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Combining implicit and explicit techniques to reveal social desirability bias in electricity conservation self-reports

Abstract

While questionnaires are still the most common way to survey consumers’ behaviors, it is known that respondents’ answers can be affected by the social desirability attributed to the behavior under investigation. To check whether a social desirability bias also affects electricity consumption self-reports, a study was carried out adopting an explicit (questionnaire) and implicit measurement technique (the autobiographical Implicit Association Test, aIAT). Three behaviors were probed in this way, with a sample of 180 participants (60 for each behavior). The analysis of the congruence between explicit and implicit answers confirms that desirability bias is at stake in self-reported measures of electricity conservation; it also shows that different behaviors – in this same domain - can be subject to this bias to a different extent and that a considerable amount of participants need to be considered as ambivalent. The methodological and conceptual implications of these findings and of the method are discussed with respect to pro-environmental studies and interventions.

Keywords: electricity conservation; social desirability; implicit measures; aIAT.
1. Introduction

The investigation of environmentally conscious consumption (Antil 1979; Linn, Vining and Feeley 1994; Murphy, Lacznia and Robinson 1979; Tracy and Oskamp 1984), re-use of products (De Young 1986, 1991), and recycling practices (De Young 1986, 1991; Ebreo and Vining 1994; Goldenhar and Connell 1993) relies heavily on the use of questionnaires. They are preferred in case behavioral data are not available or large amounts of data need to be collected and analyzed according to socio-demographic factors such as geographic area of residence, education, income, etc. Questionnaires are also more convenient to be administered, built and interpreted than ethnographic or observational studies, and this makes them a most likely tool to be used when surveys of electricity consumption are endeavored outside the academic field.

However, the validity of self-reported data has always been a concern in psychology and the social sciences (Fisher 1993; McGuire 1986). Expressing a certain opinion is in itself a behavior (Suchman and Jordan 1992) located in a certain cultural space, thus answers collected with a questionnaire are subject to social constraints and practices; one of the consequences might be the so-called social desirability bias (e.g., Levy 1981; Peltier and Walsh 1990; Robinette 1991; Simon and Simon 1975; Zerbe and Paulhus 1987) according to which respondents would deny any association with socially undesirable traits and behaviors (Chung and Monroe 2003; Zerbe and Paulhus 1987). The discrepancies found when self-reported behaviors are compared with automatically recorded behavior seem to indirectly suggest that environmental behavior is as subject to social desirability as any other. For instance, Kantola, Syme and Campbell (1984) show that self-reported behavioral change in energy consumption does not predict the consumption recorded through a meter. Similarly, Hirst and Goeltz (1985) compared self-reported data with utilities data; they found that in comparison with utilities data or with other self-reported data collected with another technique, statements on energy conservation were inaccurate. Corral-Verdugo shows (1997) that self-reported conservation
behavior (reuse and recycling) has a low correlation with observed conservation behavior and is related to the realm of social convention and desire more than to the actual practices adopted.

Social desirability would bear at least two kinds of implications for scholars investigating energy consumption behavior. On the one side, it raises methodological concerns, since a behavior whose occurrence can be concealed to avoid unfavorable social responses is hardly measurable with self-reported techniques alone and calls for other direct data collection methods or for special strategies to overcome biases in the respondents. On the other side, social desirability speaks of the normative status of a behavior in a given society, namely if it is condemned or tolerated and under which conditions. That energy consumption is regulated not just by economic or practical reasons but also by social norms, so that people will be judged more or less favorably based on their electricity consumption behavior, has already been shown: energy consumption is connected to values such as comfort, efficiency, wealth (van Raaij and Verhallen 1983) so that consuming energy affects the way in which a person is positioned with respect to these values. It would also be interesting to check whether sustainability has become a value to this respect, so that energy waste becomes an undesirable behavior to the point of affecting the consumers’ declarations about their own habits.

