



Citizen Coherence and Cultivated Cleanliness: Using Technology-Induced Social Norms to Strengthen Sustainable Household Bonds

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Social identity and social capital are critical to human well-being and sustainable development. However, existing research on sustainable behavior typically treats these factors merely as taken-for-granted preconditions to environmental protection. This paper argues that they can also be direct outcomes of environment-oriented efforts, thus becoming drivers of sustainable societies. As part of a larger research project on household recycling and waste behavior, the authors assess and compare perceived social identity and social capital of residents in a multi-family residential dwelling in Sweden before ($N = 66$) and after ($N = 18$) exposure to a social norm-based intervention delivered through a smartphone app. Reported levels of social identity and social capital were higher after (vs. before) the intervention, both compared to participants' own previous measurement and a control group. Together, the current research offers a novel perspective on technology-enabled social norms. Specifically, such norms may not only create sustainable responses immediately, but may also play a pivotal role in shaping more sustainable communities in the long run. Future studies are needed to elucidate the specific psychological mechanisms driving the observed effects and shed further light on whether, when, and why social norms may foster sustainable responses with a clear social connotation.

Keywords: social norms, new technology, sustainability, social identity, social capital, transformative consumer research

INTRODUCTION

The sustainability literature has long been focused on environmental aspects. More holistic sustainability approaches capturing and including a social dimension of sustainability have only recently been introduced (Beske-Janssen et al., 2015), with frameworks such as the planetary boundaries (Rockström et al., 2009; Steffen et al., 2015) being expanded through the social “doughnut model” (Raworth, 2017) and methods such as life cycle assessments (LCAs) (Heiskanen, 2002) being further developed into social LCAs (Benoît et al., 2010; Guinée et al., 2011). At the same time, sustainability problems such as climate change present a social dilemma (i.e., benefits of action are shared collectively while costs often operate at the individual level) which may only be understood and resolved through closer investigation of social aspects such as human cooperation

(Boon-Falleur et al., 2022). Two important constructs with demonstrated downstream effects on a wide range of outcomes linked to collaboration and compliance are social identity and social capital (Lochner et al., 1999; Selman, 2001; Barnes et al., 2020; Van Bavel et al., 2022) as described in further detail below and in the remainder of this article.

The Role of Social Identity and Social Capital in Sustainable Development

Social identity is understood as the degree to which an individual identifies as a member of a given social group, while social capital refers to an individual's network and ties to friends, neighbors, or acquaintances (Tajfel, 1974; Forrest and Kearns, 2001; Uzzell et al., 2002). While related, both constructs are independent: An individual may identify strongly as a FC Barcelona fan¹ without knowing many others in that group, while students may have close ties with their classmates but identify only loosely with the overall university's student body. The factors of social identity and social capital are basic human needs (Maslow, 1981) and present widely agreed upon developmental targets (UNGA, 2015), highly correlated with socio-economic welfare (Easterly et al., 2006) and considered crucial for continued growth (OECD, 2011). Communities rich in social capital have been shown to be more resilient in moments of crisis (Gutiérrez et al., 2011), enable long-term sustainable use of collectively-managed natural resources (Woolcock, 2001; Pretty, 2003), and have the potential to avoid the "tragedy of the commons" (Ostrom, 1990; Dietz et al., 2017). On the more negative end, social capital (or rather, its gradual disintegration) has also gained renewed attention in the public discussion as inequalities, populist political views, hate crimes, loneliness among vulnerable groups, and premature deaths – referred to as "deaths of despair" – are on the rise (Case and Deaton, 2020).

Although social capital and social identity are not completely absent in the existing sustainability literature, they are often implied merely as preconditions, as in studies using social normative influence to foster environmentally beneficial behaviors (Allcott, 2011; Loschelder et al., 2019) that assume a certain degree of social identity in the invoked reference group. However, a more prominent, explicit focus on social identity and social capital in sustainability research may also provide relevant insights not just into their roles in supporting environment-oriented interventions, but as direct outcomes of such interventions and thus drivers of sustainable societies in their own right.

