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## **Practice-based spill-over effects: Evidence from Calgary's municipal food and yard waste recycling pilot**

Analyzing the 'spill-over effects' of environmental interventions is vital for understanding how they contribute to broader societal transitions towards or away from sustainability. Past research analyzing spill-over effects has produced inconsistent results, which we argue is in part due to its assumption that social life consists of rational and autonomous individuals. By contrast, we place practices as central units of inquiry, arguing that social practice theory opens up promising alternative sets of theoretical and methodological possibilities for analyzing spill-over effects. Using the City of Calgary's municipal food and yard waste recycling pilot program known as the 'Green Cart Pilot' (GCP) as a case study, we adopt a mixed methods approach to analyze 'practice-based spill-over effects' (PSEs). The results suggest that the GCP had positive PSEs on dry recycling and food shopping, and negative PSEs on home composting. These PSEs could be tracked through the shared elements and geographies of mutually evolving practices, providing opportunities to respond with further interventions informed by social practice theory.

Keywords: spill-over effects; social practice theory; mixed methods; recycling; environmental policy.

### **Key messages:**

- Social practice theory offers a promising alternative framework through which to analyze spill-over effects

- We used mixed methods to analyze ‘practice-based spill-over effects’ of the City of Calgary’s Green Cart Pilot
- We found both positive and negative practice-based spill-over effects transmitted through the shared elements and geographies of mutually evolving practices

## **Introduction**

At least on paper, it is widely accepted that addressing burgeoning environmental issues such as climate change and biodiversity loss necessitate comprehensive changes to contemporary ways of living, working and playing (WCED 1987; UN 2000, 2015; UNEP 2012). However, it is also evident that individual environmental policy interventions are not equipped to target or facilitate this necessary transformation, and instead must break it up into manageable pieces (e.g. getting people to bike to work, to recycle, or to change their light bulbs). The question of whether these pieces will somehow ‘add up’ to the transformation required has, over the past couple of decades, spurred significant research and policy interest in tracking and characterizing the ‘spill-over effects’ of environmental interventions – that is, their additional, non-targeted effects on sustainability (Thøgersen 1999; De Young 2000; Thøgersen and Ölander 2003; Thøgersen and Crompton 2009; Austin et al. 2011; Truelove et al. 2014; Maki and Rothman 2016).

To date, research into spill-over effects has drawn on theories from environmental psychology, social marketing and economics: theories that assume that social life consists of rational and autonomous individuals (Southerton et al. 2004;

Shove 2004, 2010; Hargreaves 2011; Webb 2012; Browne et al. 2015). The spill-over effects implied by this assumption – which we label hereon as ‘behavioural spill-over effects’ (BSEs) – occur when the adoption of pro-environmental behaviours (PEBs) motivates individuals to adopt or abandon subsequent PEBs. Yet despite significant scholarly effort, “to date research on spillover effects has generated mixed and at times conflicting results” (Truelove et al. 2014, 127; see also Austin et al. 2011), raising questions about the validity of the idea, both conceptually and empirically (Barr et al. 2011, 2013; Wieser et al. 2014).

We argue that these inconsistent results stem in part from limitations to the above assumption underlying BSEs research. We posit that social practice theory offers a more promising analytical framework by positioning *practices*, rather than individuals, as central units of inquiry (Giddens 1984; Schatzki 1996; Reckwitz 2002; Warde 2005; Shove et al. 2012). Practices differ from behaviours as they are not driven by individuals’ beliefs or attitudes, but rather comprised of interconnected elements that depend upon and ‘recruit’ individuals to routinely integrate them through performance (Shove et al. 2012).

The potential of social practice theory for offering both a critique and alternative theory of social change to mainstream individual consumer-based models has increasingly been recognized by sociologists and human geographers in the past decade, particularly in the UK (e.g. Warde 2005; Shove 2010; Shove et al. 2012; Watson 2012; Ozaki and Shaw 2014; Browne et al. 2015; Mylan 2015) and Australia (e.g. Strengers 2011, 2012; Maller et al. 2012; Moloney and Strengers 2014, Strengers et al. 2015). Yet despite this outpouring of scholarship, social practice theory has so far not gained significant traction among Canadian social scientists at a time when environmental interventions will likely continue to be high on the agenda following the federal

government's recent, highly publicized plan to put a price on carbon (CBC News, 2016). In this study, we draw on social practice theory research to justify the need for alternative ways of conceptualising spill-over effects, and then outline a framework for analyzing what we label as 'practice-based spill-over effects' (PSEs). Using mixed methods that align with this framework, we investigate the PSEs of the City of Calgary's food and yard waste recycling pilot known as the 'Green Cart Pilot' (GCP). The goal is to explore the potential usefulness of analyzing PSEs for environmental policymakers, practitioners and researchers, both in Canada and elsewhere.

