Social Interaction in Responsibility Ascription: The Case of Household Recycling

Kjell Arne Brekke[1], *Gorm Kipperberg*[2], *Karine Nyborg*[3]

Abstract

Duty-orientation implies a warm glow of giving as well as a cold shiver of not giving enough. If duty-oriented consumers learn their moral responsibility by observing others' behavior, social interaction in contribution behavior arises. However, since moral responsibility is a burden, duty-oriented consumers may be less willing to accept responsibility if their information about others' behavior is uncertain. Data from a survey on households' glass recycling indicates that perceived responsibility is a major determinant for reported recycling; that responsibility ascription is influenced by beliefs about others' behavior; and that people are, indeed, reluctant to accept responsibility based on uncertain information.

JEL codes: D11, D12, D64, Q53

Keywords: Voluntary contributions, duty-orientation, recycling, joint FIML estimation.

Acknowledgements: Funding from the Research Council of Norway through the SAMSTEMT program is gratefully acknowledged. Thanks to Yuko Onozaka, Michael Rauscher, Mari Rege, an anonymous reviewer, and many seminar participants for valuable comments. The major part of this article was written while Brekke and Nyborg were employed by the Ragnar Frisch Centre for Economic Research, partly during their participation in the project "Environmental economics: policy instruments, technology development, and international cooperation" at the Centre for Advanced Study (CAS) at the Norwegian Academy of Science and Letters in Oslo. The financial, administrative and professional support of both the Frisch Centre and CAS are much appreciated.

[1] Department of Economics, University of Oslo. Phone: +47 22841169, e-mail: k.a.brekke@econ.uio.no.
[2] Department of Business Administration, University of Stavanger, NO-4036 Stavanger. Phone: +47 51831000, e-mail: gorm.kipperberg@uis.no
[3] Corresponding author: Department of Economics, University of Oslo, P.O. Box 1095 Blindern, NO-0317 Oslo, Norway. Phone: +47 22857283, fax: +47 22855035, e-mail: karine.nyborg@econ.uio.no.

1. Introduction

A substantial number of experimental studies have concluded that individuals contribute more to public goods when *others'* contributions increase (see, for example, Fishbacher et al. 2001, Krupka and Weber 2004, Croson et al. 2005). Nevertheless, the underlying motives causing such social interaction are still insufficiently understood. Recent research indicates that preferences for social approval, reciprocity, and conformity are all at play (Rege and Telle 2004, Bardsley and Sausgruber 2005). Moreover, several studies have indicated that people ascribe to many different, possibly conflicting norms, and that observations of others' behavior serve as a means to activate specific norms in the observer's mind (Reno et al 1993, Cialdini et al. 1990, Krupka and Weber 2004). Social psychologists further emphasize what they call *informational social influence*: "we conform because we believe that others' interpretation of an ambiguous situation is more correct than ours and will help us choose an appropriate course of action" (Aronson et al. 2005, p.241).

In this paper, we wish to focus on what we will call *duty-orientation*, a type of motivation which has been relatively little discussed within the economics literature. A duty-oriented individual prefers a self-image as a decent or socially responsible kind of person; moreover, he suffers a loss of self-image if he does not fulfill his perceived personal responsibilities (Brekke et al., 2003). Duty-orientation can thus be regarded as an extension of the standard impure altruism model (Andreoni 1990): just like the impure altruist, the duty-oriented gets a warm glow which is increasing in the size of his contribution; but unlike the impure altruist, the warm glow is decreasing in the perceived responsibility, and there is also a cold shiver of not giving enough (Bruvoll and Nyborg 2004). If the perceived responsibility is kept fixed, duty-orientation is behaviorally indistinguishable from a "warm glow" model. As soon as perceived responsibility changes, however, behavior and utility will generally be affected (Brekke et al. 2003, Bruvoll and Nyborg 2004, Nyborg 2008).

In the present paper, we will follow Nyborg et al. (2006) in assuming that, if in doubt about the right thing to do, people infer their individual responsibility by looking at

others' behavior: That is, informational social influence comes into play, causing social interaction in individual contributions.

While the concept of responsibility is rarely invoked in economics, it is a core concept in the psychological literature on moral behavior. The norm activation theory, originally formulated by Shalom Schwartz (1970, 1977), posits that two conditions are required for an individual to activate a norm. First, the individual must accept that there is a public good/bad aspect of his private actions. This is called awareness of consequences. Second, the individual must ascribe personal responsibility for the issue at hand. These are necessary, but not sufficient, conditions for making moral decisions. Empirical tests of the theory in general support its main claims (Stern et al. 1999).

A proper understanding of the causes of social interaction effects in voluntary contributions to public goods is potentially important for policy analysis. One reason is that, since responsibility may be felt as a burden, duty-oriented individuals may consciously or unconsciously avoid situations in which they fear a heavy burden of responsibility will be imposed upon them. Similarly, they might try to shy away from information which could potentially indicate that they ought to take responsibility (Lazear et al. 2005, Dana et al. 2007, Nyborg 2008). They could also, as our data indicates, be reluctant to accept responsibility on the basis of uncertain information, giving themselves the benefit of the doubt. Hence, if duty-based motives are important for voluntary contributions, policies designed to increase contributions should take into account that although people may contribute out of a feeling of responsibility, they may also try to avoid situations in which this feeling arise.

To test the hypothesis of duty-oriented social interaction, we have collected survey data on glass recycling in Norwegian households. Recycling of household waste is a prime example of voluntary contributions to a public good: typically, it is costly to the individual in terms of time or inconvenience, while the environmental benefits resulting from the individual's efforts are non-rival, non-excludable, and hardly noticeable to the individual himself. Glass recycling systems in Norwegian municipalities differ both in the private cost of recycling they induce on the households, due to differing local recycling policies, and in the degree to which other households' recycling behavior is observable.[1] The survey was conducted in 2004 by Statistics Norway and provides a

substantial amount of background information on each respondent. Our empirical results are consistent with the claim that duty-orientation is central to recycling behavior; that responsibility ascription is influenced by the perception of what others are doing; and, finally, that people are reluctant to accept responsibility based on uncertain information, indicating that responsibility is in fact a burden.

When interpreting the results, it is important to keep alternative explanations in mind. If people report to recycle more the more they think others recycle, this could be caused by a multitude of factors. As is well known from the literature (see Manski, 2000 for a survey) it is difficult to identify social interaction effects empirically. People living in the same neighborhood, or groups of friends or relatives, may behave similarly for many other reasons than social interaction; they may, for example, face the same waste collection system. We partially control for this by including data for a large number of factors that should pick up some of these effects, including policy variables, average levels of glass recycling in the respondent's municipality, family status, income, education level, political preferences and environmental attitudes; but of course, this does not grant complete avoidance of the problem.

Further, although social interaction in recycling behavior might originate from duty-orientation (combined with social learning of responsibility), it could alternatively, or in addition, be caused by other individual motives. One such possible motive is the fear of social sanctions, or the desire for social approval (e.g. Coleman 1990, Lindbeck et al. 1999, Rege 2004).[2] If it is primarily those who comply to a social norm themselves who sanction non-compliers, the expected social sanction for violating a norm will be increasing in the share of norm compliers, and the individual's benefits from recycling will be increasing in others' recycling behavior. Similarly, social interaction in recycling behavior can occur due to pure conformism; that is, individuals may prefer to consider themselves "normal", thus preferring to conform to commonly expected standards of behavior. Finally, the existence of reciprocal preferences, meaning that individuals prefer to repay kindness with kindness and meanness with meanness, is by now well documented by experimental research (e.g. Fehr and Gächter 2000, Fehr and Fischbacher 2002, Camerer 2003). In a public good context, this may imply that reciprocal individuals are willing to contribute only if others are doing so too (Ledyard 1995). However, the

distinction between reciprocity and duty-orientation is not necessarily clear-cut: For example, a duty-oriented person *A* may ascribe to a "meta-norm" saying that if another person *B* exploits *A*'s ascription of responsibility, *A*'s responsibility (towards *B*) is cancelled. This interpretation views reciprocity as a special case of duty-orientation.

The above-mentioned motives are presumably intertwined; for a given individual, all of them may play a role, and it is hardly possible to isolate each in an empirically clear-cut way. In the econometric analysis below, however, we will do our best to distinguish duty-orientation from the most obvious alternative motives causing social interaction.

2. Duty-orientation

2.1. Cognitive dissonance: Actual vs. ideal behavior

The main hypothesis we study in this paper is that recycling decisions may be motivated by duty-orientation, and that this can lead to interaction effects through social learning of individual responsibility.

A duty-oriented individual prefers to keep a self-image as a decent or responsible kind of person, someone who can be trusted to do what "a person such as I do in a situation such as this" (March and Olsen, 1995, p.7). Further, if he does not live up to his perceived responsibilities, this will impair his self-image.

