Information**

- Your Property Type is: Residential
- Property Value : 1 355 771
- Tariff rate: 0.89%
- Period: 2014/09/11-2014/10/11

**Your Refuse Charges were Calculated as follows:**

**Stand Number: 558748**

**Total for Refuse: R352.56**

**Additional Information**

- Your Property Type is: Residential
- No. of collections: 4
- Tariff: R88.41

**VAT**

**Charged at 14%:**

**R250.85**

**Giving us the Total Charge for this bill of:**

**R 2 042.66**

**Your Account Information:**

The name of your account holder is:  
Your account number is:  
The tax invoice number of this bill is:  
And it is due by:

**Mr. W.K.M. Brown**  
**185 395 325**  
**44697822**  
**2014/11/30**

**Figure 8A.** Experimental group 7 – “Utility Stacked Bar” bill

# Billing

BILLING HOLDING LIMITED REG NO  
1204/215275/05  
VAT REG NO 8920582049

Western Cape Region  
PO Box BELVILLE 23

**CONTACT CENTRE:** (084) 092 9843  
**Fax NO:** (021) 092 2934  
**E-MAIL:** info@billing.co.za  
**WEB:** www.billing.co.za



# Billing

TEL: 08600 37834  
SMS: 083 325 23053  
084 903 23453  
082 328 48393

CUSTOMER SERVICE WEBSITE  
WWW.BILLING.CO.ZA/CUSTOMER

Dear Mr W.K.M Brown  
From 11 Lover's Walk, Rondebosch

You owe a Total of: **R2089.66**  
For your electricity, water, refuse, rates, unpaid amounts and taxes. Here are the details of the charges:

### Your Account Summary is:

You had previously owed:	R264.42
But you paid:	R217.42
And owe for this period:	R2 042.66
So, you owe a Total of:	R2.089.66

But where do these charges come from?

### Your bill can be broken down as follows:

Your Electricity for the period was:	R265.50
Your Water for the period was:	R174.75
Your Rates and Taxes for the period were:	R988.00
Your Refuse for the period was:	R352.56
VAT	R 250.85
Adding up to the total you owe of:	R2 042.66

But how were these charges calculated?

Please Turn Over to find out



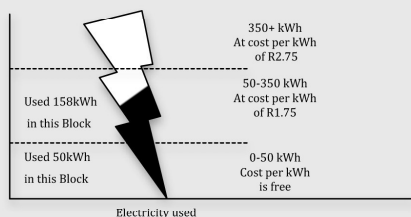
### Payment Information



DIRECT DESPOSIT DETAILS  
BANK: GHT  
BRANCH CODE: 372



**Your Electricity Charges were Calculated as follows:**

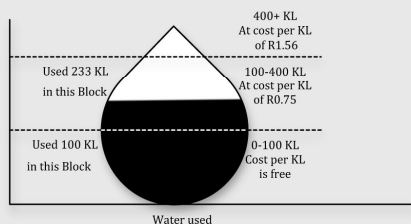


**Additional Information**

- Your Meter Number is: 2591446
- The Current Reading is: 459192kWh
- The Previous Reading is: 458984kWh
- Your Total Consumption: 208 kWh
- The Type of Reading was : *Actual*
- Reading Dates were: 2014/9/13-2014/10/11

Total: R 276.50

**Your Water Charges were Calculated as follows:**



**Additional Information**

- Your Meter Number is: 5487161
- The Current Reading is: 5646441
- The Previous Reading is: 5646108
- Your Total Consumption: 333KL
- The Type of Reading was : *Actual*
- Reading Dates were: 2014/9/13-2014/10/11

Total: R 174.75

**Your Property Rates were Calculated as follows:**

Stand Number: 558748

Total for Rates: R988

**Additional Information**

- Your Property Type is: Residential
- Property Value : 1 355 771
- Tariff rate: 0.89%
- Period: 2014/09/11-2014/10/11

**Your Refuse Charges were Calculated as follows:**

Stand Number: 558748

Total for Refuse: R352.56

**Additional Information**

- Your Property Type is: Residential
- No. of collections: 4
- Tariff: R88.41

**VAT**

Charged at 14%:

R250.85

Giving us the Total Charge for this bill of:

R 2 042.66

**Your Account Information:**

The name of your account holder is:

Mr. W.K.M. Brown

Your account number is:

185 395 325

The tax invoice number of this bill is:

44697822

And it is due by:

2014/11/30

Figure 9A. Experimental group 8 – “Graphical Math” bill

# Billing

BILLING HOLDING LIMITED REG NO  
1204/215275/05  
VAT REG NO 8920582049

Western Cape Region  
PO Box BELVILLE 23

**CONTACT CENTRE:** (084) 092 9843  
**Fax NO:** (021) 092 2934  
**E-MAIL:** info@billing.co.za  
**WEB:** www.billing.co.za



# Billing

TEL: 08600 37834  
SMS: 083 325 23053  
084 903 23453  
082 328 48393

CUSTOMER SERVICE WEBSITE  
WWW.BILLING.CO.ZA/CUSTOMER

Dear Mr W.K.M Brown  
From 11 Lover's Walk, Rondebosch

You owe a Total of: **R2089.66**  
For your electricity, water, refuse, rates, unpaid amounts and taxes. Here are the details of the charges:

### Your Account Summary is:

You had previously owed:	R264.42
But you paid:	R217.42
And owe for this period:	R2 042.66
So, you owe a Total of:	R2.089.66

But where do these charges come from?

### Your bill can be broken down as follows:

Your Electricity for the period was:	R265.50
Your Water for the period was:	R174.75
Your Rates and Taxes for the period were:	R988.00
Your Refuse for the period was:	R352.56
VAT	R 250.85
Adding up to the total you owe of:	R2 042.66

But how were these charges calculated?