### **Limitations to behavioural spill-over effects research**

Various theories have been proposed to explain the presence and direction of BSEs, summarized in Table 1. Among the most prominent are self-perception theory, cognitive dissonance, moral licensing, single-action bias, and rebound effects (Thøgersen and Crompton 2009; Austin et al. 2011; Truelove et al. 2014). These theories share the implicit assumption that spill-over effects originate and are transmitted via the cognition of individuals through a three-step process. First, individuals acquire new information through the adoption of an initial PEB (such as the one targeted by an intervention). Second, this influences individuals' beliefs about subsequent PEBs: a stage argued as contingent upon the *perceived* links between PEBs. As Austin et al. (2011, 100) note, "One of the most important pre-requisites for spillover of pro-environmental behaviours is a perceived relationship between the trigger and outcome behaviours" (see also Thøgersen 2004). Finally, the resulting

change in beliefs about subsequent PEBs translates into changes in behaviour (Ajzen 1991), implying a positive or negative BSE.

Despite the number and diversity of these theories, “their sum provides only circumstantial evidence, rather than tested and verified proof, of the existence of spillover effects” (Austin et al. 2011, 22; see also Barr et al. 2011, 2013; Wieser et al. 2014; Truelove et al. 2014; Maki and Rothman 2016). We argue that the apparent inconsistencies in research results stem from three main limitations to underlying assumptions. First, individuals arguably do not always categorize seemingly related PEBs as such. For example, in a study where individuals were asked to group behaviours that seemed similar “in some important way”, environmental criteria were rarely used (Austin et al. 2011). Instead, behavioural categorizations were “highly personal, contextual and influenced by a number of different constructs that were pertinent to participants’ own lives” (Austin et al. 2011, 67).

The second limitation is that even when individuals hold beliefs about certain behaviours, they often fail to act in accordance with them: the now-infamous ‘attitude-behaviour gap’ (Kraus 1995; Ajzen 2001; Hobson 2003; Vermeir and Verbeke 2004). Some scholars have attempted to bridge this gap by arguing that more contextual factors need to and can be accounted for (e.g. Kaiser and Wilson 2004; Kaiser et al. 2010; Maki and Rothman 2016). However, others argue that ongoing efforts to ‘patch up’ these theories fail to account for how the factors themselves become constituted within particular contexts (e.g. Southerton et al. 2004; Shove 2003, 2010; Hargreaves 2011, 2012). As Shove (2010, 1276) argues, “there is no obvious limit to the number of possible determinants and no method of establishing their history, their dynamic qualities, their interdependence or their precise role in promoting or preventing different behaviours.”

Relatedly, the third limitation of BSE theories is that their framing of where and how spill-over effects happen (i.e. through the cognition of individuals) fails to capture an intervention's effects on broader socio-technical contexts within which behaviours are adopted (Hobson 2006, 2012; Macrorie 2012; Ozaki and Shaw 2014). For example, Hargreaves (2011, 94) describes how a workplace sustainability initiative that failed to meet its behaviour change targets still led employees to “question and redefine the meaning and nature of working at [the company], and specifically to incorporate pro-environmental aspects into their professional identities.”

Together, these three limitations suggest a need to experiment with alternative theories of social change that may better account for spill-over effects. To that end, we argue below that social practice theory has the potential to address these limitations and change how spill-over effects are conceptualised and investigated.

### **Theoretical framework for analyzing practice-based spill-over effects**

Social practice theory has been developed by a diverse array of scholars (e.g. Bourdieu 1977, 1990; Giddens 1979, 1984; Schatzki 1996; Schatzki et al. 2001; Reckwitz 2002; Warde 2005; Shove 2010; Shove et al. 2012). Although the result is not a unified body of work (Shove et al. 2012), social practice theory's basic argument is that social research should study “neither the experience of the individual actor, nor the existence of any form of social totality, but social practices ordered across space and time” (Giddens 1984, 2).

