# Low Carbon Readiness in Social Context:
# Introducing the Social Context of Environmental Identity (SCE) Model

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## Data Availability Statement

Data are available from the first author.


**Key words:** environmental identity, low carbon readiness, climate change mitigation, social capital, social context

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## Abstract

Low Carbon Readiness (LCR) is an aspect of environmental identity, an individual citizen's willingness to reduce carbon emissions and transition to low carbon lifestyle as a personal striving. Nevertheless, individuals' personal strivings are strongly influenced by the social context in which they are situated. We propose the Social Context of Environmental Identity (SCE) model which postulates that social contexts for LCR have a nested structure. The micro-level Home is linked with other households through social networks at the meso-level Community, which are further embedded in a macro-level Society. These contexts are likely to influence LCR through different mechanisms. Home can exert direct influences by monitoring and reminding each other of the need to engage in low carbon behaviours. Community affects individuals' readiness by providing social capital. The macro-level

Society exerts social influence through societal norms, not only its current descriptive norm, but also through its dynamic norms about the changing trends into the future. We have tested and found support for these propositions in three national cross-sectional data sets from Australia. Our discussions will centre around a need to investigate social and cultural processes involved in climate change mitigation, and to link these insights to public policies.

**Key words:** environmental identity, low carbon readiness, climate change mitigation, social capital, social context

## Low Carbon Readiness in Social Context: Introducing the Social Context of Environmental Identity (SCE) Model

Climate change is one of the greatest challenges for humanity in the 21st century and beyond. On the one hand, human economic activities, largely driven by fossil-fuels at present, are the main driver of greenhouse gas (GHG) emissions and global warming (IPCC, 2014, 2018). On the other hand, against the background of growing human population (estimated 7.7 billion in 2019 increasing to 10.9 billion by the end of the century), the United Nations suggests inclusive economic growth is needed to eradicate poverty and hunger (United Nations, 2019a). How can humanity balance the need to support everyone's current material needs while sustaining a stable global climate for current and future generations of humanity? This is a global issue at the heart of the question of sustainable development (Brundtland, 1987). Despite the urgent need for further mitigation efforts, carbon emissions continue to rise (IPCC, 2014, 2018) and international collaborations keep stalling. Although national and globally-coordinated climate policies are needed, such institutional responses require citizens' willingness to adopt a variety of measures to reduce GHG emissions.

To address the issue of climate change at the level of national and international institutions as well as at the level of individual citizens, there is a need to craft cultures of sustainability – cultures that enable and support citizens' sustainable behaviours and societal engagement with sustainability. One critical aspect of such cultures is conceptions of human-nature relations, that is, conceptualizations about how humans relate to the rest of nature (Kashima, in press). Further, conceptualizations about how humans as a generic category relate to the rest of nature can have a psychological force especially if such conceptions are appropriated by individuals, who adopt views about how their own self as a member of humanity relates to the rest of nature. This individual-level counterpart of conceptions of human-nature relations is environmental identity, how one's self relates to nature (Clayton, 2012; Clayton & Opotow, 2003a).

To begin to investigate the role of environmental identity in the context of climate change mitigation, we focus on an aspect of environmental identity called Low Carbon Readiness (O'Brien et al., 2018) – an individual's readiness to transition to a low carbon lifestyle. Believing that an identity is fundamentally socially shaped, as per Mead (1934), we propose a Social Context of Environmental Identity (SCE) model, and report its preliminary test with three samples of Australian residents.

**Human Niche Construction, Urbanization, and Environmental Identity**

All life forms adapt to their environment by modifying their environment and constructing their own niche (Laland et al., 2000). For example, beavers build their nests and dams – the beaver-made environment if you will – to adapt to their environment. Likewise, humans build the human-made environment to adapt to the environment. Unlike beavers, humans construct not only the physical built environment such as houses and cities, but also the social environment including their communities and institutions. The activities to construct a species-specific niche is called niche construction. What makes the human niche construction possible is the human capacity for cultural transmission – transmission of not only the physical artefacts that humans make (e.g., houses, roads), but also symbolic artefacts that embody cultural ideas and practices (e.g., worldviews, rules) (Kashima et al., 2019).