CONCEPTUAL FRAMEWORK

Social Norm-Based Interventions and Their Influence on Social Identity and Social Capital

Making social norms salient by, for instance, providing information about how others are behaving or which behaviors

others approve or disapprove of, is an effective way to influence behaviors (Cialdini et al., 1990; Schultz, 1999). The influence of the social norm is moderated by who these "others" are (Schultz et al., 2008; Mertens and Schultz, 2021; Otterbring, 2021), meaning that it is paramount to carefully select a reference group that is *comparable* (Festinger, 1954) and *important* (Tajfel, 1974) to the influence targets. Studies using social normative influence thus typically select a reference group that shares a social identity with the influence targets (e.g., other FC Barcelona fans) and make the desired behaviors of this reference group salient (e.g., using public transport to get to the stadium). In this sense, the common social identity is used as a means to an end (i.e., to increase the influence of the social norm; cf. Chou and Nordgren, 2017). However, social norm messages do not only make the norm salient – they also make the reference group salient. Although this relationship is understudied in the literature, it appears reasonable that this salience should be associated with an increased identification of the influence targets with the reference group and hence a strengthened social identity.

Connecting this general line of logic with the literature on social capital (e.g., Forrest and Kearns, 2001; Pretty, 2003; Ntontis et al., 2020), it can further be assumed that a strengthened social identity should be positively associated with social capital: people feeling connected to their neighbors through a shared social identity should be more open to making new ties with members of this social group, thus creating a stronger network and increasing social capital. Therefore, a behavioral intervention based on social norms should also increase the social capital within the reference group of the norm.

Study Setting and Hypotheses

The current research examines to what extent social identity and social capital can be outcomes of – rather than just taken-for-granted preconditions for – a sustainability-oriented behavioral intervention. Specifically, the authors report the results of a longitudinal study employing novel 'smart' waste disposal infrastructure and a purpose-built smartphone app to investigate whether a digitally administered social norm-based intervention with the primary goal of improving household recycling rates could also increase social capital (measured by the number of neighbors residents know by name) and social identity (measured by a reported sense of place identity and affinity with the neighbors) among residents in a Swedish multi-residential family dwelling. As the first prediction, the social norm-based intervention is expected to increase identification with the invoked reference group and thus strengthen the social identity of the influence targets. Moreover, as a second prediction, this increased social identity should arguably make influence targets more likely to form new connections with members of the invoked social group, thus increasing social capital. Accordingly, the authors hypothesize:

H1: Intervention participants will report a stronger sense of social identity both after (vs. before) the intervention and when compared with control participants.

¹An anonymous reviewer requested us to clarify the meaning of this abbreviation. In the current context, FC refers to a football/soccer club (as in "Futbol Club Barcelona").

H2: Intervention participants will report knowing a larger number of members of their social group both after (vs. before) the intervention and when compared with control participants.

METHODOLOGY

The study was connected to a larger research project that collected objective waste data on the household level in a multi-family residential setting and investigated the impact of social norm feedback on households' waste and recycling behavior in this context. While the results of that overarching project in terms of changed waste and recycling behaviors are reported elsewhere (Siepelmeier et al., 2022), the current article investigates the impacts of the social norm-based behavioral intervention on social identity and social capital (H1-H2).

Participants and Descriptive Details

All 153 households living in three apartment buildings forming one building block in the novel "smart-city" (Shahrokni et al., 2015) district "Stockholm Royal Seaport" in Sweden were potential participants in the overarching research project, as they all disposed their waste through "smart" waste chutes equipped with novel technology that objectively quantified waste amounts and recycling levels for each household. These residents were invited to download a smartphone app giving them access to statistics and social comparison feedback about their household's waste and recycling behavior (i.e., a social norm-based intervention). The app was available for Apple and Android users and required an activation code which residents received on a postcard or could request upon opening the app. In addition to the postcards, posters in public areas of the apartment buildings were used to advertise the smartphone app and its functions to all residents and elicit participation. To create realistic conditions comparable to those faced by commercial apps and hence ensure high ecological validity (Carbon, 2020; Gidlöf et al., 2021), residents chose freely whether they wanted to download the app and were not assigned to user or non-user conditions. Out of the 153 households who could have potentially installed the smartphone app and thus be exposed to the social norm intervention, 66 residents (from 59 different households) decided to do so.