As Giddens suggests, practices neither determine nor are determined by individual choices. Rather, they are entities that persist beyond and between particular

performances and are constituted by interconnected elements that give them shape, and influence what is understood to be the ‘normal’ way to perform them (Shove et al. 2012). Although these elements have been described and categorized differently, the version of social practice theory used in this study follows Shove et al.’s (2012) categorization of meanings (symbolic meanings, ideas, aspirations), competences (know-how, skill, technique) and materials (things, technologies, physical entities). For example, current practices of household garbage disposal might be constituted by meanings of convenience, disgust, cleanliness, civic duty, freedom from responsibility and environmental and health concerns. The competences involved include knowledge of when something is garbage, techniques of sorting out recyclables and knowledge of when and how to take out garbage for collection. And finally, the materials involved include the garbage itself, indoor and outdoor garbage bins, bags, garbage trucks and landfills.

For such practices to persist, the interconnections between their elements need to be consistently reproduced through recurrent performances. Over time, these performances can become deeply habituated, making them “neither fully conscious nor reflective” (Warde 2005, 140). However, practices that no longer ‘make sense’ to perform will fragment or evolve. For example, burning garbage in one’s back garden is no longer deemed acceptable, particularly in urban areas, with households now expected to participate in municipal garbage collection programs.

Thus, although social practice theory is often associated with routine and habit, “practices also contain the seeds of constant change” (Warde 2005, 141). Yet change is rarely fully endogenous to a particular practice (Shove et al. 2012; Watson 2012). Instead, as the above example suggests, waste burning practices have evolved in relation to other practices (i.e. participating in municipal collection programs). Appreciating

relations *between* practices is therefore an essential part of social practice theory (Watson 2012).

These relations occur as practices compete or collaborate with each other for the time of practitioners, the space to be practiced, and/or supplies of requisite elements (Shove et al. 2012). For example, driving competes with cycling for space on roads, time spent commuting, and meanings such as convenience, speed and comfort. Often simultaneously, driving also collaborates with practices including shopping and attending work and school by sharing spatial and temporal arrangements, material infrastructures and meanings (Shove et al. 2015). Such relations do more than enable practices to persist, but rather often lead to the hybridization or reconfiguration of practices involved (Shove et al. 2012, 89). For example, collaborative relations between driving and grocery shopping have shaped these practices (supermarkets have become larger and more distant from residential areas) and increased their co-dependency (Shove et al. 2015).

Generally, practices that are more strongly related – through being spatially or temporally “proximate” or linked through the “connective tissue” of shared elements – are more likely to mutually influence each other (Shove et al. 2012). However, this is never guaranteed. Mylan (2015) notes that certain practices may ‘resist’ change, particularly when strongly related to other relatively stable practices, or when they are “tightly coupled” – that is, comprised of elements that are closely linked together. Understanding whether and how certain practices affect each other thus requires attending to the practices’ specific compositions and relations to other practices, as well as their relations to each other.

Such an understanding is especially important to develop for practices targeted by environmental interventions. This is because changes to these practices may lead to

PSEs – that is, changes to related but non-targeted practices in ways that are relevant to sustainability. To examine how this can occur, the remainder of this article draws on a case study of a food and yard waste intervention in the city of Calgary.

## **The Green Cart Pilot case study**

### Background

Since March of 2012, the City of Calgary has facilitated the GCP within four communities “to test the collection and customer experience of food and yard waste diversion” (City of Calgary 2013, 1). The GCP involves weekly collections of food and yard waste from 7500 residences within chosen communities, with collected waste delivered to an industrial-scale composting facility. It was designed to run alongside an existing mixed dry recyclable collection program (the ‘Blue Cart Program’) and garbage collection program (the ‘Black Cart Program’). The four GCP communities were selected “to achieve a cross section of the representative communities and create efficiencies within existing operational parameters” (City of Calgary 2013, 1).