The goal of the present study is to investigate the social desirability of electricity consumption behavior with a different rationale than the studies mentioned above, i.e. by combining self-reported data with implicit measures, an attempt that, to the best of our knowledge, has not been made before in this domain. The implicit measure used here is the autobiographical Implicit Association Test, aIAT (Sartori, Agosta, Zogmaister, Ferrara and Castiello 2008), which was developed to capture the existence of a memory trace of an autobiographical event. We are interested in knowing if explicit responses are in the direction of a socially desirable response and if they are consistent or not with implicit responses. In the next sections we provide a brief description of implicit measures, followed by the method and results of the study.
2. Implicit measures

Implicit measures represent a methodological strategy to investigate aspects or phenomena about which participants cannot be asked directly, because they either do not have access to such phenomena or would be reluctant to provide information about them. Racial prejudice is one of such phenomena: people are either not aware of their racial prejudice, because it is deeply rationalized (as is typical of symbolic or modern racism, Whitley, Kite, 2010) or might be aware of their racial prejudice, but would not report it because of its cultural despicability (McConahay, Hardee and Batts, 1981). When studying this kind of phenomena, implicit measures allow to circumvent participants’ lack of awareness or the risk of response biases while collecting data.

Implicit measures are named after the fact that a certain phenomenon is captured indirectly, by measuring another related phenomenon. One paradigm frequently used for collecting implicit measures of the attitudes towards a target constructs uses that construct as a priming stimulus, and checks if it interferes/facilitates the execution of a subsequent categorization task. For instance, the picture of a Black or White person can be shown immediately before defining the negative or positive value of an adjective (Fazio and Olson, 2003). If priming with a Black person picture facilitates the recognition of a negative adjective, then this means that the priming stimulus has activated negative connotations. In this way, the racial prejudice is not investigated directly but through the effect it has on another task. The advantage is that the participant can hardly manipulate the outcome and does not need to be able to report about the construct under investigation. An overview of several different kinds of implicit measures and their predictive validity is offered by Fazio and Olson (2003).

In the last two decades, one of the most common paradigms for collecting implicit measures besides the priming paradigm has been the Implicit Association Test (IAT; Greenwald, McGhee and Schwartz 1998). The IAT assumes that performance (response time) is better when an
association is well established between concepts in the participant’s semantic memory. In particular, it is a computer-administered categorization task that relies on the assumption that if two concepts are strongly associated, then using the same keys for both of them will lead to a shorter response time (Donders 1969). The IAT is used to investigate evaluations, stereotypes or self-esteem (Fazio 1990) and has been validated by showing that it can discriminate groups that differ along some known attribute, or by assessing its predictive validity, with mixed results (Fazio and Olson, 2003).

A novel variant of this test is its autobiographical version (aIAT) (Sartori et al. 2008). Differently from the classic IAT, the autobiographical IAT is more appropriate if the goal is to investigate the occurrence of a certain behavior and the tendency to deny it when undesirable. Its goal is to reveal factual knowledge regarding autobiographical events, namely ‘an individual’s ability to remember events he or she has experienced directly’ (Sartori et al., 2008, p. 1) instead of investigating semantic memory as in classic IAT. It could be used to establish whether an autobiographical memory trace is encoded in the respondent’s mind/brain. More specifically, with the autobiographical IAT it is possible to evaluate which one of two autobiographical events is true. The rationale is that an event of which the participant has a memory trace (even if unaware) gives rise to faster response times when it shares the same key as true sentences.