Although the impact of human niche construction to the planetary system was negligible for most of the human history (Brooke, 2014), since the Industrial Revolution, the human niche construction began to outpace the capacity of the planetary ecosystem to process human products and residues (e.g., waste, $CO_2$, and other outputs and side effects of human activities) and absorb its impact (Rockström et al., 2009; Steffen et al., 2015). Urbanization has perhaps further exacerbated this process. Most of humanity used to live in rural areas; however, a majority is now living in the urban environment (Ritchie & Roser, 2019) – a trend expected to continue well into the future (United Nations, 2019b). Much of what surrounds many of us now is the human-made environment populated by other humans and cultural artefacts (Judge et al., accepted). One consequence is that much of the human activities interacts with the rest of nature only indirectly through our use of the artefacts. This removes direct feedback from the rest of nature about the ecological impact of our behaviours. Furthermore, the cultural artefacts such as books, movies, and other goods for cultural consumption appear to include fewer references to the natural environment. At least this has been well documented in English-speaking cultures (Kesebir & Kesebir, 2017; Wolff et al., 1999). The upshot of these is a cultural disconnect of humanity from the rest of nature.

One way of reconnecting humanity to the rest of nature is through cultural ideas and practices. Culturally constituted conceptions of human-nature relations, if they foreground the deep connection between humans and the rest of nature, can symbolically re-embed humanity within nature. Indeed there are many non-Western cultures around the world that regard humans and nonhumans as deeply linked (e.g., Descola, 2013; ojalehto et al., 2017), and some Western writings consider humans' embeddedness in nature (Naess, 1989). These cultural ideas can then be appropriated or elaborated by individuals as their own, as part of their self (Bragg, 1996; Kashima et al., 2014), in the form of environmental identity (Clayton, 2012; Clayton & Opotow, 2003a; Mayer & Frantz, 2004; Schultz, 2002; Schultz et al., 2004; van der Werff et al., 2013; Whitmarsh & O'Neill, 2010), i.e., how individuals think of their own relations with nature. Consistent with this reasoning, how people think of the human-nature relations (Kashima et al., 2014) and value nature (van der Werff et al., 2013, 2014) underpin environmental identity.

As Clayton (2012) noted, environmental identity is a multi-faceted construct. It varies in the extent to which self-nature relation is socially influenced (Clayton & Opotow, 2003b), with some reflecting the public reputation of environmental friendliness (e.g., Whitmarsh & O'Neill, 2010), but others revealing more emotional connectedness to nature (e.g., Mayer & Frantz, 2004) and intrinsic motivation to protect the natural environment (e.g., Pelletier et al., 1998). Kashima et al. (2014) proposed environmental striving as a psychological construct that taps this deeply personal, ego-involved, and intrinsically motivating environmental identity. It is an aspect of personal strivings (Emmons, 1986), which Emmons defined as "what individuals are characteristically aiming to accomplish through their behaviour or the purpose or purposes that a person is trying to carry out (Emmons, 1986; p. 1059)." For some individuals, the protection and sustenance of the natural environment is one such emotionally charged personal endeavour that he or she strives to carry out in life. It may be speculated that this is a more strongly internalized form (Ryan & Deci, 2017) of one's connection to nature. Indeed, environmental striving appears to be associated with costly environmental behaviour than other measures of environmental identity (Kashima et al., 2014).

As an aspect of environmental striving, O'Brien et al. (2018) introduced the construct of Low Carbon Readiness (LCR). It taps an individual's emotionally charged personal commitment to reduce GHG emissions. Low Carbon Readiness Index (LCRI), a short, reliable, and valid measure of LCR, asks whether respondents "work hard to reduce greenhouse gas emissions", feel good if they do so, and feel bad if they fail to do so. As a scale, it can predict a variety of self-reported household behaviours and behavioural

intentions to reduce GHG emissions as well as actual electricity use. LCRI positively correlated with a popular measure of environmental attitudes, the New Ecological Paradigm (Dunlap et al., 2000), about .50, and another measure of environmental identity (Whitmarsh & O'Neill, 2010) at .55, but most strongly with environmental striving (Kashima et al., 2014) at .65 (O'Brien et al., 2018). The present paper focuses on this Low Carbon Readiness as a personal striving to reduce GHG emissions. This is because the reduction of GHG emissions is central to climate change mitigation.