Please Turn Over to find out



### Payment Information



DIRECT DESPOSIT DETAILS  
BANK: GHT  
BRANCH CODE: 372



**Your Electricity Charges were Calculated as follows:**

Used 50 kWh in this Block **X** 0-50 kWh is free = R 0  
Used 158kWh in this Block **X** 50-350 kWh at cost per kWh of R 1.75 = R276.50  
Used 0 kWh in this Block **X** 350+ kWh at cost per kWh of R 2.75 = R 0

R276.50

Total: R276.50

**Additional Information**  
Meter Number: 25491446  
Current Reading: 459192kWh  
Previous Reading: 458984kWh  
Total Consumption: 208  
Reading Type: Actual  
Reading Dates: 2014/9/13-  
2014/10/11

**Your Water Charges were Calculated as follows:**

Used 100 KL in this Block **X** 0-100 KL is free = R 0  
Used 233 KL in this Block **X** 50-400 KL at cost per KL of R 0.75 = R174.50  
Used 0 KL in this Block **X** 400+ KL at cost per KL of R 1.56 = R 0

R174.50

Total: R 174.75

**Additional Information**  
Meter Number: 5487161  
Current Reading: 5646441  
Previous Reading: 5646108  
Total Consumption: 333  
Reading Type: Actual  
Reading Date: 2014/9/13 -  
2014/10/11

**Your Property Rates were Calculated as follows:**

Stand Number: 558748  
Total for Rates: R988

**Additional Information**  
Property: Residential  
Property Value: 1 355 771  
Tariff rate: 0.89%  
Period: 2014/09/11 -  
2014/10/11

**Your Refuse Charges were Calculated as follows:**

Stand Number: 558748  
Total for Refuse: R352.56

**Additional Information**  
Property: Residential  
No. of Collections: 4  
Tariff: R88.14

**VAT**

Charged at 14%: R250.85

Giving us the Total Charge for this bill of: R 2 042.66

**Your Account Information:**

The name of your account holder is: Mr. W.K.M. Brown  
Your account number is: 185 395 325  
The tax invoice number of this bill is: 44697822  
And it is due by: 2014/11/30

Figure 10A. Experimental group 9 – “Foreign Language” bill

## La Facturación

BILLING HOLDING LIMITED REG NO  
1204/215275/05  
VAT REG NO 8920582049

La Provincia Occidental del Cabo PO Box BELVILLE 23  
EL CENTRO DEL CONTACTO : (084) 092 9843  
NU: (021) 092 2934  
E-MAIL: info@billing.co.za  
WEB: www.billing.co.za

Estimado Sr (o Sra) Mr. W.K.M. Brown  
De 11 Lover's Walk, Rondebosch  
Nos debe un total de: R 2089.66

Por la electricidad, el agua, la basura, con la tarifa y los impuestos. Los detalles de las cifras siguen:

Su extracto de la cuenta:

La deuda anterior contó:	R264.42
Pero pagaste:	R 217.42
Y por este periodo nos debe:	R 2 042.66
Así que, ahora, nos debe un total de:	R 2.089.66

¿Pero, por qué estás cifras?

Su factura puede desglosar como sigue:

Su uso de electricidad durante este periodo contó:	R 265.50
Su uso de agua durante este periodo contó:	R 174.75
Sus tarifas y impuestos durante este periodo contaron:	R 988.00
Su uso de basura durante este periodo contó:	R 352.56
Sumando al total de la deuda de:	R 2 042.66

¿Pero como calculábamos estas cifras?

Por favor voltee la página para averiguar

La información de pago

LOS DETALLES DE DEPÓSITO DIRECTO  
BANCO: GHT  
EL CÓDIGO DE SUCURSAL: 372  
EL NÚMERO DE CUENTA BANCARIA: 832740394

**Las cifras de su uso de electricidad se calculó como:**

Usado 50kWh en seccion primero  
Usado 158kWh en seccion segundo  
350+ kWh  
Al precio de R2.75 por kWh  
50-350 kWh  
Al precio de R1.75 por kWh  
0-50 kWh  
No hay costo por kWh (es gratis)  
La electricidad usado

La información adicional  
• El número de su contador es: 2591446  
• La lectura actual: 459192kWh  
• La lectura anterior: 458984kWh  
• Su consumo total: 208 kWh  
• La manera de la lectura: Real  
• Las fechas de la lectura: 2014/9/13-2014/10/11

**Las cifras de su uso de agua se calculó como:**

Usado 100KL en seccion primero  
Usado 233KL en seccion segundo  
400+ KL  
Al precio de R1.56 por KL  
100-400 KL  
Al precio de R0.75 por KL  
0-100 KL  
No hay costo por KL (es gratis)  
El agua usado

La información adicional  
• El número de su contador es: 5487161  
• La lectura actual: 5646441  
• La lectura anterior: 5646108  
• Su consumo total: 333KL  
• La manera de la lectura: Real  
Las fechas de la lectura: 2014/9/13-2014/10/11

**Sus tarifas y impuestos fueron calculado como:**

El número de su stand es: 558748  
Las cifras son: R 988  
Nos da un total por las cifras de tarifas  
y impuestos de: R 988

La información adicional  
• El tipo de su propiedad: Residencial  
Con un valor de mercado de: 1 355 771  
Cobrado a la tarifa de: 0.89%

**Sus cifras de basura fueron calculado como:**

El número de su stand es: 558748  
Las cifras son: R 352.56  
Nos da un total por las cifras de basura de: R 352.56

La información adicional  
• El tipo de su propiedad: Residencial  
• Con un valor de mercado de: 4  
• Cobrado a la tarifa de: R88.41

**Con el IVA**

Cobrado a la tarifa de 14%: R 250.85

Nos da la cifra total por este periodo de: R 2 042.66

**La información de su cuenta es:**

El nombre del dueño de la cuenta es: Mr. W.K.M. Brown  
El número de su cuenta: 185 395 325  
El número de la factura de impuestos de esta factura es: 44697822  
Y es por este periodo: 2014/11/30

Figure 11A. Experimental group 10 – “Symbols & Foreign Language” bill

## La Facturación

BILLING HOLDING LIMITED REG NO  
1204/215275/05  
VAT REG NO 8920582049

La Provincia Occidental del Cabo PO Box BELVILLE 23  
EL CENTRO DEL CONTACTO : (084) 092 9843  
NU: (021) 092 2934  
E-MAIL: info@billing.co.za  
WEB: www.billing.co.za

Estimado Sr (o Sra) Mr. W.K.M. Brown  
De 11 Lover's Walk, Rondebosch  
Nos debe un total de: R 2089.66

Por la electricidad, el agua, la basura, con la tarifa y los impuestos. Los detalles de las cifras siguen:

Su extracto de la cuenta:

La deuda anterior contó:	R264.42
Pero pagaste:	R 217.42
Y por este periodo nos debe:	R 2 042.66
Así que, ahora, nos debe un total de:	R 2.089.66

¿Pero, por qué estás cifras?