Brekke et al. (2003) proposed a model in which person *i*'s self-image as socially responsible is decreasing in the distance between *i*'s actual contribution and a morally ideal contribution. Moreover, they assumed that the morally ideal contribution was that contribution which would have maximized social welfare had it been provided by everyone.[3] Other examples of models in which individuals suffer disutility from the distance between actual and some "ideal" behavior can be found in Sugden (1984), Woodward and Warren-Boulton (1984), Cappelen et al. (2007), and Konow (2006).[4] These specifications relate nicely to what psychologists call *cognitive dissonance* (Festinger 1957), the idea that a divergence between a person's behavior and his values causes discomfort (see Aronson et al. 2005, p. 166, for a discussion).

If the individual's perception of the ideal contribution is zero, he can keep a good self-image (or avoid cognitive dissonance) by contributing nothing. The higher the ideal contribution, however, the harder it is to keep a good self-image. With the model specifications of the above papers, a high perception of the ideal contribution is, all else given, a burden; so if responsibility ascription were an ordinary choice, we would expect every individual to choose no responsibility at all. In the present paper, we will assume that for a duty-oriented person, responsibility ascription is an inference – the result of a learning process – and not a choice as such.

Assume that the individual's choice of whether or not to recycle glass waste is discrete: either he recycles ($RECY_i$=1), or he does not ($RECY_i$=0). Assume, moreover, that the individual does not consider recycling a morally inferior activity; thus, we can disregard the possibility that he feels a moral duty *not* to recycle. A duty-oriented individual will experience a self-image loss if he does not fulfill his perceived responsibility to recycle. Let $RESP_i$=1 denote that *i* perceives glass recycling as his responsibility, while $RESP_i$=0 means that he does not. Thus, we will assume that a duty-oriented individual *i*'s self-image benefit S_i from recycling glass can be written[5]

$$(1) \qquad S_i = \begin{cases} -K & \text{if } RECY_i = 0 \text{ and } RESP_i = 1 \\ 0 & \text{otherwise} \end{cases}.$$

This reflects the view that for a duty-oriented individual, cognitive dissonance will arise if his actual contribution falls short of what he believes he ought to have contributed.

2.2 Responsibility ascription

As mentioned above, we will consider responsibility ascription an inference, not a choice. Following Nyborg et al. (2006), we will assume that, if in doubt about the right thing to do, people infer their individual responsibility by looking at others' behavior.

Several reasons can be given for this hypothesis. First, the individual may interpret others' behavior as an indication of the social importance of glass recycling (informational social influence). Second, as discussed in the introduction, reciprocity might possibly operate via meta-norms for responsibility ascription among duty-oriented

individuals, meaning that if others do not conform, the individual's own moral responsibility is cancelled out. . Third, in a complex world, no-one can take responsibility for everything; this generates a need for formal or informal rules for division of labor in society, including norms for whether individuals, firms, or the public sector are the ones responsible for provision of public goods in various contexts. In some communities, for example, the waste treatment system is based on household sorting at source, while elsewhere, sorting is done at central facilities or not at all, leaving households with little or no responsibility for waste sorting. If an individual is uncertain of whether glass recycling is indeed an individual responsibility in his community, the behavior of comparable others is an indication of the role he is expected to take.

The hypothesis of social interaction in responsibility ascription can then be specified as follows: All else given, an individual *i* accepts responsibility whenever the share of others who recycle glass, *p,* is sufficiently high. More specifically, let T_i be an individual threshold, which is unknown to the researcher; our assumption is that individual *i* accepts responsibility whenever $p > T_i$. Note that T_i may differ between individuals: some individuals are more ready to accept responsibility for recycling, for example because they are concerned about environmental quality, while others, who may be less concerned about the environment, or less convinced that recycling is important, could have a higher threshold T_i .

An individual's knowledge of *p* will usually be imperfect, however. Let P_i be *i*'s estimate of *p*, and assume, for simplicity, that P_i is the median of *i*'s subjective probability distribution for the true share of glass recyclers *p*. Since the threshold T_i is unknown to the researcher, our empirical prediction is that the probability of responsibility ascription is increasing in the individual's belief of the share of glass recyclers, P_i.

2.3 Reluctance

Recycling is usually costly in terms of time and effort. Consequently, as explained above, every individual would be weakly better off if he did *not* accept responsibility (see, for example, Bruvoll and Nyborg 2004). Now consider an individual whose assessment of the share of recyclers is sufficiently high to indicate that he does have a

responsibility, i.e., $P_i > T_i$, but who is highly uncertain about his assessment P_i. Thus, he knows that if he accepts responsibility, he is quite likely to do so just because of a mistake. It seems reasonable, then, that since responsibility is a burden, he may choose to give himself the benefit of the doubt. In the following, we will use the term *reluctance* about such a tendency to give oneself the benefit of the doubt, not accepting responsibility based on uncertain information. Reluctance is thus related to how confident an individual must be that the true share of recyclers is above his threshold in order to accept responsibility (and not to the level of the threshold as such).

To formally define this, consider first an individual whose assessment is just equal to his threshold; $P_i = T_i$. Then $\Pr(P_i > T_i) = \Pr(P_i < T_i) = 50\%$, and according to the individual's beliefs, it is equally likely that he should and should not accept responsibility. In this case, which gives the maximum doubt about implied responsibility, a reluctant individual would not accept responsibility. A reluctant individual would only accept responsibility if the evidence in favor of responsibility clearly dominates the evidence in favor of no responsibility, that is, if $\Pr(P_i > T_i) > \Pr(P_i < T_i)$, and hence $\Pr(P_i > T_i) > 50\%$. In accordance with this argument, we will assume that an individual accepts responsibility only if he must reject, with a given level of confidence α, the hypothesis that the share of others who recycle glass is below his threshold:

(2) $\quad RESP_i(P_i) = 1$ if $\Pr(p < T_i) < \alpha$

Note that while thresholds may differ between individuals, the confidence level α is assumed to be common for all. If α =½, there is no reluctance, and uncertainty of P_i will not matter for responsibility ascription. If α < ½, we will say that individuals are reluctant to accept responsibility. Thus, we assume individuals' null hypothesis to be that they have no responsibility; they accept responsibility only if this null hypothesis must be rejected. Different confidence levels will imply different tradeoffs between potential type I and type II errors. Reluctance, i.e. α < ½, means being more concerned about not making type I-errors (erroneously ascribing responsibility) than about not making type II-errors (erroneously not ascribing responsibility). This corresponds to standard statistical inference.

Just like any null hypothesis is unlikely to be rejcted by poor data, the null hypothesis of no responsibility is unlikely to be rejected when individuals are very uncertain about others' behavior. That is, although each individual does his best to make a correct guess about how common it is to recycle glass, a reluctant individual gives himself the benefit of the doubt if he is very uncertain about whether the true share p is really above his threshold T_i.

If individuals were, on the other hand, eager to accept responsibility, we would have $\alpha > ½$. This might be expected if responsibility were not a burden but rather, for example, increased the warm glow of giving. In the econometric study, we do not assume that respondents are reluctant; rather, we let the data decide.

In the questionnaire, our question about P_i is formulated as a question about how common respondents think glass recycling is in their peer group. If the threshold T_i always corresponds to the respondent's interpretation of the word "common", the above theory would imply that for reluctant individuals, uncertainty would only be expected to matter for those reporting that recycling is common (high P_i). However, some individuals may be willing to accept responsibility even if recycling is relatively uncommon; that is, it is possible that threshold levels are quite low. Hence, it is possible that uncertainty also has an impact for P_i classified as low in our data. Both for high and low P_i, however, the effect of certainty on responsibility ascription, according to the above model, is weakly positive for reluctant individuals.

To conclude: If people are reluctant, certainty in beliefs about the share of recyclers weakly *increases* the probability of responsibility ascription, presumably more so for high values of P_i. Similarly, if people are eager, certainty weakly *decreases* the probability of responsibility ascription, presumably more so for low values of P_i. We return to the econometric specification below.

2.4 Predictions

Our main hypotheses, taking into account that our data on recycling and responsibility are binary, can now be summarized as follows:

a) *Social learning of responsibility:* The probability that $RESP_i = 1$ is increasing in P_i, all else equal.

b) *Reluctance in responsibility ascription:* The probability that $RESP_i = 1$ is increasing in reported certainty about P_i, all else equal.

c) *Duty-orientation:* The probability that $RECY_i = 1$ (recycling is chosen) is increasing in responsibility ascription $RESP_i$ (higher when $RESP_i = 1$), all else equal.