**Social Context of Environmental Identity (SCE) Model**

As Clayton and Opotow (2003b) noted, environmental identity develops in interaction with nature, but also with the social environment. Indeed, ever since Mead (1934), social shaping of self has been central to social psychological approaches to self and identity (Fielding et al., 2008; Kashima et al., 2002; Leary & Tangney, 2003). Here, we propose and report preliminary tests of the Social Context of Environmental Identity (SCE) model, which combines Bronfenbrenner's (1977) socioecological framework with the perspective that social communication and interaction in everyday life is foundational to the cultural shaping of social reality (Kashima, 2014). In this view, environmental identity, and LCR in particular, dynamically develops in micro- (Home), meso- (Community), and macro-level (Society) processes of social interaction and information flow.

**Home (Microdynamics).** Home is a social context typically defined by a physical dwelling. Here, micro-level social processes occur among individuals living in the same household through dense, mostly face-to-face and embodied interpersonal or small group interactions. In the context of sustainability, Stern (2008) drew attention to the significance of home as a locus of environmentally significant behaviours. Clearly, many routine behaviours at home (e.g., wearing warmer clothes in winter) can curtail energy use and therefore GHG emissions, and more costly, but more effective, GHG emissions reduction behaviours (e.g., energy efficient home appliances, insulation) to occur in the household (Stern, 2011). Importantly, Ando et al. (2015) showed that home is a locus of cross-generational transmission of sustainability culture, where children observe their parents' behaviours and acquire pro-environmental orientation – paper recycling behaviour in this case – both in Japan and Germany.

When multiple individuals live in a household, cooperation among them as well as coordination of their opinions and behaviours are necessary to enact GHG emissions reduction behaviours. Indeed, qualitative research on green consumer purchases (Hamilton & Catterall, 2007), energy and water use (Gram-Hanssen, 2007; Hargreaves et al., 2013), and

the management of material possessions (Collins, 2015) all show a combination of collaboration and conflict among co-habiting members, including adult-members, between parents and children, and even children's subversive behaviours at least in Western European countries (UK and Denmark). So much of the co-habiting members' behaviours is interlocked with and interdependent of each other, that Eon, Morrison, and their colleagues (Breadsell et al., 2019; Eon et al., 2018) suggested that household is a system of practice where co-habitants' more or less habitual daily behaviours (e.g., showering) enable, but also constrain, each other's behaviour. If someone changes his or her behaviour (e.g., taking a longer shower), it has ramifications for others (e.g., not taking showers before work). Obviously, single occupant households do not have this constraint, but at the same time lack other co-inhabitants' social and material support.

**Community (Mesodynamics).** At the meso-level, community is here construed as a network of households, whose members communicate and interact with each other across the boundaries of households perhaps through face-to-face meetings, but often by other means such as telephones and social media. With Cohen (2013), we regard community as a symbolic construction, whose meaning is produced and reproduced in the context of symbolically mediated social interaction (Di Masso et al., 2014; Di Masso et al., 2019). As people interact with others outside home who are regarded as members of a community, these interactions – whether online or offline – generate a cognitive representation of a community as social connectivities.

Community can provide a significant social context for environmental identity. First, interactions with community members about their symbolically constructed community can connect people to the community and the natural environment associated with the community. Broadly in line with this reasoning, communications with community members appear to facilitate sustainability. Hopper and Nielsen (1991) found that recruiting neighbours to encourage and remind others in their community about recycling significantly increased recycling behaviour (see Abrahamse & Steg, 2013, for a meta-analysis). Further, positive interactions with community members can generate emotional connection to the community. If the community is a physical locale, or a place, these emotional connections are called place attachment or place identity (for reviews, see Gifford, 2014; Lewicka, 2011; Scannell & Gifford, 2010a), which can also include attachment to the natural environment of the place (Scannell & Gifford, 2010b). Place attachment consistently predicts pro-environmental behaviours (for reviews, see e.g., Gifford, 2014; Lewicka, 2011). Forsyth et al. (2015) also experimentally showed that residents strengthened their pro-environmental behaviour

intentions (e.g., cleaning up the creeks and waterways in the local area) when the local identity (either neighbourhood or city) was made salient.