Su factura puede desglosar como sigue:

Su uso de electricidad durante este periodo contó:	R 265.50
Su uso de agua durante este periodo contó:	R 174.75
Sus tarifas y impuestos durante este periodo contaron:	R 988.00
Su uso de basura durante este periodo contó:	R 352.56
Sumando al total de la deuda de:	R 2 042.66

¿Pero como calculábamos estas cifras?

Por favor voltee la página para averiguar



La información de pago

LOS DETALLES DE DEPÓSITO DIRECTO  
BANCO: GHT  
EL CÓDIGO DE SUCURSAL: 372  
EL NÚMERO DE CUENTA BANCARIA: 832740394

## La Facturación

TEL: 08600 37834  
SMS: 083 325 23053  
084 903 23453  
082 328 48393

EI SITIO DEL SERVICIO DE ATENCIÓN  
AL CLIENTE  
<http://www.billing.co.za/CUSTOMER>

**Las cifras de su uso de electricidad se calculó como:**

Usado 50kWh en seccion primero  
Usado 158kWh en seccion segundo  
350+ kWh  
Al precio de R2.75 por kWh  
50-350 kWh  
Al precio de R1.75 por kWh  
0-50 kWh  
No hay costo por kWh (es gratis)  
La electricidad usado



La información adicional  
• El número de su contador es: 2591446  
• La lectura actual: 459192kWh  
• La lectura anterior: 458984kWh  
• Su consumo total: 208 kWh  
• La manera de la lectura: Real  
• Las fechas de la lectura: 2014/9/13-2014/10/11

**Las cifras de su uso de agua se calculó como:**

Usado 100KL en seccion primero  
Usado 233KL en seccion segundo  
400+ KL  
Al precio de R1.56 por KL  
100-400 KL  
Al precio de R0.75 por KL  
0-100 KL  
No hay costo por KL (es gratis)  
El agua usado



La información adicional  
• El número de su contador es: 5487161  
• La lectura actual: 5646441  
• La lectura anterior: 5646108  
• Su consumo total: 333KL  
• La manera de la lectura: Real  
Las fechas de la lectura: 2014/9/13-2014/10/11

**Sus tarifas y impuestos fueron calculado como:**

El número de su stand es: 558748  
Las cifras son: R 988  
Nos da un total por las cifras de tarifas  
y impuestos de: R 988



La información adicional  
• El tipo de su propiedad: Residencial  
Con un valor de mercado de: 1 355 771  
Cobrado a la tarifa de: 0.89%

**Sus cifras de basura fueron calculado como:**

El número de su stand es: 558748  
Las cifras son: R 352.56  
Nos da un total por las cifras de basura de: R 352.56



La información adicional  
• El tipo de su propiedad: Residencial  
• Con un valor de mercado de: 4  
• Cobrado a la tarifa de: R88.41

**Con el IVA**

Cobrado a la tarifa de 14%: R 250.85

Nos da la cifra total por este periodo de: R 2 042.66

**La información de su cuenta es:**

El nombre del dueño de la cuenta es: Mr. W.K.M. Brown  
El número de su cuenta: 185 395 325  
El número de la factura de impuestos de esta factura es: 44697822  
Y es por este periodo: 2014/11/30

## Appendix B. ANOVA Results and Additional Regression Outputs

**Table 1.1B.** ANOVA results for the race variable among treatment groups

Source	SS	df	MS	F	Prob > F
Between groups	17.77609	9	1.975121	0.64	0.7649
Within groups	3728.986	1205	3.094594		
Total	3746.762	1214	3.086295		

**Table 1.2B.** ANOVA results for the gender variable among treatment groups

Source	SS	df	MS	F	Prob > F
Between groups	1.426998	9	0.158555	0.64	0.7677
Within groups	316.0558	1266	0.249649		
Total	317.4828	1275	0.249006		

**Table 1.3B.** ANOVA results for the age variable among treatment groups

Source	SS	df	MS	F	Prob > F
Between groups	14.44895	9	1.605439	0.25	0.9862
Within groups	7932.55	1250	6.34604		
Total	7946.999	1259	6.312152		

**Table 1.4B.** ANOVA results for the income\_group variable among treatment groups

Source	SS	df	MS	F	Prob > F
Between groups	5.948937	9	0.660993	1.85	0.0563
Within groups	447.0312	1248	0.358198		
Total	452.9801	1257	0.360366		

**Table 2B.** Comparison between the “Foreign Language” and “Symbols & Foreign Language” group’s overall/basic/utility/tariff performance

VARIABLES	(1) Total Correct Answers		(2) Basic Questions		(3) Utility Questions		(4) Tariff Questions	
	1	2	3	4	5	6	7	8
<b>Symbols &amp; Foreign Language Coloured</b>	0.548 (0.665)	0.144 (0.682)	-0.0757 (0.280)	-0.193 (0.291)	0.406 (0.328)	0.231 (0.323)	0.218 (0.202)	0.106 (0.202)
<b>Indian</b>		1.168 (1.157)		0.613 (0.564)		0.539 (0.624)		0.0156 (0.221)
<b>White</b>		1.393 (1.498)		-0.000974 (0.611)		0.610 (0.711)		0.784** (0.397)
<b>Female</b>		2.059** (0.814)		0.384 (0.346)		0.760** (0.377)		0.915*** (0.272)
<b>Age</b>		-1.013 (0.686)		-0.378 (0.287)		-0.102 (0.335)		-0.533*** (0.201)
<b>Age Squared</b>		1.749 (1.231)		0.663 (0.497)		0.810 (0.611)		0.275 (0.381)
<b>Medium Income</b>		-0.0332 (0.0250)		-0.0122 (0.00976)		-0.0155 (0.0125)		-0.00555 (0.00804)
<b>High Income</b>		0.162 (0.754)		0.128 (0.332)		-0.0734 (0.365)		0.107 (0.204)
<b>Wave</b>		0.574 (1.478)		0.186 (0.640)		0.0830 (0.643)		0.305 (0.459)
<b>Constant</b>	7.841*** (0.460)	-11.03 (14.32)	3.932*** (0.199)	-3.011 (5.957)	2.947*** (0.223)	-4.230 (7.019)	0.962*** (0.138)	-3.787 (4.337)
<b>Observations</b>	271	244	271	244	271	244	271	244
<b>R-squared</b>	0.003	0.074	0.000	0.049	0.006	0.141	0.004	0.186