Over the course of 12 months, app users were exposed to social comparison feedback in the app (i.e., the social norm intervention), which used neighbors in the same building block as a reference group and provided waste statistics and comparisons within this context. For example, a graph displayed a household's amount of unsorted waste in comparison to the waste amount of the top 10% of neighbors (i.e., the 10% of neighboring households with the lowest amount of unsorted waste) and the average amount of unsorted waste among the neighbors (Siepelmeier et al., 2022). The smartphone app was also used to distribute electronic surveys to its users. Baseline levels of social identity and social capital were measured with a survey that app users had to fill out upon first opening the app and before being able to use any of its functions (i.e., prior to the intervention), followed by a second measurement through a voluntary follow-up survey distributed 9 months later.

TABLE 1 | Descriptive statistics, including means (and standard deviations) on demographic variables.

Demographic variable	Control participants	Intervention participants
Participant age	43.04 years (12.05)	45.06 years (14.22)
Number of adults in household	1.88 adults (1.08)	1.72 adults (0.96)
Number of children in household	1.04 children (1.17)	0.72 children (0.90)

All residents who downloaded the app were automatically enrolled as participants in this study, which resulted in 66 participants during the first wave of data collection, followed by 18 participants who subsequently replied to the follow-up survey. As such, the study used a longitudinal approach.

To rule out a selection bias account, and hence counter the possibility that participants with a certain demographic profile could have been more prone to complete the follow-up survey, the authors tested for demographic differences in age, number of adults in the household, and number of children in the household between intervention participants (who replied to the survey both before and after the intervention; $N = 18$) and control participants (who solely replied to the pre-intervention survey; $N = 48$). A lack of demographic differences between intervention and control participants would strengthen the confidence that any possible differences on the focal dependent variables would be due to the intervention rather than any of these potential confounding variables. As expected, three independent samples t -tests found no differences on any of these demographic variables between the groups (all $ps \geq 0.30$). **Table 1** presents descriptive details across both groups of participants on these variables.

Procedure

Participants initially received an electronic survey through the app they had installed for the purpose of the overarching research project and replied to a set of items linked to their neighborhood. Four items were used to measure social identity: participants' stated a) affinity with the neighbors living in the same building; b) affinity with the neighbors living in the same block; c) neighborhood trust; and d) sense of residence identity. The items were averaged to form a composite index of social identity, which was found to be reliable both at the first wave of data collection ($\alpha = 0.76$) and during the follow-up survey ($\alpha = 0.72$). Furthermore, to measure social capital in the area, participants indicated how many of their neighbors they knew on a continuous measure without fixed response alternatives. Scale properties were varied for the social identity and social capital measures to reduce the impact of common method bias (Podsakoff et al., 2012; Gasiorowska et al., 2022; Otterbring and Folwarczny, 2022). All items are clearly stated in **Table 2** below, including information about scale formats, prior research using similar measures, and – when applicable – reliability estimates in terms of Cronbach's α . Note that reliability estimates cannot be provided for social capital, given that this construct was captured

TABLE 2 | Overview of measures, scale formats, and reliability estimates.

Construct	Measure(s)	Scale format	Reliability
Social identity (Postmes et al., 2013)	a) Affinity with the neighbors living in the same building "How strong are your ties with neighbors in your building?"	1 = very little; 7 = very much	Pre-intervention: $\alpha = 0.76$. Post-intervention: $\alpha = 0.72$.
	b) Affinity with the neighbors living in the same block "How strong are your ties with neighbors in your block?"	1 = very little; 7 = very much	
	c) Neighborhood trust "Do you feel that you can trust the people living in your block?"	1 = no, not at all; 7 = yes, completely	
	d) Residence identity "I strongly identify as a Stockholm Royal Seaport resident"	1 = fully disagree; 7 = fully agree	
Social capital (Lochner et al., 1999)	How many neighbors do you know by name?	Open-ended question	NA

through a single-item measure. Such single-item measures are valid if they represent clear and unambiguous constructs, as in the current case (Bergkvist and Rossiter, 2007).

