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HOUSEHOLD RECYCLING BEHAVIOUR: A BEHAVIORAL PERSPECTIVE

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To my homeland

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Abstract

Environmental issues put short-term economic gratification in direct conflict with long-term survival of the planet: they are no longer considered 'distant'. There is a causal link between the disposal and treatment of waste and global environmental problems. Recycling is one of the most effective remedies to the problem of waste.

There is evidence of an intention-action gap in household recycling behavior. The psychological nature of the decision to recycle is the most likely explanation for this intention-action gap.

The present dissertation combines behavioral economics and psychology of incentives. It studies the cognitive processes underlying the recycling intention-action gap and offers a theoretical framework to design effective nudges.

The work consists of three sequential articles: the first two articles include a lab experiment, the third runs a computer simulation. Article 1 considers a semantic stimulus and tests the priming effect on recycling behavior of two stereotypes: the environmentalist and the conscientious citizen. Article 2 considers a contextual (conceptual plus visual) stimulus and tests the priming effect of two induced feelings: spirituality and nature. Article 3 develops an agent-based model to assess the effects of the major findings of Article 1 and 2 on the system as a whole.

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AN OVERVIEW

Prologue

One of the most popular and inspirational quotes by Mohandas Gandhi, an ideological and political leader, a man of thought and action, is:

“Your beliefs become your thoughts,
Your thoughts become your words,
Your words become your actions,
Your actions become your habits,
Your habits become your values,
Your values become your destiny.”

I am not sure whether the original intention of the Mahatma was to use the verb ‘become’ as a warning or as an exhortation, but I like to interpret it in the latter way. My doctoral thesis is an intellectual and creative circular journey that navigates the psychological foundations of household recycling behavior. Following the roadmap established by Gandhi’s quote, this dissertation goes from the thoughts that households entertain and accept about recycling to the destiny of our planet and back, as in a virtuous cycle, to the renewed convictions of households about recycling. Every step along the journey has a precise psychological content: the intent of this dissertation is to offer an original view about each one of these passages.

All research, and mine is no exception, is the result of some serendipitous combination of personal attitudes, educational backgrounds, scientific interests, and lucky encounters. I think it is important to keep that in mind to have a comprehensive understanding of this work. In this specific case, my enthusiasm for the environmental issues is the reason why I chose to address the problem of recycling. My educational background is all about economics and behavioral

economics in particular: my knowledge in the field of economics has played a key role in selecting the standpoints for the analysis of the recycling phenomenon. My scientific interests became those related to cognitive biases, priming and social norms as soon as I began to read psychology literature. Finally, my research has been steered by the collaboration with three prime universities, Vienna University of Economics and Businesses, the University of Trento and the University of Verona, and their passionate professors. I owe a lot to all of them.

Causes and Magnitude of the Waste Problem

Environmental issues are no longer considered 'distant' or 'abstract' and put short-term economic gratification in direct conflict with long-term survival of the planet. It is conventional wisdom that there is a causal link between the disposal and treatment of waste and global environmental problems. The ongoing climate change due to persistent pollution in terms of accumulation of waste and toxic emissions is universally considered as a human-imposed threat that demands immediate attention. Waste treatment and disposal activities, especially landfilling and incineration, are major causes of the global warming emergency.

The consequences of the increasing waste generation range from pollution to the preservation of our natural landscapes: all problems that bring along a variety of health issues. Landfilling, incineration and illegal dumping are responsible for the pollution of air, water and soil as well as noise and other nuisances. Ordinary landfills, for example, are the source of chemical substances pervading the soil, fresh and salt waters. Incinerators, on the other hand, generate noise that can provoke hearing diseases, stress-related problems, and sleep disturbances. In addition, waste incinerator systems release toxic residues: heavy metals, dioxins and furans can be found in gases, water and ashes resulting from the incinerating process.

In terms of health issues, dangerous infectious illnesses, such as Dengue fever, that are prevalent in developing nations, are believed to be perpetuated by unsanitary waste disposal methods. Higher prevalence of reproductive disorders, including low birth weight, is common in areas located near existing and former landfills. Although

unequivocal scientific results have not been delivered yet, there are 'cancer clusters' within close proximity to landfills. As far as the incinerating activity is concerned, people living near the factories are exposed to toxic compounds, for example dioxin. Dioxin is known to be particularly harmful: it may cause cancer, neurological damages and may disrupt reproductive systems, thyroid systems and respiratory systems.

Among the causes of the accumulation of waste, mass production is certainly at the top of the list. Over the last one hundred years, rapid economic growth, coupled with urbanization and a growing appetite for consumer goods, has contributed to the rise and expansion of mass production. Any production process and any production technique generate some form of waste at one time or another.

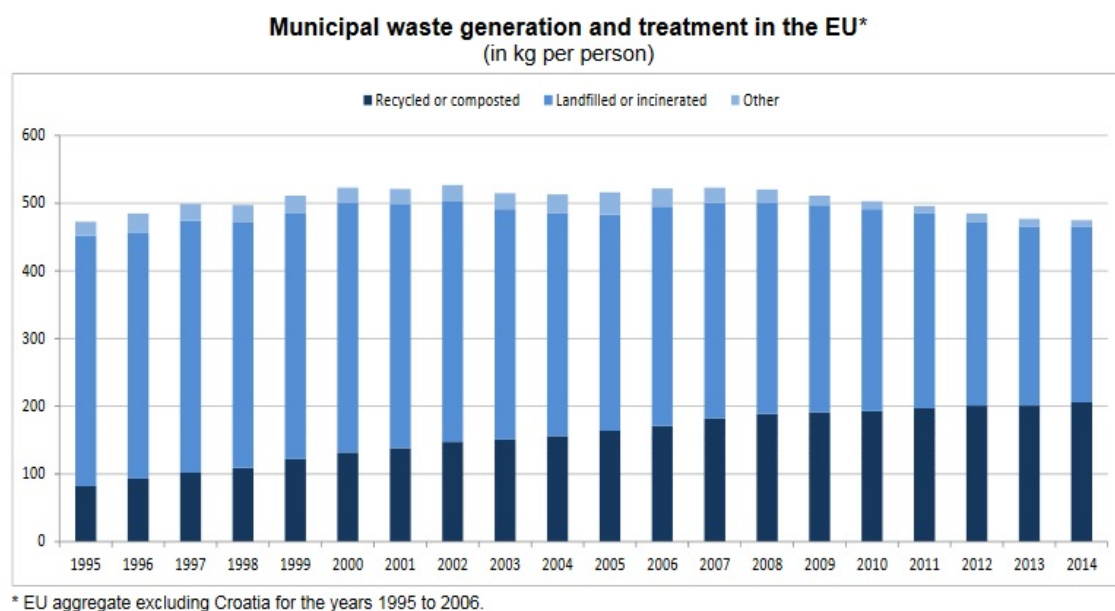
A number of current sociological trends lead us to believe that the waste problem will be growing over time. These trends may differ between developed and developing countries and include:

- *Overpopulation and continuing high demographic growth.* According to 2012 UN projections, global population is expected to reach between 8.3 and 10.9 billion by 2050.
- *Accelerating resource exploitation.* The depletion of non-renewable natural resources is not confined to the unsustainable extraction of fossil fuels, but it concerns also other phenomena, for example intensive agriculture and extraction of subsoil minerals. The use of natural resources in the world is expected to quadruple by 2050 and, at the current rate of depletion, virgin materials alone will not be enough to satisfy the global demand.
- *Over-consumption due to higher incomes.* A culture of unfettered consumerism is commonly reinforced by the economic theory that a progressively greater consumption of goods is economically beneficial, if not essential, to the survival of modern economies.

If we observe the future from a European perspective, the legislative effort of the European Parliament makes the situation appears slightly more promising. According to the European Public Agenda, the waste management sector is expected to achieve significant results in the near future in terms of the reduction of the

noxious impacts of waste on the environment. However, the increasing complexity of current waste management systems on the one side, and demanding environmental protection targets on the other side, make the design of effective waste management strategies and policies a difficult task. The EU Waste Framework Directive (Directive 2008) outlines the general principles of good waste management. Waste prevention is the most desirable option, followed by the preparation of waste for re-use, recycling and other forms of recovery, with incinerators and landfills as the last resort. According to the Environmental Data Centre on Waste, produced by Eurostat, each European citizen generated in 2014, 475 kg of waste per capita on average (see Figure 1). The EU Waste Framework Directive (Directive 2008) introduces also a new ambitious recycling rate target to be achieved by 2020 for European countries: 50 percent.

Figure 1: Municipal waste generation and treatment in the Europe



Among EU countries, Italy represents an interesting case study. Italy seems to be on the right path to reach the EU recycling target of 50 percent of municipal solid waste by 2020; however the cross-regional differences are still problematic, in 2015 only 9 out of 20 regions achieved such rate. Low household participation in recycling, insufficiently skilled manpower, irregular collection services, inadequate equipment

for waste collection are the key factors complicating the scenario in the regions that fell behind. Even for the virtuous regions the positive trend may be reverted. In fact, the ancient urban structure of most Italian cities is the cause of the increasing traffic congestion, which adversely affects the productivity of solid waste fleets. Their productivity is reduced by the long hauls required of the fleet, as open lands for disposal are further and further away from urban centers. Local authorities have to conceive new procedures to improve worker and vehicle performance and to expand the services offered to a growing urban population.

The Economics of Waste Management

The risks affecting the planet in terms of pollution, resource depletion, health and quality of life in general have giant economic implications. Reducing the amount of waste through re-use and through the adoption of a more environmentally friendly consumption model would help to contain current and future costs. Some costs are direct and evident; others are hidden and often underestimated. In terms of energy recovery, for example, most of the times the amount of energy spent in the manufacturing of consumption goods exceed the amount freed in the incinerating process. Another example of hidden costs refers to the preservation of our land. Public sites, where both illegal waste dumping and its legal disposal happen, are deteriorating and consequently lowering their value and that of the surrounding properties. The visual impact and the degradation of plant and animal habitats are seriously affected. Moreover, illegal dumping is a vicious circle as it attracts further illegal dumping, making an always-bigger share of a country's territory unavailable for people and unproductive for businesses.

Generally speaking, the economic impact of waste is twofold: not only does waste represent an enormous loss of resources in the form of both materials and energy, but also its treatment and disposal create environmental damages and impose an enormous collective cost upon society.

Whilst the economic literature offers a reasonably comprehensive coverage of the present cost-related aspects of the waste issues, including those of health and

environment, there are still large uncertainties about the future challenges that countries will have to face to win the 'waste war'. In fact, a precise scientific assessment of the health and environment risks associated with incinerators and landfills, to be compared with the benefits of these waste-processing techniques, has still to be fully elaborated.

The positive effects of waste treatment and disposal are mainly connected to energy recovery and job creation and an extensive economic and technical literature on the subjects can be retrieved. It suffices to mention that the largest benefits of energy recovery derive from incinerators, particularly if the heat generated can be used directly for processing heat or district heating systems. Electricity production returns far lower benefits than heat because of the poor conversion efficiency of incinerator heat.

The Importance of Recycling

Waste prevention is the most elementary remedy to the problem of waste management; companies should adopt new manufacturing methods and consumers should demand more environmentally friendly products and less packaging. The second best remedy is recycling; i.e. the distinction in the collection and processing of waste between materials for recovery and materials for disposal. The benefits of recycling are numerous: natural resources such as water and minerals are preserved, pollution is reduced as long as the use of new raw materials is prevented, energy is saved, new jobs are created in the related recycling sector. Recycling is a growing and developing integrated industry; it consists of a number of diverse players presiding over different parts of the value chain: there are companies operating in the collection and transportation of waste, factories processing waste, organizations dealing with recycling training, marketing and education. The amount of jobs created every year by the recycling industry has been growing exponentially over the past ten year. Recycling creates more jobs at higher income levels than landfilling or incinerating waste.

From Thoughts to Words

If recycling is solely an economic problem one should look for economic solutions. Neoclassical economics and its assumptions of utility maximization, rational preferences and complete information, accepts that households take into account all possible costs when deciding their recycling behavior. Three possible explanations of the observed recycling rate are offered by mainstream economics. The first relates to the amount of information received and elaborated by households. If households do not recycle enough, it means that they do not have enough information about the recycling problem or that they do not 'believe' the catastrophic consequences described by this information, i.e. information is ineffective. Second, the costs of non-recycling are hyperbolically discounted: households are aware of the potential immediate benefits connected to a higher recycling rate, but these benefits are so far away in the future that their present value is insignificant. Third, the benefits of non-recycling are reaped by the household that performs it, while the costs are suffered by a third party or third parties: it is the problem known to economists as 'negative externalities'. Ronald Coase, a British economist of the University of Chicago Law School, identified the solution based on the concept of property rights. The Coase theorem states that when economic agents can negotiate their rights to perform a behavior that is costly for society as a whole, the resulting welfare is more beneficial to both parties than the outcome of any pre-assigned rights. The idea of negotiable property rights has been applied in several contexts and countries and raises the questions whether monetary incentives can solve the economic problem of recycling. Sadly enough, the second article of this dissertation shows scientific evidence that monetary incentives are ineffective most of the times.

A fourth justification is offered by neoclassical economics to explain the inter-generational problem of environmental costs. It claims that the costs of a lower than optimal recycling rate fall on future generations and the wellbeing of future generations is not relevant in household decision-making. I think that this explanation is clearly against common sense about human nature. Therefore, the

scenario that opens up in front of us is that households make a commitment to recycle but they cannot live up to it. This is what Gandhi formulates as “your words become your actions” and I refer to as the intention-action gap and it is the subject of the present dissertation.

From Words to Actions

I had to depart from neoclassical economics and embrace behavioral economics to understand the psychological content in the recycling behavior. The psychological nature of the decision to recycle is one of the most likely explanations for the intention-action gap. This gap is clearly revealed by the EU citizens’ answers contained in the European Commission report ‘Attitudes of European Citizen towards the Environment’ of April 2014. According to the report, the majority of the EU population (54 percent) think that “sorting the waste so it can be recycled” is the top priority among the daily activities that can contribute to protect environment. In 2011 the answers to the same question reflected a larger majority (59 percent), but the EU citizens’ perception of the importance of recycling remains nonetheless significant. Even more unexpectedly, in another section of the same report, 72 percent of the EU citizens declare that they had sorted most of their domestic waste during the past month; 8 percent more than three years before. These results are not easily reconciled with actual recycling rates: according to Eurostat estimates, EU average recycling rate was 38 percent in 2014. The recycling intention-action gap oscillates between 16 and 34 percentage points.

From Actions to Habits

In the American Journal of Psychology, habits are described as: "more or less fixed ways of thinking, willing, or feeling acquired through previous repetition of a mental experience". By definition, habits tend to stick: old habits are hard to break and new habits are hard to form.

My research question is whether it is possible to form and consolidate new, virtuous

habits when households deal with the daily activity of recycling. To answer this question, a wider theoretical angle on habits is needed and I found it in the decision-making theory proposed by behavioral economics. The dual-process theory, which was popularized by Kahneman, a psychologist who won a Nobel Prize in economics, challenges one of the most basic and traditional principles of economics: decision-making is a unitary process, a simple matter of integrated and coherent utility maximization. The dual-process theory suggests that decision-making is driven by the interaction between automatic and controlled mental processes. These processes involve two separate cognitive systems respectively: an implicit and unconscious system ('System 1') and an explicit and conscious system ('System 2'). System 1 is fast, effortless, unintentional: it produces an intuitive and habitual response. System 2, on the other hand, is heuristic-based, analytical, deliberate and effortful. It involves a rational and deliberate judgment based on additional information collected actively by the individual and on the conscious application of rules that have been acquired through learning.

The working hypothesis of the present research is that System 1 tends to dominate over System 2, especially in a reiterated activity such as garbage disposal. Recycling decisions/actions are surpassed by habits and the motivational discrepancy that households experience when having to perform a recycling activity can be construed as the dominance of System 1 over System 2. However, there are some exceptions: the most important exception, for the purposes of this thesis, is when the subject is required to account for or justify her actions.

The conclusion is therefore straightforward: if recycling habits (System 1) have to be changed in a permanent way, the recycling decisions must become a salient, conscious cognitive process, which can gradually initiate a new routine.

From Habits to Values and Destiny

A cognitive process becomes salient when it integrates one or more values. Outside of any monetary incentive, two classes of values have been included in this research: a set of intrinsic motivations (or injunctive social norms) as opposed to a set of

extrinsic motivations (or descriptive social norms). At an early stage of the research, both classes of social norms are appropriately associated with two stereotypes: the 'environmentalist' and the 'conscientious citizen'.

As the research progresses, intrinsic motivations become the central theme of the dissertation. In particular, two sources of intrinsic motivation are considered: spirituality and nature. The spiritual dimension does not coincide with the religious dimension of life: it contains it and matches another quote by Gandhi "The earth, the air, the land and the water are not on inheritance from our fore fathers but on loan from our children. So we have to handover to them at least as it was handed over to us". The love of nature is also a profound dimension that evokes freedom, a sense of mystery and belonging and commands a sense of protection.

The Experiments

At this stage of my journey, a final *tessera* of the mosaic was missing before completing the theoretical foundations and undertaking the experimental part of the dissertation. It was necessary to choose an instrument to make the identified values salient: a psychological manipulation that prompts System 2 to take control when households deal with recycling. Priming is a psychological effect that makes the cognitive elaboration of an event easier when it is preceded by a related stimulus; it increases the sensitivity of a person to certain stimuli due to prior experience. The connection between the event and the stimulus can be of different types, for example semantic, perceptual, or conceptual, depending upon the sense activated. Priming, by extension, describes also the associated manipulation technique that consists in the activation of specific associations and representations held in memory that can control an activity or task. The technique is built upon the associative network model of human memory.

The experimental part of this dissertation, and its natural development, would have required a field experiment: the costs and the difficulties of the implementation of a field experiment suggested to run two pilot laboratory experiments and a stochastic simulation model to evaluate the systemic impact of the proposed hypotheses.

Experiment 1

The first experiment was held in Vienna and is the subject of Article 1. The type of priming used is a semantic priming. This experiment requires a preliminary study to identify a collection of words able to retrieve in the mind of the subject the stereotypes of the environmentalist and the conscientious citizen. In the second phase of the experiment, the actual recycling behavior is observed through the way subjects dispose of a paper cup and a plastic lid. Social norms are an integral part of the concept of civic duty and a stratagem was devised to let the subjects see what others were doing.

The most interesting part of this experiment is that experimental data allow the researcher to distinguish between subjects' commitment to recycle and their level of attention in performing the task. The conclusions are quite surprising.

Experiment 2

The conclusions of the first experiment had as natural consequence two refinements: the second experiment focuses exclusively on injunctive social norms and utilizes a combination of multiple stimuli to obtain contextual priming: a visual and a conceptual stimulus were used. Similarly to the previous experiment, a rigorous, burdensome work had to be done to evaluate the images to be selected for the priming. The conceptual stimulus, on the contrary, was borrowed by two validated questionnaires. The second experiment adds also two measures to the actual observation of recycling behavior. The first measure considers cleaning as a viable proxy for recycling; the second is a self-reported evaluation of the recycling behavior.

Experiment/Simulation 3

Although Article 3 is the only article contained in this doctoral dissertation that has been published so far, it recaps and fuses all the conclusions of Article 1 and 2. The object of the stochastic simulation is, in fact, threefold. The first object is to test the functioning of our conclusions in a systemic and dynamic model. The second object is to understand the interaction between the incentives that had been considered separately in the first and second experiments. Third, on the basis of our findings, the article provides the policymaker with a few guidelines on how to nudge

households to embrace a virtuous recycling behavior.

Article 1

The Effect of Semantic Priming on Recycling: Two Stereotypes

INTRODUCTION

In 2011 the European Commission undertook to carry out a poll to analyze the “attitude of European citizens towards the environment”. The results of the survey were published in August of the same year. In one of the sections, the survey examines the environmental issues that are of main concern to the European citizens. The growing amount of waste produced is a major concern for 33 percent of respondents. In another section, respondents are asked to describe what kind of environmental activities they carry out on a regular basis. The single most popular measure mentioned is the separation of waste for recycling, cited by percent of the respondents (Eurobarometer, 2011).

These results are not easily reconciled with actual recycling rates: 2011 EU average recycling rate did not exceed 40 percent, according to Eurostat statistics (Eurostat, 2014).

We offer three possible explanations for the apparent discrepancy. Firstly this discrepancy could be attributed to the inherent limitations of a questionnaire survey. On top of the limitations of the research instrument, one should consider the contingent effects of the extensive media coverage received by two tragic environmental events occurred in the first half of 2011: the Gulf of Mexico oil spill and the Fukushima nuclear disaster. A second possible explanation relates to the capacity of municipal policy instruments to satisfy the growing demand for recycling services among households. Thirdly, there exists a gap between household intentions and actual behaviors. This motivational discrepancy, the so-called ‘intention-action’ gap, that households experience when having to perform a recycling activity is precisely the subject of our study. We will investigate the nature of this gap and propose a coherent theoretical

foundation upon which the effectiveness of a variety of motivational strategies to bridge this gap can be discussed.

The Theoretical Foundation

The Theory of Planned Behavior (TPB) (Ajzen, 1991) has been used across a multitude of disciplines and fields, including waste recycling, to explain the intention-action gap. However, the theory's degree of success in understanding the determinants of recycling behavior has been mixed. We adopt a totally different approach and try to overcome the drawbacks of the TPB model following two major perspectives. To begin with, we approach the problem through the observation of actual behaviors in a laboratory, in contrast to a series of questions in written form recorded in the questionnaires employed by the TPB. Next, we dispute the sufficiency of subjective social norms posited by the TPB; alternatively we are going to favor injunctive and descriptive social norms as primary motivational drivers. The logic of our alternative approach is confirmed by the greater share of attention that behavioral economics has recently captured relative to other subfields within economics. In fact, recycling is by all means also an economic decision: separating waste is for households a costly and time-consuming activity. Behavioral economics can provide unrivaled insights into household recycling behavior.

Behavioral economics, and more specifically the dual-process theory (Groves & Thompson, 1970; Kahneman, 2011), challenges one of the most basic and traditional principles of economics: decision-making is a unitary process, a simple matter of integrated and coherent utility maximization. The dual-process theory suggests otherwise: decision-making is driven by the interaction between automatic and controlled mental processes. These processes involve two separate cognitive systems respectively: an implicit and unconscious system ('System 1') and an explicit and conscious system ('System 2'). System 1 is fast, effortless, unintentional: it produces an intuitive response. It uses information that is readily available and mostly visual and operates on the

recognition of a typical configuration of signs or on similarities with previously encountered situations. System 2, on the other hand, is heuristic-based, analytical, deliberate and effortful. It involves a rational and deliberate judgment based on additional information collected actively by the individual and on the conscious application of rules that have been acquired through learning.

Our working hypothesis is that the motivational discrepancy that households experience when having to perform a recycling activity can be construed as the dominance of System 1 over System 2. Norenzayan et al. (2002) suggest that the intuitive cognition, System 1, tends to dominate over formal cognition, System 2, although both systems are typically active simultaneously. This seems to be the case especially when a subject is engaged in a reiterated activity, such as disposing the garbage. However, the dominance of System 1 over System 2 can be overturned by a variety of circumstances, including the demand for accountability or justification of one's actions. This hypothesis is consistent with the temporary positive effect observed in a number of recycling campaigns. Typically, in the first days of a recycling campaign, a range of new information is provided: households need to activate System 2 to absorb and process this information. The dominance of System 2 strengthens intentions and improves intention-behavior consistency, resulting in an increased recycling rate. Unfortunately System 2 is 'uneconomical' and, after a period of time, the brain enters an energy-saving mode by defaulting back to the effortless System 1 and the old 'automatic' behavior is restored. System 2 is uneconomical not only because "the overall capacity for mental effort is limited", but also because "effortful processes tend to disrupt each other, whereas effortless processes neither cause nor suffer much interference when combined with other tasks (Tversky & Kahneman, 1973; Pashler & Sutherland, 1998)."

The Research Questions

Our study is set out to answer two fundamental questions. The first question concerns the possibility to activate separately both System 1 and System 2 in the household decision to recycle. The second question is about the motivational strategies that can be developed to prolong System 2's dominance over System 1 long enough for recycling to become an 'automatic' activity.

A recent study by John, Cotterill et al. (2011) shows that it is possible to induce households to change their recycling behavior in a lasting way. The authors leverage the concept of social norms by providing each household with a relative measure of her 'recycling performance'. Social norms are sets of beliefs about what other people are doing or what they approve or disapprove of doing (Cialdini, Reno & Kallgren, 1990): therefore a social norm-based message engages heuristic-based processing characteristic of System 1. Letting households know where they stand in terms of recycling relative to others in their neighborhood proves to be much more effective than other forms of communication, impersonal or personal, including canvassing, i.e. face-to-face personal interaction.

On top of social norms, other forms of intervention that engage the deliberate, rational consideration of an issue, typical of System 2 processing, can be used in combination with social norms, sparking a virtuous cycle. Among these forms of intervention, intrinsic incentives are inevitably the most effective ways to activate System 2 and nudge households towards more environmentally friendly behavior. There is good evidence that intrinsic motives have a stronger hold on people than purely instrumental, economic ones. One of the most interesting findings of Missios and Ferrara (2011) is that the most important factor motivating recycling is whether and the extent to which it is considered beneficial for the environment. Similarly, Frey and Oberholzer-gee (1997) find evidence that policies designed to promote environmentally responsible behaviors relying on economic incentives may be ineffective for households

driven by strong moral motives as these policies may undermine individuals' sense of self-esteem or civic duty.

