

HOUSEHOLD COOPERATION IN WASTE MANAGEMENT: INITIAL CONDITIONS AND INTERVENTION

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Abstract. The need to divert municipal solid waste away from landfill is an important policy goal in many countries, and the possibility that households cooperate in this endeavor, an oft pursued solution. There is a vast body of theoretical and empirical work which provides insights on the kind of household conditions and intervention that may stimulate such cooperation. This paper reviews the relevant literature in environmental and behavioural economics and synthesizes it around two themes: (1) initial conditions conducive to cooperation (including household motives and constraints and, by association, the demographics of cooperative households) and (2) intervention that may stimulate (or suppress) cooperation. Three distinct attributes of intervention are examined in particular detail, namely convenience, charges and communication. The paper concludes by providing a succinct set of cues for policy-makers and scheme-operators wishing to stimulate household cooperation in waste management, and by identifying gaps in the literature which merit further research.

Keywords. Charges; Communication; Convenience; Cooperation; Household; Waste

1. Introduction

Few environmental problems exemplify market-failure better than the problem of solid waste does. Its generation, a direct by-product of economic production and consumption, is intimately linked to economic activity and likely to remain so for the next few generations (Kinnaman, 2009; Ferrara and Missios, 2012). This comes at considerable economic cost: besides the costs of collection and transportation (and associated risks), as well as land acquisition, and infrastructural operating and closure costs (Adhikari *et al.*, 2010), waste generates well-documented environmental externalities (Kinnaman, 2006).

In several countries around the world, landfills are still the main solution for this waste stream (OECD, 2008). Associated external effects may include dust, odour, noise, pests, accident risk, air and climatic emissions (notably methane) and various discharges to soil, to ground/surface water bodies and to the marine environment. This can lead to their contamination, to negative health effects and to harmful effects on biodiversity and economic activity (Hoornweg and Bhada-Tata, 2012; European Environmental Agency, 2013). Other end-of-pipe solutions, such as incineration, are also associated with air and climatic pollution (Linderhof *et al.*, 2001; Edgerton *et al.*, 2009). Illegal storage or disposal of waste imposes even greater risks (Kuo and Perrings, 2010). While infrastructure in developed countries is increasingly built to mitigate environmental damage, this reduction in external costs comes at the expense of higher *explicit* costs. Policy-makers face a tough job in weighing the environmental and consequent socio-economic costs of poorly-managed waste against the (capital and running) costs of infrastructure, the (administrative,

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implementation and enforcement) cost of policy-design, and the possible losses in utility and productivity resulting from intervention.

Household waste is considered to be a particularly problematic source of waste (European Environmental Agency, 2009, 2013), and constitutes the bulk of Municipal Solid Waste (MSW) worldwide. World Bank projections suggest that, globally, MSW has increased from 0.7 billion tonnes per year in 2002, to 1.3 billion tonnes in 2012. It is forecast to rise to approximately 2.2 billion tonnes per year by 2025 (Hoorweg and Bhada-Tata, 2012). This increase is driven both by larger numbers of urban residents (estimated to rise from 2.9 billion in 2002 to 4.3 billion in 2025) and by higher per capital disposal rates (forecast to increase from 0.64 per person per day in 2002, to 1.42 per person per day in 2025). These, in turn, are associated with higher incomes, more intensive use of packaging materials and more disposable goods.

An oft adopted policy solution to reduce household waste going to landfill, is to encourage its separation at source into recyclable or compostable components. Even if the cost of household time, storage, transportation, infrastructure, and management systems may not always be significantly outweighed by the non-market social benefits of reducing environmental externalities, the goal of increasing household participation in waste separation is one that is vigorously pursued in several countries and regions (Kinnaman, 2006). Sometimes this policy stems from mandatory supra-national goals, as is the case in European Union countries (Kinnaman, 2006; European Environmental Agency, 2009, 2013). Certainly, the net benefits are larger when one considers the potential of reducing virgin material use (Dijkgraaf and Gradus, 2004; Ferrara and Missios, 2005), although rates of recovery vary between material types, and the reconversion process itself may use considerable amounts of energy (Hoorweg and Bhada-Tata, 2012). Whether separation/recycling activities are substitutive of waste reduction efforts by households constitutes still another complication, though studies generally find both outcomes to work in tandem (e.g. Van Houtven and Morris, 1999; Dijkgraaf and Gradus, 2004; Dahlén and Lagerkvist, 2010; Bucciol *et al.*, 2015).

The extent of policy intervention in the domain of household waste separation and recycling participation is mirrored by the voluminous economic research on the determinants of household cooperation in such activities. Spanning at least four decades, this literature is rich and nuanced, and includes a well-developed theoretical backbone that started with models of waste production (Wertz, 1976), and was later extended to consider recycling and illegal disposal (Fullerton and Kinnaman, 1996). Building on economic theories of altruism in the field of public goods (Andreoni, 1990), and upon insights on altruistic, moral and environmental behaviour from the field of social psychology (Schwartz, 1970; Schwartz, 1977; Stern, 2000), recent theoretical work has turned its attention to household motives, and the way in which these may interact with recycling intervention (Brekke *et al.*, 2003; Bruvold and Nyborg, 2004; Brekke *et al.*, 2010).

The main muscle of this literature lies, however, in the range of applied studies which seek to ascertain the determinants of household waste generation and cooperation under different intervention regimes and in different contexts. Applied work in this field typically proceeds by deriving and estimating a reduced-form equation, or system of equations, and employing data drawn from one or more municipalities, or across an entire country. Much work on the economics of recycling is, in fact, based on aggregated cross-sectional, or panel data (e.g. Wertz, 1976; Callan and Thomas, 1997, 2006; Kinnaman and Fullerton, 2000; Berglund and Matti, 2006; Beatty *et al.*, 2007; Hage and Söderholm, 2008; Sidique *et al.*, 2010). This said, household-level survey-based data has become increasingly popular in economic analysis of recycling behaviour (e.g. Thøgersen, 1994; Van Houtven and Morris, 1999; Jenkins *et al.*, 2003; Berglund, 2006; Saphores *et al.*, 2006; Hage *et al.*, 2009; Sidique *et al.*, 2010). The use of experimental or quasi-experimental techniques characterizes some of the more recent efforts to understand the determinants of cooperation in the field (e.g. Bernstad, 2014; Czajkowski *et al.*, 2014).

In examining the extent of household cooperation in waste management, economic papers have mainly focused on waste separation rates, that is, recycling waste as a fraction of total waste generation

(see for instance Callan and Thomas, 1997; Ando and Gosselin, 2005; Hage and Söderholm, 2009; Dahlén and Lagerkvist, 2010; Kuo and Perrings, 2010; Abbott *et al.*, 2011; Bel and Gradus, 2014; Lange *et al.*, 2014). In some instances authors focus on rates of recycling in single streams of waste (e.g. bottles in Viscusi *et al.*, 2011), while in others, the analysis extends to multiple streams (e.g. Ferrara and Missios, 2005). In some studies, recycling weight per capita was considered as the key dependent variable (e.g. Bartelings and Sterner, 1999; Yau, 2010; Briguglio *et al.*, 2015). This figure naturally captures not only changes in separation effort but also in waste generation itself (Yau, 2010), a concern which is also the case when cooperation is captured by recycling waste volumes (e.g. Nestor and Podolsky, 1998; Dijkgraaf and Gradus, 2004; Dahlén and Lagerkvist, 2010).

Some work has sought to capture the extent of household cooperation by quantifying the effort or the time spent on recycling (e.g. Reschovsky and Stone, 1994; Jenkins *et al.*, 2003; Meneses and Palacio, 2005; Meneses, 2010; Sidique *et al.*, 2010), including, for instance, recycling frequency (Barr, 2003), the number of waste fractions sorted (Ferrara and Missios, 2005; Czajkowski *et al.*, 2014), and the time dedicated to rinsing/separating waste (Berglund, 2006). The broader literature in psychology also considers intent to recycle and attitudes towards waste management as variables of interest (Hornik, 1995). This is the case in a handful of the papers reviewed here, some of which focus on attitudes (e.g. Valle *et al.*, 2005; Berglund, 2006), others on intent (Taylor and Todd, 1995; Barr 2004; Knussen and Yule, 2008; Bezzina and Dimech, 2011; Lange *et al.*, 2014). A small number of recent papers assess willingness to pay for recycling providing a monetary value of the net marginal cost of cooperation to households (Bruvoll *et al.*, 2002; Berglund, 2006).

Turning to the determinants of cooperation, while the early focus of applied work lay on demographic characteristics which could predict participation (e.g. Callan and Thomas, 1997; Hong and Adams, 1999), more recent work on recycling economics has also focused on the moral underpinnings of cooperation by household members (Brekke *et al.*, 2010; Viscusi *et al.*, 2011; Abbott *et al.*, 2013). In assessing the role of intervention, by far the strongest emphasis in economic studies on household waste has been on the responsiveness of households to convenience-based attributes and to monetary incentives, both of which change the cost-benefit trade-off faced by households (Reschovsky and Stone, 1994; Van Houtven and Morris, 1999; Jenkins *et al.*, 2003; Kinnaman, 2009; Kinnaman and Takeuchi, 2014). The role of communication as part of the intervention toolkit has received far less attention, not just in recycling, but in environmental economics more generally (Glaeser, 2014). Nonetheless, useful insights can be drawn from economic research on public goods and social dilemmas (e.g. Ledyard, 1995; Ahn *et al.*, 2010) as well as from work in the field of economic psychology on framing and priming to stimulate cooperation in environmental decisions (e.g. Ölander and Thøgersen, 2014).