Certain elements were introduced within participating households to increase enrolment in the GCP’s targeted practices of food and yard waste recycling. Materials included a 120L Green Cart, a 7L kitchen pail for food waste, 120 compostable liner bags for the kitchen pail, 20 paper bags for yard waste, along with a Green Cart collection truck arriving on a weekly basis (City of Calgary 2013). Competences were provided through written instructions on the City of Calgary’s website and mailed-out brochures with collection calendars and visuals explaining what can and cannot be

recycled. Finally, meanings of civic and environmental benefit were emphasized on the City of Calgary website and periodic brochures (e.g. see City of Calgary 2015a).

For the research reported in this article, we selected two of the four GCP communities (Southwood and Cougar Ridge) along with two ‘control communities’ (Haysboro and West Springs). Southwood and Cougar Ridge were chosen because they contain diverse geographic, demographic and socio-economic characteristics according to the City of Calgary Community Profiles database (City of Calgary 2015b), and thus represented a reasonable range of the households that the GCP affected or could affect if it were scaled city-wide. Haysboro and West Springs were selected as control communities because they were adjacent and had similar characteristics to Southwood and Cougar Ridge respectively (City of Calgary 2015b). For analysis, Southwood and Haysboro were compared directly to each other and so were defined as Community Pairing A, while Cougar Ridge and West Springs were defined as Community Pairing B.

## Methods

We analyzed PSEs of the GCP in two stages, using two distinct methods. In the first stage (June 2015), 16 recorded, face-to-face semi-structured interviews were conducted at randomly selected households within each of the two GCP communities. Interviewees were asked about their experience participating in the GCP, and whether/how this had affected some of their other routines and habits (i.e. had PSEs). Interviews were conducted at 21% of households approached (32 out of a possible 152), and ranged between four and 25 minutes in duration. Recordings were subsequently analyzed for content, as well as discursive qualities – such as reactions to questions, emotions, and

ease of answering. The latter was to attempt to account for and understand practices performed without much conscious reflection, making them difficult for interviewees to describe or explain (Hitchings 2012; Pugh 2013; Wieser 2014).

The results from these interviews then informed the construction of household surveys, 160 of which were conducted within GCP *and* control communities to determine the extent and magnitude of the PSEs identified within the semi-structured interviews. Questions asked about dry recycling rates, defined as the estimated percentage of dry recyclables that were recycled appropriately; the importance of purchasing food with ‘minimal non-recyclable packaging’, defined on a scale of 0 to 10; and yard waste home composting rates, defined as the estimated percentages of food and yard waste that were home composted. Survey questions also queried the rated importance of purchasing food that is ‘organic’, and of purchasing food that is ‘local’. These two other sustainability-relevant meanings within food shopping were not raised by any interviewees during the semi-structured interviews, and so investigating them served as a way of testing the consistency of the PSEs produced by the two methods.

Surveys were administered in person in June 2015 at 40 randomly selected households within each of the four communities, avoiding households that were sampled in the semi-structured interviews. Surveys were conducted at 19% of the households approached (160 out of a possible 842), were recorded when the resident consented, and ranged in length from three to ten minutes.

Answers were statistically analyzed for the strength and significance of variation in practice performance between pilot and control communities (controlling for variation between community pairings), as well as the correlation between food and yard waste recycling rates and other practices within GCP communities. Given that the data for these analyses were estimated by respondents and not normally distributed, we

treated them as ordinal (McCullagh and Nelder 1983). This meant that estimated percentages (i.e. of recycling or home composting rates) were rounded to the nearest 10 so that the ordered categories could be evenly distributed (we assumed that this would not greatly decrease the precision of respondent's estimates). Statistical analyses were conducted using ordinal logistics models, and likelihood-ratio chi-squared ( $\chi^2$ ) statistics were estimated with alpha ( $\alpha$ ) set at 0.05. Answers to open-ended questions that queried reasons for performing different practices were categorized and compared in terms of their frequency of occurrence. To simplify analysis, answers of respondents from GCP and control communities were grouped together and only the three most frequently cited reasons of each practice were compared. We also reviewed survey recordings and included select quotes to provide specific stories of respondents' experiences with the GCP.