The aforementioned desirable transition from intuitive cognition to formal cognition is made smoother when an intrinsic incentive is combined with the appropriate type of social norms. A motivational strategy based on the interaction of social norms and intrinsic/extrinsic incentives can be refined considering the difference between 'descriptive' social norms and 'injunctive' social norms. Descriptive norms depict what does happen and are based on the observation of what other people do; injunctive norms depict what should happen, i.e. what a particular culture approves or disapproves. The study of John described earlier resorts to a feedback approach and is therefore hinged on the former type of social norms (John, et al., 2011). The use of injunctive social norms, on the other hand, does not require a factual observation but the adoption of a frame of reference. An intrinsic incentive based on the belief of the importance of the environment is more likely to lead to the cognitive shortcut of the type of an injunctive social norm. Vice versa, a extrinsic incentive based on a generic sense of duty leads to the shortcut of the type of descriptive social norms.

The Technique: Priming

The existence and intensity of intrinsic/extrinsic incentives depend on a number of factors and may vary across different households and different communities. However, they can be ignited by a technique used in psychology to train a person's memory: priming. Priming is by all means different from the form of memory that relies on the direct retrieval of information as it occurs outside of conscious awareness. Priming is a psychological effect that makes the cognitive elaboration of an event easier when it is preceded by a related stimulus; it increases the sensitivity of a person to certain stimuli due to prior experience. The connection between the event and the stimulus can be of different types, for example semantic, perceptual, or conceptual, depending upon the sense activated.

Priming, by extension, describes also the associated manipulation technique that consists in the activation of specific associations and representations held in memory that can control an activity or task. The technique is built upon the associative network model of human memory: a concept is stored as a node in a network and is related to other similar concepts to form a 'cluster'. When a cluster is activated, those clusters that are more closely connected receive a share of activation by 'propagation' and are therefore more likely to emerge to consciousness. For example, when participants in an experiment were exposed, as part of a purported 'language study', to words related to 'kindness', they subsequently responded perceiving a target person as kinder compared to the judgment of a control group about the same person (Srull & Wyer, 1979). Accessibility of a certain concept, i.e. the likelihood of retrieval from memory and subsequent use, depends not only on the nature of the related stimulus but also on prior exposure to the very same concept and on how far back in time this exposure goes (Higgins & King, 1981; Wyer & Srull, 1986).

Priming is a powerful tool in psychology research: for example, priming techniques were among the earliest developed methods for studying social cognition and social judgments. Elaborating on the seminal semantic priming studies (Meyer & Schvaneveldt, 1971; Neely, 1977), researchers have been using priming to investigate stereotype and attitude associations without relying on self-reports (Dovidio, Evans & Tyler, 1986; Fazio & Williams, 1986; Gaertner & McLaughlin, 1983). Furthermore, priming techniques can be employed to map the network of associations for any single individual.

The psychological literature distinguishes three main mechanisms responsible for the priming effect: a) assimilation: when primes are incorporated in the mental construct of the subject; b) anchoring: when primes are used as a reference for evaluating new information; c) correction: when primes alter the cognitive process of the subject.

The relevance of assimilation effects for knowledge accessibility has induced some authors to conclude that assimilation is "the most natural" (Martin, Seta & Crelia, 1990) and "the basic effect of recent and frequent activation" (Higgins,

1989). Researchers have proposed numerous models leading to the interpretation of the impact of primes on accessibility. One of the most convincing examples is the excitation-transfer model (Higgins, Bargh & Lombardi, 1985; Wyer & Carlston, 1979; Bryant & Miron, 2003). This theory claims that individuals can transfer the residual excitation raised by a certain experience to a new activating condition whose intensity is greater than that of the original experience. The excitation generated by an instigated emotion persists in time and the portion of excitation left over has consequences on emotions that may arise later and may be different in kind. The theory has a wide range of applications, but two fundamental caveats must be considered. As a general rule and particularly in the specific case of the elaboration of social judgment, the subject must reach an "excitatory threshold" before the new activating condition is experienced (Zillmann, 1983). In addition, the residual excitation induced by any experience tends to fade over time. According to this model, primes work as the original stimulus/experience and their processing produces the residual excitation necessary to bring to consciousness the corresponding representation, which becomes more likely to be used in judgment.

Strull and Wyer (1989) offer an alternative mechanistic model to explain the connection between primes and accessibility. They propose that the human memory consists of a set of "storage bins". Mental constructs are stored in these bins, one layer over the other, following the chronological order in which they were activated. When a stimulus is elaborated to perform a social inference, the relevant matching bin is located and searched from the top down. The mental constructs at the top are more likely to be brought to consciousness and utilized: in this model knowledge accessibility becomes a function of relevance and time. As long as primed constructs remain on top, they are likely to be utilized in subsequent cognitive processes.

Smith and DeCoster (1998) explore knowledge accessibility employing a connectionist model. This approach is inspired by the architecture of the human brain, which is formed by networks of interconnected neurons, the so-called

neural networks. Any information that the brain processes coincides with the simultaneous activation of a great number of connections to form a specific pathway. Every synaptic pathway of a neuron has a certain 'weight' that defines the strength of the received message. These pathways are similar to the pathways of brightness across the pixels of a computer monitor that form pictures or words. In this framework the role of a stimulus is the activation of an initial set of neural networks that expands as more networks are involved. The resulting pathway, i.e. the concept brought to mind, is defined partly by the exogenous stimulus and partly by the weights of the connections. Every time a pathway is triggered, the weights of the connections are adapted to make it easier to replicate the same pathway in the future. The more a pathway is compatible with the weights of the connections, the easier it is to access the related knowledge: primed constructs 'lubricate' the formation of pathways.

The results of accessibility do not always reflect the primed stimulus in a unique, predefined direction. An assimilation effect happens when the result goes in the same direction of the prime; a contrast effect produces consequences that are opposite to those intrinsically 'suggested' by the prime. The characteristics of the primed stimulus define what type of effect will be produced. Stapel & Koomen (2001) prove that close and highly relevant stimuli lead to assimilation rather than contrast. Schwarz and Bless (1992) develop an inclusion-exclusion model where the hypothesis is that a stimulus generates two mental representations: one is easily incorporated in a mental construct, the other is used as a standard of comparison. When the primed mental construct is used as a standard for social judgment, an 'anchoring' effect appears. The authors claim that the representation by incorporation is likely to produce an assimilation effect, whereas the representation by anchoring produces a contrast effect.

A contrast effect can also proceed from the attempt, conscious or unconscious, to avoid the effects of a prime or to neutralize its influence. According to a number of empirical studies, this 'correction effect' seems to depend more upon the structure of the mental processing of the prime than upon the

characteristics of the primed stimulus. Martin's set-reset model, for example, assumes that correction occurs mostly under three circumstances (Martin, 1986). First, the subject has to be aware of possible biases and attempt to ignore, in their judgment, thoughts perceived to be the result of a primed stimulus (Herr, 1986). Second, the individual must also have a theory about the direction of the bias. Lastly she has to have the motivation and the cognitive capacity to correct the bias. Occasionally corrections are driven by a priori, naïve theories or by processes that are beyond individual reasoning capabilities: this process, termed 'resetting', leads to overcorrection when the bias's perceived magnitude is overestimated.

THE EXPERIMENTAL DESIGN

So far we have laid down the cornerstones of our research. The battlefield is the recycling problem. The enemy is the dominance of System 1 over System 2. The military strategy is the combination of intrinsic/extrinsic incentives and social norms. The weapons are the priming techniques. Before describing the experimental section of the study, we need to specify the strategy in greater detail and select one intrinsic and one extrinsic incentive: we call them 'care for the environment' and 'sense of duty' respectively. These two incentives identify two corresponding stereotypes: the 'Environmentalist' and the 'Conscientious Citizen'.

The experimental section, run with undergraduate students, consists of two studies and validates the theoretical hypotheses proposed in the fundamental part of the present research report. In the first study (Study 1), a number of associative words are selected and their precise relation with the two incentives is analyzed. More specifically, we explore the structure of the mental lexicon of the participants to the experiment: for each type of incentive a set of relevant clusters of words are classified and employed to decipher the subjects' active

mental models. The recognized active mental models lay the foundations for the priming manipulation in the second study (Study 2).

Study 2 elaborates on the idea that the couple of incentives, 'care for environment' and 'sense of duty', may affect participants' recycling behavior if appropriately primed. We choose those semantic primes that are most closely related to the stereotypes of the Environmentalist and the Conscientious Citizen. Study 2 tests two hypotheses on three separate groups of participants: one group is the control group; the second group is exposed to the Environmentalist stereotype; the third to the Conscientious Citizen stereotype. All participants are not allowed to observe the recycling behavior of other participants except for the third group, whose choice is transparent. The two hypotheses are the following:

- *Hypothesis 1 - commitment:* The injunctive social norm based on the Environmentalist stereotype and the descriptive social norm based on the Conscientious Citizen stereotype have both a substantial positive effect on the recycling behavior of participants: their commitment to recycle is strengthened.
- *Hypothesis 2 - attention:* The injunctive social norm based on the Environmentalist stereotype and the descriptive social norm based on the Conscientious Citizen have both a substantial positive effect on the level of attention and carefulness in the recycling behavior: the proportion of misplaced recyclable items is lower.

The average level of commitment for each group is measured by calculating the proportion over total students of the sum of those students who drop the recyclable materials (i.e. paper and plastic) in the correct recycling bins (i.e. paper in the recycling bin for paper; plastic in the recycling bin for plastic) plus those who do not separate but drop the recyclable materials in one of the correct recycling bin (i.e. paper and plastic together in the recycling bin for paper or paper and plastic together in the recycling bin for plastic). This ratio should be compared to the expected recycling rate of a group of Austrian, young and educated individuals. Although this specific recycling rate is not available

and we used the control group as a benchmark, one should notice that in 2013 Austria reached the highest recycling rate (63 percent) among the EU countries. The level of attention of each participant is measured by the ratio of students who drop the recyclable materials (i.e. paper and plastic) in the proper recycling bins (i.e. paper in the recycling bin for paper; plastic in the recycling bin for plastic) over the number of students committed to recycling. This ratio is compared to the benchmark of the population provided by the control group.

STUDY 1

We utilize the Word Association Test (WAT) in order to retrieve the participants' associative word structures induced by the two types of incentives/stereotypes.

The term association is used in psycholinguistics to refer to the connections or relations between ideas, concepts, or words that exist in the human mind (Sinopalnikova, 2004; Benthin, Slovic, Moran, Severson, Mertz & Gerrard, 1995; Slovic, Flynn & Layman, 1991). WAT, which was proposed for the first time by F. Galton, is a technique to test these associations. It has been widely used in psychology by prominent psychiatrists such as C. Jung, G. H. Kent and A. J. Rosanoff. The first large-scale study featuring the WAT goes back to 1910 and was carried out in England by Kent & Rosanoff (1910) with 1,000 men and women. They used 100 probe words and read one word at a time to a person who was to return the first word that comes into her mind. After analyzing the data, the authors claim that there exists uniformity in the organization of associations and that individuals shared stable networks of connections among words. More recently, Bahar and Hansell (2000) discuss the WAT as one of the commonest and oldest methods for investigating cognitive structures and report its importance in the work of numerous researchers.

The underlying critical assumption in a word association test is that the order of the response retrieval from long-term memory reflects at least a significant part of the structure within and between concepts. In a word association test, the

degree of overlap of response hierarchies is a measure of the semantic proximity of the stimulus words.

If the assumption holds, the WAT is a powerful psychological instrument to identify the associative meaning of a semantic stimulus. Word association displays the respondent's feeling of "what goes with what": the structure of human situational working memory, a sort of user-driven Thesaurus. The semantic stimulus creates clusters of associated response words that reveal the respondent's unconscious and conscious understanding of the stimulus. In accordance with the pioneering study of Kent & Rosanoff, conventional WATs include a series of words presented to individual respondents. For each word, participants are instructed to respond with the first word that comes to mind. Freud believes that such responses provide clues to peoples' personalities; cognitive psychologists, more simply, use this procedure to investigate how semantic information is stored in memory.

Several studies have demonstrated that word associations are almost always based on a word's meaning, as opposed to its physical, e.g. phonetic, properties. For example, a typical response to the word 'knife' might be 'fork' or perhaps 'spoon', but not 'wife' or 'life'. Over the years, psychologists have collected extensive data about the relative frequencies with which various responses are given to different words and are able to measure the associative strength between a vast number of couples of words. Several methodologies to measure the associative power of a couple of words have been devised. For example, if 90 percent of the members of a group respond with the word 'nurse' when given the word 'doctor', this number (90) becomes the index of the associative power of the words 'doctor' and 'nurse'. An alternative way of measuring the associative power of a word on another word consists of measuring the time the subject takes, in a WAT, from the moment that the stimulus-word is given to the moment the response-word is generated. Most of the times the relative scales of the two measures coincide: frequency and reaction time design very similar maps.

Our experiment is conceived to take into account three possible complications. The first complication arises when the majority of the association-words are paradigmatic verbal responses, i.e. responses that are in the same grammatical class and that may surface for example through affinity of meaning or common affixes. The second complication refers to the number of association-words: a too large number would be dispersive; a too small number would not be enough informative. We assign to each incentive/stereotype a list of approximately 20 words. The third complication is due to the generalization of those associations experienced by individuals at an earlier stage. This generalization is the result of the need to render information processing and decision-making more manageable, especially in uncertain circumstances (Zebrowitz, 1990). This approach often leads to correct interpretations of stimuli but in particular circumstances it can lead to errors due to the scarcity of information or to the overgeneralization of previous associations (Zebrowitz & Collins, 1997). These cautions are particularly necessary when the association test is a stepping stone to designing an effective priming manipulation experiment: not only did we double-check that our association-words are not too general, or so specific to trigger past association experiences, but we also attempted a rigorous categorization of the associative words.

Subjects and design

160 Italian undergraduate students took part in the experiment. The gender distribution is 67 percent female students and 33 percent male students, aged 20 to 37 years. We intentionally selected only Italian native-speakers students. One of the main findings of Read's (1993) research on word association tests is that native speakers show remarkably stable patterns. This evidence reflects the sophisticated lexical and semantic networks that the subject has been developing during her systematic, natural acquisition of the language (Read, 1993). On the other hand, second-language learners construct associations that are much more diverse and unstable; often their responses are based on links to the stimulus words that are purely phonological, rather than semantic.

Procedure

The data collection procedure was designed and executed to minimize the participants' bias. The experiment took place in a familiar setting right after a lecture class. The subjects were divided into two equal groups: each student was given a single sheet of paper: for half of the sheet 'Environment' was the header at the top of the page, for the other half the header was the word 'Duty'.

Students were asked to fill each column with as many words as possible - we suggested twenty words - that would come to their mind when reading the word Environment and the word Duty. The subjects were also verbally instructed to complete the task as quickly as possible and to not indulge in thinking about the meaning of the headers. In addition to this verbal recommendation, to prevent overthinking about the meaning of the stimuli, the students were given a time frame of less than five minutes to complete each header.

Methodology

The participants' associative words collected for each of the two semantic stimuli (Duty and Environment) are arranged using semantic mapping. Semantic mapping are graphic organizers of a network of words. The ultimate purpose of creating a semantic map is to visually display the meaning-based connections between a word or phrase and a set of related words or phrases (Leydesdorff & Welbers, 2011).

The schematic relations portrayed by the semantic maps compose a concept. The same concept can be composed by multiple relations with different types of knowledge associated. For any concept there are at least these three types of associations:

- association of class -- the order of things the concept falls into;
- association of property -- the attributes that define the concept;
- association of example -- the examples of the concept.

For instance, Pearson and Johnson analyze the concept of "federal". First, in terms of association of class, notice that a federation belongs to the class of things called 'forms of government.' It is one of many such forms, including

monarchy, patriarchy, plutocracy, etc. Second, the properties of a federation include for example the uniting common interests of various political units or the division of the legislative, judicial, and executive power of a government among subunits. Third, examples of the federal form of government include the governments of the United States, Canada, and Australia (Pearson & Johnson, 1978).

The findings of semantic mapping of Study 1 allow us to acquire the key associations to the concepts of Duty and Environment; to map them; to have an immediate visual feedback of the path and intensity of such associations; and finally, to categorize these associations according to their specific nature (class-property-example).

The findings

We have gathered a total number of 737 associative words for the semantic stimulus Environment and 547 words for the stimulus Duty. We have counted some words as one single item when the same meaning is definitely implied but a different grammatical form is used: for example, verb-noun (*assumere-assunzione*), singular-plural (*amico-amici*), synonyms (*papà-padre*). The average appearance of the gathered words is 3.2 for the environmental stimulus with standard deviation of 4.9; the average is 4.0 for the civic stimulus with a standard deviation of 5.1. The range for the environmental stimulus is 1-57, for the civic stimulus is 1-43, the most frequent words are shown in Table 1.

Table 1: The most frequent words for Environment and Duty stimuli

<i>Ambiente</i>		<i>Dovere</i>	
Natura	57	Evitare	43
Casa	39	Parola	39
Albero	34	Criticare	31
Famiglia	32	Limiti	31
Verde	30	Dovere	30
Mare	29	Cittadinanza	28
Animali	24	Diritto	25
Pulizia	24	Spinto	24
Apertura	23	Gioco	23
Inquinato	23	Governo	22
Lavoro	23	Lavoro	20
Aria	21	Piacevole	20
Montagne	21	Prigione	20
Rispetto	20		

The average number of answers for each participant in the case of the environmental stimulus is 29 with a maximum of 39 words and a minimum of 19; 27 words is the average reported by subjects with the civic header, with a maximum of 36 words and a minimum of 15.

Social Network Analysis (SNA) has been used as a tool to analyze both groups of words. SNA describes the relationships and flows between nodes. The gathered words are the nodes in the network, while the links show direct and mediated relationships or flows between words. SNA provides both a visual and a mathematical analysis of associative relationships. The mathematical analysis involves three major steps: firstly we consider the frequency of the occurrences of words in the participants' responses. Secondly, based on the frequency of words, the asymmetric word matrix is generated and transformed into the co-occurrence matrix. In the asymmetric word matrix the rows represent the source of directed ties and the columns the targets. The matrix is 'asymmetric' because it represents directed links, links that go from a source to a receiver; that is, the element ij does not necessarily equal the element ji . Word co-occurrence statistics describe how words link together, one may think of these statistics as a GPS system to move from one node word to a target, and in turn capture the

relationships between words. Thirdly, measures of collocational strength have also been computed: collocational statistics quantify the power of attraction or repulsion of a node-word towards other nodes. Node words tend to attract some other words that occur close to the node with greater than chance probability; similarly they repel other nodes, which occur close to the original word with less than chance probability. Finally, the resulting matrix is arranged using the Fruchterman-Reingold layout (1991) and visualized with the 'R' package igraph (Fruchterman & Reingold, 1991).

The results of the SNA have two families of implications. The former allows us to assign a 'weight' to each word. This weight does not include only the frequency of occurrence but expresses also the power of attraction and repulsion of any node. This additional information is necessary to have a more precise calculation of the total association impact of a triplet of words (see Study 2 below). The latter family of implications allows us to identify a number of clusters, i.e. groups of words occurring closely together. These clusters of associative words can be considered as an indication of the respondents' unconscious/conscious understanding of the relevance and relationship of an explicit group of words. Clusters expose the respondents' feeling of "what goes with what", it is the structure of our situational, working memory (Kiss, 1975). The hypothesis is that, given such relationships, clusters can be used to form a user-driven thesaurus structure. Therefore, our clusters decipher the students' active mental models and lay the foundations for an effective priming manipulation aimed at encouraging recycling. Figure 1 and Figure 2 show two images where some of the most salient clusters can be spotted; Figure 1 refers to the environment header and Figure 2 to the duty header.

Figure 1: SNA output for Environment stimulus

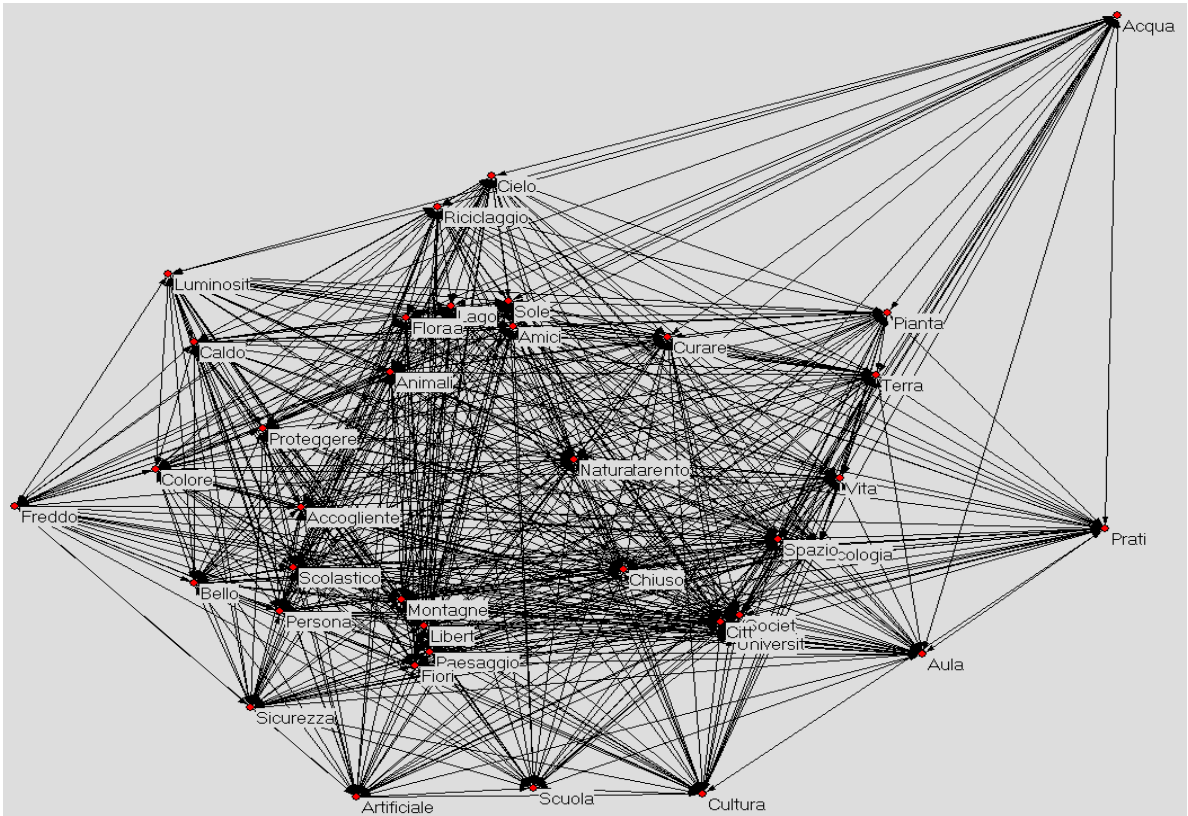
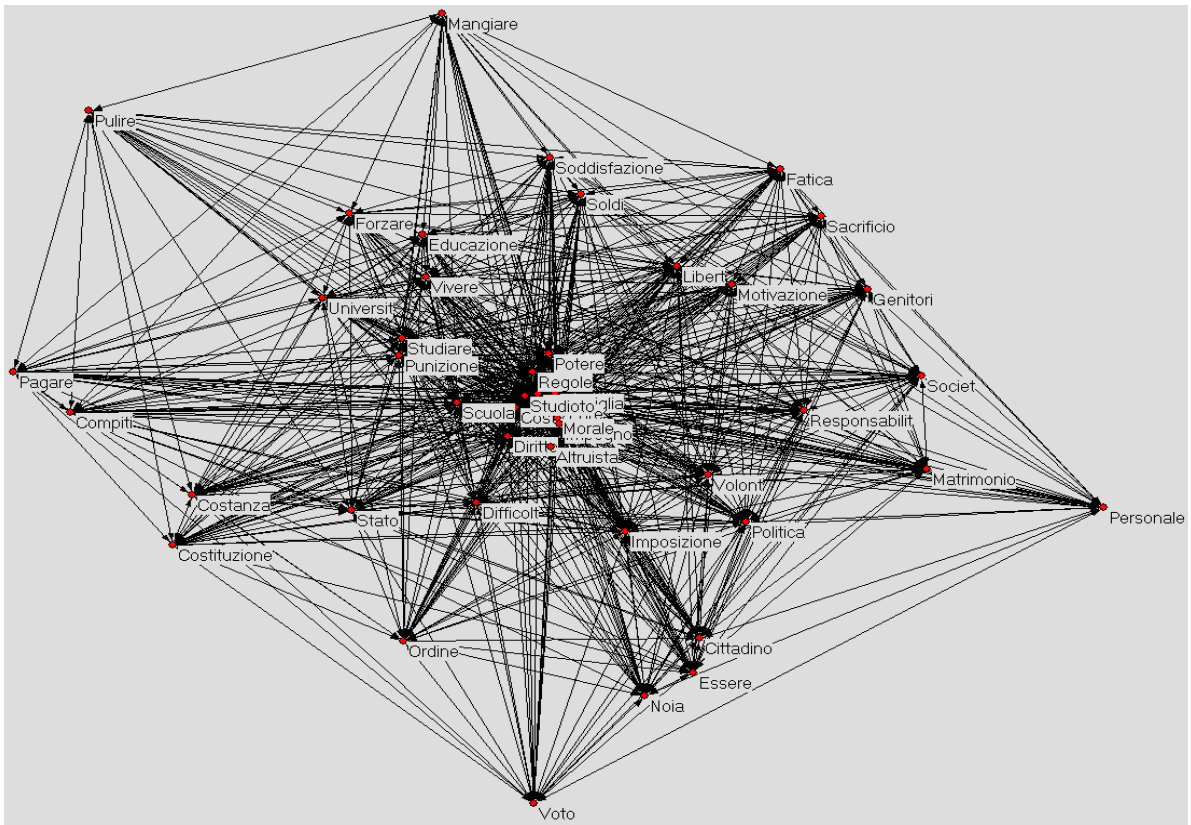


Figure 2: SNA output for Duty stimulus



Classification of collected associative words

The priming manipulation experiment that is the subject of Study 2 necessitates a thorough, formal categorization of the associative words emerging from the network analysis. We intend to investigate what are the categories that better evoke the selected stereotypes in our specific sample.