A handful of studies have assessed participation in *mandatory* recycling schemes, where fines operate in the case of non-compliance. A review of the impacts of this more heavy-handed style of intervention falls outside the remit of the present survey where household cooperation is considered to be *voluntary*, even if stimulated by convenience, charges or communication intervention. Nonetheless, it is worth noting an early assessment in the literature, which finds that, though fines may work in tandem with convenience, making recycling mandatory without providing convenient infrastructure is likely to be both unpopular and ineffective (Reschovsky and Stone, 1994). Neither Kinnaman and Fullerton (2000) nor Jenkins *et al.* (2003) find any significant positive effect on recycling in scenarios where recycling is mandated (Kinnaman and Fullerton, 2000; Jenkins *et al.*, 2003). A more recent study suggests that mandatory recycling can harm personal motivation for recycling (Ferrara and Missios, 2012). Whether recycling is mandatory or not can be a moot point - if it is neither enforced by fines, nor perceived as such by households (Bruvoll *et al.*, 2002). The relationship between a fine and participation may also be diluted by low probabilities of detection and punishment (Akers, 1990).

The sections that follow review the literature on the determinants of household cooperation in waste management activities, detailing both the kind of initial household conditions that may lead to household

participation in waste management activities, as well as the role that the design of scheme intervention plays in stimulating such cooperation. Section 2 examines the motives and the constraints that households may face in managing their waste, as well as the kind of demographics that tend to characterize participative households. This paves the way for Section 3, which examines how variations in policy design may alter the initial cost/benefit trade-offs with a view to enhancing cooperation. Three key attributes of intervention are reviewed, namely enhancing convenience, charging for waste disposal and communication campaigns. Section 4 summarizes the key policy cues and provides suggestions for further research.

2. Initial Conditions

Much of the work in economics which examines household waste management behaviour, utilizes a constrained utility maximization model as a starting point. In such a model, household members are conceptualized as wanting to enhance the utility they can achieve given their limited resources. Participation in a waste management scheme implies using limited resources, and incurs an opportunity cost (of time and of household space, for instance). But the effort may provide household members with marginal benefits, for instance the fulfilment of moral preferences. While costs may be expected to exert a negative influence on cooperation, benefits may stimulate cooperation. Furthermore, the diverse demographics that characterize households may act as proxies for these preferences and constraints, and may provide further insights on the initial conditions that can explain the willingness (or otherwise) of households to cooperate in a waste management scheme. Findings on the relationship between household motives and constraints and cooperation in waste management schemes are reviewed in Sections 2.1 and 2.2 respectively, while those between household demographics and cooperation are reviewed in Section 2.3.

2.1 Moral Motivation

There is a general consensus in the literature that household cooperation in sorting, storing and transporting recyclable waste is a behaviour driven by morality (Thøgersen, 1996). Responses to the introduction of separated waste collection schemes in the absence of any financial incentive, can be considered a manifestation of such motives (Abbott *et al.*, 2013). Indeed moral preferences may be strong enough for individuals to express a positive willingness-to-pay to recycle (Czajkowski *et al.*, 2014) and to recycle even in the presence of financial disincentives (Briguglio *et al.*, 2015).

Early commentators had practically dismissed the role of voluntary cooperation in public good scenarios (Hardin, 1968), expecting cooperation to be short-lived (Andreoni, 1995), made in error (Palfrey and Prisbrey, 1997), possibly as a recreational activity (Bruvold *et al.*, 2002). But the possibility that households may be induced to cooperate without incentive in the provision of public goods, has recently emerged as an important phenomenon (Meier, 2007). By this token, several exponents have argued that exclusive reliance on standard economic models (based on the assumption of narrow self-interest), to model waste management cooperation, falls short of offering satisfactory insights to explain observed levels of sustained cooperation by households, and therefore to adequately inform policy (Thøgersen, 1996; Berglund, 2006; Kinnaman, 2006; Hage *et al.*, 2009; Viscusi *et al.*, 2011; Abbott *et al.*, 2013; Czajkowski *et al.*, 2014).

Much as theories of altruism (Schwartz, 1977; Stern, 2000) have provided the conceptual background to studies in recycling studies in the field of psychology (e.g. Ölander and Thøgersen, 2006), so has the theory of “warm-glow giving” (Andreoni, 1990, p. 464) served as a key theoretical workhorse, capable of explaining contributions to public goods, including recycling, in the field of economics (e.g. Abbott *et al.*, 2013). Contrary to notions of pure altruism, where the individual wants simply to benefit others by giving to a public good, the basic premise here is that the individual gets something back for cooperating: feeling good. This is an “impure” form of altruism (Andreoni, 1990, p. 464), which can encompass

pure altruism as a very special case. Because this theory envisages individuals as receiving a private benefit from giving, it is capable of explaining why people cooperate in environmental domains, even when there are no legal, financial or social pressures to do so (Nyborg *et al.*, 2006). Once integrated within a utilitarian framework, the theory sees individuals trading off this “warm-glow” (Andreoni, 1990, p. 464) against other sources of well-being, with the aim of maximizing utility, subject to household constraints.

2.1.1 *Pro-Environmental Preferences*

Although Andreoni’s theory attributes public good contributions to warm-glow, it does not examine the mechanisms behind this, nor their application to recycling specifically. Many studies that assess recycling behaviour describe the benefit that individuals receive from cooperating as being that of adhering to one’s personal pro-environmental values (Bruvoll and Nyborg, 2004; Valle *et al.*, 2005; Berglund, 2006; Halvorsen, 2008; Hage *et al.*, 2009; Brekke *et al.*, 2010; Bezzina and Dimech, 2011). Some have described household members as being driven both by a desire to feel good, and by a desire to avoid the guilt of not giving enough (Brekke *et al.*, 2003). This notion of duty-orientation, in turn, echoes research in psychology which suggests that for personal moral norms to be activated, individuals must not only be aware of the problem and of the actions that can relieve it, but they must also perceive *themselves* as able to help and feel a sense of responsibility to be involved (Schwartz, 1970, 1977; Biel and Thøgersen, 2007).

Generally, and albeit using different measures of environmental concern and efficacy belief, studies on household waste management tend to confirm a relationship with such variables (Bruvoll *et al.*, 2002; Thøgersen, 2003; Valle *et al.*, 2005; Halvorsen, 2008; Bezzina and Dimech, 2011). One recent study on waste composting finds the relationship to be insignificant (Edgerton *et al.*, 2009), suggesting that this particular type of waste may not respond to environmental motives as much as other materials separated for recycling. As in other environmental domains, the gap between environmental values and action can be attributed to the existence of other determinants (Thøgersen, 2000; Kollmuss and Agyeman, 2002). Indeed environmental attitudes and behaviour seem to be most strongly correlated when structural conditions make this possible (Guagnano *et al.*, 1995; Ölander and Thøgersen, 2006). Such conditions include favourable initial conditions (such as household demographics), and favourable interventions. The rest of this review examines both sets of conditions. Evidence of their relevance to waste management behaviour helps to explain why the environmental values of household members are insufficient to predict cooperation.

2.1.2 *Conformity Preferences*

The other main source of warm-glow which has received considerable attention in the environmental literature is that derived from adherence to social norms (Schwartz, 1977; Cialdini *et al.*, 1991; Stern, 2000; Thøgersen, 2006; Biel and Thøgersen, 2007; Schultz *et al.*, 2007). These are distinguishable from personal norms, by virtue of the fact that they are enforced by social sanction rather than pride or guilt (Frey and Stutzer, 2006). Social psychology also highlights differences between injunctive norms (what one thinks others should do) and the more influential, descriptive norms (what others actually do) (Cialdini *et al.*, 1991; Schultz *et al.*, 2007). This distinction is also reflected in economic models of environmental behaviour, some of which consider that it is *what others do* that informs the self-image benefits to be had from pro-environmental behaviour (Nyborg *et al.*, 2006). The concept of adhering to some *socially optimal recycling contribution* which individuals hold themselves up against, is also one that has featured in economic models of recycling cooperation (Brekke *et al.*, 2003; Halvorsen, 2008).

Earlier findings in psychology suggest that conformity increases in novel and ambiguous situations (Muzafer, 1935), a concept that is also entertained in economic models of conformity (Bernheim, 1994). Economic research on how people behave in public-good scenarios also suggests that conformity is higher in situations where the behaviour of others is visible (Fehr and Gächter, 2000; Fischbacher *et al.*, 2001; Nyborg *et al.*, 2006). This is confirmed in recycling research which suggests that both novelty and visibility hold relevance for understanding household cooperation, particularly at the early stages of an intervention (novelty) and wherever recycling facilities or collection are visible to the public (Vining and Ebreo, 1990; Taylor and Todd, 1995; Barr, 2003).