To boost statistical power, and given the formal predictions (as per **H1-H2**) combined with the small sample size in the longitudinal analyses (cf. Shavit et al., 2021; Skarin et al., 2021), the authors relied on one-tailed tests, as recommended by several scholars (e.g., Jones, 1954; Cho and Abe, 2013; Lakens et al., 2018; Otterbring et al., 2021).

RESULTS

An independent samples *t*-test found no significant difference on the social identity index *prior* to the intervention [$t(64) = 0.39$, $p = 0.70$] among participants who did ($M = 4.88$, $SD = 0.99$) vs. did not ($M = 4.76$, $SD = 1.17$) reply to the second-wave survey. Similarly, there was no significant difference in the number of neighbors known *prior* to the intervention [$t(64) = 1.04$, $p = 0.30$] among participants who did ($M = 5.39$, $SD = 5.44$) vs. did not ($M = 4.17$, $SD = 3.72$) reply to the follow-up survey. These findings are important as they further indicate, on top of the lack of demographic differences between intervention and control participants (as reported in the section "Participants and Descriptive Details"), that there was no evident selection bias, indicating that both groups of participants were comparable *before* the intervention took place. Therefore, the authors proceed as follows in the main analyses. First, comparisons are made between participants who replied to the follow-up survey *after* the intervention with participants who only replied to the initial survey *before* the intervention, with the latter group of participants serving as a control. Second, these analyses are complemented with longitudinal alternatives among the subset of participants who replied to the survey both *before* and *after* the intervention.

Intervention vs. Control Participants

In partial support of **H1**, an independent samples *t*-test on the social identity index revealed that participants in the intervention group ($M = 5.24$, $SD = 0.96$) reported a marginally stronger sense of social identity linked to their neighborhood compared to participants in the control group [$M = 4.76$, $SD = 1.17$; $t(64) = 1.55$, $p = 0.06$, $\eta^2 = 0.04$], although the *p*-value was slightly

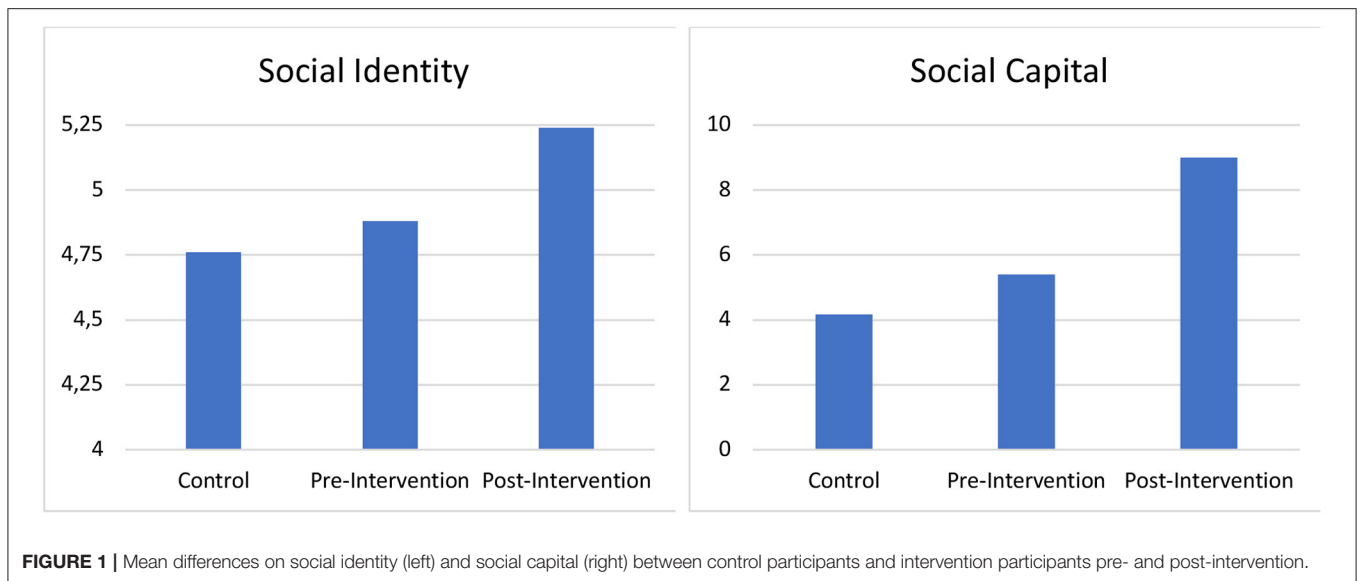
above conventional levels of statistical significance but with a moderate or typical effect size according to current conventions in psychological science (e.g., Richard et al., 2003; Gignac and Szodorai, 2016; Funder and Ozer, 2019).