We offer two types of categorizations. One possible categorization is based on Kess (1992) and Read (1993) and identifies two general criteria. The first criterion refers to the paradigmatic relation between the responses (the signifiers) and the stereotype (the absent signifier): for our purposes the basic difference between synonyms and antonyms (Read, 1993) is not really significant. The second criterion refers to syntagmatic relation between the responses (the signifiers) and the stereotype (the absent signifier) and organizes the cognitive categories into a taxonomy with three levels. Attributes such as class inclusion and degree of specificity translate into a superordinate level (dog-animal), a basic level (dog-friend) and a subordinate level (dog-retriever). The table below presents for each of the stereotypes a tentative classification along the second criterion (Kess, 1992) (see Table 2).

Table 2: Syntagmatic classification of associative words

<i>Taxonomy</i>					
<i>Environment Stimulus (%)</i>			<i>Duty Stimulus (%)</i>		
Superordinate	Basic	Subordinate	Superordinate	Basic	Subordinate
0	55	45	45	28	27

Alternatively, words can be classified according to the nature of the association mentioned above (see Table 3).

Table 3: Association classification of associative words

<i>Type of association</i>					
<i>Environment Stimulus (%)</i>			<i>Duty Stimulus (%)</i>		
Class	Property	Example	Class	Property	Example
30	40	30	40	27	33

DISCUSSION

The findings of Study 1 can be read at three levels - a general level and two levels specific to the two stimuli – and must be interpreted taking into consideration the nature of the population sample, Italian students.

The first set of conclusions one can draw from Study 1 is a sense of the extension of the concepts of Environment and Duty. The concept of Environment seems richer in associative words than the concept of Duty. However, at a closer look at the nature of the ten most frequent words, which cover respectively 43 and 54 percent, the concept of duty seems less articulate but more segmented in meanings. This is confirmed by the mostly positive meaning of the first ten associative words of environment and the mixed meanings, positive and negative, of Duty, e.g. both *evitare* (to avoid) and *gioco* (game) appear.

In terms of the shape of the frequency distribution, the two stereotypes do not show substantial differences: the average occurrence is around 4 for both stimuli and the dispersions around the mean are similar.

In the graphical and mathematical analysis of SNA, a well-defined cluster stands out in both stimuli. It is the cluster related to the concept of education. This is obviously the result of the location of the experiment and of the sample tested. The associative words belonging to this cluster, e.g. university, classroom, school, study, have different implications for the two stimuli. In the case of Environment we treat this cluster as a cognitive bias and do not consider it forward, while in the case of Duty, the same words can be treated as a student customized semantic priming technique. Another smaller cluster can be recognized around the associative word ‘society’ for both stimuli. The presence of these clusters confirms the idea that social norms play

a, most likely subconscious, role in the formation of both stereotypes and therefore it becomes one of the major tools for Study 2. Further research could be conducted to understand whether the difference in the words of the two clusters reflects the difference of the nature of the two types of social norms in action: descriptive norms for Duty, injunctive norms for Environment.

A third cluster revolves around the word 'moral/morality'. The same idea of moral behavior takes up different perspectives according to the stimulus used. In the case of Duty, the concept of morality is linked to a more formal and exterior idea of justice, for example 'govern', 'law', 'constitution'. On the opposite side, the concept of morality in the case of Environment is more the result of personal choice and lifestyle, for example the prefixes 'eco-' and 'bio-'. More generally, the associative words of Environment are more philosophical and abstract than those of Duty.

Interestingly enough, the words linked to the concept of nature, ecology or recycling are not mentioned in the associative words of Duty. We assume that this is due to the context of the experiment: the act of recycling is not salient. However, in Study 2 we are going to test whether the mediation of concepts such as social norms and morality is enough for the idea of duty to influence the recycling behavior. Not surprisingly, the concepts of nature, ecology and recycling are kindled by the idea of Environment.

We left the meaning of the header Environment quite open: it seems that the majority of students interpreted the word as intended by the experimenters: the word 'nature' is by far the dominant associative word, and more generally a significant number of associative words point to the living world. Two main feelings seem to emerge among the students: on the one hand the anxiety connected to the frailty of nature and its need for protection (safety, recycling, cure, et cetera); on the other, the feeling of peace brought by the beauties of nature (landscapes, animals, flowers, et cetera).

The header Duty can be interpreted by an even higher number of perspectives. We have already mentioned the difference between an internal, moral duty and an external, civic duty, where, generally speaking, the former implies a choice and the latter an obligation. We notice the use of a high proportion of verbs in the infinite

form: this suggests the requirement for action included in the idea of duty. As far as the source of external Duty, it is equally divided between the legal system and family relations.

Finally, our analysis of the associative words is complemented by a categorization along two dimensions: a syntagmatic taxonomy and class of association. The taxonomy of associative words reveals that the environment is perceived as the ultimate dimension of reality: no superordinate words have been reported. On the contrary, the concept of Duty seems to be a notion subordinated to a number of sources or of abstract ideas, e.g. freedom, friendship, et cetera. The prevalence of subordinate words confirms that descriptive social norms may have a key role in conditioning human behavior, especially when such behavior is not internalized, as it is the case for recycling.

The associations generated by the two semantic stimuli are almost equally distributed among the three identified types of quality: class, property, and example. Although the evidence is not overwhelming, for Environment most analogies happen to be based on a set of properties, consistently with the capacity of nature to generate emotions. It is therefore a more automatic cognitive process. For the concept of Duty, the distribution is less uniform: the belonging to a certain class and the abundance of examples seem to be the dominant correspondences. The origin of certain duty (class) and its consequences (example) seems to respond to a more intense mental effort, a more conscious cognitive process.

STUDY 2

Stereotypes introduce a permanent source of bias that materializes at the time of judgment. It is almost unanimously accepted that the exposure of a person to another person who is a member of a recognized social category activates the associated stereotype automatically/unconsciously (Bargh, 1999). The stereotype is then used to fill in the missing information about the target person and to interpret

her behaviors. For instance, a well-known experiment of 1990 by Purdue and Gurtman examines the acknowledged associations among college-aged participants between certain negative traits and old age: it shows how these associations exhibit an 'automatic' component. When participants to an experiment are subliminally primed with the word 'old', they recognize in a target the negative traits of old age significantly faster than when they are subliminally primed with the adjective 'young'. Similar studies on the stereotypes related to age confirm the conclusions of Perdue (Perdue, et al., 1990). Many different studies have shown that the use of a stereotype, even in an earlier or unrelated situation and as long as it is carried over for a time long enough to exert an unintended, passive influence, conditions the interpretation of a certain behavior (Horton et al., 2007; Bargh, Chen & Burrows, 1996; Higgins, 1989).

The theory we rely on to explain how various stereotypes work is the Social Identity Theory (SIT). It is an alternative theoretical framework that assumes that different stereotypes may work differently depending on the characteristics of the reference group that the subject belongs to. According to this theory, "psychological group membership has primarily a perceptual or cognitive basis" (Turner, 1999). The mental construct of social identity is built on the existence of a relation with a defined category of people and defines who we are in terms of similarities and differences; it also provides the grounds for shared social action. The majority of studies on social norms attribute their effectiveness to the 'right' identification of a reference group: in order to maximize the effect of social identity on recycling behavior, we must make sure that not only the targeted social identity is conspicuous but also that the norms referring to that identity are known and salient (Goldstein, Cialdini & Griskevicius, 2008).

These theoretical foundations persuade us that the chain 'intrinsic/extrinsic incentive-stereotype-priming' is a strategy to influence the recipient's recycling behavior that is worth investigating further.

METHOD

Subjects and Design

To compose an experiment with three samples of 54 subjects, a total of 165 participants from Vienna University had to be recruited: 3 participants did not follow the instructions they were given and did not dispose of the cups and kept them. The nationality of most respondents is Austrian. The recruitment occurred by email notification for the majority of participants; those who did not participate following the email invitation were passer-by in the main hall of the university.

The incentive for participating in the experiment was to venture in a lottery where there was a chance of 5 percent to win 20 euros. All participants were told that the experiment was about a blind taste test to evaluate an orange juice. In addition, the participants exposed to the priming manipulation were said to be involved also in a language ability test.

The composition of the sample is 56 percent female and 44 percent male participants; the average age is 22 years and the range between 18 and 40 years.

Procedure

The laboratory accommodates up to 10 students and a number of successive rounds of experiment were taken during one single day. Each round was randomly assigned either one of the two priming conditions – ‘Environmentalism’ and ‘Conscientious Citizen’ stereotypes - or the control group, while the last rounds were designed to achieve a total of 54 usable participants for each condition.

A Scrambled Sentence Test was submitted only to the participants of the two primed groups, while a taste test form and the cup of juice was handed out to all participants. The juice was given in a paper cup with a plastic lid. The color of the cup was black and the plastic lid was grey for all three groups: any possible priming effect due to different colors can therefore be disregarded.

Students were not instructed to dispose of the cup and lid and no particular instructions or details about where and how to drop them were given.

Students were invited to respect the following order: filling the Scrambled Test, if any, drinking the juice, and finally filling the taste test.

The effect of social norms is made observable by allowing the participants to the group primed with the environmental stimulus and to the control group to leave the laboratory room as soon as they had finished filling out the taste test. Instead the participants to the group primed with duty stimulus were asked to wait until the slowest participant had finished her taste test, when all together could leave the room.

The Scrambled Sentence Test consists of 30 collections of words, each collection composed of a number of words including three semantic stimuli, i.e. three 'key words'. The key words were chosen among those suggested by an exact replica of Study 1, which was conducted in Austria at Vienna University, in the German language (see Appendix A and Appendix B). The resulting words are slightly different between the two studies, to reflect the peculiarities of the two cultures and languages. The importance to have a replica of Study 1 in German is confirmed by the difference of the most frequent word associated to the concept of duty in each experiment: in the Italian experiment it has a negative meaning (*evitare* = to avoid/dodge), while in the Austrian experiment, it has a positive meaning (*verantwortung* = responsibility) (see Table 4).

Table 4: The most frequent associative words for each stimulus

<i>Pflicht - Duty stimulus</i>		
<i>German associative words</i>	<i>English translation</i>	<i>Frequency</i>
Verantwortung/verantwortlich	Responsibility	46
Schule/Volkschule	School	34
Arbeit/arbeiten	Work	32
Müssen/muss/etwas tun zu müssen/etw. muss gemacht werden	Have to	24
Pflichtbewusstsein/Bewusstsein/bewusst/bewusstes Handeln	Consciousness	19
Uni/Universität/Studium/Studium beenden/studieren	University	19
Lernen	Study	18
Verpflichtung/Pflichtgefühl/Schulpflicht/Gefühl	Commitment	16

<i>Umwelt - Environment stimulus</i>		
<i>German associative words</i>	<i>English translation</i>	<i>Frequency</i>
Natur	Nature	72
Nachhaltigkeit/nachhaltig/nachhaltig wirtschaften	Sustainability	38
Schutz/Umweltschutz/Klimaschutz/schützen	Protection	38
Wald/Regenwald/Baum/Bäume	Forest	38
Schmutz/Verschmutzung/Umweltverschmutzung	Dirt	37
Grün	Green	30

The key words are allocated to the 30 collections according to a thoughtful mix of three criteria. A) The frequency of occurrence. B) The weight of each word as defined in Study 1. The sum of the weights of the key words is approximately equal for each collection: low-frequency words with heavy weight may pair up with other low-frequency/heavy weight words and generate an impactful triplet. C) The belonging of each word to a specific cluster. This process of forming the triplets is by nature a discretionary process, although it is informed by the inputs collected in two separate runs of the WAT, one in Italy and one in Austria.

The subject was required to use all or some of the words of the collection and construct a grammatically correct and meaningful sentence, as quickly as possible. The two Scrambled Sentence tests differ only for the choice of the key words: 90 words intended to prime an environmental attitude, 90 intended to prime civic awareness.

The taste test form consists of four questions on the taste, texture, smell and overall attributes of the juice, to be evaluated using a Likert-type scale ranging from 1 to 10.

After the participants' completion of the tasks, two experimenters observed the recycling performance of each subject. More specifically, the set-up of the experiment gives each subject two courses of action: the former is to drop the cup and the plastic lid together in a undifferentiated bin, which was intentionally positioned inside the laboratory and close to the entrance, in a visible place. The latter course of action is to walk approximately ten meters to reach three recycling bins - paper, plastic and aluminum - which were also situated in a visible place but outside of the laboratory room. Students who had decided to walk to the recycling bins had two choices: either recycling properly and separate plastic from paper; or dropping the plastic lid with the paper cup together into one of the two recycling trash bins. Additionally to make sure that students noted the recycling bins, before the beginning of the experiment all participants were forced to wait standing in the vicinity of the recycling bins for approximately three minutes. The design of the experiment aims at replicating the marginal additional effort that households have to put to recycle their waste:

1. The subject has to walk a certain distance to reach the recycling bins, which may or may not be close to the bin dedicated to undifferentiated trash.
2. The subject has to undertake:
 - 2.1 a mental effort to figure out the recyclable materials and control the recycling process;
 - 2.2 a physical effort to separate her garbage as most retail packaging includes more than one recyclable material.
3. Recycling may require an unpleasant physical contact with filthy items.

RESULTS

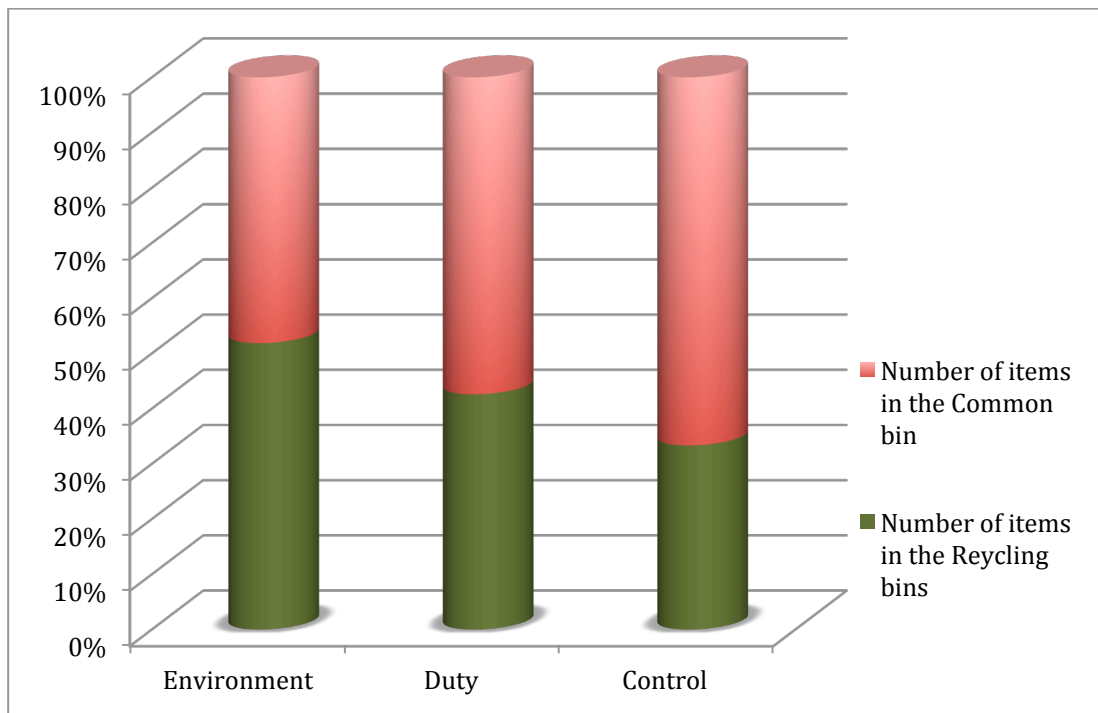
The conclusion that can be inferred from of Study 2 are divided into two sections. The first section focuses on the effect of the priming manipulation on the level of commitment to recycle. To this purpose, we are allowed to group those who recycle correctly and incorrectly: we consider those students who leave the room with the intention to reach the recycling bins as equally motivated. The second section

investigates the reasons for recycling incorrectly. We assume that all participants approaching the recycling bins have an unambiguous intention to recycle: we attribute their mistakes to a lack of attention.

Thus, the discrete numerical data measuring the priming effect of the words contained in the Scrambled Sentence Test on the intention/commitment to recycle are analyzed using a 2×2 Chi-Square test: correctly and incorrectly recycled items versus non-recycled items in each of the two primed conditions. The results reveal a positive priming effect in the case of the environmental priming (51.9 percent show an intention to recycle versus 33.3 percent of the control group) and a positive effect also in the case of the civic awareness priming (42.6 percent show an intention to recycle versus 33.3 percent of the control group).

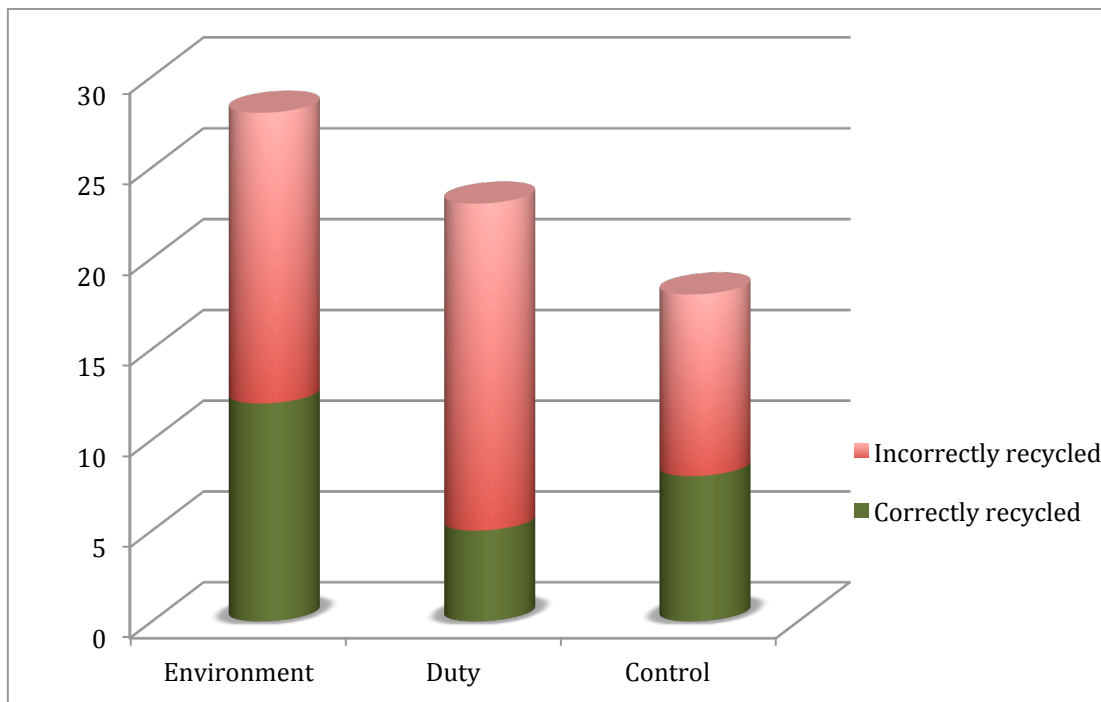
These results are consistent with our expectations. Hypothesis 1 of this study, i.e. the commitment to recycle is strengthened by the two priming techniques, is accepted at a 90 percent significance level for the stimulus Environment is $\chi^2(1)=3.787$; $p=0.052$, while for the stimulus Duty it is not statistically significant is $\chi^2(1)=0.983$; $p=0.321$.

Figure 3: Amount of recycled items vs. amount of non- recycled items



The priming effect of the words contained in the Scrambled Sentence Test on the intensity of the intention to recycle is analyzed using a 2×2 Chi-Square test: correctly recycled items versus non-correctly recycled items in each of the three conditions. The results of intensity to recycle are not statistically significant: for the stimulus Environment is $\chi^2(1)=0.011$; $p=0.915$, while for the stimulus Duty is $\chi^2(1)=2.404$; $p=0.121$. The marginal effect of the priming manipulation is evaluated considering the control group as a proxy of the physiological error for the whole population. The results reveal a trivial negative effect in the case of the environmental priming (42.8 percent of the participants who intend to recycle do it correctly versus 44.4 percent for the control group) and a substantial negative effect in the case of the civic awareness priming (21.7 percent of the participants who intend to recycle do it correctly versus 44.4 percent for the control group). These results are not consistent with our expectations. Hypothesis 2 of this study, i.e. the intensity of the commitment to recycle is strengthened by the two priming techniques, is rejected for both the stimulus Environment and for the stimulus Duty.

Figure 4: Number of items dropped in the correct bin versus non-correct bin



DISCUSSION

Study 2 offers two groups of findings: the first refers to the commitment to recycle and the second to the strength of that same commitment to recycle. The presence of three conditions and, for each condition, of three observations of recycling behavior, generates a matrix of nine possible combinations. In spite of a fair size of the whole sample, the large number of possible combinations reduces the number of observations in each element and weakens the scope of the findings and their statistical significance. We have to limit ourselves to analyze the directions of the priming effects.

The first group of findings can be summed up in four points:

1. The effect of the priming manipulation based on the selected stereotypes on the intention to recycle is positive, as suggested by Hypothesis 1. 51.9 percent of the Environmentalist primed subjects show an intention to recycle, 42.6 percent for the Conscientious Citizen primed subjects, 33.3 percent for the control group. These results confirm the possibility to bridge the above-mentioned intention-action gap in recycling behavior through an appropriate semantic priming technique.
2. In absolute terms, the results of the experiment are lower for all three conditions than the benchmark of Austrian population (63 percent). We cannot say whether this is a result of the characteristics of the sample and/or the structural limitations of a laboratory experiment.
3. The effect of priming manipulation induced by the idea of nature is more powerful than the manipulation induced by the idea of civic duty (10 percent difference).
4. The effect of the descriptive social norms cannot be observed. The design of the experiment is based on the assumption that the control group, and consequently the Conscientious Citizen primed group, would perform a recycling behavior in line with the average Austrian citizen. Unfortunately we observe a recycling ratio much lower than expected for both groups and close to the probability of chance. This means that descriptive social norms may cancel out as subjects observe random recycling behaviors and there is no leader among the participants.

The second group of findings is not statistically significant and seem to reject Hypothesis 2. We assume a physiological error in dropping the recyclable materials in the correct bins equal to the one observed for the control group (55.6 percent), which is abnormally high. Our experimental results show an error ratio, i.e. the rate of incorrectly recycled materials over total recycled materials, higher than the benchmark: 57.2 percent for the Environmentalist, 78.3 percent for the Conscientious Citizen. The remarkable difference for the priming based on the sense of civic duty is likely to be the result of social norms. In this case, the observed behavior of fellow students reflects a spread lack of attention and carefulness.

A possible explanation for the extremely high error ratio in all three conditions is the increased dominance of System 1 over System 2. This special cognitive attitude may be caused by the combination of the characteristics of the university's premises and its neighborhood and the type of cups and lids used in the experiment. The cups and lids were similar to the ones used in most of the cafes where students of Vienna University spend their time between classes: the proportion of these cafes offering recycling bins is extremely low and certainly much lower than the average Viennese café. Students may have developed a habit to dispose of their coffee cups in one single gesture.

The combination of the two groups of findings seems to conflict with the extended literature about littering and social norms, about recycling behavior and non-monetary incentives.

The results do not reveal any decisive causal inference between priming based on the Environmentalist stereotype and recycling behavior. In a more conclusive way, we observe the null impact of priming based on the Conscientious Citizen stereotype on recycling behavior; as a matter of fact this priming reduces the level of mental effort once the decision of recycling has been taken.

As a word of caution, these conclusions assume that the priming technique is effective and the process of selecting the verbal stimuli performed in Study 1 is uncritically accepted: the 90 words used in the WAT may not work as expected. Before rejecting the hypothesis that the Environmentalist and the Conscientious Citizen stereotype are useful conceptual stimuli for priming a virtuous recycling

behavior, we recommend to expand the present research in two directions: a) using a different tool for selecting semantic stimuli; b) testing the transition from solely semantic stimuli to conceptual stimuli.

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Appendix A

Thirty collections of 'key words' chosen for stereotype Environmentalist in the Scrambled Sentence Test.