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 3B.** Comparison between the “Process” and “Graphical Math” group’s overall/basic/utility/tariff performance

VARIABLES	(1) Total Correct Answers		(2) Basic Questions		(3) Utility Questions		(4) Tariff Questions	
	1	2	3	4	5	6	7	8
<b>Graphical Math</b>	0.575 (0.892)	0.515 (0.893)	0.201 (0.316)	0.170 (0.315)	0.336 (0.412)	0.228 (0.401)	0.0373 (0.315)	0.116 (0.309)
<b>Coloured</b>		-0.423 (1.293)		-0.283 (0.487)		-0.556 (0.551)		0.417 (0.458)
<b>Indian</b>		1.623 (1.823)		-0.277 (0.629)		0.531 (0.785)		1.369** (0.657)
<b>White</b>		2.651** (1.198)		0.288 (0.418)		0.953* (0.523)		1.409*** (0.406)
<b>Female</b>		-2.570*** (0.914)		-0.628* (0.321)		-1.058** (0.408)		-0.884*** (0.310)
<b>Age</b>		0.883 (1.383)		0.289 (0.469)		0.846 (0.604)		-0.252 (0.584)
<b>Age Squared</b>		-0.00987 (0.0275)		-0.00367 (0.00941)		-0.0138 (0.0121)		0.00756 (0.0122)
<b>Medium Income</b>		0.694 (0.994)		0.396 (0.353)		0.271 (0.460)		0.0265 (0.329)
<b>High Income</b>		2.371 (1.968)		0.213 (0.663)		0.763 (0.817)		1.395** (0.691)
<b>Wave</b>		-2.913*** (0.902)		-1.432*** (0.313)		-2.484*** (0.403)		1.002*** (0.316)
<b>Constant</b>	10.63*** (0.625)	1.124 (16.78)	4.425*** (0.228)	2.309 (5.707)	4.015*** (0.280)	-3.584 (7.281)	2.187*** (0.216)	2.399 (6.845)
<b>Observations</b>	268	242	268	242	268	242	268	242
<b>R-squared</b>	0.002	0.132	0.002	0.112	0.002	0.203	0.000	0.194

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 4B.** Comparison between the “Logic” and “Process” group’s overall/basic/utility/tariff performance

VARIABLES	(1) Total Correct Answers		(2) Basic Questions		(3) Utility Questions		(4) Tariff Questions	
	1	2	3	4	5	6	7	8
<b>Process</b>	-1.116 (0.897)	-1.268 (0.906)	-0.150 (0.303)	-0.159 (0.298)	-0.667 (0.418)	-0.680* (0.412)	-0.298 (0.320)	-0.428 (0.326)
<b>Coloured</b>		0.0427 (1.369)		-0.0724 (0.500)		-0.164 (0.539)		0.280 (0.513)
<b>Indian</b>		0.605 (2.324)		-0.563 (0.730)		0.672 (1.221)		0.496 (0.746)
<b>White</b>		3.025*** (1.143)		0.157 (0.375)		1.088** (0.502)		1.780*** (0.415)
<b>Female</b>		-2.367** (0.934)		-0.816*** (0.310)		-0.959** (0.426)		-0.592* (0.326)
<b>Age</b>		0.724 (1.789)		0.608 (0.556)		0.804 (0.758)		-0.689 (0.645)
<b>Age Squared</b>		-0.00939 (0.0388)		-0.0127 (0.0120)		-0.0135 (0.0161)		0.0169 (0.0139)
<b>Medium Income</b>		2.259** (1.023)		0.726** (0.348)		0.920* (0.470)		0.614* (0.352)
<b>High Income</b>		1.367 (2.202)		0.191 (0.725)		0.356 (0.928)		0.819 (0.774)
<b>Wave</b>		-3.455*** (0.935)		-1.299*** (0.314)		-2.637*** (0.429)		0.481 (0.338)
<b>Constant</b>	11.74*** (0.644)	5.215 (20.65)	4.576*** (0.199)	-0.461 (6.442)	4.682*** (0.311)	-2.437 (8.903)	2.485*** (0.236)	8.113 (7.455)
<b>Observations</b>	266	236	266	236	266	236	266	236
<b>R-squared</b>	0.006	0.150	0.001	0.125	0.010	0.212	0.003	0.166

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 5B.** Comparison between the “Bar” and “Stacked Bar” group’s overall/basic/utility/tariff performance