Procedurally, the autobiographical IAT differs from classic IAT because the categorization task is executed along a logical dimension (True/False) instead of an evaluative dimension such as pleasant/unpleasant. The test includes two types of sentences: sentences describing events that are certainly true or certainly false (e.g., I am sitting in front of a computer vs. I am climbing a

\[\text{Footnote 1}\] A demo page with several different IATs is offered at this URL: https://implicit.harvard.edu/implicit/takeatest.html.

\[\text{Footnote 2}\] The $D$ index includes a penalty for incorrect trials, and expresses the IAT effect (the difference in performance between the two double-categorization blocks) in terms of the standard deviation of the latency measures. It is calculated by subtracting corrected mean RTs in the fifth block
mountain) and sentences regarding alternative versions of an autobiographical event (e.g., I went to Paris for Christmas vs. I went to New York for Christmas). The trials constituting the aIAT are then categorization tasks of these sentences and can be simple or combined. In simple blocks, one type of sentences is categorized. In combined blocks, both categories of sentences might appear on the screen for the participant to categorize them. In these blocks, when the participant will have to use the same key to categorize true sentences and a true memory, the response time will be shorter. Thus the version of the biographical event with a memory trace will have a shorter response time when associated with true sentences. If the participant spent his/her vacation in Paris, response time will be shorter when the response key is shared by true and sentences related to New York.

In our study we will apply autobiographical IAT for indirectly detecting the memory trace of behaviors related to the usage of electric devices. We will address both rare events (e.g., checking energy labels of new appliances before purchasing them) and habitual behaviors (e.g., turning off the lights). These latter are pre-representational and unavailable to explicit description (Crossley, 2013), but still impressed in our memory and then amenable to be investigated through implicit techniques. The aIAT has been tested for the memory of specific events (Agosta, Sartori, 2013) and has also been tested – although more rarely - for the memory of habitual behaviors (e.g., drug abuse, Sartori, Agosta, Zogmaister, Ferrara, & Castiello, 2008).

3. Method

The goal of the study was to investigate whether social desirability affects energy conservation behavior. We run three different experiments, each one using explicit and implicit techniques to assess the occurrence of a specific unsustainable behavior, i.e. “leaving the lights turned on in the household;” “leaving the battery charger of the phone in the light socket after the use;” and “ignoring the kW/h of a household appliance before its purchase.” The reason why these
behaviors were selected is explained below. Each behavior is studied using two different methods: an explicit measure (questionnaire), and an implicit one (aIAT).

3.1 Study hypotheses

The first hypothesis is aimed at controlling the effectiveness of the procedure through which the three behaviors have been selected for this study – namely that they are waste behaviors whose occurrence is explicitly denied by participants.

H1: *When asked through a questionnaire, the majority of participants declare to operate so as to conserve electricity*

The study then considers whether and where there is any incongruence between the explicit and implicit measure of each specific behavior investigated. The research question is then the following, for each behavior investigated:

RQ1: *Is there any discrepancy between implicit and explicit measures?*

3.2 Participants

The overall sample consisted of 180 adults (95 men and 85 women; M age=45.9 years, SD=11.2); each one was inquired about one behavior, since administering three aIATs would have been too tiresome. Therefore we had 60 participants for each behavior. All participants had normal or corrected-to-normal vision. Two participants were lost due to data corruption (i.e., one in the second and one in the third experiment).

Participants were recruited in public places, such as museums and public libraries, where they were not in a hurry and could benefit from a quiet environment during the test. Only adults (30 years or older) were recruited as participants, because some initial pilots with undergraduate students gave ambiguous results: the effect size of the *D* index (Greenwald, Nosek and Banaji 2003) was near 0 in the third behavior (“checking/ignoring the kW/h of a household appliance before purchasing it”), which is in the range that, according to Cohen, makes the data ambiguous.
(Cohen 1988). We assumed that this ambiguity was due to the fact that undergraduate students are not familiar with some of the behaviors investigates (e.g., purchasing household appliances). Hence, we decided to include only people older than 30 years in the sample. No compensation was given for participating in the study.