In the theoretical discussion so far, we have disregarded other motives than duty-orientation, such as conformity and the fear of social sanctions. It is useful to note, however, that these motives would imply predictions differing slightly from those specified in a) – c). If people are duty-oriented and infer their responsibility via peer behavior, we expect a positive correlation between P_i and $RECY_i$ (due to a and c above). However, we expect this relationship to be indirect, via the impact P_i has on responsibility ascription. The duty-orientation model itself provides no reason to expect a *direct* relationship between P_i and $RECY_i$. If recycling were, on the other hand, motivated by the fear of social sanctions and/or conformity, but not duty-orientation, it is hard to see why ascription of responsibility would be a relevant concept at all. In particular, we can see no reason why *uncertainty* of P_i would matter for responsibility ascription in that case.

If, after adjusting for the effect of background variables, there is a correlation between recycling behavior and beliefs about peer recycling, we will interpret this as indications of social interaction. If the correlation is indirect, through the effect of peer recycling on responsibility ascription, we will consider this evidence indicating duty-oriented motivation. This interpretation is strengthened if data indicates reluctance in responsibility ascription. If the correlation between believed peer recycling and own behavior is direct, however, *not* operating through perceived responsibility, this is taken as an indication that recycling is motivated by conformity, fear of social santions, or by reciprocal preferences which do not operate via duty-orientation.

For completeness, let us thus add a fourth testable hypothesis. In accordance with the above argument, this hypothesis would be expected to hold if at least some part of the social interaction in recycling behavior is caused by *other* motives than duty-orientation:

d) *Direct social interaction in recycling behavior:* The probability that $RECY_i = 1$ (recycling is chosen) is is increasing in P_i, all else equal.

3 Data

The empirical application in this paper is based on data from a Statistics Norway household survey conducted in Norway in 2004 (Hougen, 2005).[6] Descriptive statistics for the variables we employ are reported in Table 1.[7]

3.1 Dependent variables

Responsibility ascription is measured by the variable RESP, which was constructed from a survey question that asked the participants to indicate their extent of agreement with the statement *I feel a responsibility to recycle glass*. It takes the value 1 if the respondent agreed (either completely or partially) with this statement and the value 0 if the respondent disagreed with it.[8] Recycling behavior is measured by the variable RECY, which represents *reported* recycling behavior.[9] It takes the value 1 if the respondent indicated that either *most* or *all* of the household's recyclable glass (not considering deposit-refund items) is typically recycled, and 0 otherwise. As reported in Table 1, the sample mean for RESP is 0.86, meaning that 86% of the respondents are classified as ascribing responsibility for glass recycling. The mean for RECY is 0.77, which means that 77% of the respondents are classified as living in households that recycle glass materials.[10]

There is a strong correspondence between the two outcome variables (correlation coefficient of 0.395) with the variable RESP taking the same value (0 or 1) as RECY in about eight out of ten cases. This suggests a strong positive relationship between responsibility inference and recycling behavior. At the same time, it is noteworthy that as many as 16% of the people who stated they feel a recycling responsibility do not recycle glass. This shows that responsibility ascription is not a sufficient condition for responsible behavior. Furthermore, among the people who are classified as *not* ascribing responsibility, 36% nevertheless report to recycle glass. This result indicates that behavior, which is of ultimate interest, could be driven by other motivations than a sense of responsibility, including standard economic incentives, social sanctions, and conformity. The goal of the econometric estimations is to isolate social interactions in responsibility ascription and recycling behavior, while controlling for other determinants.

3.2 Independent variables

Variables for explaining ascription of responsibility and recycling behavior can be categorized as a) social interaction measures, b) waste policy variables, c) standard socioeconomic and demographic variables, d) other background variables. The *social interaction measures* are P, CERT, and SOCSANC. The first of these, P, measures the respondent's assessment of how common glass recycling is within her immediate social group.[11] Second, CERT measures the degree to which the respondent was certain about this assessment. According to our *learning* and *reluctance* hypotheses, respectively, RESP is expected to be positively associated with these two variables (see section 2.4). Furthermore, P could also affect RECY directly (hypothesis d above; for example, if people have conformity preferences), whereas we have no prior for a direct relationship between CERT and recycling. Finally, SOCSANC captures fear of social sanctions (by not recycling). These three variables take on discrete values between 1 and 4 in our sample data. The sample means for P, CERT, and SOCSANC are 3.06, 3.14, and 1.98, respectively. This suggests that, on average, the respondents think glass recycling is common in their immediate social groups, are sure about this assessment, but do not necessarily fear social sanctions.[12]

The *waste policy variables* include CURBGR, MSAVE, and GLASSKG. Theory on household waste management decisions suggests that CURBGR (presence of a curbside recycling program) and MSAVE (presence of a user fee on waste disposal) should operate as positive inducements for recycling (Jenkins 1993, Fullerton and Kinnaman 1996, Morris and Holthausen 1994). However, the empirical literature is mixed with regards to their effects on recycling of particular materials (see, for example, Jenkins et al. 2003, Ferrera and Missios 2005, and Kipperberg 2007). These policy variables could also help explain RESP. Households may perceive the presence of a (voluntary) curbside recycling program and waste fees as a signal that sorting glass is their responsibility. Unobserved variation in local waste policies may also affect all households in a municipality. As one means to (at least partially) account for this, we include GLASSKG (per capita kilo of glass recycled at the municipality level) in our empirical specifications. This variable may also partially capture the effect of other unobserved variables such as local geography, local culture, and so on.[13]

The socioeconomic and demographic variables (MALE, HHSZ, KIDS1, KIDS2, EDU1, EDU2, HWORK, INCH, INCM, AGE) are intended to capture any potential gender, education, age, income, and more generally, life-cycle, effects in both responsibility ascription and recycling behavior. As far as recycling behavior goes, these variables typically have ambiguous theoretical priors and yield mixed empirical results (both in terms of estimated signs and statistical significance), as discussed extensively in the empirical literature (for example, Kipperberg 2007 studies recycling in Norway, Ferrera and Missios 2005 recycling in Canada, and Jenkins et al. 2003 study the recycling behaviors of households in the United States).

Other respondent background information is captured by the variables GOVERNM, ENVIRON, ENVAWARE, and BLUE. The variable GOVERNM measures the perception that recycling is mandated by the government. This variable is expected to have a positive influence on RECY, and possibly also directly on RESP.[14] The variables ENVIRON and ENVAWARE are environmental attitudinal measures, the former directly related to recycling and the latter measuring general awareness. We include these variables in our estimation as it seems reasonable that such attitudes could affect positively both outcomes.[15] The variable BLUE is an indicator variable for whether the respondent had voted for a political party to the right of the Norwegian political center (symbolized by the color blue in Norway) in the last election.

Finally, it is worth pointing out that the latter three variable categories play the role of *ceteris paribus* controls for the social interaction hypotheses tested in this paper. By including these variables in the estimation, we hope to reduce (though we cannot eliminate) the likelihood of finding statistical support for any given hypothesis due to spurious correlation, omitted variable bias, or an endogeneity issue, econometric challenges extensively discussed in the social interaction literature (see, for example, Manski 2000 and Brock and Durlauf 2001).

4. Econometric model

Below we describe a full information maximum likelihood (FIML) joint responsibility-recycling model based on the earlier conceptual framework, which *implicitly* captures the role of duty-orientation in recycling behavior. This FIML model is

formally a bivariate probit model. Recall that responsibility ascription is regarded as a psychological inference, which may be influenced by peer behavior and other factors. Recycling, on the other hand, is regarded as the outcome of a utility maximizing choice problem, involving considerations of both pecuniary and non-pecuniary factors. The responsibility outcome and recycling outcome are linked through a joint error structure that yields a quantitative measure of the effect of responsibility ascription on recycling behavior. The central idea is that responsibility ascription alters the payoff from recycling; specifically, it leads to a recycling utility premium ("warm glow"), or conversely, a utility loss ("cold shiver") from not recycling. We therefore expect a positive correlation between the two outcomes, holding all else constant. Examples of other studies that have taken a similar approach to investigating connections between two discrete outcomes are Berrens et al. (1998), Bohara et al. (2007), and Greene (1998).

4.1 The joint FIML responsibility-recycling model

Let $Z_{1i} + \varepsilon_{1i}$ represent the data generating process for responsibility such that a person ascribes responsibility ($RESP_i = 1$) if and only if $Z_{1i} + \varepsilon_{1i} > 0$, where Z_{1i} is an observable (deterministic) component and ε_{1i} is an unobservable (random) component. Similarly, let $Z_{2i} + \varepsilon_{2i}$ represent the data generating process for recycling with deterministic component Z_{2i} and random component ε_{2i}. The error components are assumed to have zero mean and standard deviation of σ_1 and σ_2, respectively.