VARIABLES	(1) Total Correct Answers		(2) Basic Questions		(3) Utility Questions		(4) Tariff Questions	
	1	2	3	4	5	6	7	8
<b>Stacked Bar</b>	-1.266 (1.050)	-1.665 (1.110)	-0.574* (0.318)	-0.631* (0.346)	-0.390 (0.466)	-0.549 (0.473)	-0.303 (0.411)	-0.486 (0.428)
<b>Coloured</b>		0.936 (1.720)		0.312 (0.571)		-0.189 (0.797)		0.813 (0.641)
<b>Indian</b>		2.107 (2.181)		-0.00450 (0.629)		0.716 (0.958)		1.396 (0.857)
<b>White</b>		1.069 (1.357)		-0.357 (0.413)		0.397 (0.548)		1.029* (0.558)
<b>Female</b>		-0.254 (1.090)		0.111 (0.334)		-0.0346 (0.470)		-0.330 (0.432)
<b>Age</b>		4.383* (2.449)		2.175*** (0.801)		1.319 (1.027)		0.889 (0.922)
<b>Age Squared</b>		-0.103* (0.0527)		-0.0498*** (0.0175)		-0.0304 (0.0217)		-0.0222 (0.0197)
<b>Medium Income</b>		3.866*** (1.186)		1.150*** (0.382)		1.489*** (0.503)		1.227*** (0.454)
<b>High Income</b>		7.409*** (1.803)		2.203*** (0.497)		2.563*** (0.817)		2.643*** (0.733)
<b>Wave</b>		-2.935*** (1.109)		-0.908*** (0.338)		-2.886*** (0.473)		0.859* (0.447)
<b>Constant</b>	13.56*** (0.698)	-31.34 (28.29)	4.977*** (0.209)	-17.85* (9.139)	5.069*** (0.315)	-5.778 (12.04)	3.519*** (0.286)	-7.713 (10.67)
<b>Observations</b>	265	229	265	229	265	229	265	229
<b>R-squared</b>	0.005	0.167	0.012	0.160	0.003	0.242	0.002	0.134

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 6B.** Comparison between the “Utility Bar” and “Utility Stacked Bar” group’s overall/basic/utility/tariff performance

VARIABLES	(1) Total Correct Answers		(2) Basic Questions		(3) Utility Questions		(4) Tariff Questions	
	1	2	3	4	5	6	7	8
<b>Utility Stacked Bar</b>	-2.008** (1.013)	-2.052* (1.042)	-0.641** (0.289)	-0.689** (0.295)	-0.885* (0.470)	-1.063** (0.458)	-0.481 (0.423)	-0.300 (0.445)
<b>Coloured</b>		1.752 (2.008)		0.138 (0.542)		0.397 (0.922)		1.216 (0.754)
<b>Indian</b>		4.305** (1.839)		0.663 (0.421)		1.265 (0.840)		2.378*** (0.885)
<b>White</b>		3.251** (1.362)		0.226 (0.368)		1.068* (0.587)		1.957*** (0.581)
<b>Female</b>		-0.585 (1.077)		0.0474 (0.304)		0.0486 (0.479)		-0.681 (0.446)
<b>Age</b>		3.683** (1.686)		0.583 (0.581)		1.529** (0.744)		1.572** (0.609)
<b>Age Squared</b>		-0.0768** (0.0350)		-0.0111 (0.0124)		-0.0320** (0.0150)		-0.0337*** (0.0125)
<b>Medium Income</b>		1.602 (1.220)		0.626* (0.350)		0.582 (0.541)		0.393 (0.502)
<b>High Income</b>		0.0430 (2.276)		0.297 (0.582)		-0.809 (0.944)		0.555 (1.014)
<b>Wave</b>		-3.352*** (1.083)		-1.221*** (0.300)		-3.217*** (0.486)		1.086** (0.465)
<b>Constant</b>	14.36*** (0.703)	-25.14 (19.63)	5.221*** (0.185)	-0.580 (6.664)	5.550*** (0.336)	-7.810 (8.831)	3.588*** (0.304)	-16.75** (7.083)
<b>Observations</b>	262	221	262	221	262	221	262	221
<b>R-squared</b>	0.015	0.125	0.019	0.116	0.013	0.226	0.005	0.157

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 7B. Satisfaction with the bill per treatment group**

VARIABLES	How do you feel about the bill, as a whole?		How do you feel about the way in which the bill presented the various electricity and water tariffs?		This bill was silly.	
<b>Logic</b>	1.038*** (0.273)	1.179*** (0.280)	1.661*** (0.301)	1.920*** (0.310)	-0.112 (0.193)	-0.233 (0.196)
<b>Process</b>	1.326*** (0.281)	1.245*** (0.293)	1.910*** (0.318)	1.907*** (0.327)	-0.352* (0.189)	-0.293 (0.198)
<b>Bar</b>	1.408*** (0.273)	1.467*** (0.282)	2.412*** (0.302)	2.531*** (0.322)	-0.384** (0.187)	-0.404** (0.197)
<b>Stacked Bar</b>	1.509*** (0.270)	1.537*** (0.277)	2.662*** (0.300)	2.660*** (0.312)	-0.623*** (0.189)	-0.673*** (0.199)
<b>Utility Bar</b>	1.262*** (0.338)	1.128*** (0.351)	1.746*** (0.401)	1.811*** (0.415)	-0.470** (0.187)	-0.560*** (0.194)
<b>Utility Stacked Bar</b>	1.298*** (0.264)	1.280*** (0.283)	2.126*** (0.324)	2.153*** (0.341)	-0.379** (0.180)	-0.392** (0.187)
<b>Graphical Math</b>	1.155*** (0.276)	1.159*** (0.284)	1.844*** (0.317)	1.929*** (0.327)	-0.170 (0.185)	-0.204 (0.193)
<b>Foreign Language</b>	-1.085*** (0.309)	-1.026*** (0.323)	-0.397 (0.334)	-0.310 (0.336)	0.428** (0.196)	0.404** (0.200)
<b>Symbols &amp; Foreign Language</b>	-1.099*** (0.276)	-1.203*** (0.291)	-0.0909 (0.310)	-0.0554 (0.326)	0.529*** (0.189)	0.506** (0.198)
<b>Coloured</b>		0.107 (0.210)		0.263 (0.248)		-0.0796 (0.123)
<b>Indian</b>		0.349 (0.232)		0.608** (0.255)		-0.135 (0.172)
<b>White</b>		0.987*** (0.164)		1.180*** (0.189)		-0.314*** (0.106)
<b>Female</b>		-0.301** (0.134)		-0.386** (0.160)		0.0773 (0.0870)
<b>Age</b>		-0.300 (0.317)		0.171 (0.350)		0.0121 (0.210)
<b>Age Squared</b>		0.00803 (0.00702)		-0.00187 (0.00761)		-0.00100 (0.00454)
<b>Medium Income</b>		0.217 (0.154)		-0.189 (0.179)		-0.0944 (0.0991)
<b>High Income</b>		0.449* (0.264)		0.0562 (0.313)		-0.0376 (0.169)
<b>Wave</b>		-0.0639 (0.143)		-0.113 (0.176)		-0.00283 (0.0913)
<b>Constant</b>	4.971*** (0.195)	7.492** (3.549)	4.476*** (0.209)	1.768 (3.946)	3.562*** (0.139)	3.888 (2.382)
<b>Observations</b>	1,010	907	999	896	1,046	935
<b>R-squared</b>	0.193	0.253	0.172	0.221	0.071	0.089