3.3 Behavior selection

We selected the behaviors to investigate through a pilot study. We used the answers to a questionnaire administered to 204 adults recruited in public spaces (126 women, 78 males, aged $M=48.64\ SD=12$) and piloted for question comprehensibility. In the section of interest here, respondents were asked if they always, sometimes, or never performed a series of specific electricity conservation/waste behaviors. We looked for the items in which respondents tended to show a full adoption of conservation behavior. We also considered three more constraints. First, a behavior had to be described in very short sentences, since the implicit test relies on response time; second, a behavior had to allow five different ways of expressing it, since five variants of the same sentence are needed for the aIAT (see Section 3.3.2). Third, a behavior needed to be very common, so that all study participants are likely to have faced the decision of performing it or not. Among the behaviors included in the original questionnaire, three ones matched all the abovementioned constraints. These behaviors were the following: (i) turning the lights off, a behavior that 88.12% of the respondents declared to always perform; (ii) leaving the battery charger in the socket when the phone is fully charged, which 61.58% of the respondents declared to never perform; (iii) checking the kW/h of a household appliance before purchasing it, which 78.71% of the respondents declared to always do.

3.4 Measurement techniques

3.4.1 Explicit measure
A short questionnaire was administered, asking participants to respond “yes” or “no,” according to whether they practiced or did not practice one of three behaviors: (i) I leave the lights turned on in my household; (ii) I leave the battery charger of the phone in the light socket after the use; (iii) I ignore the kW/h of a household appliance before purchasing it. The questionnaire also collected participants’ data (age and sex).

3.4.2 Implicit measure

An aIAT for each of the three behaviors was built. Each required to categorize a set of sentences. Two dimensions were available: True/False and Conservation/Waste. Two types of sentences were used: sentences regarding certainly true or certainly false behaviors unrelated to electricity consumption (e.g., ‘I’m sitting on a chair’ vs ‘I’m sitting on a sofa’) and sentences involving behaviors related to electricity consumption, representing either conservation (e.g., “I always turn the lights off”) or waste (e.g., “Usually I inadvertently leave some lights on”). Pressing one of two keys on the keyboard operated the categorization. While “true” and “false” were always associated with the same two keys, the labels related to energy conservation or waste were associated sometimes with the same keys as “true” and “false”, sometimes with the keys in the opposite order. Table 1 reports the sentences used for one behavior, i.e., leaving the battery charger of the phone in the light socket after the use.

<table>
<thead>
<tr>
<th>CATEGORIES</th>
<th>SENTENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>“True”</td>
<td></td>
</tr>
<tr>
<td>1. Sono davanti ad un computer</td>
<td>1. I’m in front of a computer</td>
</tr>
<tr>
<td>2. Sono seduto sulla sedia</td>
<td>2. I’m sitting on a chair</td>
</tr>
<tr>
<td>3. Sto rispondendo con la tastiera</td>
<td>3. I’m entering my responses with a keyboard</td>
</tr>
<tr>
<td>5. Sto facendo un test di psicologia</td>
<td>5. I’m taking a psychology test</td>
</tr>
</tbody>
</table>
Sentences were structured into five blocks as schematized in Table 2; simple blocks served to practice the classification procedure and combined blocks were the critical ones because they contained both types of sentences. The response time (RT) emerged in the these combined blocks suggests which version of the autobiographical event (electricity conservation or waste) left a memory trace and is then more likely to have occurred.

Table 2. Different blocks of sentences and labels associated to the response keys. Critical blocks are marked with an asterisk (adapted from Sartori et al., 2008).
Administration of the aIAT was computerized. All blocks were designed and implemented with the software E-prime (Psychology Software Tools, Inc., Pittsburgh, PA). Data was collected with the same software (responses latencies in milliseconds) and used for the subsequent analysis.

The aIAT procedure was the same as described in Sartori et al. (2008). Stimuli (sentences describing a participant’s behavior) appeared one by one at the center of the computer screen. Participants were requested to categorize the sentence as quickly and accurately as possible by pressing one of two labeled keys, one on the left (i.e., the “A” key) and one on the right (i.e., the “L” key) of the keyboard from the perspective of the participant sitting in front of the computer screen. Reminders of the key meaning (i.e., “True,” “False,” “On,” “Off”) were displayed on the screen. An error signal appeared for 300 ms when an incorrect response occurred, namely when the respondent did not assign the behavior to the correct category (e.g., pressed the key labeled with “off” with the sentence “Usually I forget some lights turned on”).