Work in psychology based on social identity and self-categorization theories, also finds that norm effects are moderated by the extent to which individuals actually identify with the context/group from which they stem (Goldstein *et al.*, 2008; Nigbur *et al.*, 2010). This too is found in experimental economics research, which documents higher contributions to public goods among homogenous groups (Gächter and Thoni, 2005), or where relationships are durable (Ostrom, 1998). Similarly, in the recycling field, there is evidence which suggests that the degree to which individuals feel a sense of community makes a positive difference (Owen and Videras, 2006). Indeed, in cross-sectional studies, small, close-knit, rural communities with permanent residents (rather than those high in tourism, migrants or rental residents) tend to find stronger participation (Callan and Thomas, 1997; Hong and Adams, 1999; Jenkins *et al.*, 2003; Dijkgraaf and Gradus, 2004; Ferrara and Missios, 2005; Hage and Söderholm, 2008; Halvorsen, 2008).

Although convergent behaviour is notoriously hard to identify (Manski, 2000; Frey and Stutzer, 2006), some studies in the economics of recycling have documented situations in which the perceived social norm of recycling exerts a positive influence on cooperation. This is especially so in cases where the cooperative behaviour takes place at visible drop-off sites (e.g. Sidique *et al.*, 2010). One difficulty with assessing the role of social norms is that these can be absorbed into personal norms (Schwartz, 1977), such that the distinction between personal and social norms is merely one of degree to which they are internalized (Thøgersen, 2006). To circumvent this problem, some studies employ constructs that combine the presence of both (e.g. Bezzina and Dimech, 2011). Some authors measure both personal and social norms separately and nonetheless find a positive relationship between perceptions of others' recycling efforts and the households' own efforts (e.g. Hage *et al.*, 2009). Others have distinguished both a direct effect of social norms as well as an indirect effect when interacted with personal norms (Valle *et al.*, 2005). The findings are not entirely unequivocal: in Viscusi *et al.* (2011) the effect of the social norm was not significant (Viscusi *et al.*, 2011). One reason for this may have been the manner in which norm was measured (by asking respondents whether they believed their neighbours would be upset with someone who did not recycle), and the fact that many respondents did not perceive there to be such a norm in the first place.

2.1.3 Political Preferences

While the recycling literature has paid considerable attention to environmental preferences and conformity as drivers of cooperation, elsewhere in the environmental economics literature, political preferences have started to emerge as promising predictors of household participation in public-good schemes (Kahn, 2007; Torgler and García-Valiñas, 2007; Dupont and Bateman, 2012; Costa and Kahn, 2013). Political interest, for instance, tends to be associated with higher environmental concern (Wakefield *et al.*, 2006; Torgler *et al.*, 2007) and right-wing ideology tends to be associated with lower willingness-to-pay for environmental goods, for environmental taxes and for environmental causes (see Dupont and Bateman, 2012 for a succinct review). A similar question has recently emerged in political science, investigating whether political preferences spill from voting to real-world behaviours (Gerber and Huber, 2010), including contributions to public goods (Bolsen *et al.*, 2014)

and recycling specifically. Political preferences were found to interact with the way that recycling was presented to create diverse levels of recycling intent (McBeth *et al.*, 2013). Democrats and Liberals were also found to have higher actual recycling rates in the United States (Coffey and Joseph 2013).

Furthermore, in some economic studies on the determinants of recycling cooperation, political preferences have been considered as important control variables. Participation has been found to be higher among political activists in the Netherlands (Dijkgraaf and Gradus, 2004), among Green Party supporters in Sweden (Hage and Söderholm, 2008), and in some instances even among non-voters in Norway, whose higher recycling rates were attributed to protesting waste disposal fees (Halvorsen, 2008). In Brekke *et al.*'s 2010 study where political party affiliation was found to be insignificant as a determinant, the authors nonetheless argued that ignoring its effect could lead to exaggerated predictions of other moral motives (Brekke *et al.*, 2010). A recent study from Malta finds that voluntary recycling uptake was much higher in regions characterized by pro-government sentiment (Briguglio *et al.*, 2015). The role of political preferences as a determinant of household cooperation in waste management schemes appears to be an area that is ripe for further investigation.

2.2. Constraints Inhibiting Cooperation

Household members may have strong motivations to cooperate in a waste management scheme, but may still not cooperate if the marginal cost of doing so outweighs the marginal benefit. The economics literature on household waste has paid due attention to the opportunity costs that households may incur, whenever participation implies the use of some scarce household resource, such as time or space. Such constraints create negative pressures on cooperation regardless of the attributes of the intervention (be they incentives, convenience or communication-based) but they help policy-makers and scheme-operators identify the kind of households that may be resistant to cooperate. Moreover, the presence of such initial constraints helps inform the design of the intervention in order to tip households in favour of participation.

2.2.1 Time and Space

One important finding that, in fact, emerges strongly, across the majority of studies, is that household constraints do tend to suppress cooperation in waste management. Theoretically the availability of household time and of household space, or more precisely, the lack thereof, is often modelled in economics as imposing a shadow-cost on household cooperation in recycling (Brekke *et al.*, 2003; Bruvoll and Nyborg, 2004; Brekke *et al.*, 2010). Although not everyone perceives the process of waste management as a burden in itself (Bruvoll *et al.*, 2002; Meneses, 2010), separating waste for recycling usually requires some household space and household members' time (Bartelings and Sterner, 1999; Halvorsen, 2008). These are limited resources, constrained by the availability of non-working time and by dwelling size, both of which are capable of yielding utility when used in ways other than sorting/storing waste.

In fact, empirical studies have been fairly consistent in finding that factors like limited storage space – especially outdoor space, like yards and porches – suppress uptake of recycling (Jenkins *et al.*, 2003; Ando and Gosselin, 2005). Limited time, similarly acts as a constraint on participation (Berglund, 2006; Suwa and Usui, 2007; Hage and Söderholm, 2008). Smells and the risk of attracting rats and other pests create further constraints towards particular types of waste, like biodegradable waste separation (Ölander and Thøgersen, 2006). The relevance of these kinds of constraints is further confirmed by consistent findings on the role of convenience attributes in intervention design (reviewed in Section 3).

2.2.2 *Habit*

While constraints can be considered as part of the cost-benefit trade-off which household members could actively consider, a further force which may constrain household behaviour, albeit in a less cognitive manner, is that of habit. In psychology, habit is known to act as a standard operating procedure, rendering actions routine, such that, after a certain time, no decision-making is actually entertained at all (Stern, 2000). In empirical assessment of household waste management behaviour, an oft used proxy for habit is the duration of a waste management programme itself. This is typically found to be a positive and significant determinant of participation (Bartelings and Sterner, 1999; Sidique *et al.*, 2010; Bucciol *et al.*, 2015; Briguglio *et al.*, 2015). But even apart from past behaviour, habitual behaviour measured as *frequency* has also been found to be an important determinant of uptake and intent in at least one study that examined the role of habit in more detail (Knussen and Yule, 2008).

2.3 *Demographic Characteristics and Cooperation*

Practically all studies that examine what determines recycling, feature a fairly standard set of demographic variables like education, age, income, gender, dwelling/household size and community characteristics. These are typically employed as proxies for the preferences and constraints described above, or as additional controls to reduce unobserved heterogeneity in a model. The findings are diverse and generally weak (Hornik, 1995), which is not entirely surprising, considering that they are only weakly linked to theoretical underpinnings. Diverse methodological approaches, and the diverse waste stream and schemes make it harder for household demographics to systematically predict household cooperation (van den Bergh, 2008).

2.3.1 *Education and Income*

The educational level of respondents (expressed, for instance, as years spent in education or degrees earned) is sometimes used to proxy environmental knowledge and awareness levels. As such it is normally hypothesized (and found) to exert a positive influence on cooperative effort (Hong and Adams, 1999; Jenkins *et al.*, 2003; Ando and Gosselin, 2005; Saphores *et al.*, 2006). The relationship may also be non-linear (Callan and Thomas, 2006) or occur only below certain levels (Ferrara and Missios, 2012). Similar findings emerge in environmental willingness-to-pay studies, where higher education is linked to higher offers for environmental services (Czajkowski *et al.*, 2014).

Some authors (e.g. Meneses and Palacio, 2005; Nixon and Saphores, 2009; Bezzina and Dimech, 2011) find no significant explanatory power on the education variable. One oft-considered reason for this lack of signal, is that the positive pressures of higher education may be off-set by the negative pressures of a higher opportunity cost of time which higher education households may incur (given that higher education is linked to higher income). In one Sweden-based study on household recycling, the relationship was not only found to be non-positive but actually negative, and statistically significant at the 5% level. The authors, in fact, suggest that this may be due to the high correlation between education, income and employment rates (Hage and Söderholm, 2008).