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

**Table 7B. (continued) Satisfaction with the bill per treatment group**

VARIABLES	The bill was too cluttered.		There was no logical flow in this bill.		It was hard to find information on this bill.	
<b>Logic</b>	-0.816*** (0.226)	-0.933*** (0.236)	-0.766*** (0.212)	-0.977*** (0.218)	-1*** (0.206)	-1.202*** (0.216)
<b>Process</b>	-0.859*** (0.224)	-0.812*** (0.235)	-0.995*** (0.201)	-1.063*** (0.214)	-1.219*** (0.201)	-1.198*** (0.212)
<b>Bar</b>	-1.243*** (0.226)	-1.238*** (0.231)	-1.204*** (0.217)	-1.309*** (0.232)	-1.606*** (0.211)	-1.679*** (0.227)
<b>Stacked Bar</b>	-1.316*** (0.223)	-1.291*** (0.235)	-1.107*** (0.220)	-1.186*** (0.230)	-1.384*** (0.220)	-1.349*** (0.236)
<b>Utility Bar</b>	-1.080*** (0.227)	-1.148*** (0.242)	-0.971*** (0.212)	-1.144*** (0.224)	-1.248*** (0.205)	-1.312*** (0.220)
<b>Utility Stacked Bar</b>	-0.805*** (0.226)	-0.779*** (0.239)	-0.775*** (0.210)	-0.896*** (0.221)	-1.236*** (0.207)	-1.237*** (0.222)
<b>Graphical Math</b>	-1.149*** (0.225)	-1.127*** (0.229)	-0.882*** (0.203)	-1.015*** (0.213)	-1.395*** (0.202)	-1.405*** (0.208)
<b>Foreign Language</b>	-0.0217 (0.221)	0.0113 (0.225)	-0.108 (0.211)	-0.150 (0.222)	0.0986 (0.207)	0.0521 (0.218)
<b>Symbols &amp; Foreign Language Coloured</b>	-0.193 (0.212)	-0.293 (0.218)	-0.0719 (0.205)	-0.213 (0.211)	-0.228 (0.204)	-0.265 (0.218)
<b>Indian</b>		-0.131 (0.183)		-0.146 (0.158)		-0.148 (0.161)
<b>White</b>		-0.656*** (0.194)		-0.236 (0.187)		-0.441** (0.196)
<b>Female</b>		-0.622*** (0.127)		-0.597*** (0.112)		-0.636*** (0.120)
<b>Age</b>		0.195* (0.107)		-0.00829 (0.0955)		0.131 (0.101)
<b>Age Squared</b>		0.0563 (0.230)		-0.0781 (0.230)		-0.0303 (0.214)
<b>Medium Income</b>		-0.00164 (0.00496)		0.00101 (0.00501)		0.000228 (0.00460)
<b>High Income</b>		0.174 (0.120)		0.153 (0.105)		0.187* (0.110)
<b>Wave</b>		0.319 (0.202)		0.308 (0.192)		0.174 (0.197)
<b>Constant</b>	4.816*** (0.157)	4.592* (2.625)	4.127*** (0.156)	5.459** (2.603)	4.771*** (0.143)	5.445** (2.453)
<b>Observations</b>	998	895	1,037	932	1,017	912
<b>R-squared</b>	0.083	0.119	0.081	0.115	0.139	0.169

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

**Table 7B. (continued) Satisfaction with the bill per treatment group**

VARIABLES	This bill was too complex for me to understand in the time available.	-0.772***	Answering the questions about this bill made me angry.	-0.237
<b>Logic</b>	-0.613*** (0.232)	-0.772*** (0.240)	-0.141 (0.232)	-0.237 (0.246)
<b>Process</b>	-1.029*** (0.231)	-1.026*** (0.230)	-0.323 (0.231)	-0.354 (0.245)
<b>Bar</b>	-1.406*** (0.244)	-1.542*** (0.259)	-0.506** (0.246)	-0.716*** (0.260)
<b>Stacked Bar</b>	-1.269*** (0.240)	-1.199*** (0.247)	-0.765*** (0.235)	-0.775*** (0.253)
<b>Utility Bar</b>	-0.988*** (0.236)	-1.063*** (0.242)	-0.446* (0.233)	-0.475* (0.251)
<b>Utility Stacked Bar</b>	-1.128*** (0.236)	-1.132*** (0.252)	-0.460** (0.234)	-0.480* (0.255)
<b>Graphical Math</b>	-1.060*** (0.228)	-1.078*** (0.227)	-0.382* (0.230)	-0.425* (0.243)
<b>Foreign Language</b>	0.239 (0.233)	0.190 (0.237)	0.333 (0.243)	0.330 (0.258)
<b>Symbols &amp; Foreign Language Coloured</b>	0.291 (0.210)	0.226 (0.215)	0.435* (0.224)	0.409* (0.235)
<b>Indian</b>		0.141 (0.171)		-0.110 (0.178)
<b>White</b>		-0.630*** (0.209)		-0.453** (0.201)
<b>Female</b>		-0.778*** (0.137)		-0.606*** (0.129)
<b>Age</b>		0.405*** (0.110)		0.0530 (0.105)
<b>Age Squared</b>		-0.160 (0.251)		-0.0981 (0.269)
<b>Medium Income</b>		0.00244 (0.00540)		0.00163 (0.00588)
<b>High Income</b>		-0.0134 (0.125)		0.0488 (0.121)
<b>Wave</b>		-0.307 (0.218)		-0.0941 (0.195)
<b>Constant</b>	4.689*** (0.161)	6.876** (2.854)	3.373*** (0.178)	4.847 (3.026)
<b>Observations</b>	1,009	901	1,042	933
<b>R-squared</b>	0.116	0.190	0.050	0.085