Figure 1 illustrates the composition of the five blocks grouping the sentences. In Block 1 (containing 20 trials) participants categorized the sentences along the logical dimension True vs. False by pressing the left key if the sentence was True (e.g., “I am in front of a computer”) and the right key if the sentence was False (e.g., “I’m in front of a television”). In Block 2 (20 trials) participants classified sentences along the critical dimension of conservation vs. waste; the left key was associated to conservation (“off”) and the right to waste (“on”). In Block 3 (60 trials, double-categorization block) participants were requested to press the left key if the sentence was True or described a conservation behavior, and the right key if the sentence was False or described a waste behavior. Thus, in this block, true and conservation shared the left key, while false and waste shared the right key. In Block 4 (40 trials) participants practiced an inverted
classification with respect to Block 2: they had to press the left key for waste and the right key for conservation. In Block 5 (60 trials, double-categorization block), like in Block 3, participants were requested to answer to two different categories of stimuli with the same response set but with the opposite combination than in Block 3: true and waste shared the same key (left), false and conservation shared the right key. The order of the critical, double categorization blocks 3 and 5 was counterbalanced across subjects.

**Figure 1.** An example of the sentences used in the different blocks of the aIAT

### 3.5 Procedure

After agreeing to participate in the study, participants were lead individually to a room of the public facility hosting the study, and were asked to seat in front of the computer administering the task. After reading and signing the informed consent, they started the study consisting of two
phases, (1) filling in the questionnaire, and (2) completing the aIAT. The order of the two phases was counterbalanced across subjects. The entire session lasted about 20 minutes. At the end the participant was debriefed. The participant filled in the questionnaire in paper-and-pencil modality; in case of need, the researcher was available during the self-administration to provide clarifications. The data collection occurred in Italy in 2010.

3.6 Data analysis

The data collected with the questionnaire consisted of the yes/no dichotomous answers to the question regarding the enactment of a conservation behavior.

Regarding the aIAT, two measures were taken: mean Reaction Time (RT) in the double-categorization blocks (3 and 5) and $D$ index (Greenwald et al. 2003). RTs was used to check the reliability of the participants’ performance at the aIAT: RTs shorter than 150 milliseconds were discarded because they meant that the participant’s response anticipated the stimulus, whereas RTs longer than 10000 milliseconds meant that the participant was not paying attention, and were also discarded. The $D$ index was used for the comparison with the explicit measure; positive $D$ values suggest that the memory trace encoded in the respondent’s mind corresponded to electricity conservation (i.e., faster RTs in the task associating “true” with “energy conservation”).

To identify the participants with an unambiguous memory trace, we used a more conservative method than simply referring to the ±0.20 cut-off proposed by Cohen (Cohen, 1988). For each participant, we calculated the 90% bias-corrected and accelerated bootstrap confidence interval for the $D$ index, using 1000 random samples. This statistical simulation is widely used to