Income itself captures other theoretical priors such as financial flexibility (to purchase recyclables) and higher waste-generation levels (from which to separate recyclable waste) (Saltzman *et al.*, 1993; Callan and Thomas, 2006). Both priors, theoretically, exert positive pressures for recycling levels. On the other hand, higher income also comes with a higher opportunity cost of time, which could exert *negative* pressures on cooperative effort (Bruvoll *et al.*, 2002; Halvorsen, 2008). Indeed, in a good number of studies, the income variable is positive but not statistically significant (Kinnaman and Fullerton, 2000; Callan and Thomas, 2006; Hage and Söderholm, 2008; Hage *et al.*, 2009). In such studies, authors

argue that the positive and negative effects of income seem to work against each other, resulting in an insignificant co-efficient on the income variable or proxy. The collinearity of socio-economic variables, like education and income also serves to reduce the explanatory power of each of them. This said, the relationship between income and recycling has been found to be significantly positive in a large number of studies (Jenkins, 1993; Callan and Thomas, 1997; Nestor and Podolsky, 1998; Suwa and Usui, 2007; Viscusi *et al.*, 2011). Relationships are particularly strong and positive for some recycling streams (like paper) given that certain products (like newspaper) are more likely to be purchased by higher income households (Jenkins *et al.*, 2003; Ferrara and Missios, 2005).

2.3.2 Age and Gender

Many recycling studies include an age-related variable as a determinant of cooperation, stipulated as household mean age, children by age group, or fraction of household members above or below a certain age (Vining and Ebreo, 1990; Bruvoll and Nyborg, 2004; Saphores *et al.*, 2006; Sidique *et al.*, 2010). While people beyond retirement age may have lower opportunity costs of time, as well as stronger levels of adherence to social norms (Bruvoll and Nyborg, 2004; Hage *et al.*, 2009; Bucciol *et al.*, 2015), this positive pressure on recycling may theoretically be off-set by the lower consumption levels that may also be at play. In some contexts (e.g. Jenkins, 1993), it is some other age group of the community which is found to recycle more (for instance, in Jenkins, 1993, the proportion aged 18–49). In general, however, elderly residents are found to recycle more (Vining and Ebreo, 1990; Meneses and Palacio, 2005; Saphores *et al.*, 2006; Sidique *et al.*, 2010).

Having young children in the household may provide a stronger (bequest) motive for pro-environmental behaviour (generally) and increased exposure to awareness-raising in schools (Dupont, 2004). But these positive pressures do not always outweigh the higher opportunity costs of time in families with children in waste management domains (Edgerton *et al.*, 2009). In fact, in one cross-country study, children under the age of five were found to suppress almost any stream of waste recycling (Ferrara and Missios, 2012).

In household-level studies, gender is sometimes included as a control variable, on the general expectation (drawn from the broader environmental literature) that females exhibit more pro-social behaviour (Zelezny *et al.*, 2000). Females do tend to report higher recycling participation rates (Ando and Gosselin, 2005; Meneses and Palacio, 2005; Oates and McDonald, 2006; Saphores *et al.*, 2006), and to bear a greater share of recycling chores (Meneses and Palacio, 2005), including recycling electronic waste at drop-off centres (Saphores *et al.*, 2006). This said, not all studies that control for gender find this to be a significant distinction (Hage and Söderholm, 2008; Hage *et al.*, 2009; Sidique *et al.*, 2010), suggesting that once other factors are accounted for (e.g. time, education, age), gender *per se* does not offer additional explanatory power.

2.3.3 Dwelling Size and Community Characteristics

Dwelling characteristics often emerge as significant indicators of household space constraints. Houses are associated with higher recycling rates than multi-family dwellings, like apartments (Ando and Gosselin, 2005; Hage and Söderholm, 2008; Hage *et al.*, 2009; Abbott *et al.*, 2013). For similar reasons, population density (associated with smaller dwellings) is sometimes hypothesized (and found) to exert negative pressures on cooperation (Berglund, 2006; Callan and Thomas, 2006; Suwa and Usui, 2007). Household size, in terms of its members, is sometimes used to proxy time constraints: larger households offer a bigger pool of leisure time from which recycling time may be drawn (Barr, 2003, 2004; Jenkins *et al.*, 2003; Ando and Gosselin, 2005; Valle *et al.*, 2005; Suwa and Usui, 2007; Nixon and Saphores, 2009), perhaps at a decreasing rate as size increases (Callan and Thomas, 2006).

Studies using aggregate data often include community characteristics as proxies for moral motives. Small communities and retirement areas tend to have higher recycling rates in comparison with large, highly urbanized centres, possibly capturing structural differences, as well as elements like higher identification with the locality and stronger norms (Callan and Thomas, 1997; Hage and Söderholm, 2008; Halvorsen, 2008). Recycling also tends to be higher among home-owners, who are theorized to have stronger attachment levels to their community (Jenkins *et al.*, 2003; Ferrara and Missios, 2005; Hage and Söderholm, 2008) in contrast with newly-arrived immigrants, foreigners and rental dwellers (Hong and Adams, 1999; Dijkgraaf and Gradus, 2004; Hage and Söderholm, 2008).

2.4 *Synthesis*

The literature reviewed thus far suggests that household cooperation in waste management is stimulated by members' desire to fulfil their moral preferences, and suppressed by the constraints of limited space and time. Habit also plays a role in determining household waste management behaviour. The literature further suggests that demographic characteristics can act as proxies for such preferences and constraints, in turn providing useful clues as to which households are more likely to participate in recycling schemes. Higher educated persons, females as well as residents in close-knit communities are associated with stronger cooperation, while smaller dwellings and households face higher constraints and demonstrate lower cooperation. Income and age cohorts, on the other hand, are harder to associate with cooperation as they can proxy several motives and constraints. These initial conditions offer various entry points for policy-makers or service-providers aiming to stimulate cooperation in waste management.

3. Intervention

Theoretically, the environmental benefits of waste management accrue collectively to all members of society: like other public goods, such benefits are characterized by non-rivalry and non-excludability (Baumol and Oates, 1988). If households are made up of rational, self-interested individuals, then it follows, by traditional economic assumptions, that they will tend to free-ride on the efforts of others. Individuals consider their private costs and benefits, to the exclusion of consideration of external (or social) costs, thereby over-producing environmentally harmful waste (Wertz, 1976; Fullerton and Kinnaman, 1996). Although the emergence of moral motives as drivers of cooperation suggests that households may glean some private benefits in waste management cooperation, there remains a theoretical justification for government intervention to reduce waste externalities to optimal levels.

In theory then, government intervention can change waste management outcomes by altering the cost-benefit trade-offs that households face. Charges can make it more expensive for households to not cooperate or more financially rewarding for them to make the effort; convenience based attributes can relieve costs of cooperation by making fewer demands on time and space; communication can address information imperfections by promoting the convenient scheme attributes and the presence of charges. Moreover, if individuals derive private moral benefits from cooperation, then there is further scope for communication as moral suasion as an avenue to boost the perceived benefits of cooperation (Briguglio *et al.*, 2015).

In practice, intervention aimed at stimulating household cooperation in public goods typically does include not only the provision of infrastructure but also other elements like incentives and public communication (Gsottbauer and van den Bergh, 2011). A key question facing policy-makers is how best to combine elements of such intervention to achieve desirable outcomes (Fullerton *et al.*, 2010). This requires consideration not only of reliability, cost-effectiveness and economic efficiency, but also of concerns like distributional equity and political feasibility (Gsottbauer and van den Bergh, 2011). The next sections organize the findings from the literature around these three key components of waste management

intervention targeting household cooperation, namely convenience, charges and communication. Each section reviews the theoretical underpinnings, the evidence, and some of the key concerns.

3.1 Convenience

On the ground, the main point of entry for intervention by policy-makers and service-providers has generally been to design waste infrastructure and management schemes aimed at improving convenience and lowering costs and thereby boosting cooperation by households. Two meta-studies (Hornik, 1995; Ferrara and Missios, 2012) confirm that convenient scheme attributes do, in fact, constitute key precursor to cooperation. In their cross-country analysis, Ferrara and Missios conclude that having *any* type of service results in more recycling, but that kerb-side facilities tend to have the greatest positive impacts (Ferrara and Missios, 2012). Kerb-side collection services increase recycling (Jenkins *et al.*, 2003), even diverting recyclable waste from other (cheaper to administer but less convenient) disposal options (Beatty *et al.*, 2007).

Recycling also increases with more accessible collection (Ando and Gosselin, 2005; Saphores *et al.*, 2006) and with the possibility of combining recyclables (Judge and Becker, 1993; Wright *et al.*, 2014). Higher frequency of collection also increases uptake (Ferrara and Missios, 2005; Kuo and Perrings, 2010), a factor that can also be attributed to stimulating habit (Knussen and Yule, 2008; Viscusi *et al.*, 2011). Recent papers have examined whether it is possible to make the indoor aspects of recycling more convenient: providing convenient storage and collection system is found to help in recycling of biodegradable materials (Ölander and Thøgersen, 2006). Moreover, installing equipment for convenient segregation considerably increases separation of food waste, both in the short and long term (Bernstad *et al.*, 2013).