The above mixed methods approach is a clear contrast to those usually used in BSEs research, as we were not testing for the BSEs of pre-defined 'PEBs'. Beginning with an open-ended empirical exploration—i.e. the semi-structured interviews—rather than a priori assumptions of what spill-over effects might be aligns more with social practice theory, wherein “practices have emergent and uncontrollable trajectories” (Shove and Walker 2010, 475). Although previous social practice theory research has examined practices within context, this has mainly been achieved through qualitative studies with small sample sizes (although see Bellotti and Mora 2014; Browne et al. 2015), hence the inclusion of the household survey in this research.

## Results

*Interview responses.* All 32 interviewees were enrolled to some degree in both of the GCP's targeted practices of food and yard waste recycling. When asked whether this experience had affected other routines or habits in their households or elsewhere, many interviewees hesitated or gave 'thinking sounds' (e.g. hmmm). In the end, ten said that it had. Four interviewees claimed that it had led them to dry recycle more both in the household (with the Blue Cart Program) and elsewhere. Two of these four described this as an emotive process, where, after getting used to sorting out food and yard waste, seeing dry recyclables in the rubbish bin felt "weird". Another discussed how the presence of the Green Carts had forced him to think about and develop a technique for sorting out waste.

Two other interviewees claimed that the GCP has led them to purchase food with less packaging. One of them noted that she purchased more unpackaged fruits and vegetables because she felt that "it's more helping the environment when you compost." The other was clear in his attribution of agency to the Green Cart, or more specifically, its role in the practice of separating out food waste from non-recyclable packaging that led him to replace his Keurig® coffee maker with hand ground coffee. As he said:

"I had a Keurig, I got it as a gift, but I used to just use that for coffee. But it came with those little pods, but now getting the green bin I don't use the pods at all anymore and I got rid of the Keurig, too wasteful... It [the Green Cart] made me very aware of exactly what was going where."

Notably, this PSE was not immediately obvious to this interviewee, as his answer was initially negative. It was not until after the interview had been completed that he re-opened his door and called the interviewer back to give the above response.

Food and yard waste recycling with the GCP also appeared to play a role in reducing or eliminating home composting practices among some interviewees. When asked about home composting, some interviewees seemed to get slightly defensive, immediately explaining that there was no need to because they lived in a GCP community. For example, one's reaction was "Well, we have the Green Cart! Duh!" Since the GCP began, none of the 32 interviewees had begun home composting and four of the five that were beforehand had fully or partially switched over to the GCP. All four of these interviewees had switched over primarily because of the relative "convenience" of the GCP, with one also noting that she had found it difficult to produce good soil and keeping away pests from her home composter.

As such, the interviews yielded relevant stand-alone insights into the types and directions of potential PSEs. They were also used to construct the survey, the results of which offered different insights into the PSEs' extents and magnitudes.

*Survey responses.* Overall, respondents within GCP communities participated in the programme's targeted practices, with 95% taking part in either food or yard waste recycling. The most commonly cited reason for participating was convenience, followed by general environmental benefits and the reduction of waste (Figure 1).

Dry recycling appeared to relate to the practices of food and yard waste recycling, with rates significantly higher in GCP communities than control communities ( $\chi^2(1, n=159)=6.00, p=0.014$ ; Figure 2), with no interaction effect ( $p=0.530$ ). Further, dry recycling rates were positively correlated to rates of both of food waste recycling

( $\chi^2(1, n=80)=7.15, p=0.008$ ) and yard waste recycling ( $\chi^2(1, n=80)=10.48, p=0.001$ ) within GCP communities. Like food and yard waste recycling, the most commonly cited reasons for dry recycling were “environmental benefit”, “reducing waste” and “convenience” (Figure 1).

A majority (89%) of respondents collected their dry recyclables in at least one indoor bin before transferring them outside to their blue cart. For respondents within GCP communities, the presence of an indoor dry recyclables bin was not significantly correlated to food waste recycling rates ( $\chi^2(1, n=80)=1.49, p=0.221$ ), *unless* the dry recyclables bin was located in the kitchen (which it was 74% of the time), in which case the correlation was positive ( $\chi^2(1, n=80)=11.75, p<0.001$ ). However, the presence of an indoor dry recyclables bin was not at all correlated to yard waste recycling rates ( $\chi^2(1, n=80)<0.01, p=0.972$ ), even if the bin was located in the kitchen ( $\chi^2(1, n=80)=0.13, p=0.714$ ).