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2 The $D$ index includes a penalty for incorrect trials, and expresses the IAT effect (the difference in performance between the two double-categorization blocks) in terms of the standard deviation of the latency measures. It is calculated by subtracting corrected mean RTs in the fifth block from mean RTs in the third block and then dividing the result by the inclusive standard deviation of the two blocks.
estimate the confidence interval for effect sizes – such as Cohen’s d (e.g., Kelley, 2005) – and, as in the present case, to estimate the precision of individual measures (e.g., Nocera & Ferlazzo, 2000; Parker, 2006). The confidence interval represents the uncertainty, due to the sampling error, about the actual memory trace Δ (i.e., the hypothetical D value calculated from a large number of trials). A confidence interval entirely above zero suggested a prevalent memory trace related to the conservation version of the autobiographic behavior, while a confidence interval entirely below zero suggested a prevalent memory trace related to the wasting version of the autobiographic behavior. A confidence interval that included zero suggests that the effect of the memory trace was not strong enough to emerge above the noise, thus the memory trace of that participant was defined neutral/uncommitted. This is compatible with the memory trace of a participant not strongly committed to either conserve or squander energy: in these participants neither version of the autobiographical behavior (conserving or wasting) is prevailing. We tested this interpretation by visually inspecting the collected data (see Fig 2, 3, and 4 in the Results section below), checking whether alternative interpretations could be sustained. For instances, the noise could have hidden the effect of the memory trace if participants with uncommitted trace had greater measurement error in the D index. Yet the width of the confidence intervals of participants with an uncommitted trace are comparable to the width of the confidence intervals of participants with a definite trace, so this interpretation is not supported. We could also hypothesize that participants with an uncommitted trace have no autobiographic memory of that behavior, yet since we observed the largest proportion of uncommitted traces in the most common of the explored behaviors (i.e., the light) this interpretation cannot be sustained for most of the participants. In brief visual inspection of the data suggest that the coexistence of memories traces of conservation and wasting behavior is the prevalent factor behind the undetermined D values.

Since in we could not determine with certainty which memory trace was prevalent, we did not included participants with undetermined D in the following analysis (i.e., 50.0% for the light,
44.1% for the battery charger, 15.3% for the kW/h). The distribution of the $D$ values in the undetermined participants did not suggest the presence of a bias towards either saving or wasting behavior.

4. Results

In each experiment, HP1 was tested by considering the percentage of explicit responses oriented toward energy saving, while RQ1 was addressed by calculating the percentage of participants declaring to conserve energy but obtaining a negative or neutral $D$ value.

4.1 Experiment 1: Turning the lights off/on

The majority of respondents to the questionnaire (88.3%) declared that they turn the lights off. For this behavior, HP1 is confirmed; the majority of participants - when asked directly through a questionnaire - declared to conserve electricity. Regarding the correspondence between implicit and explicit measure, in the implicit measure, this percentage decreased: the performance at the aIAT suggests that for 60.0% of the participants there is a defined memory trace associated with turning off the light when leaving a room. Thus the percentage of respondents declaring to conserve energy but showing a contradictory memory trace amounts to 36.7% of the whole sample (Figure 2) and to 40.7% of the respondents that declared to engage in the conservation behavior.
Figure 2. Scatter plot for the behavior consisting of “to leave the lights turned off/on in the household.” On the x-axis is the $D$ value; on the y-axis are the questionnaire responses. A random number has been added to each value so the points do not lie on top of each other. The error bars represent the 90% confidence intervals. The legend describes each data point (i.e., a participant) according to the response at the questionnaire (Q) and the measured memory trace (D).

4.2 Experiment 2: Unplugging the charger

For the behavior, “leaving the phone battery charger in the light socket after the use,” 79.7% of the respondents to the questionnaire declared they never leave the charger inserted after the phone is charged. Thus, for this behavior, HP1 is confirmed, since the majority of participants declared to conserve electricity when asked directly through a questionnaire. In the aIAT, this percentage decreases: 63.6% of participants seem to have memories clearly associated to unplugging the battery charger of the phone after use. Considering the results from self-reported measures and aIAT together, the percentage of respondents declaring to conserve energy and showing an aIAT performance suggesting an opposite memory trace amounts to 21.2% of the whole sample (Figure 3) and 29.2% of the participants declaring to conserve electricity.
**Figure 3.** Scatter plot for the behavior “to leave or not the phone battery charger in the light socket after the use.” On the x-axis is the $D$ value; on the y-axis are the questionnaire responses. A random number has been added to each value so the points do not lie on top of each other. The error bars represent the 90% confidence intervals. The legend describes each data point (i.e., a participant) according to the response at the questionnaire (Q) and the measured memory trace (D).