Convenience matters whether the scheme includes price incentives or not. The majority of studies consider the role of convenient attributes when these operate in synergy with incentives, and set out to parse out the effects of convenience versus incentives. Several studies consider regimes that include both enhanced convenience and *charges* for waste (for instance, Judge and Becker, 1993; Nestor and Podolsky, 1998; Bartelings and Sterner, 1999; Linderhof *et al.*, 2001; Jenkins *et al.*, 2003; Dijkgraaf and Gradus, 2004; Ferrara and Missios, 2005; Saphores *et al.*, 2006; Beatty *et al.*, 2007; Dahlén and Lagerkvist, 2010, 2012). In some such studies, the synergistic effects of convenience-based attributes and charges have been examined. The findings indicate that ease of separation of certain materials (like plastic) (Hage and Söderholm, 2008) and enhanced infrastructure/convenience create stronger responses to a charge (Callan and Thomas, 1997, 2006; Bartelings and Sterner, 1999). Other studies consider whether convenience matters when recycling waste disposal is subsidized (e.g. Reschovsky and Stone, 1994; Callan and Thomas, 1997; Viscusi *et al.*, 2011).

A good number of studies also consider the role of convenience in waste separation regimes devoid of any form of charges (e.g. Barr, 2004; Ando and Gosselin, 2005; Berglund, 2006; Halvorsen, 2008; Hage *et al.*, 2009; Bezzina and Dimech, 2011; Bernstad *et al.*, 2013; Czajkowski Kądziała and Hanley, 2014), while a recent study presents an interesting scenario in which residents recycled in the presence of (low) financial disincentives (Briguglio *et al.*, 2015). The findings strongly indicate that *ceteris paribus*, with or without the presence of price incentives, convenience-based attributes generate a positive effect on cooperation.

3.1.1 Concerns with Enhancing Convenience

It is safe to say that the key concern with making recycling schemes more convenient to households, is the cost of doing so (Kinnaman, 2006). Concerns that the cost of recycling programmes may outweigh their benefits have long been expressed, particularly if these unnecessarily offer state-of-the art infrastructure

and service (Judge and Becker, 1993). As discussed earlier in this review, the social benefits of reducing environmental externalities do not always justify the cost of household time, storage, transportation, infrastructure, and management systems (Kinnaman, 2006), at least not for materials with low recover potential or involving high energy use for recovery (Hoorweg and Bhada-Tata, 2012).

A finding that also merits caution is that just as making recycling more convenient helps increase recycling, making *mixed* waste disposal convenient hinders recycling cooperation: the closer (Berglund, 2006) and the easier (Kuo and Perrings, 2010) it is to bin mixed (unseparated) waste, the lower recycling participation seems to be. While establishing collection and disposal methods for waste is still a challenge in many developing countries, several developed countries also offer highly convenient (and expensive) kerb-side waste collection mechanisms, alongside that of recycling.

An emergent concern is the prospect that, in the process of making recycling more convenient, the moral benefits of contributing may somehow be suppressed (Brekke *et al.*, 2003), though there is no evidence in practise that this is sufficiently large to overwhelm the positive effects of convenience on cooperation.

3.2 Charges

Since the earliest papers on the economics of household waste (Jenkins, 1993; Fullerton and Kinnaman, 1996; Hong and Adams, 1999), right up to the most recent work (Watkins *et al.*, 2012; Bel and Gradus, 2014; Buccioli *et al.*, 2015) contributions on the economics of household waste, have mainly focused their attention on the role of price in intervention. The main question asked has been whether paying more per unit for mixed waste disposal (relative to recycled waste), enhances the degree to which households cooperate in waste management schemes.

Indeed, monetary incentives constitute the canonical economic remedy to any environmental market-failure to incentivize households through price-based intervention (Hahn, 1989). Similarly, in the literature on the economics of waste, monetary incentives have also occupied centre-stage (Fullerton and Kinnaman, 1996; Kinnaman and Takeuchi, 2014). Theoretically, a “Pigouvian Tax” equal to the externality cost of waste, is capable of reducing waste up to the point where the marginal benefits of internalization equal the marginal costs of abatement (Pigou, 1960). This type of tax encourages lower-cost households to undertake the greatest level of effort, thereby minimizing damage to society both statically and dynamically (Baumol and Oates, 1988). And, as a double-dividend, such taxes raise revenue which can be used to reduce the (distorting) burden of the overall tax system, or ear-marked for waste management (Goulder and Parry, 2008), albeit the more successful the tax is in raising revenue, the less successful it is in changing behaviour (Fullerton and Kinnaman, 1996; Fullerton *et al.*, 2010). From the perspective of a utility-maximizing households with income constraints, the higher the marginal price of waste disposal, the less waste they will want to produce, considering that households derive benefits from using this income in ways other than paying for waste (*ceteris paribus*).

On the ground, a practical example of a Pigouvian tax for waste is the oft-called Pay As You Throw tax, levied on garbage weight. Volume-based (rather than weight-based) schemes can come close to this theoretical ideal, and are easier to administer, but may lead to distortion through compaction. In practice, within the European Union alone, the majority of states employ volume-based schemes, although several do use weight-based schemes or a combination of systems including frequency-based schemes (Watkins *et al.*, 2012). While differentiated charging of mixed/recycled waste has occupied centre-stage in both theory and practise, the design of alternative incentives (like deposit-refund schemes) has also received some attention (see for instance, Ashenmiller, 2011). An insightful overview of the distinctions between advance disposal fees, recycling subsidies and deposit-refund schemes (in a producer context) is provided in Palmer *et al.* (1997), who find evidence for the latter as the least-cost option (Palmer *et al.*, 1997). Fullerton *et al.* (2010) also argue that alternative systems such as advance disposal fees for certain products

or deposit-refund schemes may reduce certain risks (for instance the risk of illegal dumping), though they caution that these can also be more costly to operate (Fullerton, Leicester and Smith, 2010).

The majority of studies that set out to assess the role of price-based incentives confirm that they do indeed stimulate household cooperation in waste separation/recycling activity (Jenkins, 1993; Nestor and Podolsky, 1998; Bartelings and Sterner, 1999; Linderhof *et al.*, 2001; Dijkgraaf and Gradus, 2004; Ferrara and Missios, 2005; Callan and Thomas, 2006; Hage and Söderholm, 2008; Sidique *et al.*, 2010; Bucciol *et al.*, 2015). Some authors also report significant waste reduction effects (Van Houtven and Morris, 1999; Dahlén and Lagerkvist, 2010). This price effect appears to be vivid from the earliest studies (Jenkins 1993), to meta-reviews of such studies (e.g. Ferrara and Missios, 2012; Bel and Gradus, 2014), and across a wide range of waste materials (Ferrara and Missios, 2005).

There is, however, a small number of studies that fail to find a significant effect and the reasons for this merit consideration. Authors of such studies have argued that a reason for a low price effect may be that residents were already recycling prior to the introduction of a fee; that they may have reacted by compacting waste or indeed by dumping it illegally instead of recycling more of it (Fullerton and Kinnaman, 1996); that the price was too low for the high-income households upon which it was levied or that it sent a discontinuous signal, being subscription-based (Jenkins *et al.*, 2003). Reschovsky and Stone (1994) find price effects to only be significant in the presence of kerbside recycling collection, echoing findings presented earlier on the positive synergies between charges and convenience-based attributes (Reschovsky and Stone, 1994).

In general, reviews reveal a relatively low elasticity of response to price (Van Houtven and Morris, 1999; OECD, 2008; Watkins *et al.*, 2012) and considerable variation in its level: elasticity is estimated to lie between -0.12 and -0.39 (Kinnaman, 2009). Some studies detect larger long-run elasticities, as households find ways to react to the price (Dahlén and Lagerkvist, 2010). Others find that, in the long run, the effect of tax actually wears off (Suwa and Usui, 2007). Some leading exponents in the field have questioned whether the elasticity of response (albeit in the right direction) is sufficient to justify tariffs, particularly when considering other possible consequences (Kinnaman, 2006). In a recent meta-regression analysis (using a sample of 65 price elasticities from economic studies), Bel and Gradus (2014) find that elasticities tend to be higher in weight-based systems (Bel and Gradus, 2014).

Parsing out the net effect of price is somewhat confounded by the fact that per unit fees are generally accompanied by expanded door-to-door collection systems (Kinnaman, 2006) and/or intense promotion and education programmes (Thøgersen, 2003). Further obscuring the measurement of impact are, firstly, the lack of uniform, comparable waste collection in cross-sectional studies (Dahlén and Lagerkvist, 2010); secondly, the increased rigour in measurement of waste that typically accompanies the introduction of fees; and, thirdly, the unaccounted-for diversions of waste into compaction illegal disposal (Fullerton and Kinnaman, 1996).

3.2.1 *Concerns with Charges*

Although certainly popular in the field, waste disposal taxes are not universally adopted (Gsottbauer and van den Bergh, 2011). Their administrative and political costs, as well as environmental costs given the possibility of illegal-disposal of waste (Watkins *et al.*, 2012; Kinnaman and Takeuchi, 2014), and, to some degree, emerging concern with psychological reactions to the presence of a fee, are among the key issues that stack up as concerns with their use. Such concerns, have led some leading exponents to question whether the elasticity of response is sufficient to justify the presence of waste charges (Kinnaman, 2006).