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 7B. (continued) Satisfaction with the bill per treatment group**

VARIABLES	Answering the questions about this bill made me bored.		The bill has everything I want from a bill.	
<b>Logic</b>	-0.0677 (0.167)	-0.158 (0.180)	0.957*** (0.231)	0.945*** (0.254)
<b>Process</b>	-0.0369 (0.166)	-0.124 (0.180)	1.276*** (0.239)	1.167*** (0.264)
<b>Bar</b>	-0.00830 (0.183)	-0.0839 (0.199)	1.439*** (0.239)	1.497*** (0.261)
<b>Stacked Bar</b>	-0.00549 (0.185)	-0.0251 (0.202)	1.439*** (0.226)	1.300*** (0.248)
<b>Utility Bar</b>	0.202 (0.180)	0.0725 (0.197)	1.451*** (0.230)	1.450*** (0.252)
<b>Utility Stacked Bar</b>	-0.0577 (0.175)	-0.167 (0.190)	1.369*** (0.244)	1.345*** (0.266)
<b>Graphical Math</b>	-0.0569 (0.182)	-0.130 (0.198)	1.304*** (0.235)	1.299*** (0.250)
<b>Foreign Language</b>	0.218 (0.179)	0.144 (0.190)	-0.0609 (0.224)	-0.125 (0.249)
<b>Symbols &amp; Foreign Language Coloured</b>	0.0897 (0.160)	-0.0767 (0.170)	0.244 (0.225)	0.184 (0.247)
<b>Indian</b>		0.0966 (0.141)		0.0950 (0.159)
<b>White</b>		-0.0446 (0.171)		0.602*** (0.184)
<b>Female</b>		-0.0609 (0.110)		0.669*** (0.130)
<b>Age</b>		-0.00755 (0.0907)		-0.0888 (0.0997)
<b>Age Squared</b>		-0.209 (0.248)		0.0955 (0.211)
<b>Medium Income</b>		0.00497 (0.00543)		-0.00168 (0.00452)
<b>High Income</b>		0.0460 (0.103)		-0.127 (0.111)
<b>Wave</b>		0.537*** (0.199)		-0.0857 (0.198)
<b>Constant</b>	3.077*** (0.116)	5.347* (2.765)	2.417*** (0.182)	1.056 (2.416)
<b>Observations</b>	1,041	928	943	845
<b>R-squared</b>	0.006	0.020	0.141	0.185

## Appendix C. Experiment Instructions and Experimental Design for the Graph Group

### Figure 1C. Experiment instructions

#### Experiment Information

If you are selected into this study you will be asked to log on to Vula each day for 30 consecutive days and complete a short 2 minute exercise each day. You will start the study with R200 owed to you. You will not have to log onto Vula each day, that part is up to you entirely.

However, we must warn you that for each day that you do not complete the short 2 minute exercise for that day R5 will be deducted from the initial R200 owed to you. Thus if you are selected into this study and complete each day's short 2 minute exercise then you will receive R200 at the end of the study. However if you do not complete the exercise on 3 of the days during the study, you will receive  $R200 - 3 \times R5 = R185$ .

The daily short 2 minute exercise will consist of roughly 5 questions each day. These questions will require no skill or special knowledge to answer. Each day's exercise will only be able to be completed on that day and will change day to day in at least one of its aspects.

This recruitment form will include a personality test which we expect will take you 5-6 minutes to complete. The results will be shared with you at the end of the experiment in just over one month's time. Overall we expect the entire recruitment questionnaire will take you 10 minutes to complete. Once you have completed the recruitment questionnaire, you will be eligible to be selected into this study, for which you will be paid between R200 or R50 at the end of the study, depending upon how many of the daily 2 minute question sets you decide to answer. Payment will be available for collection at the UCT cashier's office in the first two weeks of UCT's first semester in 2015.