<i>'Umwelt'</i>			
1.	Natur	Leben	Klimawandel
2.	Nachhaltigkeit	Klima	Leben
3.	Tiere	Ressourcen	Wald
4.	Pflanzen	Ökosystem	Natur
5.	Klimawandel	Schmutz	Natur
6.	Schmutz	Grün	Wald
7.	Tiere	Schmutz	Zerstörung
8.	Erderwärmung	Nachhaltigkeit	Verschmutzung
9.	sauber	Natur	Nachhaltigkeit
10.	Ressourcen	Sauber	Tiere
11.	Grün	Klimawandel	CO2
12.	Natur	Gefährdet	Ressourcen
13.	Natur	Menschen	Nachhaltigkeit
14.	Klima	Leben	Tiere
15.	Grün	Ressourcen	Ökosystem
16.	Schutz	Leben	Klimawandel
17.	Natur	Nachhaltigkeit	Schutz
18.	Nachhaltigkeit	CO2	Pflanzen
19.	Pflanzen	Klimawandel	Zerstörung
20.	Wald	Schmutz	Grün
21.	Grün	Leben	Sauber
22.	Pflanzen	Ökosystem	Leben
23.	Nachhaltigkeit	Schutz	Wald
24.	Schutz	Schmutz	Nachhaltigkeit
25.	Ökosystem	Grün	Schmutz
26.	Schutz	Wald	Schmutz
27.	Leben	Abgase	Klima
28.	Abgase	Ökosystem	Pflanzen
29.	Natur	Abgase	Sauber
30.	Zerstörung	Leben	Grün

Appendix B

Thirty collections of 'key words' chosen for stereotype Conscientious Citizen in the Scrambled Sentence Test.

<i>'Pflicht'</i>			
1.	Disziplin	Müssen	Verantwortung
2.	Regel	Erfüllen	Erfolg
3.	Grundwehrdienst	Stress	Zwang
4.	Gesetz	Verpflichtung	Arbeit
5.	Aufgaben	Zwang	Uni
6.	Recht	Aufgaben	Verantwortung
7.	Grundwehrdienst	Disziplin	Aufgaben
8.	Müssen	Lernen	Arbeit
9.	Bewusstsein	Verantwortung	Regel
10.	Gesetz	Schule	Stress
11.	Disziplin	Verpflichtung	Müssen
12.	Regel	Notwendig	Müssen
13.	Unangenehme	Erfüllen	Verantwortung
14.	Gesetz	Lernen	Erfüllen
15.	Uni	Unangenehm	Müssen
16.	Disziplin	Erfüllen	Recht
17.	Schule	Arbeit	Pflichtbewusstsein
18.	Pflichtbewusstsein	Disziplin	Unangenehm
19.	Schule	Verpflichtung	Verantwortung
20.	Unangenehm	Lernen	Müssen
21.	Arbeit	Grundwehrdienst	Gesetz
22.	Zwang	Aufgaben	Stress
23.	Stress	Schule	Pflichtbewusstsein
24.	Disziplin	Stress	Gesetz
25.	Schule	Uni	Lernen
26.	Müssen	Familie	Bewusstsein
27.	Erfüllen	Schule	Verantwortung
28.	Verpflichtung	Stress	Gesetz
29.	Grundwehrdienst	Stress	Helfen
30.	Pflicht	Recht	Verantwortung

Article 2

The Effect of Contextual Priming on Recycling: Two Stimuli

INTRODUCTION

The Waste Problem

The waste problem has become one of the most daunting issues of our time. Its impact extends well beyond the imbalance between limited natural resources and human material demand; it has a negative effect on public health and pollutes the environment. The World Bank provides a quantitative overview of the magnitude of the problem: each year 1.3 billion tons of waste are produced worldwide and that number is expected to soar to 4 billion tons by 2100, due to demographic dynamics, urbanization and rising consumption. WasteZero, one of the largest waste reduction companies in the U.S., calculates that “about US \$200 billion a year is spent on solid waste management and lost energy resources from disposing trash” (WasteZero, 2015).

Governments, especially in the developed nations, are aware of the waste problem and they have implemented a large amount of regulations and public policies. Collection and disposal are critical issues, but changing people’s behavior so that societies are encouraged to reduce and recycle waste is also crucial. While household recycling activity has increased in recent years, the amount of trash produced has increased as well, and at a faster rate. Even though politicians have set higher and higher goals, the recycling rate in the developed countries has been stagnating in recent years. Households do not perceive the waste problem as serious as other ecological catastrophes our earth has been experiencing. For example, rarely the recycling problem is at the top of daily news, and if you are not an environmentalist you probably have never paid attention how many plastic bags you use during an ordinary day.

There are a number of perfectly rational reasons for this attitude. We offer the hypothesis of hyperbolic discounting. The so-called hyperbolic discounting is the tendency of humans to discount the future at a high rate: people tend to choose an increasingly smaller reward over a larger reward as delay occurs. For example, the time we gain by throwing a paper napkin and a plastic plate in a common trash bin is valued more than the extra work we will have to do to deal with the waste problem, including the financial cost we will have to pay for it. Hyperbolic discounting, applied to a number of situational factors, such as the time we need to spend cleaning and separating trash, acquiring knowledge about what can be recycled and what can not, coping with inefficient recycling systems in our neighborhood, determines the recycling routine we have been observing in the last few years, which has produced stagnating recycling rates (Ainslie & Haslam, 1992). Other reasons of the household attitude towards the recycling problem are not so rational. Behavioral economics brings a new perspective to the recycling problem. Recycling is not just an economic, educational, or political problem – it also has a psychological content that cannot be underestimated. We believe that the psychological content in the recycling behavior is one of the most solid explanations for the intention-action gap revealed by the EU citizens' answers contained in the European Commission report 'Attitudes of European Citizen towards the Environment' (April, 2014) and actual recycling performance. According to the report, the majority of the EU population (54 percent) think that "sorting the waste so it can be recycled" is the top priority among the daily activities that can contribute to protect environment. In 2011 the answers to the same question reflected a larger majority (59 percent), but the EU citizens' perception of the importance of recycling remains nonetheless significant. Even more unexpectedly, in another section of the same report, 72 percent of the EU citizens declare that they had sorted most of their domestic waste during the past month; 8 percent more than three years before. These results are not easily reconciled with actual recycling rates: according to Eurostat estimates, EU average recycling rate was 38 percent in 2014 (Eurostat, Recycling rate of municipal waste, 2016).

The reasons behind this gap between predicted and actual recycling performance can be attributed to the technical difficulties of implementing an efficient recycling management system. These difficulties refer to both households and sorting centers, to both the collection and handling of recycled materials: for example the organization and routes of collection trucks, the location of bins, et cetera. However, the 'technical explanation' does not exhaust the problem: Germany, for example, has developed one of the world's most efficient recycling management systems and in 2014 achieved the highest recycling rate (64 percent) among EU members. We conclude that the difference that still remains between intentions and actions is, at least partially, accounted for by psychological factors.

The roadmap of the present paper includes the study of the psychological content of the recycling action-intention gap under two perspectives. The first perspective relates to the field of motivations; the second to the dual-process theory of decision-making. We will keep these perspectives separate although they have a number of overlapping regions. A systematic understanding of the psychological content of recycling behavior is necessary to achieve the ultimate objective of this paper: testing a set of incentives based on the cognitive process of contextual priming. Before reviewing the state-of-the-art theory of incentives and elaborating on its applications to household recycling behavior, we distinguish two main categories of incentives: monetary and non-monetary.

Recycling: Monetary Incentives

Monetary incentives are widely and successfully used in many public policy schemes, including waste recycling. Container-deposit legislation – i.e. any law providing that the customer is refunded the monetary deposit on soft-drink, juice, milk, water, and/or other containers at the point of sale - is one of the most relevant examples in Europe. The so-called Recycling Rewards Programs, which have been implemented with minor modifications in different cities of the United States, are another relevant example of monetary incentive. In these programs, on a weekly or

monthly basis, a number of households among those who separate waste are randomly selected and receive a cash reward.

No matter how the financial incentive is designed, it is cost-efficient: its costs are low compared to other types of schemes, where promotion, monitoring and evaluation can be very expansive. On the other hand, there are issues related to monetary incentives that do not seem fully appreciated by most of the scientific production about recycling and that might weaken their effectiveness. The scientific literature concentrates on the description of collecting systems and on the fee structure charged to households for waste management. This lack of a comprehensive framework of analysis induces a wrong perception on the household side and this misperception leads to a number of issues that have to be considered when evaluating a waste fee structure. First, households do not easily distinguish the true rationale for waste management fees; they are not able to recognize the difference between the costs of the recycling process per se and the costs of waste collection services. We argue that before implementing any monetary incentives for waste separation, policy makers should create an environment where households have a clear understanding of the recycling chain process. Second, the discretionary conceded to municipalities in designing fee regimes - as it is the case of Italy where each *comune* has an autonomous system of computing waste management fees - contributes to enhance the misperception of households. In particular, households add the costs, in terms of resources and time, incurred in the process of separating waste with the fees paid for collecting services and thus achieve the sense of having fulfilled any civil and moral obligation. A third possible issue relates to the way the perception of unfairness can weaken household motivations for recycling. In a series of experimental games based on empathy, Van Lange (2007) proves that under specific circumstances altruism can be combined with egalitarianism/fairness to strengthen motivation. Given the present attitude of suspicion and unfairness versus local tax authorities, household motivation to separate waste based on altruism may be impaired. This situation has been experimentally replicated and studied repeatedly by game theory with the so-called 'ultimatum game'. Finally, waste fee structures have another possible motivational issue related to the perception of

fairness: the impossibility to combine a progressive taxation with a 'pay-as-you-produce' regime. For example, in the majority of Italian municipalities, waste management fees are calculated on the basis of the size of the house (measured in squared meters or number of rooms) and often the number of people actually living in the household is not taken into account. This structure may satisfy the progressivity of taxation but it is perceived as unfair and crowds out household motivations to treat waste in a more environmentally friendly way.

Recycling: Non-Monetary Incentives

Non-monetary recycling incentives, such as peer pressure, community engagement, direct mail, award ceremonies, are also widely used in public policies, although they are often employed on a temporary basis. The reciprocal influence of monetary and non-monetary incentives has not been studied satisfactorily yet: scientific literature has focused alternatively either on one or the other. Usually economics literature brings light on monetary incentives and waste fees, whilst the psychological literature focuses on the psychological mechanisms and motivations of recycling behavior, i.e. non-monetary incentives. More specifically psychology leverages on moral beliefs and social norms to explain the voluntary recycling behavior of households. An important exception of psychological literature analyzing the impact of monetary incentives on pre-existing non-monetary recycling motivations is due to Brekke, Kverndokk and Nyborg: the authors claim that household recycling efforts are mostly motivated by social norms and suggest that the introduction of financial incentives may crowd-out intrinsic motivations and may reduce self-image. Non-monetary incentives based on social norms have to be devised taking into consideration a wide variety of issues. The most important issue is the identification of the pertinent reference group in terms of age, education, social class, location, et cetera. An extensive literature already exists on the subject of reference group identification but it may not be up to date with the rapid evolution of most societies. More generally, non-monetary incentives based on social norms require a more considerate approach than monetary incentive: not only is the average recycling

rate already above the 'physiological' rate in the majority of developed countries so that any marginal increment of the recycling rate poses a difficult challenge, but also the attitude of new generations toward environmental problems have evolved significantly.

Similarly, also non-monetary incentives based on information that intends to shake moral consciousness raise a variety of issues for discussion. One of these issues refers to the effectiveness of the information provided to households about the environmental risk associated with waste management. For example, information that contains too many numerical data may be impossible to handle on the household side and is therefore inefficient. A well-known application of this principle can be found in the study of the dynamics of charity donations and was reported for the first time by behavioral economists: the picture of a single, easily recognizable child is a much stronger emotional trigger for giving than an informative but anonymous picture.

THE PSYCHOLOGICAL CONTENT OF RECYCLING BEHAVIOR

Motivations

Motivation is a catchall concept to describe how people are moved to behave in a certain way or direction. As a matter of fact, motivation is a complex and multi-dimensional notion and we need a rigorous working theory upon which to build our understanding of household recycling behavior. The Self-Determination Theory (SDT) proposed by Deci and Ryan (2000) defines motivation in terms of "energy, direction, persistence and equifinality of activation and intent". Equifinality is a term borrowed from systems theory and refers to the fact that the same result can be obtained through several different trajectories. The basic idea behind the SDT is that the more people are free to choose, the more motivated they are. Deci and Ryan identify three innate needs that motivate the self to behave in a certain way and that contribute to the psychological health of an individual. These needs are competence,

autonomy and relatedness. In spite of the universality of these needs, saliency activations are modulated according to time, culture, social context or experience (Deci & Ryan, 2002).

Inside the framework established by the SDT, Deci and Ryan elaborate on the basic distinction between intrinsic and extrinsic motivations. People can be motivated because they value an activity or because there is some form of external coercion. They can behave from a sense of personal commitment or from fear of being observed and evaluated. The issue of whether people stand behind a behavior out of their interests and values or do it for reasons external to the self, is a matter of great significance in every culture (Johnson, 1993) and represents a crucial dimension by which people judge their own and others' behavior (deCharms, 1968; Fritz, 1958; Ryan & Connell, 1989; Ryan & Deci, 2000). This distinction between having an internal motivation versus being externally pressured is uncomplicated in the case of non-economic factors that motivate household recycling behavior: altruism belongs to the former, social influences, personal inconvenience or household storage space to the latter.

Intrinsic motivation

Intrinsic motivations are the result of a number of natural desires: efficacy, curiosity, freedom, revenge, loyalty, sympathy, lust, love, steadiness, security, possess, et cetera. Deci and Ryan organize these needs under three headings: competence, which is the feeling of being capable; autonomy, the feeling of acting with a sense of choice and control; and relatedness, the feeling of positive, strong social ties. Csikszentmihalyi and Rathunde insist on two specific attributes of these needs: they are central drivers of the cognitive and social development process of any individual and, as a consequence, they are a source of enjoyment and vitality (Csikszentmihalyi & Rathunde, 1993; Ryan & Deci, 2000).

The Cognitive Evaluation Theory (CET) is a precursor of the SDT and focuses on two issues: the dynamics and reciprocal influence of intrinsic and extrinsic motivations and how social and environmental factors help or hinder intrinsic motivations.

In terms of dynamics, for our purposes it is important to underline that intrinsic motivation may weaken over time due to repetitive actions (Ryan & Deci, 2000).

In terms of the reciprocal influence of intrinsic and extrinsic motivations, the theory challenges the idea that intrinsic and extrinsic motivations are additive: the combination of the two forms of motivations does not increase their cumulative effect (Atkinson, 1964). An extensive array of studies shows that extrinsic rewards, such as deadlines and surveillance, tend to curb intrinsic motivations (Amabile, DeJong, & Lepper, 1976; Plant & Ryan, 1985). In some specific circumstances, however, extrinsic rewards do not compromise the intrinsic motivation of individuals: for example when they do not depend on performance and do not seem to control behavior (Deci, Koestner, & Ryan, 1999).

Finally, in terms of social climate, one that is supportive, rather than controlling, tends to inflate intrinsic motivation (Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). Vallerand and Reid (1984) describe the exception of feedbacks: positive evaluations of performance, although they are not a manifestation of autonomy, sometimes have a positive effect on intrinsic motivations (Deci, Koestner, & Ryan, 1999). Accordingly, Deci and Ryan (2000) argue that information that underscores the competence of individuals also strengthens intrinsic motivation.

Extrinsic motivation

We study extrinsic motivations because they may have a psychological content. This happens when extrinsically motivated behaviors are integrated into the sense of self. The Organismic Integration Theory (OIT), developed by Deci and Ryan as a sub-theory of the SDT, specifically addresses the subject of extrinsically motivated behaviors, their different forms and the contexts in which they may be internalized (Ryan & Deci, 2000). An organismic perspective, to be complemented with a dialectical one, i.e. interaction with the social context, translates into a theory that assumes that human beings are active, they tend to welcome challenges and to fulfill their potentials.

The OIT describes the transition from an external regulation of behaviors to an internal regulation, which is the only form of regulation that allows self-determined behaviors and intrinsic motivations. Five different types of regulation associated to different types of extrinsic motivation are identified (Ryan & Deci, 2000).

1. *No regulation*: associated to amotivation;

2. *External regulation*: it is the least autonomous, it is performed to obtain reinforcers or to avoid punishments;
3. *Introjected regulation*: a defined behavior is internalized, but not fully accepted as part of one's self. This behavior is performed to avoid sense of guilt, remorse, shame or to enhance one's self-esteem;
4. *Regulation through identification*: it involves the conscious appreciation of the value of a defined behavior such that its performance gives a fulfilling sense of autonomy;
5. *Integrated Regulation*: it is the most autonomous form of extrinsically motivated behavior and it occurs when regulations are fully assimilated with the self. The significance of this behavior is extremely high because it is consistent with personal values and objectives but it is still instrumental to achieve a pre-determined goal. This pre-determined goal is precisely the reason why integrated behaviors are classified as extrinsically motivated although they share a number of qualities with intrinsically motivated ones.

The OIT claims that internalization is more likely to occur when the three basic needs of competence, autonomy and relatedness are satisfied. Ryan, Stiller and Lynch, for example, find that children internalize school's extrinsic regulations when they have a strong sense of relatedness, when they feel secure and cared for by parents and teachers. Autonomy is particularly important for the integration of regulations into a person's sense of self. Deci, Eghrari, Patrick and Leone (1994) offer laboratory evidence of the power of the sense of autonomy on the process of internalization of regulation: the more a regulation is matched with the subject's other goals, the more it facilitates a sense of autonomy and the more easily it is internalized.

Dual-Process Theory

The present study discards monetary incentive and focuses on non-monetary incentives. Similarly, we believe that extrinsic motivations, especially in the least integrated forms, achieve inferior results in influencing household recycling behaviors. The theoretical reasons for these inferior results have been discussed

above. There are also at least two technical reasons why, in the long run, intrinsic motivations are more effective than extrinsic motivations. The first limitation is the sustainability of extrinsic motivations: the amount of rewards that can be given out is limited and, in most cases the end of the rewards coincides with the end of the motivation. Secondly, extrinsic rewards have diminishing marginal returns. In recent times, also public policies have given up to the limits of monetary incentives and extrinsic motivations and have embraced the potential of non-monetary, intrinsic incentives.

This turnaround has happened alongside the soft revolution in the economic theory: from the neoclassical model of decision-making to psychology and the dual-process theory. Psychology states that human beings have bounded rationality as the result of a number of cognitive biases. A cognitive bias is “a systematic pattern of deviation from norm or rationality in judgment, whereby inferences about other people and situations may be drawn in an illogical fashion” (Haselton, Nettle & Andrews, 2005). Hyperbolic discounting, which was mentioned before, together with information overload are examples of cognitive biases.

Psychology and the dual-process theory can provide new, significant insights into household recycling behavior because waste disposal is a habitual and repetitive action. Psychology, and more specifically the dual-process theory, challenges one of the most basic and traditional principles of economics: decision-making is a unitary process, a simple matter of integrated and coherent utility maximization. The dual-process theory suggests otherwise: decision-making is driven by the interaction between automatic and controlled processes. These processes involve two separate cognitive systems respectively: an implicit and unconscious system (‘System 1’) and an explicit and conscious system (‘System 2’). System 1 is fast, effortless, unintentional: it produces an intuitive response. It uses information, which is readily available, in particular visual, and operates on the principle of recognition of a typical configuration of signs or of similarities with previously encountered situations. System 2, on the other hand, is heuristic-based, analytical, deliberate and effortful. It involves a rational and deliberate judgment based on additional information collected actively by the individual in her environment and on the

conscious application of rules that have been acquired through learning. “Because the overall capacity for mental effort is limited, effortful processes tend to disrupt each other, whereas effortless processes neither cause nor suffer much interference when combined with other tasks (Tversky & Kahneman, 1973; Pashler & Sutherland, 1998; Kahneman, 2011).”

Our working hypothesis is that the motivational discrepancy that households experience when having to perform a recycling activity can be construed as the dominance of System 1 over System 2. Norenzayan et. al (2002) suggest that the intuitive cognition, System 1, tends to dominate over formal cognition, System 2, although both systems are typically active simultaneously. This seems to be the case especially when a subject is engaged in a reiterated activity, such as disposing the garbage. This preference for System 1 can be mitigated by a variety of factors, including the demand for accountability or to justify one’s actions. This hypothesis is consistent with the temporary positive effect observed in a number of recycling campaigns. In the first days of a recycling campaign, a range of new information is provided: households need to activate System 2 to absorb and process this information. The dominance of System 2 results in an increased recycling rate. Unfortunately System 2 is ‘uneconomical’ and, after some time, the brain saves energy by defaulting back to the effortless System 1 and the old ‘automatic’ behavior is restored.

The research questions that this study is set out to answer are about the possibility to activate a virtuous combination of System 1 and System 2 in the household decision to recycle.

For the reasons mentioned above, recycling is a complex, private and non-spontaneous decision and System 2 sets this process in motion. In the particular context of recycling, moral and ideological incentives are inevitably among the most effective ways to activate System 2 and nudge households towards a more environmentally friendly behavior. Moral and ideological incentives belong to the category of non-monetary, intrinsic motivations. One of the most interesting findings of Missios and Ferrara (2011) is that the most important factor motivating recycling is whether and the extent to which it is considered beneficial for the

environment. Similarly, Frey and Oberholzer-gee (1997) find evidence that policies designed to promote environmentally responsible behaviors relying on economic incentives may be ineffective for households driven by strong moral motives as they may undermine individuals' sense of self-esteem or civic consciousness.

In this study we concentrate on two types of intrinsic motivations, which refer respectively to a moral and an ideological attitude: spirituality and environmental consciousness.

Households may decide to recycle because they have a 'spiritual' motivation. If this is the case the recycling decision is based on the belief that all lives are interdependent and that recycling connects people with future generations. An enormous amount of scientific literature on the consequences of religious feelings shows an increase of moral behavior and pro-social behaviors. (Ahmed & Hammarstedt, 2011; Ahmed & Salas, 2011; Batara, Franco, Quiachon & Sembrero, 2016; Clobert & Saroglou, 2013; Cohen, Mundry & Kirschner, 2014; Duhaime E.P, 2015; Gomes & McCullough, 2015; Lin P.K.F., Lin, Tong, Lee, Low & Gomes, 2016; Rand, Dreber, Haque, Kane, Nowak & Coakley, 2013; Sasaki, Kim, Mojaverian, Kelley, Park & Janušonis, 2013; Shariff & Norenzayan, 2007; Yilmaz, Karadöller, & Sofuoglu, 2016). For our purposes, the idea of religiosity is contained in, but does not exhaust, the concept of spirituality: an intrinsic motivation inspired by spirituality applies to a wider variety of cultural groups of households. However, current definitions and understanding of spirituality is difficult to circumscribe; the relationship of spirituality and nature in particular is still blurred (McCoubrie & Davies, 2006).

On the other side, environmental consciousness is easier to define: it can be both a lifestyle and a specific awareness state. In developed Western societies 'going green' has become a pervasive mantra and the choice to recycle is one of the green behaviors that households encounter on a daily basis. When households decide to recycle because they have an intrinsic, both moral and ideological, motivation, the actual magnitude of the impact of their choice on the environment and the scientific information available about it become irrelevant. The nature of the information needed to reinforce a culture or a lifestyle is therefore peculiar and totally different from traditional marketing campaigns: less informative and more emotional.

PRMING MANIPULATION

The existence and intensity of intrinsic incentives depend on a number of factors and may vary across different households and different communities. However, they can be ignited by a technique used in psychology to train a person's memory: priming. Priming increases the sensitivity of a person to certain stimuli due to prior experience and occurs outside of conscious awareness: it is different from memory that relies on the direct retrieval of information. Priming can impact the decision-making process (Jacoby, 1983) and is therefore a valuable tool for studying controllable behaviors with a socially sensitive impact, as it is the case of recycling.

Priming is a psychological effect that makes the cognitive elaboration of an event easier when it is preceded by a related stimulus. The relation between the event and the stimulus does not necessarily depend on the nature of the stimulus and, for the same stimulus, it can be perceptual or conceptual, associative or contextual.

Priming describes also the associated manipulation technique that consists in the activation of specific associations and representations held in memory before an activity or a task. The technique is built upon the associative network model of human memory: a concept is stored as a node in a network and is related to other similar concepts to form a 'cluster'. When a cluster is activated, those clusters that are more closely connected receive a share of activation by 'propagation' and are therefore more likely to emerge to consciousness. For example, when participants in an experiment were exposed as part of a purported 'language study' to words related to 'kindness', they subsequently responded perceiving a target person as kinder compared to the impressions of a control group about the same target (Srull & Wyer, 1979). Accessibility of a certain concept, i.e. the likelihood of retrieval from memory and subsequent use, depends not only on the nature of the related stimulus but also on prior exposure to the very same concept and on how far back in time this exposure goes (Higgins & King 1981; Wyer & Srull 1986).

Priming is a powerful tool in psychology research: for example, priming techniques were among the earliest developed methods for studying moral judgments. Expanding on the seminal semantic priming studies (Meyer & Schvaneveldt, 1971;

Neely, 1977), researchers used sequential priming to investigate stereotype and attitude associations without relying on self-reports (Dovidio, Evans, & Tyler, 1986; Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Gaertner & McLaughlin, 1983; Bargh, Chen, Burrows, 1996). Furthermore, priming techniques can be employed to map the networks of associations for any single individual.

Contextual priming

There are many examples of priming in the retail industry, especially in advertisement and store layouts. For example, an everyday experience of contextual priming is the shiny pictures of french fries and smoky burgers behind the cashier at any fast-food chain. In this case, the priming effect will be stronger if customers are hungry: the idea is that priming is stronger when the introduced/activated stimuli are consistent with a preexistent need or goal.