One of the earliest concerns with per unit waste fees, already hinted at above, is that in suppressing one type of environmental problem (that of waste disposal), they may actually stimulate another, worse environmental problem: illegal disposal. A number of studies have flagged the prospect of burning, hiding, compacting or transporting waste elsewhere (Fullerton and Kinnaman, 1996; Bartelings and Sterner, 1999;

Hong and Adams, 1999; Van Houtven and Morris, 1999; Linderhof *et al.*, 2001). While such options may not be considered in the absence of fees, setting a price on garbage disposal renders them more attractive on the margin (Fullerton and Kinnaman, 1996).

The introduction of financial incentives may also stimulate self-interested, cost-benefit thinking, leading to such options being entertained when they previously may not have been considered (Thøgersen, 1994; Bowles, 2008). A recent review suggests that illegal disposal may indeed be a realistic concern (Fullerton *et al.*, 2010), to the extent that avoiding marginal fees altogether and subsidizing garbage collection may be justified, as theorized in earlier literature (Fullerton and Kinnaman, 1996). But, even here, this finding is not uncontested (Watkins *et al.*, 2012; Bucciol *et al.*, 2015): contextual, demographic and moral considerations can be expected to make a difference; but, given the difficulty of finding data, they are far less scrutinized in research. Unsurprisingly, the shortage of waste treatment facilities is one factor that increases the frequency of illegal dumping (Ichinose and Yamamoto, 2011).

More recently, attention has shifted to another type of behavioural response to monetary incentives, namely that these suppress the benefits that household members get from cooperating of their own accord. In the broader environmental literature, the presence of a fee may be interpreted as controlling (Frey, 1999); as the matter of the problem having been take-over (Nyborg *et al.*, 2006); or indeed as a change from a community-based norm to one of exchange (Heyman and Ariely, 2004). Fees may suppress social sanctions, and this can also inhibit contribution (Fuster and Meier, 2010). If initial moral motives are high, then these crowding-out effects could reduce the benefits of the price incentive to such an extent that the net effect of a tax over what voluntary contribution would have produced may be nil or negative, as documented in some contexts (Frey and Jegen, 2001; Bowles, 2008). Very few studies have examined this phenomenon for waste disposal fees and those that have find no evidence that a tax erodes intrinsic motivation (Thøgersen, 2003; Halvorsen, 2008; Ferrara and Missios, 2012). One example of crowding-out effects in a waste context was that of irreversible reduction in willingness to accept a nuclear waste treatment plant once monetary compensation was offered (Frey and Oberholzer-Gee, 1997).

The interaction between moral motives and price incentives is more complex when considering that, contrary to crowding-out of moral benefits, monetary incentives can actually crowd them in. Price can be interpreted as acknowledging of effort (Frey, 1999), and higher fees have, in fact, been found to be associated with higher self-efficacy beliefs, possibly also due to their signalling a norm or inducing trial, and hence stimulating efficacy-belief (Thøgersen, 2003). This suggests that for household members, the benefit of avoiding waste disposal taxes is complementary to (and not substitutive of) the moral benefits they derive from recycling (Berglund and Matti, 2006). Distinctly different signals may be sent by the presence of a fee which can be understood as either acknowledging the good effort of households or allowing households to substitute effort by paying (Frey, 1997, 1999; Brekke *et al.*, 2010), depending on how it is communicated and perceived. In their discussion on payments to host communities for landfill siting in the US, for instance, Jenkins *et al.* (2004) present several cases where payment secures cooperation and successfully defrays opposition to landfills (Jenkins *et al.*, 2004).

Practitioners in the field will be particularly well aware of the fact that charging for waste can involve policy-makers in practical considerations beyond economic efficiency and environmental costs (Kallbekken and Sælen, 2011). The first hurdle lies in the actual design and implementation of a Pigouvian tax itself: in a world where information is costly, and administrators imperfect, setting an environmental tax itself runs into considerable institutional limitations (Fleischer, 2014). Other policy considerations which inhibit enthusiasm for such taxes include their (regressive) distributional impacts and their impact on a country's competitiveness - concerns which can be particularly vivid to finance ministers (Clinch *et al.*, 2006). These concerns hold true also of waste disposal taxes (Brown and Johnstone, 2014). Privatization of services poses another practical constraint specifically related to setting waste taxes in some countries (Davies and O'Callaghan-Platt, 2008).

Finally, it is worth considering the political considerations that may inhibit the greater use of waste fees (Thaler and Sunstein, 2008; Brown and Johnstone, 2014). This concern appears to be particularly relevant

to marginal (Pay As You Throw) waste taxes in contexts where political competition is rife, given that they are considered to be a particularly salient kind of tax (Bracco *et al.*, 2013). Researchers in this field find evidence that preferences towards waste taxes are capable of significant changes not only following experience with them (Brown and Johnstone, 2014), but also with communication in the run up to their introduction (Convery *et al.*, 2007). In other public good domains, enhanced trust towards government also increases acceptance of taxes (Clinch *et al.*, 2006), suggesting interaction effects between political preferences and fees. The question remains open as to whether this is the case with waste fees.

3.3 Communication

Although mainstream economic theory considers information to be an important *pre-requisite* for individuals to make rational decisions, in public-good scenarios, communication as intervention has traditionally been considered as an element which is hard to manipulate to obtain the necessary pay-offs (Baumol and Oates, 1988; Tietenberg, 1998). As such, it has received much less scholarly attention; and experience with measuring the effect of communication campaigns on any environmental behaviour is limited, not only in economics, but across scholarly work in social sciences more generally (Collins *et al.*, 2003; Daugbjerg *et al.*, 2014; Glaeser, 2014). Yet, on the ground, the introduction of public-good schemes is very often accompanied by some kind of communication campaign, and often accorded hefty budgets (Graber and Smith, 2005; John, 2013). This appears to also be the case in the domain of waste management, where communication aspects can range from mass media to door-stepping techniques (Bruvold and Nyborg, 2004; Bernstad *et al.*, 2013; Dupré, 2014).

The obvious starting point for communication intervention in the realm of waste management is to focus on promoting the attributes of the specific waste scheme in operation, for instance, the frequency of collection, the types of waste to be collected, the fees charged and the desired household behaviour, such as separating, rinsing and transporting waste for recycling (Dupré, 2014). In theory, given that cooperation is expected to be higher when constraints like time, effort and space are lower, then providing information on scheme attributes which relieve time, effort and space requirements should increase uptake, *ceteris paribus*.

Knowledge of scheme attributes, in fact, emerges as one of the best predictors in an early literature review in psychology (Hornik, 1995). In recycling studies which actually control for the effect of this, information campaigns connected to infrastructure or scheme attributes are found to be positively linked to participation (Vining and Ebreo, 1990; Gamba and Oskamp, 1994; Hornik, 1995; Barr, 2004; Sidique *et al.*, 2010; Bernstad *et al.*, 2013). Similarly *perceptions* of convenience or constraints (Ando and Gosselin, 2005; Sidique *et al.*, 2010; Bezzina and Dimech, 2011; Takahashi *et al.*, 2013), including perceived distance to recycling facilities (Lange *et al.*, 2014) are found to matter to observed cooperation. In fact, overall, knowledge of the recycling programme itself appears to predict uptake more than environmental awareness does (Dupré, 2014).

One set of attributes the communication of which has not, to date, received sufficient attention in recycling literature is that of incentives themselves. The question of how to communicate a fee/charge/tax is one that has recently started to be examined elsewhere in the literature, where authors have asked whether a simple fee label (its name) changes its outcomes (Chetty *et al.*, 2009; Congdon *et al.*, 2009; McCaffery and Baron, 2006). Theoretically, a label can act as a frame to direct attention to certain attributes, and, as in other framing effects, it is this re-focusing of attention that influences outcomes. There is some evidence to suggest that the word “tax” itself is one that can generate aversion (McCaffery and Baron, 2006) (and therefore stronger elasticities), particularly given certain political preferences (Clinch *et al.*, 2006; Sussman and Olivola, 2011). Studies on environmental behaviour generally find that with the right framing, and some social influence, even a temporary tax, set lower than the marginal social benefit, can bring about substantial changes in pro-environmental behaviour (Nyborg *et al.*, 2006). Findings like these

lend further insights as to why empirical reactions to taxes are more diverse than standard environmental economics would predict. They also offer considerable scope for assessing interaction effects between communication and incentives in waste management.

But beyond the promotion of scheme attributes, communication intervention can also be aimed at stimulating moral motives. With the increased recognition that cooperation in waste management is driven by moral preferences (Hornik, 1995; Thøgersen, 1996; Kinnaman, 2006; Miafodzyeva and Brandt, 2012), which are themselves capable of influence (Thøgersen, 2003), the need to examine the role of moral suasion as intervention is one that is increasingly receiving attention in environmental economics, if not to stimulate moral motives, then at least to avoid inadvertently suppressing them, a prospect whose plausibility has been highlighted in other public-good domains (Frey, 1997; Nyborg and Rege, 2003; Bowles, 2008; Croson and Treich, 2014).