Food shopping appeared to relate to food waste recycling via certain shared meanings and not others. On the one hand, importance ratings of purchasing food with minimal non-recyclable packaging were significantly higher within GCP communities than within control communities, with no interaction effect (Table 2). They were also positively correlated to food waste recycling rates ( $\chi^2(1, n=77)=4.25, p=0.039$ ) but not yard waste recycling rates ( $\chi^2(1, n=77)=2.62, p=0.106$ ) within GCP communities.

On the other hand, importance ratings of purchasing organic food were not significantly different between GCP communities and control communities (Table 2), or correlated to food waste recycling rates ( $\chi^2(1, n=79)=0.16, p=0.6900$ ) or yard waste recycling rates ( $\chi^2(1, n=79)=0.07, p=0.788$ ) within GCP communities. Nor were importance ratings of purchasing local food significantly different between GCP and control communities (Table 2), or correlated to food waste recycling rates ( $\chi^2(1,$

$n=80$ )=1.94,  $p=0.164$ ) or yard waste recycling rates ( $\chi^2(1, n=80)=<0.01, p=0.996$ ) within GCP communities.

Finally, there were no significant differences between the number of residents home composting from GCP communities (13 in Southwood and 4 in Cougar Ridge) and control communities (17 in Haysboro and 1 in West Springs). However, home composters were used at lower rates within GCP communities than they were within control communities for both food waste,  $\chi^2(1, n=33)=9.67, p=0.002$  (Figure 3a), and yard waste,  $\chi^2(1, n=33)=4.65, p=0.031$  (Figure 3b). The most common reasons for home composting for respondents within both pilot and control communities were making soil for gardening, reducing waste, and “doing the right thing” (Figure 1).

At the time that the GCP was introduced in March of 2012, 29 respondents from GCP communities had been home composting. Following the implementation of the GCP, only six of the 29 respondents continued home composting at the same rate or reduced it only for food and yard waste which in their experience did not make good soil for gardening (e.g. branches, grass clippings, paper towels, etc.). All six of these respondents were home composting primarily to make soil for gardening.

The remaining 23 respondents had stopped or significantly reduced home composting following the implementation of the GCP. Most (18) of these 23 respondents claimed that this change had been spurred by the relative convenience of the GCP, which left many of them with the feeling that, as one respondent put it, “there’s no point” to home composting. Interestingly however, nine of these respondents had previously been home composting to make soil for gardening, a meaning that is not shared with the GCP (the soil produced in the GCP’s industrial composting facility was not available to residents). Some explained the change by claiming that they had not been skilled at making good soil from home composting,

while others appeared unaware of why they had switched from home composting to the GCP until asked. For example, one respondent, who had home composted to make soil at a previous house but had not started up again upon moving to Cougar Ridge, explained: “I honestly never thought about it because we have the green bin pickup here so I feel like all my waste is being collected in a proper manner so I just never thought to do it.”

## **Discussion**

The results produced by the interviews and survey suggest that the GCP successfully introduced meanings, materials and competences to participating households, facilitating their enrolment into the targeted practices of food and yard waste recycling at relatively high rates. Ten of the 32 interviewees claimed that performing these practices had affected how they dry recycled, food shopped and home composted in sustainability-relevant ways. These ‘PSEs’ were of significant magnitude and extent according to the surveys. While much can be interpreted about how and why these PSEs occurred, this section discusses three important patterns and before concluding with their implications for environmental policymakers, practitioners and researchers.

First, the results suggest that the PSEs did not only exist conceptually in the cognition of individuals, but rather were imbued within and transmitted through the elements and geographies of the practices involved. For example, the positive PSE on dry recycling – where dry recycling rates were higher in GCP communities and positively correlated to food and yard waste recycling rates – was likely transmitted in part through the shared space of the kitchen. Here and only here, food waste recycling

rates were positively correlated to the presence of a dry recyclables bin, which in turn was positively correlated to dry recycling rates. This is evidence of collaborative interplay between the two practices as they worked their way into the kitchen space alongside its other, more entrenched practices such as cooking, serving, and washing. This interplay may have occurred as the practices together brought with them techniques of sorting waste before disposing of it (as one interviewee put it) or feelings of discomfort or “weirdness” at improperly sorted waste (according to two others).