A similar analysis on the number of neighbors known by name (i.e., social capital) showed that participants in the intervention group ($M = 9.00$, $SD = 11.41$) reported knowing a significantly larger number of neighbors than those in the control group [$M = 4.17$, $SD = 3.72$; $t(64) = 2.61$, $p = 0.005$, $\eta^2 = 0.10$], with a moderate-to-large effect size. In this analysis, however, there was one evident outlier in the intervention group, whose reported number of known neighbors (i.e., 50) was more than 3.29 standard deviations beyond the mean of the intervention group. Excluding this outlier did not change the nature or significance of the results, as intervention participants ($M = 6.59$, $SD = 5.21$) still reported knowing a significantly larger number of neighbors than control participants [$M = 4.17$, $SD = 3.72$; $t(63) = 2.07$, $p = 0.02$, $\eta^2 = 0.06$]. Because non-parametric tests are less sensitive to extreme values than their parametric counterparts given their rank-based nature, the authors also conducted a Mann-Whitney *U* test on the entire sample, including the outlier, which again revealed a significant difference between the groups ($U = 293.00$, $Z = 2.04$, $p = 0.02$). Indeed, intervention participants ($Mdn = 5$) reported knowing a larger number of neighbors than control participants ($Mdn = 4$). Taken together, this provides converging evidence for **H2**.

Figure 1 depicts the results on the dependent variables for control participants (Control) and intervention participants, with the means of intervention participants presented across both waves of data collection (Pre-Intervention and Post-Intervention, respectively). To enhance readability, the y-axis has been truncated for the social identity index.

Intervention Participants Before vs. After Intervention

In further support of **H1**, a paired-samples *t*-test on the social identity index found that participants in the intervention group reported a stronger sense of social identity linked to their neighborhood after ($M = 5.24$, $SD = 0.96$) rather than before the intervention [$M = 4.88$, $SD = 0.99$; $t(17) = 1.72$, $p = 0.05$, $\eta^2 = 0.15$]; see the left-hand side of **Figure 1**.



Similarly, and in line with **H2**, participants in the intervention group reported knowing a significantly larger number of neighbors after ($M = 9.00$, $SD = 11.41$) as opposed to before the intervention [$M = 5.39$, $SD = 5.44$; $t(17) = 2.16$, $p = 0.02$, $\eta^2 = 0.22$]; see the right-hand side of **Figure 1**. Again, excluding the outlier from this analysis did not change the nature or significance of the results [$t(16) = 3.17$, $p = 0.003$, $\eta^2 = 0.39$], as participants reported knowing a larger number of neighbors after ($M = 6.59$, $SD = 5.21$) rather than before ($M = 5.39$, $SD = 5.44$) the intervention. Also, the non-parametric version of the paired samples t -test (i.e., the Wilcoxon Signed Rank test), including the outlier, yet again revealed that these findings were robust ($Z = 2.94$, $p = 0.002$), with participants reporting knowing a larger number of neighbors after ($Mdn = 5$) relative to before ($Mdn = 4$) the intervention. In fact, only 2 of the 18 participants in the intervention group reported knowing fewer neighbors after (vs. before) the intervention, whereas 12 reported knowing more, with the remaining 4 stating familiarity with an equal number of neighbors pre- and post-intervention. As such, **H2** was strongly supported.