Only a small number of the studies on recycling control for the impact of such communication campaigns, and fewer still set out to explicitly examine their role or content (e.g. Bruvold and Nyborg, 2004; Nixon and Saphores, 2009). The thin findings indicate that communication effort (defined as grant money) is positively associated with uptake (Callan and Thomas, 2006; Sidique *et al.*, 2010), although there are likely to be considerable lags between granting an award and its expenditure. In Valle *et al.* (2005), communication, defined as recycling-related promotional messages taken in by consumers (and including television, billboards, eco-spots, radio, and national newspapers), surprisingly creates no positive impact on planned behavioural control. The authors argue that the message may have been too aggressive, or even offensive, leading recipients to ignore it and call for more in-depth analysis of the impact of communication strategies (Valle *et al.*, 2005).

While it is clear that stronger moral motives are associated with stronger cooperation levels, there remains considerable scope to investigate the payback of communication campaigns intended to stimulate such moral motives by stimulating awareness of environmental impacts, and efficacy beliefs; or by promoting the sense of responsibility, as has been investigated in other environmental domains (Ajzen, 1992; Thøgersen, 2005; Nyborg *et al.*, 2006; Steg and Vlek, 2009). The potential of longer term investments in community education to enhance social values also remains to be investigated – not only for waste but for public goods more generally (Moore and Loewenstein, 2004).

One aspect of moral suasion which has received considerable attention in promoting pro-environmental behaviour is the potential of stimulating social norms. The role of perceived norms and community influences has been reviewed in Section 2 but its specific potential as an angle for communication intervention has received limited attention in waste management economics. Modelled theoretically, informing beliefs about norms has been shown to be capable of permanent increases in instances of pro-environmental behaviour (Nyborg *et al.*, 2006). In experimental tests of the type of content of communication that stimulates cooperation, the cooperative effort of others and acknowledgement of success are found to be particularly important (Cárdenas and Ostrom, 2004). Moreover, learning about the behaviour of non-cooperating others may inhibit cooperation, not least because it undermines efficacy belief (Ledyard, 1995; Gächter and Thoni, 2005). In social psychology too, normative information, especially the actual behaviour of (relevant) others, emerges as a core stimulant of cooperation (Cialdini *et al.*, 1991; Cialdini, 2003; Schultz *et al.*, 2007; Goldstein *et al.*, 2008).

Beyond content (be it promotion of scheme attributes, moral suasion or normative communication), the source of information itself presents an interesting question and one that has been examined in persuasion science (Jensen, 2013), in political communication and in policy promotion (Graber and Smith, 2005). Key attributes known to make a source successful include authority, similarity and likeability (Dolan *et al.*, 2012). In environmental policy too, the source of information emerges as one of the more consistent determinants of impact, often acting as a heuristic by which to assess complex scientific opinion (Bator and Cialdini, 2000; Nisbet, 2009; Ahn *et al.*, 2010). Only a handful of studies in the domain of waste management have explicitly examined how the channel of communication can influence cooperation. The findings indicate that the source of information does make a difference – trusted, close, sources are more

likely to increase participation (Nixon and Saphores, 2009), including sources that are trusted politically (McBeth *et al.*, 2013; Briguglio *et al.*, 2015).

Findings in waste management also indicate that face-to-face communication matters (Nixon and Saphores, 2009), as does personal feedback (Nomura *et al.*, 2011; Bernstad *et al.*, 2013), suggesting that just as in other fields, the *channel* employed to communicate is relevant to stimulating household cooperation. In social-dilemma research conducted across numerous countries, communication in small group participative approaches is known to be effective to achieve cooperation (Ahn *et al.*, 2010), and face-to-face communication emerges as being particularly effective (Ledyard, 1995; Ostrom, 2000; Frey and Stutzer, 2006). The mechanisms underlying this result include the reduction of uncertainty, the ability to coordinate, the ability to gauge the extent to which others will cooperate the enhancement of group identity (Orbell *et al.*, 1990), as well as that of norms (Biel and Thøgersen, 2007).

That content, source and channel matter for communication effectiveness, are hardly novel insights for anyone involved in communication or marketing: these insights date back to Aristotle's elements (speaker, message, audience, occasion, effect) of communication (Jensen, 2013), they are echoed in Laswell's well-known maxim for mass communication "*who says what, in which channel, to whom, and, with what effect*" (Lasswell, 1948, p. 216) and they find resonance in social marketing approaches (McKenzie-Mohr *et al.*, 2011). They also feature in recent policy guidance based on behavioural economics (Dolan *et al.*, 2012). But behavioural economics has shed light on other, more novel insights on communication-based intervention.

The prospect that human behaviour may depart from standard economic theoretical assumption of informed rational choice, has resulted in increased recognition that the *manner* in which choice is presented may itself be an important part of any policy toolkit (Thaler and Sunstein, 2008), including that for environmental and waste management (Planas, 2013; Croson and Treich, 2014; Ölander and Thøgersen, 2014). Understanding predictable behavioural traits, known as heuristics and biases (Tversky and Kahneman, 1974, 1986), offers considerable scope not only to understand why efforts at stimulating cooperation may not always work, but also on how to design policy which does.

One such bias which has received considerable attention is the role of communication frames and the role of simple cues. Frames relate to the different manner in which equivalent prospects are presented. Given that people have limited time and cognitive capacity to assess all attributes of decision options, framing a prospect one way or the other can influence decision outcomes in several domains (Tversky and Kahneman, 1981; Tversky and Kahneman, 1986). A different presentation of the same prospect can generate weaker or stronger outcomes depending on who is targeted, such as in the field of climate-change, for instance (Nisbet, 2009). This finding also holds true in the field of waste management, where frames have been found to interact with political preferences (McBeth *et al.*, 2013).

Indeed, even subtle and peripheral cues can make a difference to behavioural outcomes. By drawing on recently activated thoughts, primes can trigger different motives to emerge, to the extent that this may stimulate pro-environmental cooperation (Biel and Thøgersen, 2007). Such effects appear to be particularly relevant when the decision is complex and when people are under cognitive load (Tversky and Kahneman, 1981, 1986). Although the effects may be short-lived (Druckman and Leeper, 2012), if a cue induces a decision to *try*, this can lead to long-term habits – a consideration that is particularly relevant to waste management (Viscusi *et al.*, 2011).

3.3.1 *Concerns with Communication as Intervention*

Communication intervention to stimulate household cooperation may, at face value, appear to be more innocuous than price-based intervention. However a number of authors have examined possible unintended consequences of communication in environmental domains, if for no other reasons, because the hefty budgets accorded could be spent more cost-effectively (Burgess, 1990; Cialdini, 2003; Nisbet, 2009;

Nolan *et al.*, 2009). Indeed while findings suggest that face-to-face and small group communication improves uptake, yet on the ground several environmental interventions continue to rely on mass media-based communication (Bator and Cialdini, 2000). Leaving aside the possibility that mass media agents may have their own agendas (Davies, 2001), and, that people are hardly ever simply passive receivers of such information (Ajzen, 1992), one realistic concern is that such appeals are simply ignored (Bator and Cialdini, 2000).

In terms of content, one concern that emerges, is that reliance on factual information alone is unlikely to suffice in stimulating environmental cooperation by those who are not interested in environmental issues (Ölander and Thøgersen, 2014). The fairly extensive research on the use of eco-labels provides useful insights here. Studies suggest that it is unlikely that a consumer pays any attention to such labels at all, unless the consumer already values protecting the environment, perceives buying behaviour as an effective means to protect it and perceives the information to be useful for this purpose (Thøgersen, 2000). Trust in the label plays a key role in driving *any* effect (Thøgersen, 2000; Daugbjerg *et al.*, 2014), and can itself be determined by the manner in which the information is presented (Topolansky *et al.*, 2013). By this token, it is a valid question to investigate whether those who are not interested in, say, recycling, may not care about information on the scheme at all - and simply ignore it.

Furthermore, while moral suasion may be a more powerful form of communication, in other environmental domains, caution has been advocated in approaches that induce fear or guilt, for these can be met with avoidance (not paying attention) rather than behavioural change (Rothschild, 1979; Thøgersen, 2005; Brekke *et al.*, 2010). Furthermore, there is a considerable body of work in environmental psychology on the notion that there may be strong interaction effects between value orientations (egoist to altruist, bio-centric to anthropocentric, eco-centric to techno-centric, citizen to consumer, hedonic, gain-framed, normative) and how communication is interpreted (Barr, 2003; Thøgersen, 2004, 2005; Berglund and Matti, 2006; Lindenberg and Steg, 2007; Schultz and Tabanico, 2007; De Groot *et al.*, 2009; Steg and Vlek, 2009). This suggests that predicting the effect of moral suasion on waste management cooperation is also a matter of knowing pre-existing preferences. In one economic study on voluntary recycling, the interaction between government promotion and unfavourable voting preferences actually suppressed cooperation among some of the households exposed to promotion (Briguglio *et al.*, 2015). At the same time, however, framing of content cannot be avoided, making it necessary for policy-makers to decide which frames to activate in communicating with the public (Thaler and Sunstein, 2008; Lakoff, 2010).

Normative communication may well be one of the strongest weapons in the communication toolkit, but it too can backfire if the desired pro-environmental behaviour is presented as regretfully *uncommon*, thereby promoting a descriptive norm (what people do) that undermines the injunctive norm (what people ought to do) (Cialdini *et al.*, 1991; Cialdini, 2003; Schultz *et al.*, 2007; Goldstein *et al.*, 2008). The *visibility* of a scheme itself (for instance by collecting regularly at the kerb-side) also sends informational signals (Oskamp *et al.*, 1991; Barr, 2003). If the signal given by other people's visible actions is positive then this acts as positive normative communication. But the opposite may well be true if what is visible is a poor effort by others.