In cognitive psychology, contextual refers to all the sensory information besides the primary task the subject is performing (Harley, 2008; McClelland, 1991). The context can activate mental processes through the exposure of the subject to external sources spatially surrounding her. These sources can be material or immaterial and they include objects, backgrounds, settings, sensations and images. Contextual sources depend also on individuals' knowledge about the world and recent experiences. Additionally, external sources do not have to happen at the same time of the task but they can also temporally precede it (Bransford & Johnson, 1973; Davenport & Potter, 2004; Fazio & Olson, 2003; De Pelsmacker, Guens & Anckaert, 2002; Weber & Johnson, 2009; Yi, 1990).

The pioneer study of Youjae Yi (Yi, 1990) about the possibilities of priming in advertising finds that contextual factors may influence the individual judgment about a product by altering the way how the same ambiguous information is elaborated. A similar study on contextual priming shows that the type of polling location influences how people end up casting their ballot (Berger, Meredith & Wheeler, 2008). On the same line, contextual priming such as the exposure to French or German music might change the consumer's preferences for different types of wine. When French music is played in the wine department of a mall, French wines exceeds 77 percent of sales; on the contrary, when German music is

played, consumers buy German wines 73 percent of the time (North, Hargreaves & McKendrick, 1999). Consumer choice can be influenced also by backgrounds of web pages priming certain product attributes. For example, in the experiment developed by Mandel and Jonson (2002) advertisements of two types of product categories, cars and sofas, are presented to participants with different background wallpapers. The advertisement submits also a list of the most important attributes to consider when buying the product. The car website contains alternatively a red and orange flame-like background, designed to prime safety, or a green background with small dollar signs, designed to prime price. The sofa website contained alternatively a blue background with fluffy clouds, designed to prime comfort, or a green background with embedded pennies, designed to prime price (Mandel & Johnson, 2002). The results prove that the priming effect is significant: participants are more likely to prefer products that excel at the primed attribute and mention the primed attribute more frequently among the ones to be considered. It is interesting to notice that, although through different cognitive processes, both participants with no previous knowledge of the product and experts of the product are equally affected by the priming manipulation.

RESEARCH DESIGN

The experimental section of the present study intends to test the functioning of two types of intrinsic motivations on recycling. These intrinsic motivations are generated by two very specific dimensions of human experience: spirituality and environmental consciousness. The way the experimental procedure reinforces and makes these two dimensions salient is through contextual priming techniques based on a combination of stimuli: the evaluation of a number of selected pictures and the answers to a specific questionnaire. The likely priming effect of the second part of the questionnaire, Effort to the Recycle Scale, is neutralized by the fact that all participants fulfill it, and it is treated as a measure of the relative effectiveness of priming.

Methods

Subjects

306 students took part in the laboratory experiment. The gender composition of the sample is: 150 (49 percent) female and 156 (51 percent) male participants, aged between 18-34 years. The vast majority of the respondents are Italian.

The experiment was held in a computer laboratory and included two rounds. The 153 students who participated in each round of the experiment, for a total of 306 students, were divided into three identical groups: 51 students for each group, for a total of six groups. The only difference between the two rounds of the experiment is the color of the recyclable materials, i.e. the color of plastic plates and paper napkins. The role of color in perceptual priming still remains unclear: the variation of the color of the recyclable materials responds to the objective of isolating the independent variable's effects of priming and helping rule out alternative explanations of the experimental results.

The color of the plates and the napkins are different for each group. In the first round of the experiment the color of the recyclable materials is pale blue for the environment-primed group, yellow for the spirituality-primed group and grey for the control group. In the second round of the experiment the color of the spirituality-primed group and of the control group is blue and grey for the nature-primed group (see Table 1).

Table 1: Color of the recyclable materials used in the experiment rounds

Type of priming for the group Color of plate and napkin	Environmental Consciousness	Spirituality	Control
Blue	Round1	Round2	Round 2
Yellow	X	Round 1	X
Grey	Round 2	X	Round 1

Procedure

The experiment was held at Trento University, Italy. According to the 2015 'Sesto Rapporto Anci-Conai su Raccolta Differenziata e Riciclo dei Rifiuti', the region Trentino Alto Adige to which the city of Trento belongs, has achieved the highest recycling rate in Italy (69 percent).

The laboratory consists of 20 isolated computer workstations and each subject occupies one workstation.

Each subject was paid four euros for participating in the experiment, which took approximately 20 minutes.

Subjects were randomly assigned to two primed groups (spirituality and environmental consciousness) and one control group.

At the beginning of the experiment participants were instructed to eat a biscuit during their computer task. The type of biscuit was selected to be as crunchy as possible and to produce many crumbs when bitten. At the workstation, each subject found the biscuit on a plastic plate with a paper napkin. The paper napkin was stapled to the plate: this simple stratagem allows the researchers to force an effort on the side of the participants to separate plastic and paper. Students were instructed to dispose of the plate and the napkin, but no particular instructions or details about where and how to drop them were given. The set-up of the experiment gives each subject two options: an option to drop the plate and the napkin in a common bin, which was intentionally positioned next to the entrance door in a highly visible place; alternatively they have the option to walk approximately 20 meters and reach the recycling bins. Similarly, the recycling bins were situated in a highly visible place. In the case of the second option, each student has two choices: either they recycle properly or they drop plastic and paper together into one recycling trash bin.

The set-up is a key feature of the experiment: we tried to reproduce the efforts of households in the ordinary recycling activity. We made sure that participants had to walk a certain distance to reach the recycling bins; that separating paper and plastic materials required a certain amount of energy; and that they were forced to physically handle dirty garbage.

Once seated, the subjects are invited to read the agreement consent form for video recording and after clicking on the 'Agree' button, they start the evaluation of five images followed by the completion of a questionnaire. The participants' hand movements while consuming the biscuit were recorded by a video camera positioned in the middle of each workstation. We took one first measure of the priming effect by counting the number of times participants waved their hands to remove crumbs from the table during the task. This measure is based on the subjective evaluation of an independent judge who has been given access to the videos recorded.

The questionnaire consists of two parts. The first part is selected consistently with the priming stimulus: the New Ecological Paradigm Scale (NEP) test for the environment-primed group. The Spiritual Involvement and Belief Scale (SIB) test for the spirituality-primed group. The second part of the questionnaire is identical for the three groups of participants and consists of the Effort to Recycle Scale test. The control group fills only the second part of the questionnaire.

Priming instruments

The images to be evaluated were chosen to potentially evoke spiritual and environmental feelings. They were picked from a large collection of images freely available on the Internet. The criterion to form the collection of images was the similarity to images used in previous researches (Symands et. al, 2010; Hartman & Apaolaza-Ibáñez, 2008). The final set of pictures to be used in the experiment was restricted to five images per stimulus, ten in total; all of them suggesting a positive, i.e. pleasant and soothing, experience.

The initial evaluation of the images was performed through a Self-Assessment Manikin (SAM) test containing two nine-point scales, 'Arousal' and 'Pleasure'. To express her emotional state each participant of each group chooses one of the nine faces (*manikins*). The state Pleasure was measured by a scale of nine manikins, indicating happy versus unhappy emotions: a smiling face for the happy state and a frowning face for the unhappy state. In the case of Arousal, one extreme of the scale was a frenzied, excited manikin with eyes wide open and the opposite extreme was a manikin calm and with eyes closed.

The SAM test offers a few recognized advantages for the purpose of our research: it is well established; simple, quick and intuitive to perform; it eliminates the problems connected to verbal language; it is easy and inexpensive to implement. A two-way ANOVA is used as a statistical test for evaluating the effectiveness in terms of emotional valence, i.e. Pleasure, of both groups of priming images.

Evaluation of Images

We choose to focus on the emotional valence scores: our hypothesis is that positive emotions are better predictors than arousals of the effectiveness of a priming technique. Secondly, we also believe that low levels of arousal have a neutral effect on the efficacy of priming because they mimic the actual positive feelings of spirituality and nature. Thirdly, there is an inverse correlation between emotional valence scores and arousal scores. These beliefs are confirmed by our findings.

We use a 3x5 factorial ANOVA to study the effects of the individual independent variable that we call 'condition' (spirituality, nature, control), as well as the interaction effect between each condition and the second independent variable, 'image' (from Image 1 to Image 5). The descriptive statistics are summarized in Table 2.

Table 2: The descriptive statistics

Descriptive Statistics					
<i>Factor</i>	<i>Group</i>	<i>Sample size</i>	<i>Mean</i>	<i>Variance</i>	<i>Standard Deviation</i>
Condition	Control	510	6,01961	3,81494	1,95319
Condition	Nature	510	7,95882	2,17708	1,47549
Condition	Spirit	510	6,37255	3,47194	1,86331
Condition x Image	Control x Image1_V	102	5,54902	4,01242	2,0031
Condition x Image	Control x Image2_V	102	5,76471	3,54805	1,88363
Condition x Image	Control x Image3_V	102	7,17647	2,74083	1,65554
Condition x Image	Control x Image4_V	102	6,12745	2,82518	1,68083
Condition x Image	Control x Image5_V	102	5,48039	4,15308	2,03791
Condition x Image	Nature x Image1_V	102	8,04902	1,2154	1,10245
Condition x Image	Nature x Image2_V	102	8,21569	1,83421	1,35433
Condition x Image	Nature x Image3_V	102	8,12745	1,91429	1,38358
Condition x Image	Nature x Image4_V	102	8,12745	2,15191	1,46694
Condition x Image	Nature x Image5_V	102	7,27451	3,25063	1,80295
Condition x Image	Spirit x Image1_V	102	5,77451	2,61202	1,61617
Condition x Image	Spirit x Image2_V	102	7,40196	2,20316	1,48431
Condition x Image	Spirit x Image3_V	102	5,64706	3,43856	1,85433
Condition x Image	Spirit x Image4_V	102	6,28431	3,41341	1,84754
Condition x Image	Spirit x Image5_V	102	6,7549	3,71161	1,92655

The null hypothesis that the means of the three conditions are equal is rejected at a 5 percent significance level. Also the interaction effect is statistically significant, $F(8, 1515) = 15,93, P < 0.05$ (see Table 3).

Table 3: ANOVA analyses

<i>Source of Variation</i>	<i>SS</i>	<i>d.f.</i>	<i>MS</i>	<i>F</i>	<i>p-level</i>	<i>F crit</i>	<i>Omega Sqr.</i>
Factor #1 (Condition)	1.088,2366	2	544,1183	189,69951	0,	3,00166	0,18322
Factor #1 + #2 (Condition x Image)	365,4366	8	45,67958	15,92557	0,	1,9445	0,05797
Within Groups	4.345,5	1515	2,86832				
Total	5.905,3915	1529	3,86226				
Omega squared for combined effect	0,25722						

We use the Bonferroni Procedure and the Fisher's Least Significant Difference (LSD) test for comparisons among groups (see Table 4) and for post-hoc comparisons (see Table 5).

Comparisons among groups reveal that the images belonging to the nature condition have a greatly stronger effect on emotional valence than the other two

conditions. The marginal effect of the spirituality condition, on the other hand, is trivial if compared to the control group (difference = 0.3).

Table 4: Comparisons among groups

Bonferroni					
<i>Alpha/N</i>	0,01667				
<i>Group vs Group (Contrast)</i>	<i>Difference</i>	<i>95% Confidence Interval</i>		<i>Test Statistics</i>	<i>p-level</i>
Control vs Nature	-1,93922	-2,1934	-1,68503	18,28448	0,
Control vs Spirituality	-0,35294	-0,60712	-0,09876	3,32781	0,00269
Nature vs Spirituality	1,58627	1,33209	1,84046	14,95667	0,
Fisher LSD					
<i>Group vs Group (Contrast)</i>	<i>Difference</i>	<i>Test Statistics</i>	<i>p-level</i>	<i>Significant</i>	
Control vs Nature	-1,93922	18,28448	0,	Yes	
Control vs Spirituality	-0,35294	3,32781	0,0009	Yes	
Nature vs Spirituality	1,58627	14,95667	0,	Yes	

Spirituality Images

Two spirituality-primed groups with different colors of the recyclable materials (yellow and blue) are analyzed as one group of 102 participants. The overall average emotional valence scores of the five images evoking a spiritual dimension range from 5.65 to 7.40 (mean = 6.37) with standard deviation ranging from 1.48 to 1.93 (see Table 7); whereas the overall average arousal scores range from 1.74 to 2.98 (mean = 2.39) with standard deviation in the interval from 1.14 to 2.00. The average results for the two scales are consistent with our expectations: the selected images about spirituality provoke positive emotions and a general sense of peace (notice that the control group shows an average valence score of 6.0).

In terms of pairwise comparison between pictures, Image 2 stands out as the most effective: the mean difference is always positive. Post hoc tests using the Bonferroni adjustment reveal the significance level of differences between pairwise comparisons (see Table 5).

Table 5: Pairwise comparisons of five spiritual images (emotional valence)

Bonferroni					
Alpha/N	0,005				
<i>Group vs Group (Contrast)</i>	<i>Difference</i>	<i>95% Confidence Interval</i>		<i>Test Statistics</i>	<i>p-level</i>
Image1_V vs Image2_V	-1,62745	-2,29412	-0,96078	6,86245	9,81232E-11
Image1_V vs Image3_V	0,12745	-0,53922	0,79412	0,53742	1,
Image1_V vs Image4_V	-0,5098	-1,17647	0,15686	2,14968	0,31737
Image1_V vs Image5_V	-0,98039	-1,64706	-0,31373	4,13401	0,00038
Image2_V vs Image3_V	1,7549	1,08824	2,42157	7,39988	2,242E-12
Image2_V vs Image4_V	1,11765	0,45098	1,78431	4,71277	0,00003
Image2_V vs Image5_V	0,64706	-0,01961	1,31373	2,72845	0,06436
Image3_V vs Image4_V	-0,63725	-1,30392	0,02941	2,68711	0,07286
Image3_V vs Image5_V	-1,10784	-1,77451	-0,44118	4,67143	0,00003
Image4_V vs Image5_V	-0,47059	-1,13725	0,19608	1,98432	0,47399
Fisher LSD					
<i>Group vs Group (Contrast)</i>	<i>Difference</i>	<i>Test Statistics</i>	<i>p-level</i>	<i>Significant</i>	
Image1_V vs Image2_V	-1,62745	6,86245	9,80764E-12	Yes	
Image1_V vs Image3_V	0,12745	0,53742	0,59106	No	
Image1_V vs Image4_V	-0,5098	2,14968	0,03174	No	
Image1_V vs Image5_V	-0,98039	4,13401	0,00004	Yes	
Image2_V vs Image3_V	1,7549	7,39988	0,	Yes	
Image2_V vs Image4_V	1,11765	4,71277	2,66608E-6	Yes	
Image2_V vs Image5_V	0,64706	2,72845	0,00644	Yes	
Image3_V vs Image4_V	-0,63725	2,68711	0,00729	Yes	
Image3_V vs Image5_V	-1,10784	4,67143	3,25388E-6	Yes	
Image4_V vs Image5_V	-0,47059	1,98432	0,0474	No	

Image 2 and 5 on the one side (see Figure 1a) and Image 3 and 1 on the other (see Figure 1b) show opposite scores in terms of emotional valence. Considering the level of statistical significance, we can conclude that Image 3 is the least effective in evoking positive emotions from participants; Image 2 is the most effective: it arouses positive spiritual feeling among participants and the comparison with the other pictures is always statistically significant. The idea is that there is at least one picture (Image 2) that triggers an effect: it functions at a group level (mean=7.4) and also in relative terms.

For a full interpretation of these results and their implications for the succeeding conclusions of the present study, it is useful to recall that the connection of emotional valence and spirituality is assumed *a priori*.

Figure 1a: spirituality Image 2 and Image 5



Figure 1b: spirituality Image 3 and Image 1



Nature Images

Two nature-primed groups with different colors of the recyclable materials (blue and grey) are analyzed as one group of 102 participants. The overall average emotional valence scores of the five images evoking the natural dimension range from 7.27 to 8.22 (mean = 7.96) with standard deviation ranging from 1.10 to 1.80 (see Table 6), whereas the overall average arousal scores range from 1.84 to 2.80 (mean = 2.06) with standard deviation in the interval from 1.36 to 1.90. The capacity of arousing positive emotions and a sense of peace is even more unambiguous in the case of nature.

Table 6: Pairwise comparisons of five nature images (emotional valence)

Bonferroni					
<i>Alpha/N</i>	<i>0,005</i>				
<i>Group vs Group (Contrast)</i>	<i>Difference</i>	<i>95% Confidence Interval</i>		<i>Test Statistics</i>	<i>p-level</i>
Image1_V vs Image2_V	-0,16667	-0,83333	0,5	0,70278	1,
Image1_V vs Image3_V	-0,07843	-0,7451	0,58824	0,33072	1,
Image1_V vs Image4_V	-0,07843	-0,7451	0,58824	0,33072	1,
Image1_V vs Image5_V	0,77451	0,10784	1,44118	3,26587	0,01116
Image2_V vs Image3_V	0,08824	-0,57843	0,7549	0,37206	1,
Image2_V vs Image4_V	0,08824	-0,57843	0,7549	0,37206	1,
Image2_V vs Image5_V	0,94118	0,27451	1,60784	3,96865	0,00076
Image3_V vs Image4_V	0,	-0,66667	0,66667	0,	1,
Image3_V vs Image5_V	0,85294	0,18627	1,51961	3,59659	0,00333
Image4_V vs Image5_V	0,85294	0,18627	1,51961	3,59659	0,00333
Fisher LSD					
<i>Group vs Group (Contrast)</i>	<i>Difference</i>	<i>Test Statistics</i>	<i>p-level</i>	<i>Significant</i>	
Image1_V vs Image2_V	-0,16667	0,70278	0,4823	No	
Image1_V vs Image3_V	-0,07843	0,33072	0,7409	No	
Image1_V vs Image4_V	-0,07843	0,33072	0,7409	No	
Image1_V vs Image5_V	0,77451	3,26587	0,00112	Yes	
Image2_V vs Image3_V	0,08824	0,37206	0,7099	No	
Image2_V vs Image4_V	0,08824	0,37206	0,7099	No	
Image2_V vs Image5_V	0,94118	3,96865	0,00008	Yes	
Image3_V vs Image4_V	0,	0,	1,	No	
Image3_V vs Image5_V	0,85294	3,59659	0,00033	Yes	
Image4_V vs Image5_V	0,85294	3,59659	0,00033	Yes	

Table 6 allows us to conclude that there is a significant difference in emotional valence of Image 5 and all the other four images, suggesting that Image 5 (See Figure 2c) is the most ineffective image in evoking positive feeling. Images 1, 2, 3 and 4 evoke positive images for participants (See Figure 2a and Figure 2b).

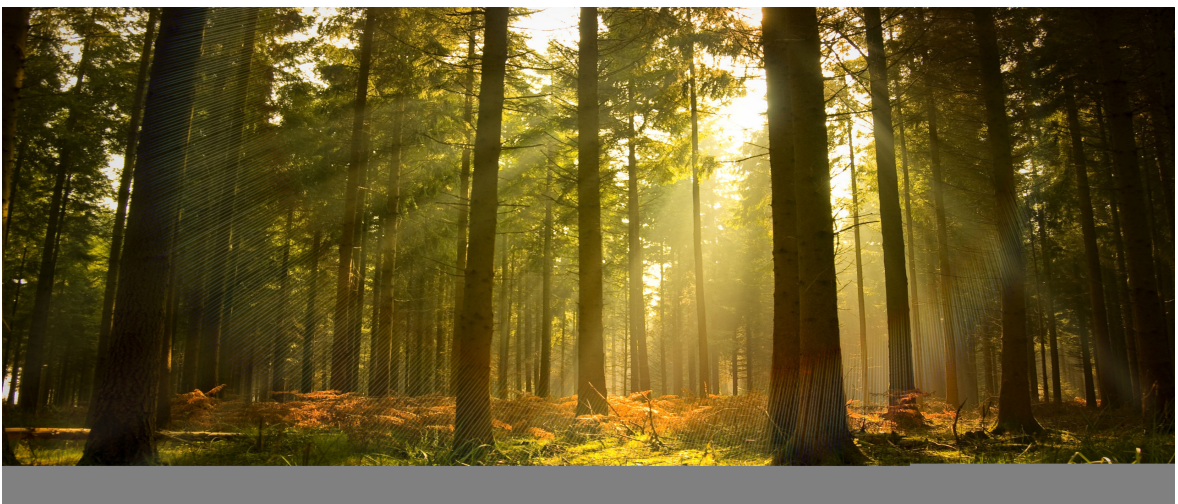
Figure 2a: nature Image 1 and Image 2



Figure 2b: nature Image 3 and Image 4



Figure 2c: nature Image 5



Geometric figure images

Two control groups with different colors of the recyclable materials (grey and blue) are analyzed as one group of 102 participants. The overall average emotional valence scores of the five images displaying basic geometric figures range from 5.48 to 7.18 (mean = 6.02) with standard deviation ranging from 1.66 to 2.04, whereas the overall average arousal scores range from 2.31 to 3.53 (mean = 3.18) with standard deviation in the interval from 1.61 to 2.18. As expected, the results are closer to the neutral state of participants and confirm the pursued effect of the nature/spirituality images.

Evaluation of Sample Attitudes

New Ecological Paradigm Scale

The New Ecological Paradigm Scale (NEP) is one of the most widely accepted, validated and reliable measurement instruments for studying public endorsement of a 'pro-ecological' worldview. The NEP was devised by the American environmental sociologist Riley Dunlap and it is designed to measure the public environmental concern using a survey instrument which consists of fifteen statements (Dunlap, Van Liere, Mertig & Jones, 2000). Respondents are asked to indicate the strength of their agreement or disagreement with each statement (Anderson, 2012).

The fifteen questions that compose the survey are based on a continuous dichotomy between the NEP and its converse, the Dominant Social Paradigm (DSP). Out of the fifteen questions, eight of them are pro-NEP items and are expected to achieve relatively high scores; the remaining seven items are anti-NEP and are expected to achieve relatively low scores. Responses are scored on a 5-point Likert scale ranging from 1 (totally disagree) to 5 (totally agree).

The survey included in the present study was conducted in Italian; it has been validated by translating the NEP in Italian and translating it back in English to ensure accuracy and rule out any modification to content or meaning.

In order to reverse-score the negatively worded questions (anti-NEP) and facilitate the understanding of the mean scores, directionality of seven items was changed

using the formula: $\text{reverse-score}(x) = \text{max}(x) + 1 - x$, where $\text{max}(x)$ is the maximum possible value for x . In our case, $\text{max}(x)$ is 5 as the Likert scale only goes up to 5. In this way all means will have a tendency towards 5 (see Table 7).

102 subjects responded to the NEP questionnaire, 54 percent are female and 46 percent male respondents. The youngest participant is 18, the oldest 30.

Table 7 shows the percentage distribution of responses to each of the fifteen items. The mean score for the fifteen items, after correcting for the directionality of the items, is 3.76; it indicates that the overall orientation of the sample belongs to the medium rank of the NEP worldview. The mean scores for pro-NEP items range from 3.41 to 4.42, whereas the mean scores for DSP items range from 2.19 to 3.93, after correcting for the directionality of the items. The frequency distribution of the pro-NEP items shows that 86.5 percent of the sample agrees with the statements, 6.9 percent is undecided and 6.9 percent disagrees. Conversely, the distribution of the pro-DSP items reveals that 25.9 percent of the sample agrees with the statements, while there is considerable number of subjects disagreeing (49.9 percent) and undecided (24.2 percent). The standard deviation in the sample ranges from 0.71 of item 9 to 1.14 of item 1.

Table 7: Frequency and mean distribution of the NEP scale items (white rows=pro-NEP, grey rows=pro-DSP)

<i>NEP Items</i>	<i>% distribution</i>					<i>Mean</i>	<i>SD</i>
	<i>Totally Agree</i>	<i>Agree</i>	<i>Unsure</i>	<i>Disagree</i>	<i>Totally Disagree</i>		
1. We are approaching the limit of the number of people the earth can support	16.7	36.3	25.5	14.7	6.9	3.41	1.14
2. Humans have the right to modify the natural environment to suit their needs	1.0	24.5	10.8	53.9	9.8	3.47	1.00
3. When humans interfere with nature it often produces disastrous consequences	42.2	48.0	2.0	7.8	0.0	4.25	0.84
4. Human ingenuity will insure that we do not make the earth unlivable	6.9	32.4	35.3	22.5	2.9	2.82	0.96
5. Humans are severely abusing environment	52.9	40.2	3.9	2.9	0.0	4.42	0.74
6. The earth has plenty of natural resources if we just learn how to develop them	25.5	49.0	8.8	14.7	2.0	2.19	1.04
7. Plants and animals have as much right as humans to exist	41.2	50.0	5.9	2.9	0.0	4.12	1.03
8. The balance of nature is strong enough to cope with the impacts of modern industries	2.9	7.8	52.9	36.3	0.0	3.23	0.72
9. Despite our special abilities humans are still subject to the laws of nature	39.6	50.3	6.9	3.1	0.0	4.29	0.71
10. The so-called "ecological crisis" facing human kind has been greatly exaggerated	1.0	7.8	14.7	50.0	26.5	3.93	0.90
11. The earth is like a spaceship with very limited room and resources	44.6	48.5	0.9	4.0	2.0	4.30	0.84
12. Humans were meant to rule over the rest of nature	2.0	8.8	19.6	47.1	22.5	3.79	0.96
13. The balance of nature is very delicate and easily upset	33.3	53.9	4.9	7.8	0.1	4.13	0.83
14. Humans will eventually learn enough about how nature works to be able to control it	2.0	9.8	27.5	44.1	16.7	3.64	0.94
15. If things continue on their present course, we will soon experience a major ecological catastrophe	52.0	40.2	4.9	2.9	0.0	4.41	0.72

Spiritual Involvement and Belief Scale

The spirituality of each participant is assessed using the Spiritual Involvement and Belief Scale (SIBS), a questionnaire based on a 5-point Likert format and developed by Hatch and colleagues (Hatch et al. 1998). The survey is aimed at assessing spirituality: it considers actions as well as beliefs; it is internally consistent; and widely applicable across religious traditions. It does not include religious terms, for example 'God', that may exclude those who are spiritual but do not profess an organized religion, or those who do not have Jewish, Christian or Muslim backgrounds. Higher scores on the scale are positively correlated with spirituality.