The hypothesis that behavior is motivated by a sense of duty through ascription of responsibility is tested by specifying that the error terms (ε_{1i} and ε_{2i}) have a jointly normal distribution given by

$$(3) \qquad \boldsymbol{\varepsilon_i} \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}\sigma_1^2 & \rho\\ \rho & \sigma_2^2\end{pmatrix}\right),$$

where $\boldsymbol{\varepsilon_i} = (\varepsilon_{1i}, \varepsilon_{2i})'$ and ρ is the correlation coefficients that capture the extent to which the error terms are correlated. As shown below, this specification permits us to derive conditional expectations that can be used to quantify the effect of responsibility ascription on recycling behavior.[16]

The joint probability that a person both ascribes responsibility and that glass is recycled (denoted p_{1i}) can be written as

$$(4a) \qquad p_{1i} = \Pr(Z_{1i}^* > -\varepsilon_{1i}^*, Z_{2i}^* > -\varepsilon_{2i}^*) = \Phi_2(Z_{1i}^*, Z_{2i}^*, \rho),$$

where $Z_{1i}^* = Z_{1i}/\sigma_1$, $Z_{2i}^* = Z_{2i}/\sigma_2$, $\varepsilon_{1i}^* = \varepsilon_{1i}/\sigma_1$, $\varepsilon_{2i}^* = \varepsilon_{2i}/\sigma_2$, and Φ_2 is the *bivariate* standard normal cumulative density function. For implementation, both σ_1 and σ_2 are normalized to one, which is unproblematic as there are no structural links (parameter restrictions) across the deterministic portions of the responsibility and recycling equations.

Similarly, the joint probability of ascribed responsibility without corresponding glass recycling (denoted p_{2i}) can be written as

(4b) $$p_{2i} = \Pr(Z_{1i}^* > -\varepsilon_{1i}^*, Z_{2i}^* < -\varepsilon_{2i}^*) = \Phi(Z_{1i}^*) - \Phi_2(Z_{1i}^*, Z_{2i}^*, \rho),$$

where Φ is the univariate standard normal cumulative distribution function.

For completeness, the joint probability that responsibility is *not* ascribed while glass *is* recycled (denoted p_{3i}), and the joint probability of no ascribed responsibility with no glass recycling (denoted p_{4i}) can be expressed, respectively, as

(4c) $$p_{3i} = \Pr(Z_{1i}^* < -\varepsilon_{1i}^*, Z_{2i}^* > -\varepsilon_{2i}^*) = \Phi(Z_{2i}^*) - \Phi_2(Z_{1i}^*, Z_{2i}^*, \rho)$$

(4d) $$p_{4i} = \Pr(Z_{1i}^* \leq -\varepsilon_{1i}^*, Z_2^* \leq -\varepsilon_{2i}^*) = \Phi_2(-Z_{1i}^*, -Z_{2i}^*, \rho).$$

The joint likelihood function $L(\boldsymbol{\varphi},\boldsymbol{\gamma},\boldsymbol{\lambda},\boldsymbol{\beta},\rho)$ used to estimate the responsibility-recycling model can be written as

(5) $$L(\boldsymbol{\varphi},\boldsymbol{\gamma},\boldsymbol{\lambda},\boldsymbol{\beta},\rho) = \prod_{\forall i} (p_1^{RESP \cdot RECY} \times p_2^{RESP \cdot (1-RECY)} \times p_3^{(1-RESP) \cdot RECY} \times p_4^{(1-RESP) \cdot (1-RECY)}).$$

4.2 Specification for responsibility ascription

The threshold T_i in Equation 2 is an unobserved (random) variable, which, from the econometrician's point of view, falls into the error term ε_{1i} (from above) along with other unobservable factors. This threshold may be influenced by individual characteristics and other background variables, including the fear of social sanctions (SOCSANC), since such sanctions may serve to remind people about their moral obligations. An individual *i* is therefore assumed to ascribe responsibility ($RESP_i = 1$) when

(6) $$Z_{1i} = \varphi_0 + \varphi_1 \cdot P_i + \varphi_2 \cdot CERT_i + \varphi_3 \cdot SOCSANC_i + \boldsymbol{\lambda}' \mathbf{X}_i > -\varepsilon_{1i},$$

where $\varphi_1 > 0$ if there is social learning in responsibility ascription, $\varphi_2 > 0$ if individuals are reluctant to take responsibility (with $\phi_2 = 0$ if they are neutral and $\varphi_2 < 0$ if they are eager), $\varphi_3 > 0$ when respondents who fear social sanctions have a larger propensity to ascribe responsibility for glass recycling than others, and **X** is a vector (with a comformable parameter vector **λ)** of other covariates that may influence the outcome.[17] The unconditional probability that *i* will take responsibility for glass recycling equals the probability that Equation (6) holds

(7) $$\Pr(RESP_i = 1) = \Pr(Z_{1i} > -\varepsilon_{1i}) .$$

4.3 Specification for recycling behavior

The glass recycling outcome is specified in terms of net recycling utility. Individual *i* is assumed to recycle ($RECY_i = 1$) if and only if

(8) $$Z_{2i} = \gamma_0 + \gamma_1 \cdot P_i + \gamma_2 \cdot CERT_i + \gamma_3 \cdot SOCSANC_i + \mathbf{\beta'X}_i > -\varepsilon_{2i},$$

where Z_{2i} can be viewed as the difference in the deterministic components of a random utility model with two choice alternatives (to recycle versus not recycle), and ε_{2i} represents the difference in the random utility components of these alternatives. Note that $RESP_i$ is not explicitly included in Equation (5). The idea that recycling is affected by responsibility ascription is captured, instead, through the error structure given in Equation 3 of the join estimation model above.

According to the theoretical framework, $\gamma_1 > 0$ if motives for recycling are of the conformist type (or if there is reciprocity which is not linked to duty orientation), and $\gamma_3 > 0$ if some people are motivated by the fear of social sanctions. The parameter γ_1 could also capture the desire for social approval since the survey only asked whether the respondent feared negative reactions from *not* recycling. If people are motivated by positive social reactions, and individuals who recycle provide more approval than others, this would not be captured by SOCSANC, giving rise to $\gamma_1 > 0$. Further, while we do not have a theoretical prior for the parameter on CERT in Equation 8, $\gamma_2 \neq 0$ if certainty about others' behavior matters for utility, in addition to its effect through responsibility. Finally,

all other control variables (including the waste policy variables) are captured in the vector **X** (with conformable parameter vector **β**). The unconditional probability that individual *i* will recycle is given by the probability that Equation (8) holds

(9) $\Pr(RECY_i = 1) = \Pr(Z_{2i} > -\varepsilon_{2i})$.

4.4 Responsibility Ascription and Recycling Behavior

As shown in Greene (2002), the probability expressions in Equations 4a to 4d can be used to formulate conditional mean functions for the recycling outcome *given* the responsibility ascription outcome. In particular, the expected recycling mean when responsibility *is* ascribed $E[RECY \mid RESP = 1]$ is given by

(10a) $$E[RECY \mid RESP = 1] = \frac{\Pr(RESP = 1, RECY = 1)}{\Pr(RESP = 1)} = \frac{\Phi_2(Z_1^*, Z_2^*, \rho)}{\Phi(Z_1^*)}.$$

Similarly, the expected recycling mean when responsibility is *not* ascribed $E[RECY \mid RESP = 0]$ is given by

(10b) $$E[RECY \mid RESP = 0] = \frac{\Pr(RESP = 0, RECY = 1)}{\Pr(RESP = 0)} = \frac{\Phi(Z_2^*) - \Phi_2(Z_1^*, Z_2^*, \rho)}{1 - \Phi(Z_1^*)}.$$

Equation 10a can be interpreted as the expected share of recyclers among people ascribing responsibility, whereas Equation 10b represents the the expected share of recyclers among people not ascribing responsibility. Evaluating these expressions at constant covariate values (e.g., sample means) yields a *quantitative* measure of the effect of duty-orientation on recycling behavior. Specifically, the difference $E[RECY \mid RESP = 1] - E[RECY \mid RESP = 0]$ can be interpreted as the *ceteris paribus* marginal effect of ascribing responsibility on the probability of recycling. Statistically, this difference will be greater than zero when $\rho > 0$. Hence, we use the statistical significance of ρ as a test of duty-oriented behavior.