Linked to this, is the prospect that the very presence of the attributes of a public-good schemes can themselves be informational, sending a message which can hint at the level of priority that government accords the issue and the role of the individual in it (Sunstein, 1996; Frey and Oberholzer-Gee, 1997; John, 2013). In the absence of communication, incentives can be interpreted as having bought the right to waste (Gsothbauer and van den Bergh, 2011). Even the very level at which the fee is set can send messages about the importance of the issue: very low or very high taxes may be better than intermediate taxes. Low taxes may support morale, high taxes work through price effects, while intermediate taxes may fall short of generating either effect (Gneezy and Rustichini, 2000).

Finally, the behaviour of the policy-making body itself can send communication signals which can complement or undermine the behaviour promoted (Jackson, 2005; Thøgersen, 2005), echoing broader concerns about lack of trust in the communicating body (Collins *et al.*, 2003; Nisbet, 2009; Daugbjerg

et al., 2014) and the possibility of communication being seen as green-washing (Glaeser, 2014). Such considerations may not be the most obvious in designing communication of a waste management intervention, but they seem to matter in other public good domains and are worth factoring into the design to avoid the prospect of the medium undermining the message.

3.4 *Synthesis*

In synthesis then, waste management intervention can, and often does involve convenience-based attributes, sometimes complemented with monetary incentives and often with some form of public communication. Such instruments may aim to enhance the (perceived) benefits from cooperation, to reduce the (perceived) costs of cooperation and to increase the (perceived) costs of waste disposal. A marginal tax on household waste disposal seems to incentivize cooperation but political implications, including low rates of substitution into recycling/reduction, the possibility of incentivizing other (polluting) options, and the possibility that taxes suppress the moral benefits, merit consideration. Communication intervention, be it the promotion of scheme attributes (including incentives themselves), awareness-raising on environmental impacts, efficacy, or norms, can also stimulate cooperation. But some considerations merit caution here too, including the prospect that (costly) mass media appeals and promotion can simply be ignored, that communication interacts with motives to create divergent outcomes; and that subtle cues (including scheme attributes themselves) can communicate messages to households.

4. Conclusion

This review started off by presenting waste management as a high-stakes issue and one with considerable private and social costs. The need to divert municipal waste away from end-of-pipe solutions by stimulating household cooperation in waste separation and recycling was presented as an important and widespread policy-objective. A considerable body of research on such cooperation was synthesized in response to two key questions, namely the initial conditions that may be associated with cooperation, and the way intervention can be designed to induce further cooperation. Policy-makers and scheme operators may benefit from the following implications emerging from these findings.

4.1 *Policy Cues*

The insights may be synthesized into three key messages for policy makers. The first is that household cooperation in waste management is stimulated by members' desire to fulfil their moral (environmental, social, political) preferences. Higher cooperation can be expected among households where such favourable preferences exist, all other factors remaining constant. Such households constitute a low-lying fruit and a favourable demographic to start with when rolling out interventions, and it would be useful to identify them, even if this is done through demographic proxies like vote and educational level. The finding that such preferences may be strong enough to see households willing to recycle without incentives is particularly important for municipalities which, for some reason or other, may be unable to institute waste disposal taxes. But even when price-based intervention is envisaged, the presence of moral preferences should still be a factor for consideration to ensure that the manner in which incentives are communicated stimulates rather than crowds-out motivation.

Secondly, the finding that households have limited space and time, and that this constrains cooperation in waste management, suggests that policy makers would do best to avoid neighbourhoods, localities or regions characterized by high constraints. These, in turn, may be proxied by demographic data on poverty, dwelling size, and household size. Additionally, the findings clearly suggest that higher cooperation can be induced by relieving the constraints. Schemes may offer more frequent collection and smaller

waste-collection containers to relieve limited space. Simple and clearly communicated waste separation processes can also relieve time constraints. A longer-term consideration is that developments which result in the construction of smaller dwellings could carry with them the added negative prospect of lower participation rates.

Thirdly, this review confirms that intervention may incur unintended consequences. Administrators are therefore called upon to pre-empt side effects (like illegal disposal, regressive impacts) of intervention and to consider not only the attributes of the schemes but also how these are perceived, and how they interact with household members' motives and constraints. One implication of these findings is the need to pay due attention to the subtle cues given by the scheme attributes and sponsors themselves. Earlier commentators have suggested that, in a world where actors are less predictable than rational models would assume, governments need to adjust fiscal and regulatory measures in an iterative process (Shogren and Taylor, 2008). As it becomes increasingly feasible to conduct randomized controlled experiments (Croson and Treich Jackson, 2005, 2014), linking research to policy-development becomes one way to collect evidence and adjust policy (Dolan *et al.*, 2012; Lunn, 2013). This ties in with the potential for future research, discussed next.

4.2 *Suggestions for Future Research*

Notwithstanding the enormity of the literature on the economics of waste, yet given the diversity in preferences for recycling among municipalities and countries (Kinnaman, 2009), empirical work on household cooperation in waste management continues to be necessary. In cross-country analyses, country-effects tend to be significant, suggesting that institutional and cultural factors play a role (Ferrara and Missios, 2012). And, while the majority of studies to date have focused on the extent to which households separate dry recyclable waste (e.g. paper, plastic, metal and glass), biodegradable waste separation, home-composting and consumption reduction have received far less attention (Thøgersen, 2003; European Environment Agency, 2009; Abbott *et al.*, 2011; Andersen *et al.*, 2012; Ferrara and Missios, 2012).

Under-explored determinants, like political preferences, also merit further study. Political promotion is not uncommon in other public-good domains (Graber and Smith, 2005; John, 2013), and it would seem relevant to examine the interactions between the promotion of waste schemes and political preferences; the impacts of politicizing intervention; and the prospect of emphasizing technocratic expertise as an alternative (Briguglio *et al.*, 2015). More broadly, the waste management field would benefit from studies on communication, including the subtle informational cues that intervention attributes may signal, as witnessed in similar studies in other environmental domains (Graber and Smith, 2005; Nolan *et al.*, 2009; Gsottbauer and van den Bergh, 2011; John, 2013; Glaeser, 2014). As mentioned in the review itself, there seems to be considerable scope to examine interaction effects among the various scheme attributes and between the scheme attributes and the households they target.

For instance, while intervention to stimulate household cooperation has been extensively studied by economists, much of the work has assumed rational self-interest as a response. Behavioural reaction to price is still a young research area (McCaffery and Baron, 2006; Congdon *et al.*, 2009), though fast making its way to the regulatory tool-kits (Dolan *et al.*, 2012; Lunn, 2013). There is potential to consider consequences in the waste management domain (Kinnaman, 2006; Davies and O'Callaghan-Platt, 2008; Fleischer, 2014). The potential to design incentives that combine the power of economics and psychology is one that has been advocated in environmental intervention (Shogren and Taylor, 2008; Venkatachalam, 2008; Gsottbauer and van den Bergh, 2011; Croson and Treich, 2014), and holds promise for improving household waste management too (Croson and Treich, 2014).

Indeed the promise of behavioural intervention more generally is one that is ripe for examination in the waste field. Its potential in stimulating pro-environmental behaviour has been examined elsewhere

(Gowdy, 2008; Shogren and Taylor, 2008; van den Bergh, 2008; Venkatachalam, 2008; Croson and Treich, 2014; Ölander and Thøgersen, 2014), and some exponents in the field have singled out waste management as an area ripe for behavioural intervention (Thaler and Sunstein, 2008; Nomura *et al.*, 2011; Planas, 2013). Research on household cooperation could assess behavioural nudges such as whether commitment devices can be employed for waste management; how time preferences influence the decision to store waste; how pro-recycling/composting default options may influence outcomes; how scheme modifications effect habit formation; and how loss-aversion can be used as a frame, among others (see for instance Karp and Gaulding, 1995; Kuo and Perrings, 2010).

Significant and sustained pro-environmental behaviour remains a scarcely documented phenomenon in generally (Shogren and Taylor, 2008; van den Bergh, 2008). Given that the management of waste by households is one area where such behaviour has been observed, often in the absence of any mandatory regime, both with and without financial incentives, the field of waste management offers researchers the opportunity to examine the kind of moral preferences, and policy, that may trigger such cooperation more generally, and beyond the field of waste (Kinnaman, 2009; Kinnaman and Takeuchi, 2014).

Finally, a long standing research question is whether and how recycling spills over to other pro-environmental behaviours, including waste reduction (Thøgersen and Grunert-Beckmann, 1997). Recent findings suggest that unless environmental norms are strong, transfers between behavioural categories are few and modest in size (Thøgersen and Ölander, 2003). Of particular concern is the prospect that increased cooperation in waste management is instead off-set, through moral licensing, by negative effects in other domains (Croson and Treich, 2014). This question becomes all the more pertinent to examine as intervention becomes increasingly successful at stimulating household cooperation in waste management.

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