The survey included in the present study was conducted in Italian; it has been validated by translating the SIBS in Italian and translating it back in English to ensure accuracy and rule out any modification to content or meaning.

102 students responded the SIBS questionnaire, of which 57 percent are male and 43 percent are female participants, aged 18-34.

The percentage distribution of responses to each of the twenty-six items is reported in Table 8. The average scores for each item range from 2.09 to 4.65 (mean=3.33) with standard deviation ranging from 0.65 to 1.29. In terms of the single participants' score, the average of all items ranges from 71 to 99 (mean=87, SD=5.22) out of a possible maximum of 130 and an expected value of the general population of 65.

Table 8: Frequency and mean distribution of the SIBS scale item

<i>SIBS Items</i>	<i>% distribution</i>					<i>Mean</i>	<i>SD</i>
	<i>Totally Agree</i>	<i>Agree</i>	<i>Unsure</i>	<i>Disagree</i>	<i>Totally Disagree</i>		
1. In the future, science will be able to explain everything	5.7	31.4	25.7	32.4	4.8	3.33	
2. I can find meaning in times of hardship	17.1	60.0	11.4	11.4	0.0	3.01	1.03
3. A person can be fulfilled without pursuing an active spiritual life	17.1	60.0	11.4	11.4	0.0	3.83	0.85
4. I am thankful for all that has happened to me	26.7	35.2	21.0	15.2	1.9	3.70	1.08
5. Spiritual activities have not helped me become closer to other people	22.9	44.8	21.9	9.5	1.0	3.79	0.94
6. Some experiences can be understood Only through one's spiritual beliefs	5.7	8.6	36.2	31.4	18.1	2.52	1.07
7. A spiritual force influences the events in my life	9.5	33.3	15.2	29.5	12.4	2.98	1.23
8. My life has a purpose	4.8	28.6	26.7	19.0	21.0	2.77	1.21
9. Prayers do not really change what happens	37.1	43.8	16.2	1.9	1.0	4.14	0.83
10. Participating in spiritual activities helps me forgive other people	29.5	21.0	25.7	18.1	5.7	3.50	1.25
11. My spiritual beliefs continue to evolve	6.7	41.0	21.0	19.0	12.4	3.10	1.17
12. I believe there is a power greater than myself	16.2	49.5	12.4	12.4	9.5	3.50	1.19
13. I probably will not re-examine my spiritual belief	29.5	37.1	21.0	7.6	4.8	3.79	1.10
14. My spiritual life fulfills me in ways that material possessions do not	8.6	21.0	20.0	35.2	15.2	2.72	1.20
15. Spiritual activities have not helped me develop my identity	1.9	8.6	24.8	48.6	16.2	2.31	0.91
16. Meditation does not help me feel more in touch with my inner spirit	4.8	12.4	24.8	35.2	22.9	2.41	1.12
17. I have a personal relationship with a power greater than myself	4.8	17.1	36.2	26.7	15.2	2.70	1.08
18. I have felt pressured to accept spiritual beliefs that I do not agree	2.9	18.1	34.3	25.7	19.0	2.60	1.08
	4.8	14.3	9.5	27.6	43.8	2.09	1.24

with							
19. Spiritual activities help me draw closer to a power greater than myself	3.8	35.2	21.9	23.8	15.2	2.89	1.16
20. When I wrong someone, I make an effort to apology	30.5	44.8	5.7	16.2	2.9	3.84	1.12
21. When I am ashamed of something I have done, I tell	9.5	55.2	20.0	15.2	0.0	3.59	0.86
22. I solve my problems without using spiritual resources	27.6	37.1	21.0	10.5	3.8	3.74	1.09
23. I examine my actions to see if they reflect my values	26.7	58.1	13.3	1.9	0.0	4.10	0.69
24. During the last WEEK, I prayed*	66.7	21.0	8.6	1.9	1.9	4.49	0.88
25. During the last WEEK, I meditated*	41.9	29.5	14.3	3.8	10.5	3.89	1.29
26. Last MONTH, I participated in spiritual activities with at least one other person**	70.5	24.8	3.8	0.0	1.0	4.65	0.65

* item 24 and 25: Totally Agree=10 or more times; Agree=7-9 times; Unsure=4-6 times; Disagree=1-3 times; Totally disagree=0 times;

** item 26: Totally Agree=More than 15 times; Agree=11-15 times; Unsure=6-10 times; Disagree=1-5 times; Totally disagree=0 times

The use of the NEP and the SIBS responds to two needs, one instrumental and one descriptive. Combined with the visual stimuli, these questionnaires create a contextual priming. The descriptive conclusions of the questionnaires are in line with our expectations: the sample has a sensitive attitude towards both the spiritual and the environmental dimensions.

RESULTS OF PRIMING ON RECYCLING BEHAVIOR

To evaluate the contextual priming effect of the two types of images, spirituality and nature, combined with the exposure to the items contained in the two questionnaires, on the recycling behavior of the participants we used two separate, reciprocally confirming actual measurements and a self-reported measure. The first measurement is the amount of recyclable materials correctly recycled versus the amount incorrectly recycled. The second measurement refers to the tolerance of each participant towards a dirty desk. There are two major reasons why we add a proxy measurement to the actual recycling behavior observed at the recycling bins:

1. The concern that the priming effect induced by the computer tasks has an immediate effect that nonetheless fades out as participants start the actual recycling activity.
2. The observed analogies between the mindsets underlying recycling and cleaning. In addition, the physical activities of cleaning and recycling share at least two fundamental features: the necessity to exert a certain amount of effort (e.g. walking to the bins, separating garbage, sweeping, vacuuming, et cetera) and to suffer the unpleasant feeling of having to touch garbage.

Results for Self-Reported Recycling

Effort to Recycle Scale

Three groups - two primed groups and a control group - have been tested with the Effort To Recycle Scale to determine the priming effect of the selected stimuli on participants' willingness to exert any effort to recycle.

The Effort to Recycle Scale was developed by Schultz and Oskamp (1996). The study of Schultz and Oskamp reveals that situations requiring a high degree of effort strongly predict recycling behavior. They find a positive correlation between attitudes of environmental concern and willingness to participate in high effort experimental recycling programs.

The Effort to Recycle Scale consists of six questions/items presented in the form of a 10 point Likert-type scale, where 1 is 'never' to 10 is 'always'. We run the test with 312 subjects, 104 for each condition. To simplify the comparison among the different stages of experiment, we reduced the samples to 102 for each condition. We excluded 6 randomly selected non-Italian students.

The non-parametric Kruskal-Wallis H Test is run three times for paired conditions, Spirituality–Nature; Nature–Control; Spirituality–Control.

Spirituality–Nature

The Kruskal-Wallis H Test shows that the difference between the nature-primed group and the spirituality- primed group is not statistically significant (see Table 9 and Table 10).

Table 9: Rank spirituality-nature

Item	Group	N	Mean Rank
Item 1	Spirituality	102	102.92
	Nature	102	102.08
	Total	204	
Item 2	Spirituality	102	98.75
	Nature	102	106.25
	Total	204	
Item 3	Spirituality	102	103.15
	Nature	102	101.85
	Total	204	
Item 4	Spirituality	102	98.67
	Nature	102	106.33
	Total	204	
Item 5	Spirituality	102	106.03
	Nature	102	98.97
	Total	204	
Item 6	Spirituality	102	107.19
	Nature	102	97.81
	Total	204	

Table 10: Test Statistics spirituality-nature

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6
Chi-Square	.013	1.277	0.030	0.888	0.757	1.304
df	1	1	1	1	1	1
Asymp. Sig.	.908	.259	.862	.346	.384	.253

Nature-Control

As far as the pairwise comparison of nature and control, the Kruskal-Wallis H Test shows that there are statistically significant differences in two out of the six items of the Effort to Recycle Scale: Item 3 ($p=0.037$) and Item 4 ($p=0.037$) (see Table 11 and Table 12). Item 3 is about the case when the recyclable material is collected at the curb on trash day. Item 4 contemplates the case when recyclable materials are collected at a special center near the participant's house. This confirms our expectations about the priming effect.

Table 11: Rank nature-control

Item	Group	N	Mean Rank
Item 1	Nature	102	105.31
	Control	102	99.69
	Total	204	
Item 2	Nature	102	107.83
	Control	102	97.17
	Total	204	
Item 3	Nature	102	110.60
	Control	102	94.40
	Total	204	
Item 4	Nature	102	111.01
	Control	102	93.99
	Total	204	
Item 5	Nature	102	104.00
	Control	102	101.00
	Total	204	
Item 6	Nature	102	99.52
	Control	102	105.48
	Total	204	

Table 12: Test Statistic nature-control

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6
Chi-Square	0.574	2.480	4.350	4.368	0.137	0.525
df	1	1	1	1	1	1
Asymp. Sig.	.449	.115	.037	.037	.711	.469

Spirituality – Control

The spirituality-control pairwise comparison shows via the Kruskal-Wallis H Test that there is a statistically significant difference only for Item 3 ($p=0.028$) of the Effort to Recycle Scale (see Table 13 and Table 14).

Table 13: Rank spirituality-control

Item	Group	N	Mean Rank
Item1	Spirituality	102	105.50
	Control	102	99.50
	Total	204	
Item2	Spirituality	102	104.09
	Control	102	100.91
	Total	204	
Item3	Spirituality	102	110.98
	Control	102	94.02
	Total	204	
Item4	Spirituality	102	106.66
	Control	102	98.34
	Total	204	
Item5	Spirituality	102	106.29
	Control	102	98.71
	Total	204	
Item6	Spirituality	102	104.43
	Control	102	100.57
	Total	204	

Table 14: Test Statistics spirituality-control

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6
Chi-Square	0.665	0.208	4.799	1.041	0.874	0.220
df	1	1	1	1	1	1
Asymp. Sig.	.415	.649	.028	.307	.350	.639

Although not statistically significant for a large number of items across the three conditions, there is an unambiguous result about the directions of the two priming effects on self-reported recycling behavior (the control group performs better only in one item out of 12); the relative effectiveness of the priming stimuli gives mixed results.

The findings of this section of the experiment suggest that priming leads to increased efforts. The following section tests if these efforts translate into actual recycling consistently with the above-mentioned study of Schultz and Oskamp (1996). This study concludes that effort is a strong moderator of the intention-action gap and the following section is expected to confirm that nature-primed and spirituality-primed participants recycle more than the control group.

Results for Hand-Sweeping Proxy

We test the effect of contextual priming on the participants' cleaning behavior by counting the number of hand-sweeping movements to remove the crumbs on the workstation desk.

We consider only the results of the priming effect on the participants' cleaning behavior in the three groups (nature; spirituality; control) to whom were handed the blue recyclable materials. A Kruskal-Wallis H Test shows that there is no statistically significant difference in the hand-sweeping scores among the three groups: $\chi^2(2)=2.534$, $p=0.282$. However the direction of the priming manipulation can be easily detected: we have a mean rank of 84.25 for the nature condition, 76.15 for the spirituality condition and 70.61 for the control condition.

In order to understand the magnitude of the effect of the color of the plate and the paper napkin on the participants' cleaning behavior, we run a Kruskal-Wallis H Test for nature and control conditions with different colors: nature-blue, nature-grey, control-grey and control-blue. Similarly to the overall previous results, there is not any statistically significant difference in participants' hand-sweeping movements among the four groups: $\chi^2(3)= 4.341$, $p=0.227$; the mean rank for nature-blue, 116.20; for nature-grey, 102.35; for control-blue, 97.63 ; and for control-grey, 93.82. Similarly to the previous case there is an unambiguous effect of priming.

Finally, we test the effect of each priming manipulation on the cleaning behavior of the participants for the three conditions, not taking into account the color of recyclable materials. A Kruskal-Wallis H Test. shows that there is no significant difference ($\chi^2(2)= 2.766$, $p=0.251$) in hand-sweeping scores between different

priming conditions, the mean rank is 164.10 for the nature condition, 152.42 for the spirituality condition and 143.98 for the control condition. Again the forecasted direction of the priming effect is confirmed.

Results for Actual Recycling Behavior

So far we have been using either a proxy for recycling behavior or a self-reported survey. In this section the study moves to an actual observation of the responses to priming manipulation in terms of recycling behavior.

First, we calculate the results of priming for three conditions, nature, spirituality and control. The three groups are tested using the same color (blue) for the recyclable materials thus neutralizing any effect of a specific color on the priming effectiveness.

Secondly, we investigate the priming effect of a specific color by considering two groups and two conditions: the two groups differ for the color and the two conditions are nature and control.

Thirdly, we calculate the combined results for each group, ignoring the color of the recyclable materials.

The results of the first calculation are analyzed with a 3x2 Chi-Square test: where the dimensions for each condition are ‘correctly recycled’ and ‘incorrectly recycled’. We recall that ‘correctly recycled’ means that the participant dropped the paper napkin in the paper recycling bin and the plastic plate in the plastic recycling bin. The results reveal a statistically significant difference ($\chi^2(2)=19.4556$; $p=0.00006$) among the three groups (see Table 15).

Table 15: Chi-square results: 3(blue nature vs. blue spirituality vs. blue control) x 2 (correctly recycled items vs. incorrectly recycled items)

Results	Correctly recycled	Non correctly recycled	Row Totals
Nature	26 (15.00) [8.07]	25 (36.00) [3.36]	51
Spirituality	6 (15.00) [5.40]	45 (36.00) [2.25]	51
Control	13 (15.00) [0.27]	38 (36.00) [0.11]	51
Column Totals	45	108	153

The results of the second calculation are obtained using a 2x2 Chi-Square test. The results reveal no statistically significant difference ($\chi^2(1)=1.4255$; $p=0.232$) between the nature condition groups and no statistically significant difference between the control groups (see Table 16a and Table 16b).

Table 16a: Chi-square results: 2(nature-grey vs. nature-blue) x 2 (correctly recycled items vs. incorrectly recycled items)

Results			
	Correctly recycled	Non correctly recycled	Row Totals
Nature_Grey	20 (23.00) [0.39]	31 (28.00) [0.32]	51
Nature_Blue	26 (23.00) [0.39]	25 (28.00) [0.32]	51
Column Totals	46	56	102

Table 16b: Chi-square results: 2(control-grey vs. control-blue) x 2 (correctly recycled items vs. incorrectly recycled items)

Results			
	Correctly recycled	Non correctly recycled	Row Totals
Control_Grey	13 (13.00) [0.00]	38 (38.00) [0.00]	51
Control_Blue	13 (13.00) [0.00]	38 (38.00) [0.00]	51
Column Totals	26	76	102

Finally, the results of the first calculation are analyzed with a 3x2 Chi-Square test. The results reveal a statistically significant difference ($\chi^2(2)=17.2832$; $p=0.0001$) (see Table 17).

Table 17: Chi-square combined results: 3(nature vs. spirituality vs. control) x 2 (correctly recycled items vs. incorrectly recycled items)

Results			
	Correctly recycled	Non correctly recycled	Row Totals
Nature	46 (30.67) [7.67]	56 (71.33) [3.30]	102
Spirituality	20 (30.67) [3.71]	82 (71.33) [1.60]	102
Control	26 (30.67) [0.71]	76 (71.33) [0.31]	102
Column Totals	92	214	306

DISCUSSION AND FURTHER RESEARCH

The purpose of the present study is both descriptive and prescriptive. It is descriptive at multiple levels. It contributes to the understanding of one of the basic reasons for the observed intention-action gap in household recycling behavior. This reason is the recurrent dominance, in governing human behavior, of the automatic cognitive process over the conscious process. The conscious control of behavior is facilitated by strong and mostly intrinsic motivations, which, by their nature, can be primed using contextual stimuli. The effectiveness of these stimuli, especially visual, is tested in a laboratory using two specific types of motivations: moral and pro-social motivations and green consciousness. It is prescriptive insofar as the results of the experiments in terms of the characteristics of priming instruments and of the population suggest a precise course of action to the policymakers.

This study consists of a single laboratory experiment, which includes a sequence of five different findings. The first set of findings is about the effectiveness of the images that were showed to the participants. It appears that generally speaking they have the capacity to awaken emotions. For the reasons mentioned above, we concentrate on the emotional side of the images' impact, rather than arousal; the extension to arousal might represent a field for further research. It appears that the emotional valence of the nature-related images surpasses that of the spirituality-related images. In terms of the effectiveness on emotions of the images selected in each group, the degree of homogeneity varies. In the case of spirituality, one picture among the five selected has a particular arousing power. The image showing the act of meditating of a person in a yoga class evokes the highest positive emotion among participants. More generally, our evidence is that the images displaying any religious symbols, see Image 1 and 3, work less effectively in creating a positive mood. Quite the opposite occurs to the set of pictures relating to nature: four of them are equally effective; one has a negative effect. A possible explanation of the low effect is the presence of water in the four arousing images, while in the fifth image there are mostly trees. One possible extension of this research is the arousing

effect of water as a visual stimulus. The brightness of the images is another explanation. A more intriguing reason may be the negative emotions that forests have in most fairy tales: it is in the woods that children expect to have the scariest encounters. Finally, it is interesting to notice that there may be a positive effect linked to a familiar, specifically Italian, landscape, as it is the case of two of the most effective pictures; this is also a possible extension of the present research.

The second set of findings confirms that the attitude of our sample towards spirituality and nature is skewed towards the upper end of the general population distribution. Participants took the NEP and SIBS questionnaires after being exposed to the priming images. This fact does not allow us to conclude whether and how the contextual stimulus provided by the questions has increased the priming effects of the images. A useful extension of the research would be threefold: (a) testing the priming effect of images and questionnaires separately; (b) testing the effect of visual priming for each image singularly; (c) testing the different effect of visual priming between populations that score below and above average in the NEP and SIBS tests.

The last three sets of findings are summarized in Table 18 and show the direction of contextual priming on recycling. The third set of results is measured through a computer test: Effort to Recycle Scale. The second group of results is measured through the proxy of hand-sweeping the workstation desk. The third group is physically observed, counting the amount of materials correctly recycled.

Table 18: Summery of findings

	Stimuli		
	Spirituality	Nature	Control
Pleasure (1-9Likert Scale)	6.4	8.0	6.0
Arousal (1-9Likert Scale)	2.4	2.1	3.2
Self-Reported Recycling (Mean Rank)	Mean rank comparable with nature and always above of control	Mean rank comparable with spirituality and consistently above of control	Mean rank consistently below spirituality and nature
Proxy Recycling (Mean Rank)	152	164	144
Actual Recycling (Correct Recycling Rate)	0.20	0.45	0.25

The Effort to Recycle Scale gives unambiguous conclusions about the direction of priming; the relative (nature vs. spirituality) impact of priming is indefinite. Although with slight differences across the six items, overall there exists a priming effect induced by the exposure to images evoking nature and spirituality. Furthermore, we cannot conclude whether the priming effect based on a green consciousness dominates on one based on the spiritual dimension. More specifically the order of the items responds to the amount of effort involved, with Item 1 serving as a benchmark; therefore the analysis must favor Items 4, 5 and 6 to draw any conclusion. Spirituality seems a slightly more powerful stimulus.

These results seem confirmed by the observation of the correlation between the number of hand-sweeping movements and the exposure to the selected stimuli, though they are not statistically significant. There is evidence, that the color may have an effect on cleaning behavior, but we cannot give any conclusive comments at this stage.

Surprisingly enough, the results of the actual recycling performance confirm only partially the conclusions above. The difference is the negative effect of the priming induced by the spirituality-based images. The reasons for this exception can be searched either in the intrinsic weaknesses of the concept of spirituality or in the technical design of the experiment. A vague understanding of the concept of spirituality, oscillating between religion and private actions such as yoga or meditation, and a blurred connection between spirituality and green consciousness are two examples that belong to the former group of reasons. In addition, spirituality may have a compensating, negative effect on recycling behavior as it is connected to something invisible and bigger, which may 'distract' the participants from a routine and habitual activity as recycling. The latter group refers mainly to the decay of the priming effect over time. Testing the actual recycling behavior of two populations, when a different amount of time between the exposure to the visual stimuli and the performance of the recycling activity has passed, could profitably provide a further confirmation.

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Article 3

A Simulation of Householders' Recycling Attitudes Based on the Theory of Planned Behavior

INTRODUCTION

The Environmental Problem on a Global Scale

The present study addresses the problem of waste treatment disposal and the related hazardous effects on the environment. It aims at creating a solid theoretical framework to predict households' recycling behavior, one of the key remedies to the problem of pollution. Specifically, the analysis is based on a simulation model of the waste chain. Under a set of assumptions, we simulate the interactions between different agents in the waste chain: households, collection trucks, and collection centers. This simulation reveals the potential of a number of waste policies and helps the policymaker to identify the most effective levers to pull in order to maximize the benefits of a waste management system. Soft ends-paternalism is the kind of policy that is considered and nudges are the tools used.

Over the last one hundred years, rapid economic growth, coupled with urbanization and a growing appetite for consumer goods, has contributed to the rise and expansion of mass production. Most production processes and production techniques generate some form of waste. In addition, most material placed on the market is destined to become waste at one time or another. Consequently, the adverse impact of waste on the planet and on human health has become an issue of major public concern.

Global environmental problems, in particular, are due to persistent pollution in terms of accumulation of waste and emissions in the environment: global warming, ozone depletion, and loss of biodiversity are universally considered as human-imposed threats that demand immediate attention. These environmental issues are

no longer considered 'distant' or 'abstract' and put short-term economic gratification in direct conflict with long-term survival of the planet.

A number of current sociological trends lead us to believe that the waste problem will be growing over time. These trends may differ between developed and developing countries and include: overpopulation, accelerating resource exploitation and over-consumption due to higher incomes. According to 2012 United Nations projections, global population is expected to reach between 8.3 and 10.9 billion by 2050 (United Nations, 2012); a growing world population has an inevitable negative effect on the depletion of natural resources. The depletion of non-renewable natural resources, in fact, is not confined to the unsustainable extraction of fossil fuels, but it concerns also other phenomena, for example intensive agriculture and extraction of subsoil minerals. The use of natural resources in the world is expected to quadruple by 2050 and at the current rate of depletion, virgin materials alone will not be enough to satisfy the global demand (Plastics Recyclers Europe, 2013). At the same time higher global income, especially in developed countries, instigates a consumer culture. A culture of unfettered consumerism is commonly reinforced by the economic theory that a progressively greater consumption of goods is economically beneficial, if not essential, to the survival of modern economies.

Not only does waste represent an enormous loss of resources in the form of both materials and energy, but also its treatment and disposal create environmental damages and impose an enormous cost upon society. The European Commission estimates the economic costs of municipal waste and hazardous waste management alone in excess of €75 billion a year (European Commission, 2007).

Landfilling and incineration contribute to the pollution of air, water and soil as well as noise and other nuisances. Dangerous infectious illnesses, such as Dengue fever, that are prevalent in developing nations, are believed to be perpetuated by unsanitary waste disposal methods. Higher prevalence of reproductive disorders, including low birth weight, is common in areas located near existing and former landfills (Centers for Disease Control and Prevention, 2013). Finally, although

unequivocal scientific results have not been delivered, there are ‘cancer clusters’ within close proximity to landfills (Lewis-Michl, et al., 1998).

The modernization of our approach to waste, the implementation of new policies to prevent waste and the creation of a solid market for recycling are pressing problems for waste management. In this framework, recycling is one of the most important actions that households can take and the public sector should critically examine an appropriate selection of incentives.

The nature and the intensity of household recycling activities in a given geographical area depend on a wide variety of factors: some of them are more technical in nature and others are related to the demographic, sociological and economic characteristics of households. In the first category fall the organizational features of the waste management process, for example waste collection schemes and recycling technologies. The overall success of a recycling stream is a favorable combination of appropriate public policies, efficient and well-organized value chain and conscious consumers. Consumer consciousness leaves room for different declinations: one of the most studied is the one involving social norms.

Nudge and Social Norms

The scientific literature distinguishes two types of incentives that can trigger household recycling motivations: monetary and non-monetary incentives. The two types of incentives have been studied in isolation and have been the subjects of different disciplines. Typically, research in economics has studied monetary incentives and waste fees; on the other hand, psychology has been concentrating on the psychological mechanisms behind household recycling behavior. In particular, to explain the voluntary recycling behavior of households, psychology leverages on the theory of moral and social norms. An original work combining the approaches of the two disciplines is due to Brekke, Kverndokk and Nyborg (2003). Their results suggest that household recycling efforts are mostly motivated by social norms and that the introduction of financial incentives may crowd-out intrinsic motivations

and reduce household self-image leading to an undesirable effect on the intensity of recycling.

Social norms are one of the most powerful customary rules that govern behavior in groups and societies. Experiments have repeatedly established that social norms are the most compelling when people are shown evidence that the behavior they are being encouraged to adopt is already practiced by peers who resemble themselves in terms of interests, values and beliefs. Social norms work primarily at a subconscious level: for example, many of the people who respond positively to a marketing campaign relying on social norms are oblivious to what drove their behavioral change.