DISCUSSION

The present longitudinal study applied a novel, explicit focus on social identity and social capital as direct outcomes of, rather than taken-for-granted preconditions for, a social norm-based behavioral intervention. Results demonstrate that an intervention primarily designed to increase environmentally beneficial behaviors also increases social identity and social capital among the influence targets. These findings have two important implications.

First, the results indicate that social norm-based interventions can indeed have a positive influence on social aspects of sustainability, even when the intervention itself is focused on sustainability aspects associated with environmental conservation. The possibility of creating sustainable “win-win outcomes” presents a novel perspective on social norm-based

interventions. In particular, the current research suggests that these interventions may play a pivotal role in supporting sustainable development efforts, considering their wide applicability in research and practice.

Second, as increased social identity and social capital may bring about additional benefits, such as stronger behavioral influence of social norms and greater community resilience, social norm-based interventions could ideally be a starting point for an almost self-reinforcing sustainability focus, potentially with far-reaching future-focused benefits. Combined with the opportunity of distributing such interventions through novel technologies (e.g., smartphone apps), this is a relevant insight for the growing stream of transformative service research, as a potential strategy to support and sustain societal and consumer well-being (Otterbring, 2017; Field et al., 2021; Ostrom et al., 2021).

Limitations and Future Research

The current work offers a novel perspective on the role of technology-induced social norms in supporting societal sustainable development, providing several interesting avenues for future research. Admittedly, however, the study is not without limitations. For example, while the longitudinal sample size is comparable with other similar studies (e.g., Skarin et al., 2021; Shavit et al., 2021), the relatively few data points in the second wave of data collection limit the ability to identify small and moderate effect sizes with sufficient statistical power. Unfortunately, the small sample size in the second wave of data collection was impossible to fully circumvent, as participants were free to choose whether to complete the follow-up survey. Still, considering that the surveys were distributed several months apart and that the response rate during the first wave of data collection was not substantially larger than that of the second wave of data collection, the results should reasonably have some predictive validity. Indeed, of the 153 households who could download the app and reply to the initial survey, 59 households (38.56%) decided to do so, corresponding to 66 residents as

some households had more than one adult who replied to the initial survey. Subsequently, 18 of those 66 residents (27.27%) also completed the follow-up survey, with these response rates being common in studies relying on similar designs (Kirkwood and Walton, 2014; Siegrist et al., 2015). Nevertheless, future research should include more households to overcome the limitation associated with small sample sizes and preferably conduct *a priori* power analyses to ascertain that the effect sizes of interest can be detected with sufficient statistical power given the set target sample size (Lakens, 2022). Moreover, as no mediating or moderating variables were documented in the current study, scholars addressing similar topics should optimally try to elucidate the specific psychological mechanisms driving the obtained effects, while simultaneously examining the replicability, generalizability, and boundary conditions of the current results. For example, several studies have shown that certain individual-differences factors may shape individuals' sustainability-related responses (Luchs and Mooradian, 2012; Folwarczny and Otterbring, 2021; Vizcaíno et al., 2021) as well as the extent to which they are influenced by social norms (Cialdini et al., 1999; Perugini and Gallucci, 2001; Stankov, 2011). Thus, future research should preferably include measures related to, for example, people's personality traits, cultural values, and the importance put on environmental protection to shed further light on whether, when, and why social norms may foster sustainable responses with a clear social connotation. As such, while this empirical investigation constitutes the first preliminary step for examining the theorizing proposed herein, more research is

needed to gain a deeper understanding of the studied outcomes and build a nomological network of cumulative evidence.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HS collected and curated the data for analysis and wrote the first draft of the manuscript. TO performed the statistical analysis and wrote sections of the manuscript. All authors contributed to conception and design of the study, contributed to manuscript revision, read, and approved the submitted version.

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