4.5 Hypothesis Tests

We can now summarize the social interaction hypotheses of this paper, stated verbally in Section 2.3, with specific references to the empirical specifications above as follows:

i) *Social learning of responsibility*

H_0: $\varphi_1 = 0$

H_A: $\varphi_1 > 0$

ii) *Reluctance in responsibility ascription*

H_0: $\varphi_2 \leq 0$

H_A: $\varphi_2 > 0$

iii) *Duty-oriented recycling behavior*

H_0: $\rho = 0$

H_A: $\rho > 0$

iv) *Direct social interactions in recycling behavior*

H_0: $\gamma_1 = 0$

H_A: $\gamma_1 > 0$

5. Estimation results

Table 2 presents estimation results for the joint responsibility-recycling model, when all categories of explanatory variables are used, and constitutes the main results of this paper. It can be noted that control variables (in matrix **X**) are significant in either or both of the outcome equations. However, because of their second-order importance to the study, we focus on the social interaction results. Alternative model specifications and robustness checks are discussed in Appendix 2.

5.1 The social interaction hypotheses

The estimated *social learning of responsibility* parameter (φ_1) is statistically significant and positive at the 0.01 level. This result indicates that people's propensity to ascribe responsibility is increasing in how common they think recycling is in their social group, consistent with prediction *a* in section 2.4.

Reluctance in responsibility ascription is captured by φ_2 (where a positive sign would imply reluctance, zero would imply neutrality, and a negative sign would suggest eagerness to ascribe responsibility). The parameter estimate is positive and statistically significant at the 0.05 level, which supports the reluctance hypothesis (prediction *b*, section 2.4). Holding everything else constant, certainty in one's assessment of peer behavior appears to increase the probability of taking responsibility, or conversely, uncertainty decreases this probability.

The estimated correlation coefficient ρ is 0.42, suggesting a positive relationship between the two outcomes. The model's joint log-likelihood of -751.30 can be compared to the sum of the two log-likelihoods of -768.95 from separate estimations with a likelihood ratio test. The test-statistic is 35.30, which exceeds the 0.01 significance level critical χ^2 value of 10.83. Hence, estimated ρ is statistically significant, which means joint estimation is statistically more efficient. More importantly, this result supports the *duty-oriented behavior* hypothesis. Further, evaluating the conditional mean functions in Equations 10a and 10b using parameter estimates and sample covariate means yields $E[RECY \mid RESP = 1] = 0.856$ and $\mathrm{E}[\mathrm{RECY} \mid \mathrm{RESP} = 0] = 0.576$. This implies, *ceteris paribus*, that ascribing responsibility increases the probability of recycling by about 28%. The 95% confidence interval for this quantitative effect of duty-orientation is (18%, 39%), based on corresponding confidence bounds for the estimated correlation parameter.

The estimated parameter γ_1 in the recycling equation is statistically significant at the 0.01 level with expected positive sign. This is consistent with our fourth hypothesis (predicion *d* in section 2.4) of a separate and *direct* effect of peer behavior on individual behavior (through conformity, reciprocity mechanisms, or through positive social approval).

Two additional social interactions observations can be made. First, estimated γ_2 on CERT in the recycling equation is insignificant, indicating that informational certainty

does not play a direct role for actual behavior. Secondly, estimated φ_3 on the variable SOCSANC is significant and positive in the responsibility equation, whereas estimated γ_3 on this variable is insignificant in the recycling equation. One possible explanation is that fear of social sanctions may invoke a sense of responsibility, without having a direct role, at least in this specific recycling context. Of course, as in any statistical analysis, such tests can only establish support for *ceteris paribus* statistical correlations, not causality; when using the words "direct" and "indirect" above, we refer the conceptual framework presented above, as a possible explanation.

5.2 Estimated marginal effects

Aside from the reported quantitative effect of responsibility ascription on recycling behavior, the above discussion was qualitative with respect to our hypotheses. It may also be of interest to look at other *quantitative* implications of the parameter estimates. Therefore, marginal effects are computed for the three explicit social interaction variables and reported in Table 3. Here, a marginal effect (ME) is defined as the change in probability of a "positive" outcome (RECP = 1 or RECY = 1) associated with a unit change in the social interaction variable of interest, where the ME's are evaluated at the sample means of the other control variables.[18]

In joint estimation, ME's for one outcome must be evaluated conditional on specific values of other outcome variables, and are subsequently not straightforward to interpret. Therefore, we first report estimated ME's from independent estimations of RESP and RECY ($\rho = 0$) as a baseline. When the responsibility outcome is separately estimated (with the same covariates as in the joint model), the ME's for P, CERT, and SOCSANC are 0.067, 0.029, and 0.020, respectively. So for example, a unit increase in P increases the probability of ascribing responsibility by 6.7%. In separated estimation of the recycling outcome, the ME's for these variables are 0.156, 0.005, and 0.013, with the latter two being statistically insignificant. This implies that a unit increase in P increases the probability of recycling by 15.6%.

For the joint model, ME's are reported for recycling behavior, conditional on whether responsibility is ascribed or not. The ME's for CERT and SOCSANC are not statistically significant, a result that is consistent with the qualitative findings reported in Table 2. We therefore focus on P (perception of peer behavior). A unit increase in this

variable is associated with an increase in the probability of recycling by 0.131 (13.1%) when responsibility is ascribed and 0.192 (19.2%) when responsibility is not ascribed, where it can be noted that the ME from the separate estimation (15.6%) lies neatly between these estimates. This makes sense, since the separate estimation did not account for the role of responsibility ascription in recycling behavior. Results from the joint model are intriguing. When responsibility is (already) ascribed a change in perception of other people's behavior can only affect individual behavior directly. However, when responsibility is (initially) not ascribed, an upward revision of how common recycling is in one's immediate social group increases the probability of taking responsibility, which has an indirect positive effect on recycling, and also increases the recycling probability directly.[19]

6. Discussion and conclusions

Our empirical results indicate that there are strong social interaction effects in recycling behavior. This holds even after accounting for *stated* fear of social sanctions. As in any econometric analysis, apparent social interaction effects might possibly be explained by omitted variable bias, spurious correlations, or endogeneity effects which are unaccounted for. Nevertheless, our results are consistent with the idea that duty-based motivation is important for recycling, that individual responsibility is socially learned, and that responsibility is a burden which individuals are reluctant to accept. In particular, we find that while there is a direct social interaction effect, possibly caused by conformity preferences, there is also a strong indirect social interaction effect, which operates through ascription of responsibility.

The direct interaction effect is unaffected by the certainty of individuals' assessments of peer behavior. For the indirect interaction effect, however, certainty is important: The more uncertain respondents are about their peers' recycling behavior, the less likely they are to accept responsibility. This is consistent with the hypothesis that people learn their responsibility from observing others, but that responsibility is a burden one is reluctant to accept.

Ascription of responsibility is not an element of standard economic models, and a final question is whether this is an interesting concept from an economic point of view.

Certainly, moral norms are important for economic outcomes in many settings, and to the extent that norm activation theory (Schwarz 1970, 1977) is correct, the moral norm will affect individual behavior more strongly when individuals have ascribed responsibility for the issue at hand. The concept of responsibility proved helpful in explaining the data in our case.

While a policy analysis is outside the scope of the present paper, let us briefly mention some arguments indicating that duty-orientation and responsibility ascription may indeed be important for policy. First, if responsibility ascription is endogenous, economic incentives for voluntary contributions might, under certain circumstances, be counterproductive, leading to *lower* contributions (as observed by e.g. Gneezy and Rustichini 2000a, b, Brekke et al., 2003). Lazear et al. (2004) show that most subjects playing the role of "dictator" in a dictator game experiment, even those who do share a lot within the context of this game, prefer to opt out of the game and keep a sum corresponding to the dictator allocation for themselves, thus sharing nothing. One explanation is that the role of dictator in such games is naturally associated with a responsibility for sharing; while when not placed in this role, no such responsibility applies. Their result provides an important reminder that although people appear to behave quite altruistically in a context associated with responsibility ascription, actual giving may be substantially lower if people can in fact choose to avoid those contexts.

Second, if social interaction in responsibility ascription is sufficiently strong, there may be multiple equilibria, and this should be taken into account in policy formation. Formalizing this idea, Nyborg et al. (2006) show that imposing a tax on "brown" products can move the economy from an equilibrium in which everyone purchases the "brown" product to another equilibrium in which everyone chooses, instead, the more costly but "green" product. Moreover, they show that the required tax is strictly lower than the Pigou level, and that the resulting change in consumption can be permanent even if the tax is temporary. This further emphasizes the need for considering economic incentives and moral motivation jointly.

The main hypotheses tested in this paper has been that duty-orientation is an important motive for recycling of glass; that there is social interaction in responsibility ascription; and that responsibility is accepted only reluctantly, implying that social

interaction effects are stronger when information about others' behavior is relatively certain. Although we cannot fully exclude the possibility of spurious relationships, the empirical predictions emerging from these hypotheses are confirmed nicely in the econometric analysis.

References

Andreoni, J. (1990): Impure Altruism and Donations to Public Goods: A Theory of Warm-Glow Giving, *The Economic Journal* 100, 464-477.