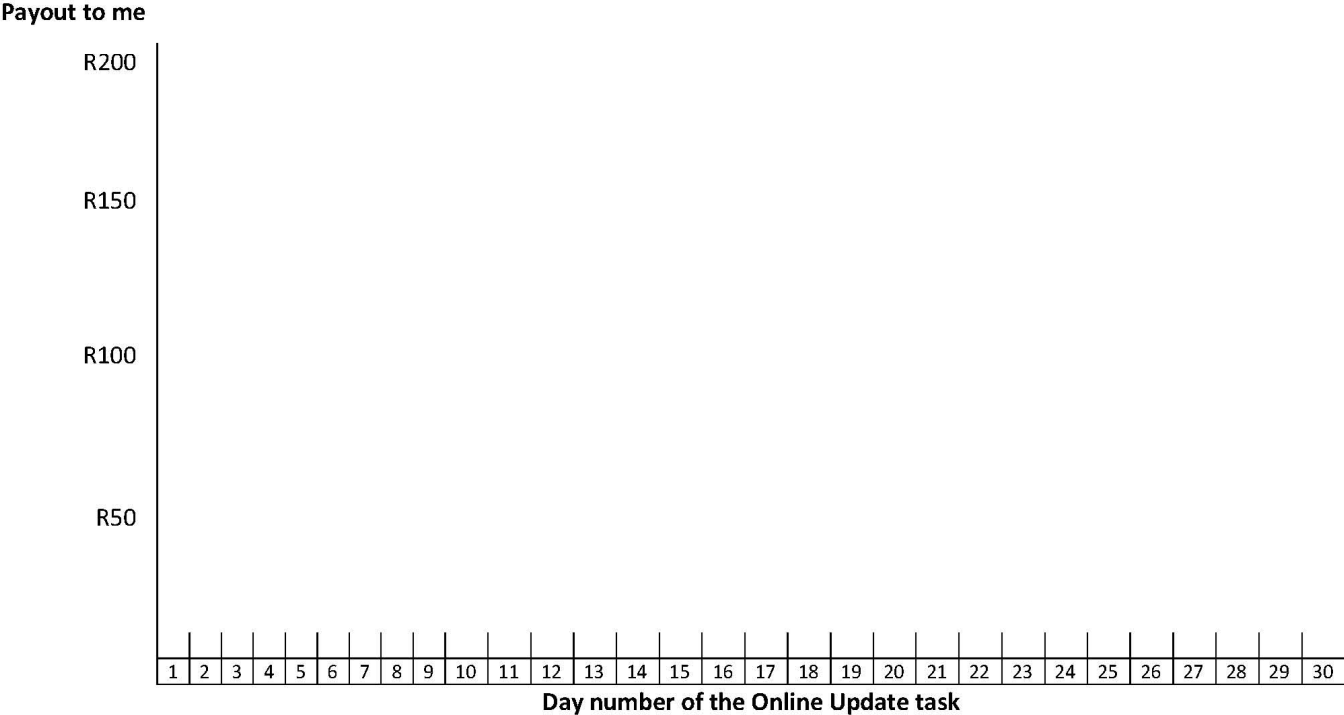


**Figure 2C.** Experimental design for the Graph group

**Log onto Vula today**  
and complete the experiment's exercise for today

**Track your total payout from this Experiment on this graph -**

Remember that you start with R200  
but you lose R5 every day that you do not do the exercise on Vula



**Appendix D.** A priori Testing, ANOVA Results, Two-sample Wilcoxon rank-sum (Mann-Whitney) Test Results

**Table 1D.** A priori testing of the psychological traits

VARIABLES	
Neuroticism	0.108 (0.0744)
Openness to Experience	-0.119 (0.107)
Agreeableness	-0.0121 (0.0938)
Extraversion	-0.0713 (0.0661)
Conscientiousness	0.206** (0.0879)
Constant	16.45*** (4.325)
Observations	355
R-squared	0.030

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 2.1D** ANOVA results for the gender variable among treatment groups

Source	SS	df	MS	F	Prob > F
Between groups	1.458435	3	0.486145	1.99	0.1155
Within groups	93.23247	381	0.244705		
Total	94.69091	384	0.246591		

**Table 2.2D** ANOVA results for the age variable among treatment groups

Source	SS	df	MS	F	Prob > F
Between groups	15.17671	3	5.058904	0.71	0.5444
Within groups	2694.196	380	7.089989		
Total	2709.372	383	7.074079		

**Table 2.3D** ANOVA results for the well-being variable among treatment groups

Source	SS	df	MS	F	Prob > F
Between groups	6.079585	3	2.026528	0.64	0.5869
Within groups	1185.733	377	3.14518		
Total	1191.812	380	3.136348		

**Table 2.4D** ANOVA results for the race variable among treatment groups

Source	SS	df	MS	F	Prob > F
Between groups	4.006656	3	1.335552	0.43	0.7335
Within groups	1128.13	361	3.125015		
Total	1132.137	364	3.110266		

**Table 2.5D** ANOVA results for the income-group variable among treatment groups

Source	SS	df	MS	F	Prob > F
Between groups	0.87375	3	0.29125	0.84	0.4717
Within groups	130.7912	378	0.346008		
Total	131.6649	381	0.345577		

**Table 2.6D** ANOVA results for the conscientiousness trait score variable among treatment groups

Source	SS	df	MS	F	Prob > F
Between groups	251.8369	3	83.94564	2.09	0.1009
Within groups	15860.85	395	40.15406		
Total	16112.69	398	40.48415		

**Table 3D.** The “enrollment\_pers” variable is not significant for the regression

VARIABLES	1
enrollment_pers	2.927 (2.545)
Constant	16.33*** (2.489)
Observations	414
R-squared	0.003

Standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 4.1D** Two-sample Wilcoxon rank-sum (Mann-Whitney) test for Control and SMS group

Treatment	Observations	Rank sum	Expected
Control	105	10007	11077.5
SMS	105	12148	11077.5
Unadjusted Variance	193856.25		
Adjustment for Ties	-1113.68		
Adjusted Variance	192742.57		
z	-2.438		
Prob> z	0.0148		

**Table 4.2D** Two-sample Wilcoxon rank-sum (Mann-Whitney) test for Control and Graph group

Treatment	Observations	Rank sum	Expected
Control	105	11176	11077.5
Graph	105	10979	11077.5
Unadjusted Variance	193856.25		
Adjustment for Ties	-1261.76		
Adjusted Variance	192594.49		
z	0.224		
Prob> z	0.8224		

**Table 4.3D** Two-sample Wilcoxon rank-sum (Mann-Whitney) test for Control and SMS&Graph group

Treatment	Observations	Rank sum	Expected
Control	105	9864.5	10920
SMS&Graph	102	11663.5	10608
Unadjusted Variance	185640		
Adjustment for Ties	-1327.89		
Adjusted Variance	184312.11		
z	-2.459		
Prob> z	0.0139		

**Table 4.4D** Two-sample Wilcoxon rank-sum (Mann-Whitney) test for SMS and Graph group

Treatment	Observations	Rank sum	Expected
SMS	105	12404	11077.5
Graph	105	9751	11077.5
Unadjusted Variance	193856.25		
Adjustment for Ties	-734.87		
Adjusted Variance	193121.38		
z	3.019		
Prob> z	0.0025		

**Table 4.5D** Two-sample Wilcoxon rank-sum (Mann-Whitney) test for SMS and SMS&Graph group

Treatment	Observations	Rank sum	Expected
SMS	105	10840.5	10920
SMS&Graph	102	10687.5	10608
Unadjusted Variance	185640		
Adjustment for Ties	-1106.99		
Adjusted Variance	184533.01		
z	-0.185		
Prob> z	0.8532		

**Table 4.6D** Two-sample Wilcoxon rank-sum (Mann-Whitney) test for Graph and SMS&Graph group

Treatment	Observations	Rank sum	Expected
Graph	105	9655.5	10920
SMS&Graph	102	11872.5	10608
Unadjusted Variance	185640		
Adjustment for Ties	-936.70		
Adjusted Variance	184703.30		
z	-2.942		
Prob> z	0.0033		