Social norms are a crucial theoretical building block of the nudge strategies designed for different public policy schemes. The concept of nudge, as developed by behavioral economists Thaler and Sunstein (2008), refers to any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives. It has been widely employed in many studies and experiments of environmental protection. It has been demonstrated that the activation of social norms encourages pro-social behavior of citizens (Cialdini, Reno, & Kallgren, 1990). In the study of John et al. (2011), the potential of nudges to encourage household recycling behavior was tested. Specifically, these authors were able to observe an increase of 3 percent in household recycling simply by resorting to relevant social or community influences in the form of an individual, relative 'recycling performance' feedback condensed into smiling or frowning faces (John, et al., 2013).

Theory of Planned Behavior (TPB)

Cognitive psychological modeling can be used to identify the driving forces behind recycling behavior and the success factors for public policies. Psychological literature establishes two major predictors of recycling behavior: situational and psychological variables. There are several theoretical cognitive frameworks

available to study the dynamics of these predictors and their impact on behavior; the Theory of Planned Behavior (TPB) (Ajzen, 1991) is one of the most accepted.

The Theory of Planned Behavior is a refinement of the Theory of Reasoned Action (Ajzen & Fishbein, 1980). It introduces the possibility that behavior is not completely voluntary and the notion of perceived behavior control. It also postulates the importance of behavioral intent in predicting actual behavior, such that behavioral intentions are elaborated in a rational way as they envisage the expected outcome and the related risks and rewards. According to TBP, three types of beliefs govern human behavior: normative beliefs, behavioral beliefs and control beliefs.

Normative beliefs, or subjective norms, refer to the subject's expectations for how other people will value a certain behavior. Social norms are a powerful incentive to recycle. The pressure exerted by family and friends increases the likelihood of recycling (Aceti, 2002). Furthermore, even the simple knowledge that family, friends and neighbors engage in recycling activities has a significant motivational effect. In this spirit, the importance of the social structure to which individuals belong is stressed by Stern and colleagues (Stern, Kalof, Dietz & Guagnano, 1995). These authors convincingly established that social structures affect individuals' experiences and ultimately their personal values, beliefs, and behaviors. Another study explored the possibility that subjective norms may be relevant only for subjects with high accessibility of collective self, i.e. the capacity of developing a set of impersonal bonds built on the identification with a common group (Trafimow, & Finlay, 1996). Correspondingly, Stiff and Mongeau expand on Cialdini's theory of normative behavior (Cialdini, Reno, & Kallgren, 1990) and dispute that the actual impact of subjective social norms is underestimated when it is measured by means of anonymous questionnaires administered in private settings (Stiff & Mongeau 1994).

Injunctive social norms reflect the beliefs of what other people approve of or think one ought to do. The component of TPB referred to as subjective norms belongs to the category of injunctive norms because it deals with the perceived social pressures that a defined group of people exerts on the subject. Injunctive social norms motivate action by highlighting the potential social rewards and punishments

for engaging or non-engaging in a certain behavior. On the contrary, descriptive social norms reflect the perception of whether other people actually perform a certain behavior. Descriptive norms evoke what is a typical or normal behavior and motivate action by providing evidence as to what is likely to be an effective, adaptive, and appropriate action. When the injunctive anti-littering norms are made salient, participants significantly improve their littering behavior (Cialdini et al, 1990). Institutions wanting to activate socially beneficial behavior should use procedures that activate injunctive social norms, since these norms appeared to be more general and more cross-situational effective (Mannetti, et al. 2004). Alternative models, such as the Integrative Model of Behavioral Prediction (IMBP; Fishbein, 2000; Fishbein & Yzer, 2003), are founded on the assumption that both injunctive and descriptive social norms play a crucial role in the relation between attitude and actual behavior and should therefore be modeled jointly. A meta-analysis performed by Rivas and Sheeran's (2003) seems to confirm this view and demonstrates that descriptive social norms account for an additional 5 percent to the 40 percent variance in intentions explained by TPB.

Behavioral beliefs, or attitudes, form the second component of TPB and refer to the expectations that a subject has about the consequences of a certain behavior. Intentions to recycle (paper) directly predict actual recycling and attitude towards recycling predicts recycling intentions (Boldero 1995). Moreover, two elements of the attitude towards recycling can be distinguished: an affective and a cognitive element (Davies, Foxall et al. 2002). The former consists of the emotional approach to the recycling imperative; the latter consists of the knowledge about the outcomes and consequences of performing the behavior (Tonglet, et al. 2004).

Control beliefs, or perceived behavioral control, the third component of TPB, refer to the subject's expectations about the impediments of performing a certain behavior and the resulting degree of success. These expectations can reflect past experiences, anticipation of upcoming circumstances, and the cultural framework the subject belongs to (Mackenzie & Jurs, 1993). Both behavioral control and attitudes are positively related to individuals' recycling motivations (Taylor & Todd, 1995). The

more difficult the recycling activity is perceived, the weaker the motivation to recycle becomes.

While the TBP has been successful at identifying the intention to act, there are two potential weaknesses of TPB: self-reported surveys and the dominance of injunctive social norms over descriptive social norms. The Theory of Planned Behavior entirely relies on self-reporting and this constitutes a serious limitation. Collected data on households may be unusable due to insincerity, misunderstanding of the questions, placebo effects, and even the way in which questions are phrased. In particular, people are often not aware of the influence of descriptive social norms on their actions. Self-reported surveys may not be a suitable method for understanding social norms' influence. At the same time, it is important to test the effects of both types of social norms simultaneously in order to provide a complete picture of their role in household recycling behaviors. This is the reason why we believe that, for the purpose of testing the motivations underlying recycling, a simulation is a useful complementary tool to conventional analysis.

Simulation is based on micro-level data and allows heterogeneity between individuals. It enables the creation of different types of households with different prevalence of one type of social norms over the other. Agent-based-modeling, a sophisticated simulation technique, allows the modeling of the interactions among individuals and the interactions between collective actions and a single individual's actions. Specifically, in a dynamic analysis and under different assumptions, household predisposition to social norms can change over time.

Psychological models like the TPB are indispensable tools for the policymaker. Understanding the determinants of recycling behavior is the necessary premise to forge policies capable of nudging, i.e., motivating, recycling behavior. It is still unclear how to design marketing and communication strategies to nudge people consistent with psychological findings. The aim of this paper is to contribute to bridge this gap by providing a new perspective for the theoretical decision support to local and regional authorities in the design of effective waste management policies. We will proceed by considering a number of theoretically founded nudge strategies. These strategies will be tested running a simulation model in a variety of

scenarios. The simulation technique will help to assess the dynamics of the model and the directions of the effects resulting from the interactions of the variables we will feed into the model. The nucleus of the research program is therefore a stochastic simulation model built in the framework of the TPB theory. A virtual society with agents, waste generation, and collection processes will be modeled and a set of stochastic outputs will be elaborated. The key parameters will be the amount of waste (R) produced by each agent and the proportion of this waste that is recycled (Rre) and placed at collection areas.

The TPB allows for the incorporation of a growing number of variables that can possibly contribute significantly to the prediction of behavior (Ajzen 1991). We will incorporate two selected variables that have been suggested to be the most essential determinants of recycling behavior (Frey & Oberholzer-Gee 1997; Missios & Ferrara 2011): ‘concern about environment’ (an injunctive social norm) and ‘sense of civic duty’ (a descriptive social norm). In particular, White (White, 2009) provides empirical support to this choice and shows how descriptive social norms and personal injunctive social norms, i.e. “individuals ought to recycle”, emerge as significant independent predictors of recycling intentions.

We elaborate three hypotheses based on the framework of TPB theory and test them in the simulation; they can be summarized like follows:

- *Hypothesis 1:* The more sensitive to injunctive social norms agents are, the less external conditions impact on agents’ intention to engage in recycling activity. In scenarios with an extremely low or high recycling rate, household intentions to engage in recycling activity are stable over time. In addition, in a scenario envisaging very low recycling rate, only agents with strong sensitivity to injunctive social norms will recycle. A sort of stable equilibrium would dominate.
- *Hypothesis 2:* The more sensitive to descriptive social norms agents are, the more external conditions impact on agents’ intention to engage in recycling activity. In scenarios with a low recycling rate, household intentions to engage in recycling activity are generally weak because of the demotivating effect of descriptive social norms. In scenarios with high recycling rate, household intentions to engage in recycling activity are strong because of the motivating

effect of descriptive social norms. A sort of reinforcing stable equilibrium would prevail.

- *Hypothesis 3:* The consequences of nudge strategies based on social norms applied to households are effective on the recycling rate. It is important to apply nudge strategies in the right sequence: first those activating injunctive social norms and later on those based on descriptive social norms. A sort of unstable equilibrium would characterize the model.

METHOD

The Agent Based Model Simulation

Agent simulations range from highly structured artificial worlds with few simple rules and constraints (Kohler & Gummerman, 2001) to more complex models in which agent interactions constrain subsequent iterations of the simulation (Sawyer, 2001) and/or in which multiple structural layers are considered (Stinchcombe, 2001). The construction of these algorithms is the most delicate part of the simulation analysis. In addition to the structure of the social networks, the key choice is the identification of a number of the agent's characteristics that are relevant for recycling behavior. They span from general demographic features, i.e., age, income, and education, to more specific attitudes, i.e., environmental sensitivity, self-confidence, and sense of social belonging. The second step is the selection of the most convenient characteristics to implement into the model. These characteristics are not necessarily those with the highest impact, since a careful selection has to take into account the scope of the analysis. In the current study the scope of the analysis is the comparison of the effectiveness of different public policies. Consequently, the characteristics to simulate are those that can be targeted by the policymaker. The choice of the number of characteristics to consider is a trade-off between the smooth running of the model and the comprehensiveness of the analysis. Finally, these characteristics have to be scaled, modeled and assigned a

probability distribution. Usually, the purpose of this stochastic effort is to endow agents with a 'personality': contemplating the possibility of fuzzy logic, i.e., a reasoning where logical statements are not only true or false, but range from 'almost certain' to 'very unlikely', implies a greater simulation realism as different agents act differently in the same situation. Agents with personality lead to the modeling of more complex interaction where, for example, hypotheses may be tested more effectively considering teams of agents with different personalities rather than single agents (Garson, 2009).

The Planned Recycling Behavior (PRB) Model

Our analysis of the possible outcomes of nudge policies employs an agent-based model to simulate the recycling behavior in different situations. We developed a simulation model on planned recycling agent behavior, which creates a virtual district with different agent types, waste generation and collection processes. The scaling of the agents' characteristics are derived from coefficients relating to the TPB and taken from a Structural Equation Model (SEM) on motivations of the recycling behavior developed by Chu and Chiu (2003). The SEM presents four important coefficients, which determine the recycling behavior: the environment attitudes, the subjective social norms, the perceived behavioral control and the moral obligation constructs. In the simulation, the last two factors compose a unique factor. The SEM values of the constructs mentioned are parameterized by approximate Bayesian computation, and used in the simulation as probabilistic factors of behaving.

The nudges policies represented by injunctive and descriptive social norms increase differently the values of the mentioned constructs. The realism of the simulation is enhanced by considering the actual parameters of one of the Kaohsiung City (Taiwan) districts: San-min (Diong, 2012). This parameters are also reported in the Chu and Chiu's (2003) survey. Coefficients and parameters used in the simulation are summarized in Table 1.

Table 1. Coefficients and parameters used in the simulation

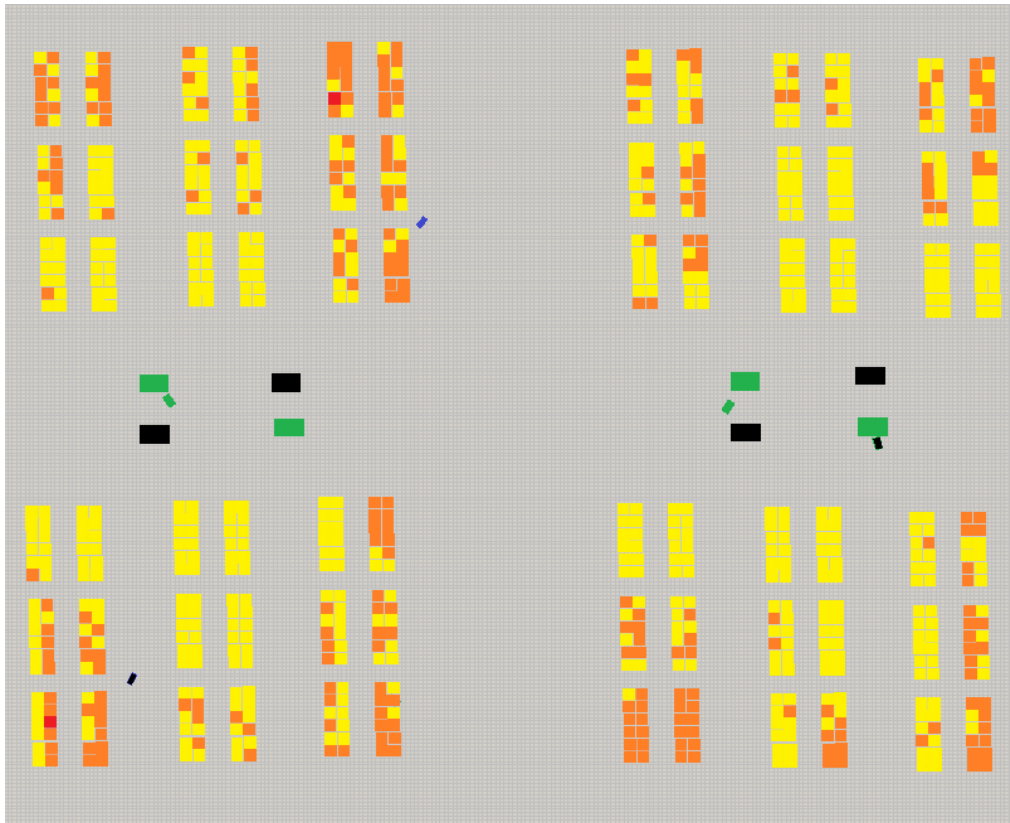
Scale	Values
Population present in the virtual district	35,3451
Total number of neighborhoods	1,100
Number of transportation systems (compose or more pick-up trucks)	8
Landfills	2
Environment attitudes	0.15
Subjective social norms	0.10
Descriptive social norms coefficient	0.74
Medium increase of recycling rate due to descriptive social norm	≈ 0.19
Medium increase of recycling rate due to injunctive social norm	≈ 0.19
Daily rubbish production for neighborhood (R and Rre) for neighborhood	427 kilo
Critical situation for a neighborhood	9 ton

To reproduce the dynamics of the city, the algorithm of the simulation consists of an open source code and is composed of three different types of agents: ‘neighborhood agents’, ‘garbage transportation system’, and ‘landfills’ (see Figure 1).

The neighborhood agent

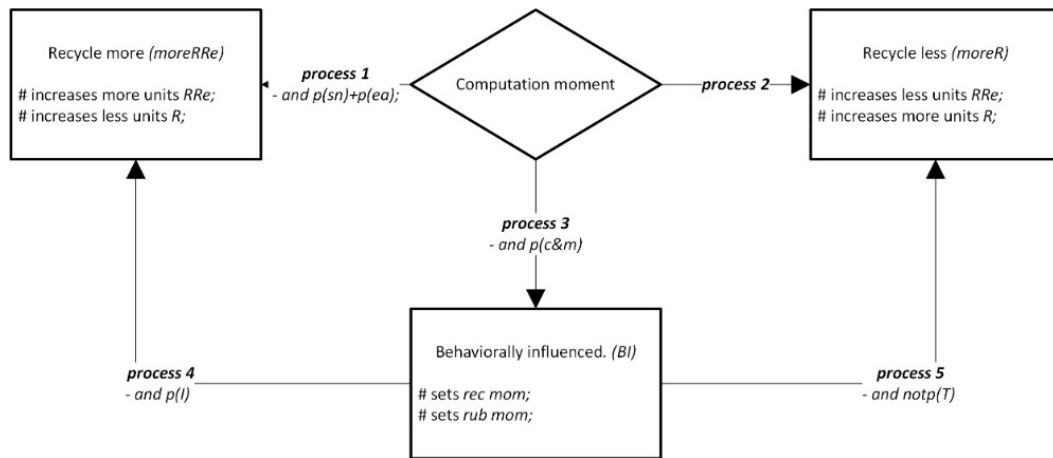
All neighborhood agents produce recycled rubbish and non-recycled rubbish. This depends on the probabilities of psychological constructs and other agent’s behaviors. Neighborhood agents recycle if they have high levels of environment attitudes and high subjective social norms. This connection is not mediated by other factors (see Diagram 1).

Figure 1. A figure from the ABM based on the PRB model. The simulation presents three different types of agents: neighborhood agents, garbage trucks and collecting points. Neighborhood agents turn color because of the level of non-recycled rubbish. When this level is equal to the critical level they turn red, orange if they are close to the critical level, yellow when the non-recycled rubbish situation is stable.



Probabilities of these psychological constructs are distributed among agents by using two Normal distributions. A neighborhood agent can also recycle if behaviorally influenced by other agents or by the environment. As for the levels of environmental attitude and subjective social norms, the coefficient of being behaviorally influenced is extracted from Chu and Chiu (2003) and is consists of a unique coefficient composed of the perceived behavioral control and the moral obligation constructs.

Diagram 1: Example of the reasoning behavior of an agent of the simulation based on the algorithm used



When an agent is behaviorally influenced, she randomly observes a neighbor agent close to her radius and is more available to produce recycled than non-recycled rubbish if the neighbor observed is recycling. On the other hand, an agent will be more inclined to produce non-recycled rubbish if neighbors are not recycling.

We define ‘peer influenced’ in recycling the proclivity of an agent to be influenced by others. The disposition to recycle over time is computed by a decay (and an inverse decay) function, based on the characteristics of human sensitivity. This function is developed starting from the conceptual model of motivation and satisfaction of needs over time (Jager & Janssen, 2012) based on the characteristics of human sensitivity.

Additionally, the environment influences the recycling behavior through peer influence. During the observation, agents also check the level of non-recycled rubbish of others. If this observed level is greater than the critical level, as reported in Table 1, the agent stops recycling. We named this effect ‘surrounding influence in recycling’, and it is computed using another decay function over time, which depends on the quantity of non-recycled rubbish present in the neighbor observed. The sum of peer influence and surrounding influence determine the probability for an agent to recycle when it is in the behaviorally influenced state.

Garbage transportation system

The model includes a transportation system that removes garbage from neighborhood agents and transports it to the collection points. The paths followed by pick-up trucks are optimized considering distance and time. Pick-up trucks move to the closest neighborhood agents to collect non-recycled rubbish and recycled rubbish. For this reason, two different types of trucks have been designed: one type collects non-recycled rubbish (green colored in Figure 1) and another one only recycled rubbish (grey colored in Figure 1). Pick-up trucks give the priority to neighborhood agents with higher non-recycled rubbish and recycled rubbish levels. Once a certain amount of rubbish is collected, garbage trucks move to the closest landfill.

Landfills

There are two types of collection points in the simulation: one for non-separated garbage and one for recycled garbage. The landfill eliminates the garbage transported by pick-up trucks over time.

The environment of the simulation

The environment of the simulation aims to reproduce a simple district composed of 1,100 neighborhood agents in a bi-dimensional space. The map is based on a square torus plane where agents consume, recycle or move. An independent variable of the environment simulation is the level of non-recycled rubbish for every neighborhood agent. When the simulation presents a value of non-recycled rubbish close to a critical level we called this condition "Rubbish ON".

The nudge policies

A second independent variable of the simulation is the use of nudge policies in the simulation. Two policies are active: an injunctive social norms policy, which increments the recycling activities of 20 percent by incrementing agents' environmental attitudes and agents' subjective social norms; and a descriptive social norms policy which increases of the same percentage the possibility to be behaviorally influenced.

RESULTS

Sixty runs of ABM simulation are conducted. They generate four scenarios, which depend on the occurrence of two specific ‘states’, i.e. ‘nudge’ and ‘rubbish’ (see Table 2). For each scenario, three variables are observed: peer influence, surroundings influence, and recycling ratio. Peer influence measures the probability that a randomly selected agent decides to recycle after realizing that another observed agent is recycling. Surroundings influence measures the probability that an agent recycles after observing ‘rubbish-free’ surroundings. Rubbish-free defines surroundings with less than 300 units of rubbish uncollected. The recycling ratio is the proportion of recycled rubbish to non-recycled rubbish.

Table 2: Scenario conditions, the occurrence of two specific states, i.e. nudge and rubbish

		State 1: Rubbish	
		OFF	ON
State 2: Nudge	ON	Scenario A (15 runs)	Scenario B (15 runs)
	OFF	Scenario C (15 runs)	Scenario D (15 runs)

The two graphs below compare the evolution of the average value of each variable for the pair ‘scenarios A and C’ and ‘scenarios B and D’. The vertical axis represents respectively the index of proportion for the recycling ratio and the index of probability for the average of the two remaining variables. The horizontal axes represent the time line; each unit of the time line corresponds to one day. The total number of days in the simulation is 1,460 or 4 years, a period that we believe to be

sufficient to assess conclusive results for the simulation and the relative effects of nudge policies.

In scenarios A and C (see Graph 1), i.e. the settings where the state rubbish is OFF and the state nudge is ON (A scenario); state rubbish is OFF and the state nudge is OFF (scenario C); peer influence and surrounding influence exhibit similar stable developments over time. The only meaningful deviation between scenario A and scenario C concerns the recycling ratio, which accounts for the nudge effect in scenario A. The increase can be evaluated at 15 percent in comparison with scenario C, a magnitude in line with the results offered by the scientific production on the recycling topic. This increment is due to the increased probability that an agent recycles when injunctive social norms apply; in fact it is clear from the graph that the higher level in the recycling ratio is largely induced by the upshift of peer influence values. Surrounding influence values do not change to a great extent because few agents achieve a critical status (see Graph 1 and Figure 2).

Graph 1: Scenarios A and C (p: peer influence; s: surrounding influence)

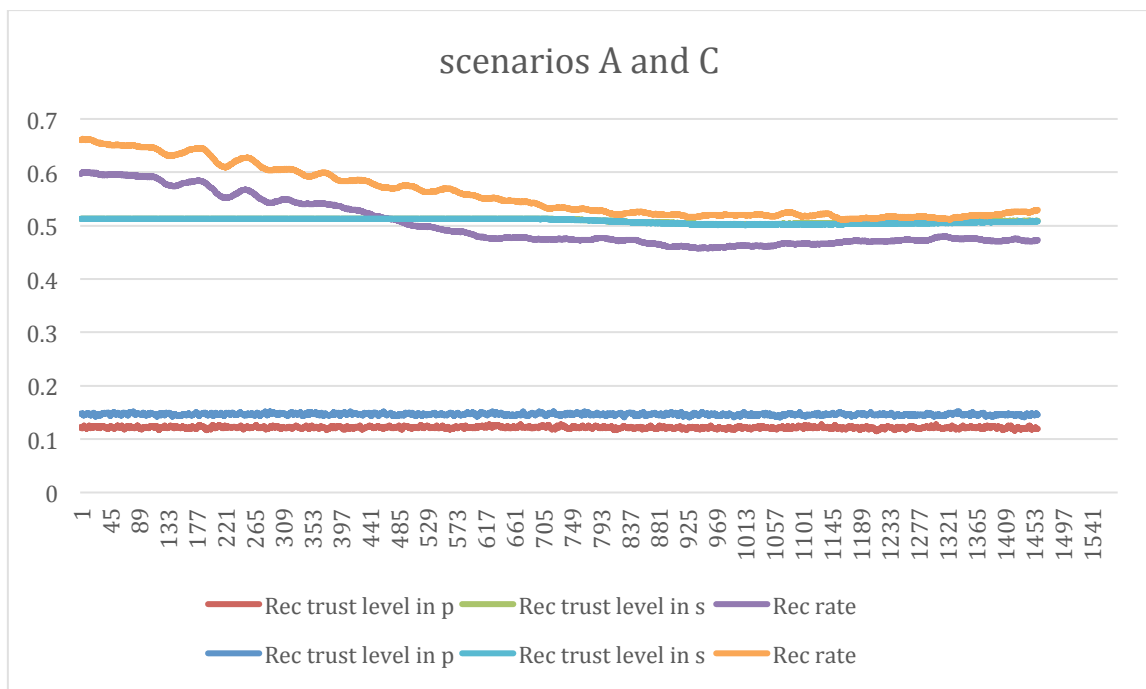
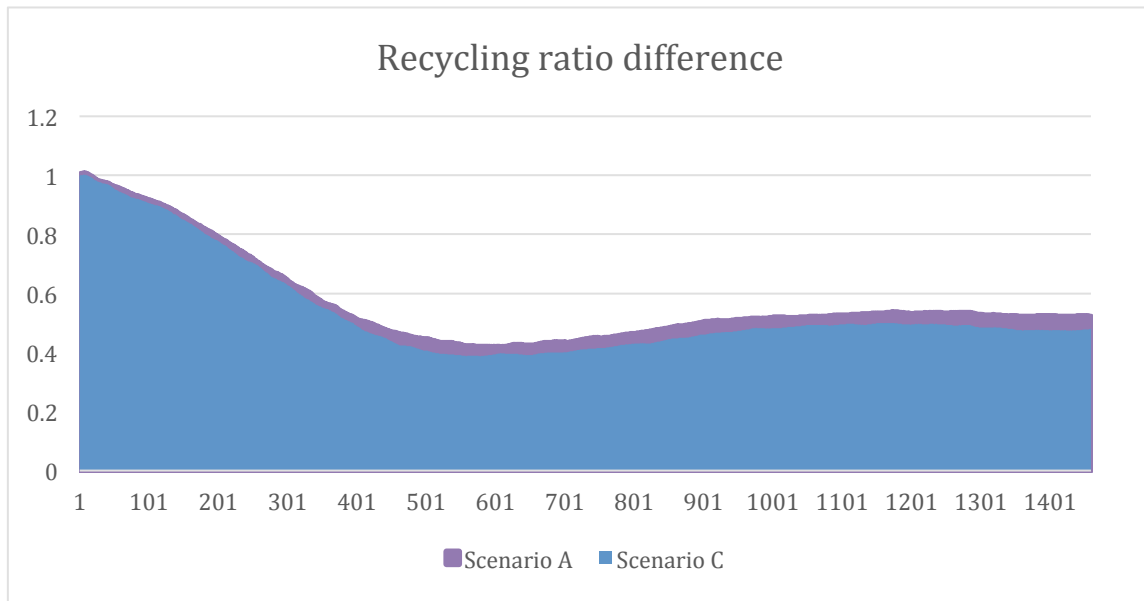


Figure 2: Recycling ratio difference



Scenarios B and D (see Graph 2), depict settings where the state rubbish is ON and the state nudge is respectively ON (B scenario) and OFF (D scenario). The state settings rubbish represent the conditions where the initial level of rubbish in the system is close to the critical level.