Aronson, E., T.D. Wilson, and R.M. Akert (2005): *Social Psychology*. Fifth Edition. New Jersey: Pearson Education International.

Bardsley, N., and R. Sausgruber (2005): Conformity and Reciprocity in Public Good Provision, *Journal of Economic Psychology* **26**, 664-681.

Berrens, R.P., A.K. Bohara, H. Jenkins-Smith, C.L. Silva, P. Ganderton, and D. Brookshire (1998): A Joint Investigation of Public Support and Public Values: Case of Instream Flows in New Mexico, Ecological Economics **27**, 189-203.

Bohara, A.K., A.J. Capland, and Therese Grijalva (2007): The Effect of Experience and Quantity-Based Pricing on the Valuation of a Curbside Recycling Program, Forthcoming in *Ecological Economics*.

Brekke, K.A , K. Nyborg and S. Kverndokk, 2003, An Economic Model of Moral Motivation, *Journal of Public Economics* 87(9-10), 1967-1983.

Kjell Arne Brekke, Gorm Kipperberg and Karine Nyborg (2007): Reluctant Recyclers: Social Interaction in Responsibility Ascription, Memorandum 16/2007, Department of Economics, University of Oslo.

Brock, W. A., and S. N. Durlauf (2001) Discrete Choice with Social Interactions, *Review of Economic Studies* **68**, 235-260.

Bruvoll, A. and K. Nyborg, 2004: The Cold Shiver of Not Giving Enough: On the Social Cost of Recycling Campaigns, Land Economics 80 (4), 539-549.

Camerer, C. (2003): *Behavioral Game Theory*. *Experiments in Strategic Interaction*, Princeton/New York: Princeton University Press/Russell Sage Foundation.

Cappelen, A., A.D. Hole, E.Ø. Sørensen, and B. Tungodden (2007): The Pluralism of Fairness Ideals: An Experimental Approach, forthcoming, *American Economic Review*.

Cialdini, R.B., R.R. Reno, and C.A. Kallgren (1990): A Focus Theory of Normative Conduct: Recycling the Concept of Norms to reduce Littering in Public Places, *Journal of Personality and Social Psychology* **58**, 1015-1026.

Croson, R., E. Fatas, and T. Neugebauer (2005): Reciprocity, Matching and Conditional Cooperation in Two Public Good Games, *Economics Letters* **87** (1), 95-101.

Coleman, J.S. (1990): *Foundations of Social Theory*. Cambridge, MA, and London: The Belknap Press of the Harvard University Press.

Dana, J, R. Weber and J. Xi Kuang (2007): Exploiting Moral Wriggle room: Behavior Inconsistent with a Preference for Fair Outcomes, *Economic Theory* 33(1), 67-80.

Fehr, E., and U. Fischbacher (2002): Why Social Preferences Matter – the Impact of Non-Selfish Motives on Competition, Cooperation and Incentives, *Economic Journal* 112, C1-C33.

Fehr, E., and S. Gächter (2000): Fairness and Retaliation: The Economics of Reciprocity, *Journal of Economic Perspectives*, **14** (3), 159-181.

Ferrera, I., and P. Missios (2005): Recycling and Waste Diversion Effectiveness: Evidence from Canada, *Environmental and Resource Economics* **30**(2): 221-238.

Festinger, L. (1957): *A Theory of Cognitive Dissonance*. Stanford, CA: Stanford University Press.

Fischbacher, U., S. Gächter, and E. Fehr (2001): Are People Conditionally Cooperative? Evidence from a Public Goods Experiment, *Economics Letters* **71**, 397-404.

Fullerton D., and T.C. Kinnaman (1996): Household responses to pricing garbage by the bag, *American Economic Review* **86**: 971–984.

Gneezy, U., and A. Rustichini (2000a): Pay Enough or Don't Pay at All, Quarterly Journal of Economics 115(3), 791-810.

Gneezy, U., and A. Rustichini (2000b): A Fine is a Price, Journal of Legal Studies 29(1), 1-17.

Greene, W. (1998): Gender Economics Courses in Liberal Arts Colleges: Further Results, *Journal of Economic Education* **Fall**, 291-300.

Greene, W. (2002): *Econometric Analysis*, 4th Edition. Prentice Hall, New Jersey.

Hougen, H.C. (2005): Omnibusundersøkelsen oktober/november 2004. Dokumentasjonsrapport. Notater 21/2005. Oslo: Statistics Norway (in Norwegian).

Jenkins, R.R. (1993): *The Economics of Solid Waste Reduction*. Edward Elgar Publishing Limited, Hants, England.

Jenkins, R.R., S.A. Martinez, K. Palmer, and M.J. Podolsky (2003): The determinants of Household Recycling: A Material-Specific Analysis of Recycling Program Features and Unit Pricing'. *Journal of Environmental Economics and Management* **45**(2): 293-318.

Kipperberg, Gorm (2007): A Comparison of Household Recycling Behaviors in Norway and the United States, *Environmental and Resource Economics* **36**(2): 215-235, 2007.

Konow, J. (2006): Mixed Feelings: Theories and Evidence of Warm Glow and Altruism. Unpublished note, Layola Marymount University.

Krupka, E., and R. A. Weber (2004): The Influence of Social Norms in Dictator Allocation Decisions, mimeo, Carnegie Mellon University.

Lazear, E.P., U. Malmendier, and R.A. Weber (2005): Sorting in Experiments with Applications to Social Preferences. Mimeo, NBER/Carnegie Mellon University.

Ledyard, J.O. (1995): "Public Goods: A Survey of Experimental Research", in J.H. Kagel and A.E. Roth (eds.): *The Handbook of Experimental Economics*, Princeton: Princeton University Press.

Lindbeck, A., S. Nyberg and J. Weibull (1999): Social Norms and Economic Incentives in the Welfare State, *Quarterly Journal of Economics*, 114(1), 1-35.

Manski, C. F., (2000): "Economic Analysis of Social Interactions," *Journal of Economic Perspectives* 14, 115-136.

March, J.G, and J.P Olsen (1995): *Democratic Governance*, New York: Free Press.

Morris, G. and D. Holthausen. (1994): The Economics of Household Solid Waste Generation and Disposal, *Journal of Environmental Economics and Management* **26**, 215–234.

Nyborg, K. (2008): I Don't Want to Hear About it: Rational Ignorance among Duty-Oriented Consumers. *Memorandum* 15/2008, Department of Economics, University of Oslo.

Nyborg, K., R.B. Howarth, and K.A. Brekke (2006): Green Consumers and Public Policy: On Socially Contingent Moral Motivation, *Resource and Energy Economics* **28** (4), 351-366.

Rege, M. (2004): Social Norms and Private Provision of Public Goods", *Journal of Public Economic Theory*, June, p. 65 - 77.

Rege, M., and K. Telle (2004): The impact of social approval and framing on cooperation in public good situations, *Journal of Public Economics* 88(7-8), 1625-1644.

Reno, R.R., R.B. Cialdini, and C.A. Kallgren (1993): The Transsituational Influence of Social Norms, *Journal of Personality and Social Psychology* **64**, 104-112.

Schwartz, S. H., 1970. Moral Decision Making and Behavior, in J. Macaulay and L Berkowitz: *Altruism and Helping Behavior. Social Psychological Studies of Some Antecedents and Consequences*, New York and London: Academic Press, 127-141.

Schwartz, S. H., 1977. "Normative Influences on Altruism", in: L. Berkowitz (ed.): *Advances in Experimental Social Psychology*, Vol. 10, New York: Academic Press.

Stern, P. C., T. Dietz, G. A. Guagnano, and L. Kalof, 1999, "A Value-Belief-Norm Theory of Support for Social Movements: The Case of Environmentalism," *Research in Human Ecology* 6, 81-97.

Sugden, R. (1984). Reciprocity: The supply of public goods through voluntary contributions. *The Economic Journal* **94**, 772-787.

White, M.D., 2004. Can Homo Economicus Follow Kant's Categorical Imperative? *Journal of Socio-Economics* 33 (2004), 89–106.

Woodward, R. and F. Warren-Boulton (1984): Considering the effects of financial incentives and professional ethics on "appropriate medical care", Journal of Health Economics, 3, 223-237.