Meanwhile, the positive PSE on food shopping – where the importance ratings of minimizing non-recyclable packaging were higher in GCP communities and positively correlated to food waste recycling – was likely transmitted through the shared materials of “food” and “packaging”. By sorting these two materials into the Green Cart and Black Cart respectively, food waste recycling associated different, contrasting meanings onto them. Specifically, food waste became associated with some of the meanings of food waste recycling shown in Figure 1 (e.g. reducing waste and environmental benefit), while packaging—particularly non-recyclable packaging—became associated with wastefulness, as the coffee maker quote highlights. These meanings were able to “stick” to their associated materials to the extent that they became relevant within the practice of food shopping. Conversely, food waste recycling did not associate different meanings onto organic food or local food specifically, which explains why their rated importance was not correlated to the practice or higher in GCP communities.

The second pattern in the results is that tightly coupled and interconnected practices appeared able to resist being affected by the GCP (see also Mylan, 2015). For example, home composting was often outcompeted by the relative “convenience” of the GCP, as the two practices shared similar meanings (e.g. reducing waste and doing the

right thing: see Figure 1) and thus could be directly compared. However, a variant of the home composting seemed to persist for a small proportion of respondents (six out of 29) that was characterized by having strong meanings of “making soil for gardening” and competences in knowing how to do so. These elements were tightly coupled with home composting specifically, and also related it to the relatively stable practice of gardening. Shifting where food and yard waste was disposed of would therefore have required not simply substituting one material (a home composter) for another (a Green Cart), but also disrupting these other elements and practice.

The final pattern in the results is that home composting and the GCP were neither static nor functionally equivalent options for food and yard waste disposal. Rather, they were distinct practices with unique configurations of elements that evolved through competition. This is suggested by the fact that a significant proportion of the respondents who gave up home composting for the GCP’s convenience had previously home composted to make soil for gardening. Given that this meaning is not shared with the GCP, it implies that the introduction of the GCP may have *changed what mattered*, as home composting altered from being about making soil to relative convenience. Extrapolating further, if home composting becomes increasingly abandoned, it is possible that certain competences (e.g. knowing how to make good soil) will also become forgotten and thus decoupled from the practice. This could develop a feedback loop that transforms the terms in which home composting competes with the GCP, leading to the latter becoming the *only* option that ‘make sense’ to individuals.

## **Conclusions and implications**

Previous social practice theory research has examined and characterized how practices relate (Shove et al. 2012; Bellotti and Mora 2014; Wieser et al. 2014; Browne et al. 2015, Shove et al. 2015) and suggested that interventions may have unintended consequences through these relations (Shove and Walker 2010; Hargreaves 2011; Macrorie 2012; Ozaki and Shaw 2014). In this article, we built on this research by defining the concept of “PSEs” and exploring its potential usefulness by analyzing the PSEs of a particular environmental intervention – the GCP. Our mixed methods approach produced results that together suggest the GCP had significant PSEs, both positive and negative in terms of sustainability. Specifically, the GCP appears to have increased dry recycling rates and the importance of minimizing non-recyclable packaging in food shopping, and decreased rates of certain variants of home composting. These PSEs were transmitted through shared elements and geographies of competing and collaborating practices that evolved in relation to each other.

Identifying and characterizing each of these unique PSEs required an initial empirical exploration of which practices might be affected and how. The semi-structured interviews seemed an appropriate methodological choice in this regard, given the consistency with their results and those of the surveys. That being said, the difficulty with which some of the interviewees answered the questions (as indicated by their hesitations and thinking sounds) suggests that further PSEs could be uncovered with more in-depth exploratory methods, such as ethnographies or longer or repeated interviews (e.g. see Hargreaves 2011; Ozaki and Shaw 2014; Browne et al. 2015).