### 4.3 Experiment 3: Checking the kW/h when purchasing appliances

Finally, 79.9% of the respondents explicitly declared that they consider kW/h when buying a new appliance. This result is in line with HP1. In the aIAT, 90.0% of participants showed to have memory associated to checking the kW/h when purchasing appliances. Considering kW/h when purchasing an appliance was not confirmed as “true” only for 8% of the participants (Figure 4) and the 10.0% of the respondents that declared to check the kW/h.
Figure 4. Scatter plot for the behavior consisting of “to check/ignore the kW/h of a household appliance before its purchase.” On the x-axis is the $D$ value; on the y-axis are the questionnaire responses. A random number has been added to each value so the points do not lie on top of each other. The error bars represent the 90% confidence intervals. The legend describes each data point (i.e., a participant) according to the response at the questionnaire (Q) and the measured memory trace (D).

The results of the three experiments are summarized in Table 3.

Table 3. A synoptic view of the results of the three experiments. Values are in percentage.

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Positive explicit assertions*</th>
<th>Positive explicit assertions /Conserving trace at IAT**</th>
<th>Positive explicit assertions/ Wasting trace at IAT**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turning the lights off</td>
<td>88.3</td>
<td>59.3</td>
<td>40.7</td>
</tr>
<tr>
<td>Unplugging the charger</td>
<td>79.7</td>
<td>70.8</td>
<td>29.2</td>
</tr>
<tr>
<td>Checking the kW/h when purchasing appliances</td>
<td>79.7</td>
<td>90.0</td>
<td>10.0</td>
</tr>
</tbody>
</table>

* out of the whole sample
** out of the people with definite autobiographical memory trace and with positive explicit assertions (N = 27, 24, 40 respectively)

5. Discussion

In all three experiments conducted in the study reported here, HP1 was confirmed: the vast majority of the respondents declared to enact a positive energy conservation behavior when asked directly through a questionnaire. The study then tested the consistency of implicit and explicit measures, founding that a portion of the respondents who declared to perform energy conservation behaviors in the questionnaire did not seem to perform at the aIAT as if they had a memory trace of that behavior. These discrepancies do not mean straightforwardly that respondents were deliberately concealing truth, but suggest that social desirability was at stake for these participants, who declared to enact a socially desirable behavior even though their implicit response did not reveal the presence of a correspondent memory trace. Therefore both the test of HP1 and the response to RQ1 show that a social desirability bias might operate when investigating energy conservation behavior with an explicit method.

The implications of these findings for research on energy consumption behavior and for sustainability interventions are several. First, self-reported data collected through questionnaires and interviews are still one of the most widely used methods in energy conservations studies and sustainable practices (e.g., Bain, Hornsey, Bongiorno, & Jeffries, 2012; de Groot & Steg, 2010; Whitmarsh & O’Neill, 2010); our findings underline once more, and with direct reference to the domain of pro-environmental behavior, that self-reported data are subject to social desirability biases when used to investigated the occurrence of a behavior. Researchers have tried several solutions to overcome this bias, for instance by using respondents’ answer to estimate the probability of actually producing a behavior (Woods 2008). However our results confirm that a
cautious approach is preferable and that implicit or observational data could improve study validity.

Second, the portion of participants who has an implicit response inconsistent with a positive questionnaire answers changed according to the behavior considered: it equaled 40.7% for leaving the lights off, 29.2% for unplugging the phone battery charger and 10% for checking the kW/h of a household appliance before purchasing it. This varying proportion suggests that different behaviors are subject to social desirability bias to a different extent because in some cases more than in other cases the wasting behavior might prevail. This consideration extends to the social desirability bias the remark according to which cross-behavioral consistency should not be expected in pro-environmental attitudes and behaviors (e.g., Bamberg, 2003; Whitford, 2002). It also suggests the opportunity to investigate not just the general determinants and barriers to pro-environmental behavior, which are known (Kollmuss, Agyeman, 2002), but the specific constraints that make a specific conservation behavior more difficult to be enacted. Some efforts in this direction are already in place (e.g., Pierce, Strengers, Sengers, Bodker, 2013) and can be furthered by acknowledging the users’ perspective on such ‘wasting’ behavior, according to which there might be reasons that make it not only more convenient but also more appropriate to their goals.