Table 1: Data Description and Statistical Summary*

Name	Description	Mean	SD	Min	Max
Outcome Variables:					
RESP	Ascribes responsibility or not	0.86	0.34	0	1
RECY	Recycles glass or not	0.77	0.42	0	1
Social Interaction Variables:					
P	Thinks glass recycling in nearest social group is common	3.06	0.80	1	4
CERT	Certainty about social group's behavior	3.14	0.66	1	4
SOCSANC	Fear of social sanctions	1.98	1.05	1	4
Waste Policy Variables:					
CURBGR	Presence of a curbside glass recycling program	0.07	0.25	0	1
MSAVE1	Can save money by recycling glass	0.05	0.22	0	1
GLASSKG	Municipal glass recycling in kilos per capita	8.07	2.62	1.5	12
Socioeconomic and Demographic Variables:					
MALE	Gender indicator (male = 1)	0.49	0.50	0	1
AGE	Respondent age	42.89	16.80	15	79
HHSZ	Household size	2.69	1.34	1	7
KIDS1	Presence of children age 6 or younger	0.18	0.38	0	1
KIDS2	Presence of children 7-19 years old	0.14	0.35	0	1
EDU1	Respondent has high school education	0.54	0.50	0	1
EDU2	Respondent has college education	0.27	0.44	0	1
HWORK	Respondent hours of house work per week	9.71	7.56	2.5	45
INCM	NOK 100,000 < HH Income < NOK 500,000	0.77	0.42	0	1
INCH	HH Income > 500,000	0.18	0.38	0	1
Other Background Variables:					
GOVERNM	Thinks government mandates glass recycling	2.39	1.15	1	4
ENVIRON	Thinks glass recycling helpful to the environment	3.29	0.96	1	4
ENVAWAR	General environmental awareness	3.38	0.68	1	4
BLUE	Voted for "blue" political party last election	0.29	0.45	0	1

* N = 1104 for all variables.

Table 2: Joint FIML Estimation of RES and REC

	RESP EQUATION (Z_1)		RECY EQUATION (Z_2)	
Variables	**Est. Par.**	**t-Stat.**	**Est. Par.**	**t-Stat.**
CONSTANT (φ_0, γ_0)	-3.689	-6.19	-3.572	-6.88
P (φ_1, γ_1)	0.485	6.71	0.623	8.86
CERT (φ_2, γ_2)	0.197	2.19	0.025	0.31
SOCSANC (φ_3, γ_3)	0.133	1.70	0.049	0.88
CURBGR (λ_1, β_1)	-0.305	-1.20	0.255	1.30
MSAVE1 (λ_2, β_2)	-0.290	-1.15	-0.052	-0.21
GLASSKG (λ_3, β_3)	0.009	0.36	0.037	1.74
MALE (λ_4, β_4)	-0.196	-1.55	0.006	0.05
AGE (λ_5, β_5)	0.003	0.64	0.001	0.18
HHSZ (λ_6, β_6)	0.052	0.83	0.101	1.69
KIDS1 (λ_7, β_7)	-0.160	-0.83	-0.217	-1.25
KIDS2 (λ_8, β_8)	-0.459	-2.32	-0.435	-2.27
EDU1 (λ_9, β_9)	0.320	2.06	0.053	0.37
EDU2 (λ_{10}, β_{10})	0.261	1.43	-0.127	-0.78
HWORK (λ_{11}, β_{11})	0.019	2.03	0.013	1.56
INCM (λ_{12}, β_{12})	-0.237	-0.83	-0.596	-1.74
INCH (λ_{13}, β_{13})	-0.170	-0.54	-0.621	-1.71
GOVERNM (λ_{14}, β_{14})	0.143	2.21	0.187	3.97
ENVIRON (λ_{15}, β_{15})	0.178	2.84	0.211	4.03
ENVAWAR (λ_{16}, β_{16})	0.450	5.38	0.391	5.58
BLUE (λ_{17}, β_{17})	0.025	0.18	-0.174	-1.55

Notes:
Estimated $\rho = 0.42$
Joint Log-Likelihood = -751.30
Sum of Independent Log-Likelihoods = -768.98 (LR Statistic = 35.30, $\chi^2_{0.01} = 10.83$)
E(RECY|RESP = 1) = 0.856
E(RECY|RESP = 0) = 0.574
95% CI for E(RECY|RESP = 1) - E(RECY|RESP = 0): (0.179, 0.393)
N = 1104.

Table 3: Marginal Effects for Social Interaction Variables

	Marginal Effect on E(RESP)[a]		Marginal Effect on E(RECY)[a]		Marginal Effect on E(RECY|RESP = 1)[b]		Marginal Effect on E(RECY|RESP = 0)[b]	
	ME	**t-Stat**	**ME**	**t-Stat**	**ME**	**t-Stat**	**ME**	**t-Stat**
P	0.0672	6.131	0.1564	9.039	0.1313	7.900	0.1915	6.589
CERT	0.0287	2.416	0.0049	0.254	0.0000	-0.002	-0.0190	-0.559
SOCSANC	0.0200	2.139	0.0133	0.989	0.0075	0.591	0.0007	0.030

Note:
ME's are computed for a 1 unit change in the relevant independent variable holding all other covariates at sample means. In the joint model, asymptotic t-statistics are computed using standard errors derived from the delta-method.
a. from independent RESP and RECY estimations ($\rho = 0$).
b. from the joint estimation model in Table 2.

Appendix: Alternative model specifications

Several robustness checks can be performed for the estimated joint model. Below, we report results suggesting that 1) omitted variables are unlikely to constitute a problem in our case, 2) removing the controls for *direct* social interaction effects would overstate the role of ascription of responsibility, and 3) removing important attitude variables would exaggerate all social interaction effects (direct and indirect).

Of particular interest is what role each variable category plays in the estimation results and hypotheses tests above. To explore this issue we drop one category at a time (leaving the remaining categories in place) and re-estimate the FIML model. Selected results are reported in Table 4. The first two columns give result for the full model (repeated from Table 2) and an intercepts-only model, for comparisons. For each alternative specification, we report the joint log-likelihood, selected parameter estimates (φ_1, γ_1, and ρ) and the computed conditional means. In general, the previously reported results are qualitatively robust. All models are found to be statistically significant vis-à-vis the intercept-only model, based on likelihood ratio tests. Furthermore, the restrictions imposed on the full model in the alternative specifications are rejected by similar tests. Hence, given our data, the joint model reported in Table 2 is the statistically superior specification.

Removing the waste policy variables (Model 3), or the socioeconomic and demographic information (Model 4), does not qualitatively or quantitatively affect the social interaction results, nor does it lead to a substantial reduction in the overall goodness of fit as measured by the joint log-likelihood. This is consistent with the parameter estimates for these variables from Table 2.

None of the waste policy variables are significant in the RESP equation. For the RECY equation, MSAVE is insignificant, whereas CURBGR and GLASSKG are borderline significant. When other categories of variables are removed, the statistical importance of these variable categories does not markedly change.

For the socioeconomic and demographic category, KIDS2, EDU1 (and marginally EDU2), and HWORK are statistically significant in the RESP equation, whereas HHSZ, KIDS2, HWORK, and the income variables (INCM and INCH) show some significance

in the RECY equation. The coefficient signs for several of these variables in the RECY equation are consistent with an *opportunity cost of time* hypothesis: individuals who live in larger households, allocate more time to household chores, and have lower household income, may have lower perceived time costs, and are therefore more likely to engage in recycling. The important implication of this robustness check is that it is unlikely that other similar types of control variables omitted from our main model specification (due to data unavailability), lead to biased or spurious correlation results.

When the social interaction variables are dropped from the model specification (Model 5), there is a substantial increase in estimated ρ vis-à-vis Model 1 (from 0.421 to 0.537), and the implied impact of responsibility on the recycling probability (from 0.279 to 0.378). This suggests that ignoring social interaction effects operating *directly* on the two outcomes would exaggerate the *indirect* linkage between them. A similar observation can be made when the *other* background variables are dropped (Model 6). In this case, the outcome correlation is 0.501 (versus 0.421) and the predicted effect of ascribing responsibility on the probability of recycling is 0.345 (versus 0.279). In addition, the parameter estimates for P are larger. Hence, it appears that ignoring perception of government pressure, environmental attitudes, and political party affiliation leads to exaggerated quantitative predictions of social learning of responsibility, and the effects of direct social interactions and duty-orientation on recycling behavior. However, it should be noted that in neither of these alternative specifications do our (qualitative) hypotheses inferences change.

Table 4: Alternative Joint Model Specifications

	Model 1: Full	**Model 2:** Intercepts	**Model 3:** Drop Policy	**Model 4:** Drop Dem	**Model 5:** Drop SI	**Model 6:** Drop Other
Log-Likelihood	-751.297	-964.288	-755.898	-769.824	-823.829	-803.964
Estimated φ_1	0.623	.	0.629	0.609	.	0.717
Estimated γ_1	0.485	.	0.484	0.464	.	0.603
Estimated ρ	0.421	0.655	0.415	0.428	0.537	0.501
E(RECY|RESP=1)	0.856	0.837	0.854	0.853	0.849	0.848
E(RECY|RESP=0)	0.576	0.355	0.579	0.572	0.471	0.500

As pointed out to us by a referee, complications may arise if social and legal pressure is correlated with, or even itself influences, people's assessment of what others

are doing. Statistically, this suggests potential multi-colinearity between the variables P, GOVERNM, and SOCGR1. In our case, a multi-colinearity issue would *increase the probability of rejecting the learning from others hypothesis* (through an increased likelihood of failing to reject the null hypothesis of a zero coefficient on the variable P). The unconditional correlation matrix for these three variables, however, suggests that multi-colinearity is not an issue of concern (details can be obtained from the authors).