The peer influence exhibits stable developments over time in both scenarios. The peer influence average values start off flat, but as agents repeatedly observe each other's behavior it reaches a slightly lower stable equilibrium because of the assessment of the simulation. Similarly, average values of the surrounding influence behave in a stable way at the beginning because the amount of garbage initially present in the system is not sufficient to drive the trend away from its stable level. Once rubbish piles up, the value of surrounding influence starts to decline and it negatively impacts the recycling ratio, after a time lag of approximately 200 units of time. The graph inverts its trend at time 500, when the recycling ratio flattens out and the surrounding influence values stabilize. The initial declining behavior of the recycling ratio is justified by the assumption of a nontrivial amount of rubbish already in the system; this assumption works as a demotivating factor for recycling behavior (see Graph 2 and Figure 3).

Graph 2: Scenarios B and C (p: peer influence; s: surrounding influence)

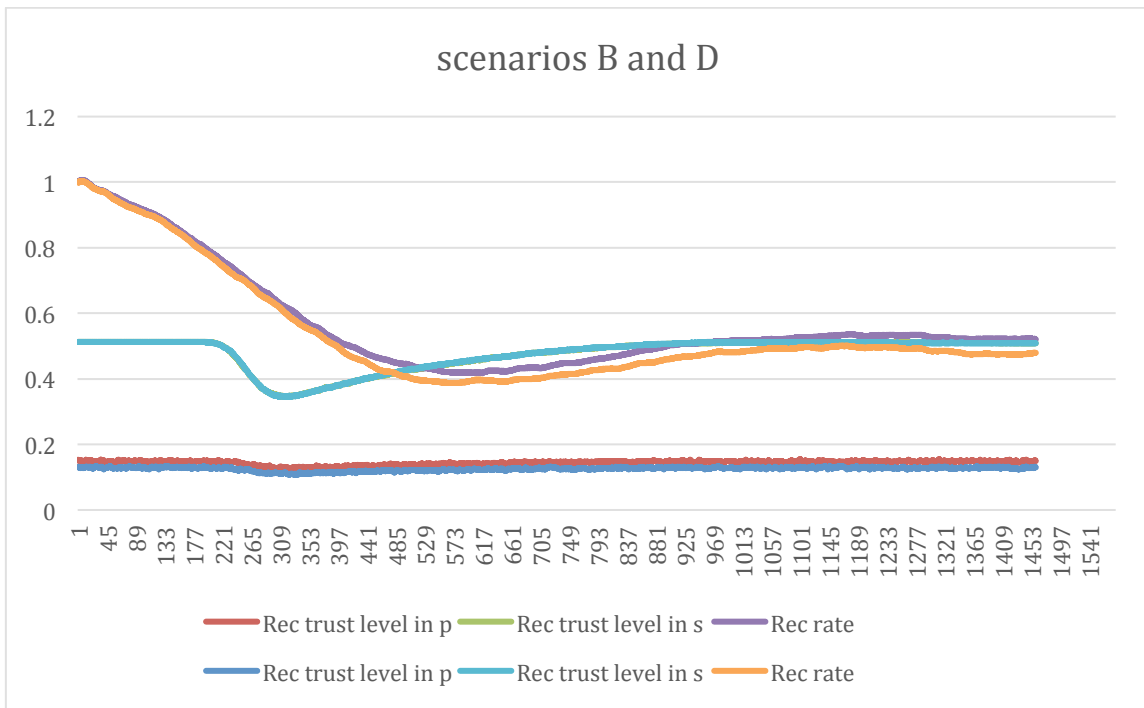
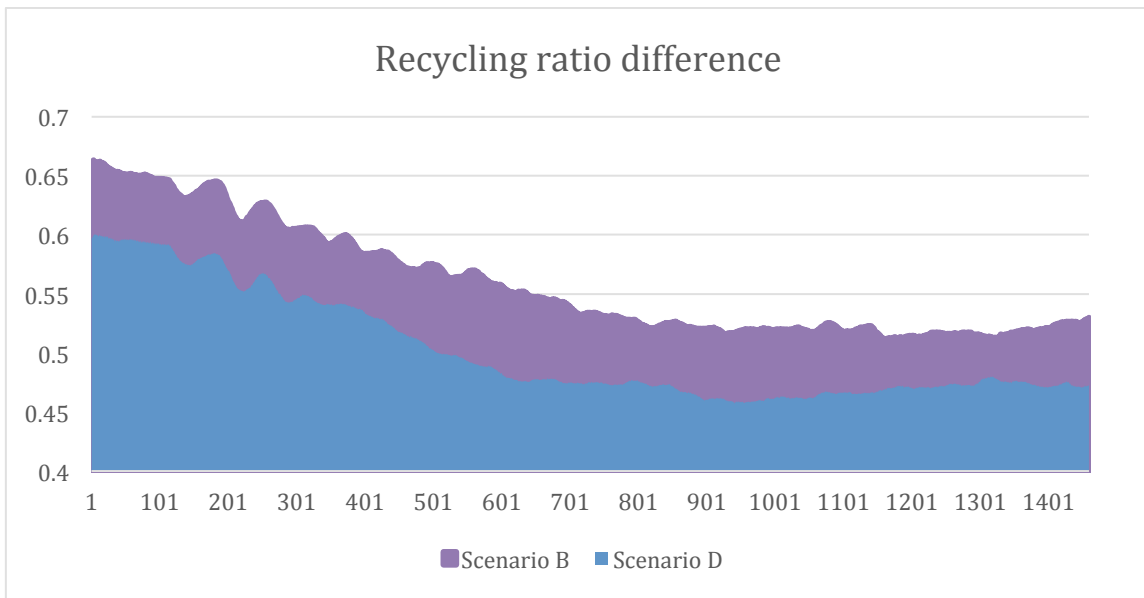


Figure 3: Recycling ratio difference



Before exploring possible confirmations from the results present in the literature, we also examined whether the initial level of rubbish (present vs. not present) and

the presence of nudges (present vs. not present) had an influence on the ratio of recycled vs. non-recycled rubbish.

To examine the ratio of recycled vs. non-recycled rubbish produced by the simulation, we ran correlation analyses for each of the 15 runs in each of the four conditions as well as for the average coefficients across each run. Results are presented in Table 3 for peer influence and in Table 4 for surrounding influence. These results suggest that the relationship between the peer influence and the ratio of recycled rubbish is generally positive but rather weak. Higher peer influence tends to increase the recycling ratio. The highest average correlation was observed for situations in which the rubbish level is high and no nudging is implemented. The relationship is weakest when no rubbish is present and nudging is implemented. However, these results do not support the notion that nudging changes the relationship between peer influence and the recycling ratio. A somewhat more dramatic effect of rubbish can be seen in Table 4, where the relationship between the surroundings influence and the ratio of recycled rubbish is quite strong and positive for simulations where no rubbish is present, and much weaker in simulations with rubbish present.

Table 3. Correlations for ratio recycled/non-recycled rubbish and peer influence

	Rubbish OFF		Rubbish ON	
	Scenario A	Scenario C	Scenario B	Scenario D
Run 1	.061*	.070**	.001	.105***
Run 2	.063*	.062*	.121***	.079**
Run 3	-.003	-.006	.166***	.106***
Run 4	.115***	.070**	.170***	.091***
Run 5	.015	.051 ⁺	.153***	.102***
Run 6	.028	.115***	.142***	.115***
Run 7	.085***	.055*	.144***	.202***
Run 8	.019	.041	.186***	.142***
Run 9	.094***	-.068**	.073**	.154***
Run 10	.057*	.040	.142***	.107***
Run 11	.082**	.043	.202***	.111***
Run 12	.098***	-.002	.151***	.116***
Run 13	.113***	.010	.115***	.101***
Run 14	-.033	-.009	.102***	.047 ⁺
Run 15	.103***	.051*	.135***	.153***
Average	.176***	.107***	.202***	.178***

Table 4. Correlations for ratio recycled/non-recycled rubbish and surroundings influence

	Rubbish OFF		Rubbish ON	
	Scenario A	Scenario C	Scenario B	Scenario D
Run 1	.690 ^{***}	.704 ^{***}	.104 ^{***}	.124 ^{***}
Run 2	.551 ^{***}	.647 ^{***}	.258 ^{***}	.177 ^{***}
Run 3	.750 ^{***}	.724 ^{***}	.229 ^{***}	.125 ^{***}
Run 4	.658 ^{***}	.549 ^{***}	.192 ^{***}	.180 ^{***}
Run 5	.575 ^{***}	.637 ^{***}	.196 ^{***}	.166 ^{***}
Run 6	.748 ^{***}	.515 ^{***}	.111 ^{***}	.225 ^{***}
Run 7	.748 ^{***}	.496 ^{***}	.204 ^{***}	.261 ^{***}
Run 8	.619 ^{***}	.629 ^{***}	.157 ^{***}	.157 ^{***}
Run 9	.777 ^{***}	.718 ^{***}	.174 ^{***}	.135 ^{***}
Run 10	.744 ^{***}	.679 ^{***}	.157 ^{***}	.111 ^{***}
Run 11	.687 ^{***}	.443 ^{***}	.261 ^{***}	.144 ^{***}
Run 12	.804 ^{***}	.627 ^{***}	.255 ^{***}	.169 ^{***}
Run 13	.770 ^{***}	.687 ^{***}	.225 ^{***}	.108 ^{***}
Run 14	.805 ^{***}	.566 ^{***}	.166 ^{***}	.154 ^{***}
Run 15	.538 ^{***}	.605 ^{***}	.215 ^{***}	.196 ^{***}
Average	.762 ^{***}	.685 ^{***}	.194 ^{***}	.161 ^{***}

Finally, we also examined whether the initial level of rubbish (ON vs.OFF) and the presence of nudges (ON vs. OFF) had an influence on the ratio of recycled vs. non-recycled rubbish. We conducted a 2x2 between-subjects analysis of variance (ANOVA) that treated each of the 15 data runs in each of the cell as independent. The dependent variable was the average ratio over all 1,460 time points in each simulation.

Results showed that the ratio was significantly higher in the nudging condition ($M=.56, SD=0.01$) than in the no-nudging condition ($M=.51, SD=0.04$), $F(1,56)=45.4, p<.001, \eta^2=.448$. Additionally, the ratio was significantly higher when rubbish (state rubbish ON) was present, ($M=.55, SD=0.02$), than when no rubbish (state rubbish OFF) was present at the start of the simulation ($M=.52, SD=0.05$), $F(1,56)=16.5, p<.001, \eta^2=.227$. A significant interaction reveals that the effect of nudging was stronger when zero rubbish (Scenario C) was present in the system, $F(1,56)=7.5, p=.008, \eta^2=.118$. A similar ANOVA with peer influence as a dependent variable showed that nudging increases the mean level of peer influence, ($M=.15, SD=0.005$; $M=.12, SD=0.009$, for nudging vs. no nudging, respectively), $F(1,56)=152.5, p<.001, \eta^2=.731$. Neither the level of rubbish nor the interaction was statistically significant ($ps>.11$). Finally, a similar ANOVA with surroundings influence as dependent variable revealed only a main effect of initial rubbish level, with higher

surroundings influence with zero rubbish (Scenarios A and C) ($M=.51$, $SD=0.001$) than with rubbish (Scenarios B and D) ($M=.48$, $SD=0.002$), $F(1,56)=3137.8$, $p<.001$, $\eta^2=.982$. The main effect of nudging had no impact, and neither did the interaction ($ps>.37$).

Taken together, the results of the ANOVA suggest that the effect of nudging can be seen particularly in the level of peer influence, while the effect of rubbish is visible particularly in the surroundings influence. It is noteworthy that although nudging affects the mean level of peer influence, it does not increase the correlation between peer influence and recycling ratio (see Table 3). Both nudging and rubbish level affect the ratio of recycled trash, with nudging working particularly well when no rubbish is present in the system.

DISCUSSION

The present study investigates the determinants of recycling behavior of households through a simulation performed via agent-based modeling. Specifically, we examine the effectiveness of different nudges to be used in informing public policies about waste management.

Agent-based models allow the simulation of the efficacy of different recycling campaigns under identical conditions, i.e., a macro-analysis or top-down analysis, and, at a later stage, allow the simulation of specific public policies under different conditions, i.e., a micro-analysis or bottom-up analysis. Moreover, agent-based models are largely built on algorithms that describe the behaviors of agents, identify their causal effects and specify critical parameter estimates. Therefore, stochastic simulation, while retaining its versatility, is also time-effective and cost-effective.

Four scenarios of ABM simulation are conducted. Each of the four scenarios is produced according to the combined occurrence of two specific features: the presence of nudge strategies and the presence of an initial level of rubbish in the system. The ANOVA results reveal that both the nudge strategies and the initial level of rubbish affect the recycling ratio of the model.

The results of our model show that the most effective strategy under consideration to induce householders to recycle is to introduce descriptive social norms in public policies. Simultaneously, it is important to consider also the recycling facilities and infrastructures and the context of the area targeted by the policymaker. The results of the model employed in this research confirm that the context in terms of the amount of rubbish sitting idle in the system has a prime influence on the effectiveness of a nudge-inspired public policy.

These findings are consistent with the mainstream literature and with the actual attempts to build successful public policies to address the recycling challenge. An actual evidence of the importance of the context is the case of Naples, a metropolitan area in south of Italy. In 2008, the city went through a rubbish emergency which left uncollected waste in the streets for several days. The visual impact created a vicious circle where household demotivation to recycle reinforced and created a national crisis. In scientific jargon this vicious circle embodies the effects of descriptive social norms. The failure to recycle in neighborhoods infested with rubbish diffusing at an accelerating rate was reproduced in the simulation presented in this research. Moreover, the mainstream literature about social norms and littering confirms that in a 'dirty' environment participants tend to litter more than those exposed to a 'clean' environment (Cialdini et al., 1990).

Three major sets of questions could be addressed to the present research. The first concerns the critiques intrinsic to any family of models, including the agent-based models. The first and most obvious critique is that human beings are more complex and intelligent than the agents stylized in the model. Yet, by reducing household motivations to those of stylized agents, complex interactions can be codified. The second intrinsic limitation is that agent-based models are stochastic: it is important to understand what this means for interpreting model results. The second class of potential questions is about the number and the choice of the variables considered in the model. In order to make the model manageable we restrained the independent variables to eight; we remain aware that variables like education, income, age and the characteristics of the area where households live play a significant role in defining recycling behavior. The choice of variables has been

informed by the object of interest: nudges based on social norms. The third class of questions attains to the quantification of the parameters used in the model. These parameters have been elaborated on the basis of Chu and Chui's work: they refer to a specific region of Taiwan and therefore might not reflect the peculiarities of other areas of the planet. Among these peculiarities, one should take into account cultural factors, cities' layouts, public policies and lifestyles. To overcome this limitation, further sensitivity analysis on some key parameters would be recommended.

The three hypotheses that we have advanced take into account the stochastic nature of the model and have to be verified in terms of average values and long-run equilibrium.

No unquestionably conclusive results can be drawn about Hypothesis 1. One of the key features of the model is that the initial proportion of households exhibiting sensitivity to injunctive social norms at the extremities of the scale is low, i.e. the consequence of the thin tails of the normal distribution. Therefore extremely high or low recycling ratios are unlikely to be achieved. Extremely high or low recycling ratios can be defined in an interval around either 1:10 or 10:1. We believe that this initial assumption is not far from the actual observation of psychological constructs. The results anticipated by Hypothesis 2 are confirmed, although the model is built in a way such that the effect of descriptive social norms does not dominate in the long run over other factors. The propositions contained in Hypothesis 2 are particularly evident in the first 500 days of the graph referring to the scenarios with initial dirty environment; the recycling ratios decrease fast. At the critical points the recycling ratios rebound slightly and flatten at a ratio of about 1:3. This is the effect of other factors taking over, mainly the state of the surroundings. Reality seems to confirm the non-dominating characteristic of descriptive social norms. The average recycling rate in Europe is about 35 percent and the highest performance of single countries does not go above 65 percent. Our forecasts, as stated in Hypothesis 3, are satisfactorily met. The effectiveness of nudges is gauged by the difference between the two recycling ratios in both graphs. These gaps show different behaviors. In the scenario with an initial clean environment the gap is significant and stable over time. In the scenario with an initial dirty environment, the gap is not observable at

the beginning before the critical time but it grows and stabilizes afterwards. The reason of this widening effect is the importance that the model attributes to the state of the surroundings. The fact that the effect of nudges is wiped out by the state of the surroundings fully validates our hypothesis that the sequence with which nudges are applied matters: injunctive social norms are a pre-requisite to the smooth implementation of policies based on descriptive social norms.

CONCLUSIONS

The present research reaches two sets of conclusions. The first set of conclusions refers to a quantitative analysis of the output of a simulation model. These conclusions are still preliminary and further sensitivity analyses of the model are recommended. Precisely, this simulation analysis helps to understand the theoretical connections between household actions and collective behavior in a simplified environment, providing a sense of the directions impressed to certain psychological constructs by external psychological stimuli. These directions are a necessary preliminary step for the second set of conclusions.

The second set of conclusions provides a number of general guidelines to design and implement an effective recycling public policy and include the appropriate tools and timing. Nudges prove to be valuable tools and the sequence with which different types of nudges are applied matters: nudges inspired by descriptive social norms are more powerful when preceded by nudges inspired by injunctive social norms.

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CONCLUSIONS

A brief summary of the scientific evidence contained in this dissertation requires a clear distinction between two levels of conclusions: findings about the instruments that are used to retrieve concepts and findings about the capacity of these concepts to induce in the subjects tested either a commitment to recycle or an actual recycling behavior. The first group of findings is instrumental to the experimental sessions of this dissertation but it also contains important evidence per se. This evidence can be used in further research and by other researchers. The second group of findings relates to the capacity of the selected stimuli to alter recycling behavior in a permanent way.

All strengths and weaknesses of a laboratory experiment and a simulation computer model apply also to this dissertation, but the distinction above adds one more limitation. In fact, any final piece of evidence revealing the capacity of a prime to induce a virtuous recycling behavior must be the fortunate combination of an effective priming instrument and a proper conceptual stimulus. When evidence reveals that the prime lacks this capacity, it is impossible to conclude whether it is due to an ineffective priming or to a weak conceptual stimulus. Further research in this direction is recommended: a matrix of stimuli and concepts to disentangle any observed negative effects should be used.

The preliminary objective of the first part of Article 1 was the formation of a collection of words useful to retrieve the stereotypes of the environmentalist and the conscientious citizen. The choice of these key words has been made on the basis of a synthetic measure of impact. The inclusion of any word takes into account three elements: a) its frequency of appearance in a Word Association Test; b) its weight as assigned by a Social Network Analysis; c) its classification along two axes: a syntagmatic taxonomy and classes of association. The experiment shows some interesting unambiguous conclusions. First of all, environment is perceived as the ultimate dimension of reality, while the concept of duty elicits a number of abstract ideas (e.g. friendship, responsibility, et cetera) or precise causes (e.g. government, family, school, et cetera). Secondly, the concept of environment is richer in

associative words than the concept of duty, which is less articulate but more segmented in meanings. The feelings aroused by the two stimuli are also very different: the anxiety connected to the frailty of nature and its need for protection (e.g. safety, recycling, cure) conflicts with the feeling of peace brought by the beauties of nature (landscapes, animals, flowers) that emerges from the stimulus named environment. Finally, the list of associative words referring to the concept of duty contains a higher proportion of verbs in the infinite form than the list referring to the concept of environment: this suggests the requirement for action included in the idea of duty.

The instrument used in the second section of Article 1 to prime the subjects is a Scramble Sentence Test consisting of ninety key associative words as emerging from the previous section. The evidence formed by the observation of actual recycling behavior distinguishes between commitment to recycle and the strength of that same commitment. The commitment to recycle induced by the idea of nature is unquestionably stronger than the commitment to recycle induced by the idea of civic duty. Again, it is impossible to weigh a direct causal relationship between the concept of duty and of descriptive social norms on the one side and the poor performance of this form of semantic priming on the other.

The evidence about the effect of the two stereotypes on the intensity of the commitment to recycle is less conclusive. The analysis considers the performance of the control group as a benchmark of the physiological rate of mistakes in dropping the recyclable materials in the wrong bin (55.6 percent). The results are surprising: both the subjects exposed to the environment prime and those exposed to the duty prime made a total number of mistakes higher than the control group (57.2 percent and 78.3 percent respectively). The extraordinary difference in the case of the civic duty is likely to be the result of social norms: descriptive social norms have a self-reinforcing effect. This self-reinforcing effect is analyzed in more details in the computer simulation reported in Article 3, which assumes descriptive social norms as one of the drivers of the model.

The same preparatory work of Article 1 had to be done also for Article 2. In this case, the evaluation of the stimuli concentrates only on one of the two stimuli that

have been used in combination: the visual stimulus. The conceptual stimulus is provided through two questionnaires that need no validation. The visual stimuli, consisting of ten images, five images for the stimulus of spirituality and five for the stimulus of nature, have been evaluated via a Manikin's emotional valence scale. The results show that the emotional valence of the nature-related images surpasses that of the spirituality-related images. In the case of spirituality, one picture stands out and has a particular arousing power. The image showing the act of meditating of a person in a yoga class evokes the highest positive emotion among participants. More generally, the evidence is that the images displaying any religious symbol work less effectively in creating a positive mood. Quite the opposite occurs to the set of pictures relating to nature: four of them are equally effective; one has a poor effect. A possible explanation of the low effect is the presence of water in the four arousing images; while the fifth image, a forest, is darker and somehow creepy. Finally, it is interesting to notice that there may be a positive effect linked to a familiar landscape, as it is the case of two of the most effective pictures.

The actual direction and intensity of the influence of the concepts of spirituality and nature has been measured in three independent ways. The first is a self-reported survey about the effort to recycle. The second way utilizes a proxy of recycling: the number of hand-sweeping movements that each participant undertakes to get rid of the crumbs on the workstation desk's surface. The third measure is based on actual observations of how subjects recycle a plastic plate and a paper napkin. The degree of uniformity of the conclusions drawn from the three measures is quite high. The first measure gives evidence of a slight priming effect on students' desire to exert more effort for recycling, for both contextual stimuli. The second measure confirms that there exists a correlation between the number of hand-sweeping movements and the exposure to images of spirituality and nature. The third measure reports a counterintuitive effect of the priming manipulation induced by the images of spirituality and positive effect of the priming of the images of nature. The reasons for this unexpected effect can be searched either in the intrinsic weaknesses of the concept of spirituality or in the technical design of the experiment. A vague understanding of the concept of spirituality, oscillating between religion and private

actions such as yoga or meditation, and a blurred connection between spirituality and green consciousness are two possible examples. In addition, spirituality may have a compensating, negative effect on recycling behavior as it is connected to something invisible and bigger, which may 'distract' the participants from a routine activity as recycling.

Article 3 examines different forms of nudges based on the priming effect of some salient concepts. The effectiveness of these nudges and the results of their interaction with other factors, such as descriptive social norms and agents' personal attitudes towards recycling, are evaluated. These results should be made available to policymakers to assist them in designing efficient recycling-oriented public policies. The instrument used to elaborate final results is a systemic, reiterated Agent Based Model simulation with a number of actors with adjusting characteristics.

The main conclusion confirms the original theoretical intuition of this dissertation: when dealing with recycling activities, System 1 dominates over System 2. The simulation confirms also that it is possible to change in a permanent way the behavioral output of System 1. A new stable self-reinforcing virtuous equilibrium is reached when System 2 takes control at an early stage of the process, i.e. at an early stage of the public policy. In fact, there is more than the idea that in a dynamic set-up, both nudge strategies, injunctive social norms and the initial level of rubbish, i.e. self-reinforcing descriptive social norms, determine the resulting recycling ratio. The results of the simulation corroborate the hypothesis that the effect of nudges depends upon the state of the surroundings in terms of collected and recycled rubbish. This implies that the sequence with which nudges are applied matters: descriptive social norms are a pre-requisite to the smooth implementation of policies based on injunctive social norms.