Finally, the discrepancy between acknowledging the social desirability of energy conservation behavior and enacting such behavior suggests that campaigns and interventions (for a review, Darby 2006; Fischer 2008; Froehlich, Findlater and Landay 2010) should not focus on sanctioning wasting behavior or praising conservation, since this might only operate on the desirability of the behavior without impacting on its actual performance.

A final comment is deserved on the large amount of participants with ambivalent memory traces. For these participants we argued that the memory traces of conservation and wasting coexisted and our description was too underspecified for them to trigger a univocal memory trace. For instance they might turn the light off under certain circumstances, but not under others.
Interestingly, ambivalent participants were numerous in the behaviors for which there was also a high percentage of participants with inconsistent explicit/implicit measures and then for which there seem to be the highest desirability effect. The implications are twofold. First, this is one additional evidence that behaviors can not be accounted for in terms of a general tendency towards saving or wasting. Instead, research must be able to detect the contextualized reasons underlying specific saving or wasting behaviors. Second, many participants with undetermined memory trace had an absolute $D$ greater than 0.20, which is often used as cut-off to identify ambiguous associations (Cohen, 1988). Thus, we strongly recommend that future studies using the D-IAT include a similar, more conservative significance test as we did, when interpreting the score of a single participant.

5.1 Limitations

Some caveats in the way in which the results of implicit measurement are used should be stated. First, the IAT still has several interpretive issues (Dasgupta, Greenwald, Banaji, 2003; De Houwer, Teige-Mocigemba, Spruyt, Moors, 2009; Fielder, Messner and Bluemke, 2006; Uhlmann, Poehlman, Nosek, 2012), although most of them are not shared by the autobiographical IAT because it does not aim to capture the association between concepts but the presence of a memory of an event. Second, the autobiographical IAT does not detect false memories, i.e., the case in which a person is convinced of the occurrence of a behavior that in fact s/he has not performed (Agosta, Sartori, 2013). The risk of detecting memories of this kind might be higher with socially desirable behaviors and with habitual behaviors, as in our case: if an event is highly relevant or desirable, its occurrence is salient; this salience might be considered by the individual as a evidence of frequency (Tversky, Kahneman, 1973) and participants can be convinced that memories of rare events are instead memories of habitual events. Therefore the detection of a memory might be not as reliable as is instead the absence of a memory. Likewise, since people are often unaware of habits, then an inconsistency between
implicit and explicit measures should not be interpreted in terms of the respondent deliberately manipulating truth, but as an evidence of the social desirability of certain habitual behaviors. Third, the ability of the test to detect a memory of an event depends on the match between the way in which the event is construed in memory and the sentences used to evoke that memory. Therefore the construction of the sentence blocks should be preceded by pilot studies in which people are free to show what meaning they attribute to those sentences. Fourth, the context can influence the way in which the construct under investigation is interpreted and then the kind of concepts with which it is associated (Fazio and Olson, 2003). Therefore, the context prior to the administration of the test should be controlled to this respect. In our case, participant were informed that the study was about energy conservation; this might have activated a context in which energy waste was not seen favorably, which is in line with our goal to study the effect of social desirability on this class of behaviors.

6. Conclusions

The results of the current study confirm that, on environmental issues, questionnaire answers cannot be considered as a reliable source of factual information regarding the actual occurrence of a certain behavior, because they are subject to a social desirability bias. They also show that for some behaviors there might be a strong ambivalence and that different behaviors can be subject to this bias to a different extent. Therefore, the data collected through a questionnaire, if combined with an implicit measure of the same behavior, can help checking whether desirability is at stake for a certain behavior.

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