We have also isolated those who disagree (partially or fully) with both of the following two statements: “If I do not recycle glass, I risk negative social sanctions from my peers”, and “The authorities have mandated that I recycle”. This enables us to focus more directly on the effect of learning responsibility from others. When only this subgroup is included, the unconditional probabilities of ascribing responsibility (RES = 1) are still increasing in P (how common one thinks recycling is among peers). A parsimonious joint model, excluding socioeconomics and political party affiliation, produced results qualitatively the same as those for the full sample. Similarly, a Probit estimation of recycling conditional on responsibility ascription (RES = 1) for those who do not feel social or legal pressure (N = 367) yielded results very similar both to those in the joint model and to those reported in Chapter 5 (details can be obtained from the authors).

[1] Glass is perhaps the *least* likely material to invoke environmental associations in people. In contrast to paper produced from scarce forest resources (at least in principle) and plastics derived from petroleum, glass is primarily made from abundant sand material. Hence, if we can find evidence of social interactions in responsibility ascription in the context of glass, similar mechanisms are likely to be at play broadly in people's recycling behaviors. In other words, we chose the material that was least likely to support our models and hypotheses. Furthermore, recycling of paper is sometimes easier and more convenient than not recycling, so paper recycling might be explained without resorting to any kind of altruism or moral preferences. For most households, glass recycling does require an extra effort.

[2] Note that while economists have usually treated positive and negative social sanctions symmetrically, this view is not always shared by psychologists.

[3] While this determination of the morally ideal contribution is inspired by Kant's categorical imperative, the model is not one of strict Kantianism, since trade-offs between moral conduct and other concerns are allowed. For a discussion of economic analysis of Kantianism, see White (2004).

[4] Typically, self-image or warm glow (S_i) in these models is specified as $S_i = -K(g_i - g^*)^2$, where K>0, g_i is i's actual contribution, and g^* is the ideal contribution.

[5] Eq. (1) is consistent with the moral motivation model of Brekke et al. (2003) under the following assumptions: 1) the self-image function is modified from $S_i = -K(g_i - g^*)^2$ in the Brekke et al. paper (where (g_i is i's actual contribution, while g^* is the contribution maximizing social welfare if everybody provided it) to $S_i = -(RESP_i)K(g_i - g^*)^2$, and 2) glass recycling is considered morally superior to not recycling (g^*=1). Brekke et al. assumed, implicitly, that when (hypothetical) consequences imply g^*>0, responsibility is ascribed. Here, we allow $RESP_i$ =0 even if g^*=1. If the individual is of the opinion that the government, not households, should take care of glass sorting and recycling, if she has reciprocal preferences and is unwilling to act when others don't, or if she has never even consciously considered the issue of glass recycling, she may not feel responsible even if she would agree that full household recycling is socially better than no recycling.

[6] Statistics Norway's *Omnibus Survey* collects socioeconomic and demographic data on Norwegian households on a quarterly basis. Researchers can request additional questions at a piecemeal rate. The fourth survey of 2004 included, in addition to our questions on glass recycling, questions on family relations and cohabitation, smoking behavior, traveling and vacations, and households' shopping trips to neighboring countries. A total of 1347 households participated in this survey, yielding a response rate of 67%. In the econometric analysis, we drop respondents with missing information (item non-response) on key variables, which reduce the usable sample size to 1104 observations (leaving a response rate of usable responses of 50.2%). The recycling-related questions, translated to English, can be found in Brekke et al. (2007), available at http://www.oekonomi.uio.no/memo/index2007.html. Since these questions only comprised a small part of the overall survey, there is little reason to suspect so-called *avid recycler* bias, which might arise in surveys strictly focused on the recycling topic.

[7] We only report statistics for the variables we used in the final estimations. Several more background variables were available from the survey (including detailed information about the respondent's labor market situation). However, due to multi-collinearity issues discovered in preliminary analysis, we take a somewhat parsimonious approach here.

[8] Note that the statement is formulated specifically in terms of responsibility for glass recycling as opposed to in terms of a sense of general environmental responsibility. The reason for this is that according to most interpretations of the norm-activation theory, ascription of responsibility is context specific. An alternative, and potentially interesting, approach would be to use multiple statements to create a responsibility ascription index. Unfortunately, a limited survey budget made this approach infeasible in our case.

[9] Research on recycling behavior typically relies on self-reported data (Jenkins et al. 2003, Ferrera and Missios 2005, Kipperberg 2007). The reason for this is that direct observation is difficult. Moreover, getting permission from households to track and quantify their recycling efforts may cause them to alter their behavior.

[10] Responsibility is measured with a binary variable (either one ascribes responsibility or one does not) and consistent with how the concept is discussed in the literature (Schwartz 1977). Recycling effort could be treated as a continuous choice, but have often been found to be approximately binary (either one recycles or one does not) when investigated at the material level (Kipperberg 2007). The ordered-categorical nature of the responsibility and recycling survey questions did allow for alternative conceptualizations and dependent variable constructions, which were explored in preliminary estimations. These estimations either yielded similar qualitative results to the ones reported here or made interpretation more difficult.

[11] The question was not framed in terms of shares or percentages, however. Rather, we asked "how common do you think glass recycling is among your friends and family?" The response alternatives were very common, rather common, rather uncommon and very uncommon. We also asked how common the respondent believed glass recycling in their municipality and in the whole country. However, in our estimations we focus on beliefs about behavior in one's immediate peer group (family and friends).

[12] Preliminary statistical explorations of P and CERT revealed that that 84% of the respondents who were certain about their assessment of others' recycling behavior thought recycling is common in their immediate social group. In contrast, those who were uncertain about this assessment, were almost evenly split between assessing recycling as common versus uncommon (52% versus 48%), which is consistent with pure guessing. Ascription of responsibility (RESP = 1) is prevalent in both groups; however, the share of respondents ascribing responsibility is significantly

higher in the certain group. This observation indicates that certainty may have an additional effect in ascribing responsibility, separate from perceived peer behavior, which is consistent with our reluctance hypothesis.

[13] The CURBGR variable is an auxiliary variable provided by Statistics Norway, whereas MSAVE is based on information provided by the respondents in the survey. The variable GLASSKG can be regarded as proxy for the overall importance of glass recycling in the municipalities, and, therefore, a type of *fixed effects* control variable.

[14] It should be noted that, to our knowledge, recycling is not mandatory in any Norwegian municipality.

[15] Note that ENVIRON and ENVAWARE could be regarded as awareness of consequences (AC) measures, a key concept in the norm activation theory.

[16] By specifying the error terms (ε_1 and ε_2) as being correlated, $RECY_i$ becomes implicitly dependent on $RESP_i$. A different identification strategy for the social learning hypothesis would be to use the responsibility measure (or its predicted value from a first-stage instrumental variable estimation) directly in the recycling equation. However, endogeneity concerns combined with lack of credible exclusion restrictions made us opt against pursuing this identification strategy. Moreover, separate estimation is statistically inefficient if common unobservable factors influence both data generating processes. Our FIML approach deals with both these issues. Nevertheless, exploratory data analysis (not reported in this paper) of this alternative approach yielded the same hypotheses inferences (qualitative results) as the ones based on joint model estimation.

[17] One may question whether CERT should enter linearly in equation (3) since, according to the theory, we expect that for reluctant (eager) individuals, the effect of certainty is stronger (weaker) if P takes a high (low) value. Ideally, we would like to estimate separately the effects of CERT when P is high or low, respectively, but given our data, this would create substantial multicollinearity problems. As an alternative specification, we have also performed estimations where CERT enters as an interaction variable with P. Most results from these estimations (available upon request) were qualitatively similar to those reported below.

[18] Other approaches to computing ME's are possible, but were deemed less intuitive or beyond the scope of the paper. Statistical significance of the ME's are indicated by the t-statistics in Table 3 and confidence intervals for these effects could be constructed using the implied standard errors.

[19] The above discussion has used phrases such as *indirect* and *direct effects*. However, as in any other empirical analysis, the results only establish (ceteris paribus) statistically significant correlations which can be suggestive of, not *prima facie* evidence for, causal relationship suggested by the proposed behavioral theory.