Such intervention-specific explorations are in marked contrast with the approach that BSEs research often takes, wherein ‘PEBs’ are grouped together a priori so that conclusions can be generalized across environmental interventions (e.g. Thøgersen and Crompton (2009, 143) discuss the politically enticing concept of the “virtuous

escalator” of PEBs). Although more time consuming, such explorations open up opportunities to respond in ways tailored to the composition and performance of particular practices, rather than the general category of ‘PEBs’. These opportunities include strengthening relations between practices subject to positive PSEs, and stabilizing practices subject to negative PSEs. For example, campaigns that highlight the wastefulness of non-recyclable packaging in food shopping (e.g. through labels showing which materials are compostable, recyclable, and non-recyclable) or introduce further elements that could become shared between the two practices (e.g. compostable grocery bags) might strengthen relations between food shopping and food and yard waste recycling, with synergistic positive outcomes for the sustainability of both practices. Meanwhile, educating about and promoting home composting in the context of gardening might tighten the interconnections between its elements and relations to this more stable practice, potentially making it more resistant to competition from food and yard waste recycling.

Of course, interventions intended to enhance or reduce PSEs have PSEs in their own right that need to be accounted for. This implies an ongoing and iterative approach to intervention design and implementation, where the PSEs of interventions are tracked and translated into further opportunities for interventions, and so on. This article has shown why such an approach might be of value, and proposed an analytical framework and some methodological tools for doing so. Further research and methodological experimentation are required to help environmental policymakers and practitioners better understand, and perhaps adjust, how their interventions contribute to broader societal transitions towards or away from sustainability.

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## Tables

**Table 1**

Theories of behavioural spill-over effects, based on Thøgersen and Crompton (2009), Austin et al. (2011), and Truelove et al. (2014)

<b>Theory</b>	<b>Information acquired through adoption of initial PEB</b>	<b>Influenced belief towards subsequent PEBs</b>	<b>Direction of BSE</b>
Self-perception theory	I have a pro-environmental identity	Congruence with identity	Positive
Cognitive dissonance	I consistently adopt PEBs	Consistency with past behaviours	Positive
Moral licensing	My moral image is strong	Need to strengthen moral image	Negative
Single-action bias	I have solved the environmental problem	Need for subsequent PEBs	Negative
Rebound effects	The financial cost of subsequent PEBs is low	Financial cost	Negative

**Table 2**

Summary and comparative statistics for importance ratings of food shopping meanings within two Green Cart Pilot (GCP) communities (Southwood and Cougar Ridge) and two control communities (Haysboro and West Springs) in Calgary. IQR indicates inter-quartile range.

			<b>Minimal non- recyclable packaging</b>	<b>Organic</b>	<b>Local</b>
			Importance rating (on a scale from 0 to 10)		
Community Pairing A	Southwood	Median	7.5	4	6
		Mode	8	0	5
		IQR	3.25	6	4
	Haysboro	Median	7	4	5
		Mode	7	5	5
		IQR	4	3	4.75
Community Pairing B	Cougar Ridge	Median	7	5	5
		Mode	7	0	7
		IQR	4	6	4.75
	West Springs	Median	5	5	5
		Mode	5	5	5
		IQR	4	4	2
GCP communities total		Median	7	5	6
		Mode	8	0	5
		IQR	4	6	4
Control communities total		Median	6	5	5
		Mode	5	5	5
		IQR	4	3	3
		$\chi^2$	4.51	0.01	2.56
Difference between pilot and control communities (controlling for variation between community pairings)		Degree of freedom	1	1	1
		<i>n</i>	156	158	160
		<i>p</i> value	0.034	0.931	0.110
		Interaction effect <i>p</i> value	0.470	0.968	0.024

## **Figure captions**

### **Figure 1**

Frequencies of reasons reported for food and yard waste recycling (light grey bars,  $n=76$ ), dry recycling (dark grey bars,  $n=160$ ) and home composting (black bars,  $n=31$ ) by respondents who were engaged in the respective practices within the communities of Southwood, Cougar Ridge, Haysboro and West Springs in Calgary

### **Figure 2**

Frequency of dry recycling rates within Green Cart Pilot (GCP) communities of Southwood and Cougar Ridge (light grey bars,  $n=80$ ) and control communities of Haysboro and West Springs (dark grey bars,  $n=79$ ) in Calgary

### **Figure 3**

Frequency of home composting rates for food waste (a) and yard waste (b) of respondents who were currently home composting within the Green Cart Pilot (GCP) communities of Southwood and Cougar Ridge (light grey bars,  $n=16$ ) and control communities of Haysboro and West Springs (dark grey bars,  $n=17$ ) in Calgary