Second, community can provide a social capital for sustainability, which we define as socially provisioned resources that enable pro-environmental behaviours. Although there are many conceptualizations of social capital (e.g., Bourdieu, 1986; Coleman, 1988; Putnam, 2001), Lin (2001) conceptualized social capital as resources that individuals can access through their social networks. To measure this, Van Der Gaag and Snijders (2005) proposed resource generator, which asks whether a respondent can access specific resources (e.g., someone handy repairing household equipment, knowing a lot about governmental regulations). To the extent that people can access resources that enable them to perform pro-environmental behaviour through social networks, they are more likely to perform pro-environmental behaviour.

In line with this, recent research in Hanzhou (China) found that both emotional attachment and having close neighbourhood ties had significant direct effects on intentions to recycle (Pei, 2019). Although somewhat less directly relevant, Fu's (2019) work in Guangzhou (China) also showed that both community attachment and social capital measured by a position generator were predictive of participation in houseowners associations (yezhu weiyuanhui) as well as relatively contentious civic engagement (e.g., protesting, signing a letter, contacting the media or government agencies), some of which may relate to sustainability. More broadly, Olli et al. (2001) showed that interpersonal ties with others who belong to pro-environmental organizations correlated with pro-environmental attitudes and behaviours in Norway. All in all, there is a strong indication that community as a social context can significantly shape environmental identity.

**Society (Macrodynamics).** At the highest macro level, society interacts with individuals typically as a cognitively represented social context, which contains information about social issues, cultural trends, domestic and international political events and natural occurrences around the world. Different to Home and Community, societal information is more likely to come to us not by direct observation, but indirectly as hearsay, i.e., second hand information transmitted through social channels, including mass media, social media, or other individuals such as family members, friends, and acquaintances. Therefore, societal information is filtered and biased through these channels; cultural representations about society are transformed as they travel through social networks (for a review of this perspective, see Kashima et al., 2019). The representations that we are exposed to critically

shape our perceptions of our society – not just events and happenings in our society, but also what society is, where its boundaries are, and what its norms are (Kashima et al., 2013).

At this macro, societal level, we examine descriptive norms in the current research. They are concerned with the extent to which other people perform a behaviour in question (Cialdini et al., 1990) and have been found to positively predict the behaviour (e.g., Manning, 2009). When manipulated in field settings, descriptive norms tend to facilitate behaviour change especially of those who fall below the normative expectations (Bergquist et al., 2019; Schultz et al., 2007). In addition, we include a more temporally extended conceptualization of descriptive norm. Dubbed dynamic norms, Sparkman and Walton (2017, 2019) pointed out that people's perceptions of societal norms include not only what people do at present, but also of societal trends about how their behaviours are changing over time. They argued that people may anticipate a future world in which the trending behaviour is normative and conforms to the emerging norm. Their experiments showed that dynamic norms may be even more effective in inducing behaviour change than descriptive norms.

Sparkman and Walton (2017) reported a greater interest in eating less meat when American participants (Amazon MTurk) were told that "Recent research has shown that, in the last 5 years, 30% of Americans have now started to make an effort to limit their meat consumption (p. 1665)" than when the norm was described statically. This effect was mediated by people's anticipation of a future change. When the future trend of norm change was directly manipulated by telling participants that the trend is "expected to continue in the near future (p. 1668)," their interest in eating less meat was greater than when no trend information was presented or a future change was not expected. In two field experiments, they found an effect of dynamic norms for inducing meatless lunch at a cafeteria of a US university and encouraging greater water conservation at a college dormitory. There is additional support for dynamic norm's effectiveness as inducing behaviour change (Mortensen et al., 2019; Sparkman & Walton, 2019).

Although these findings all pertain to specific behaviours, they may be generalized to environmental identity. Societal norms, particularly dynamic societal norms, may be critical in changing people's environmental identity. As stated above, Low Carbon Readiness is a type of personal striving, or "what a person is characteristically trying to do" (Emmons, 1986, p. 1159). Hence, if norms shape people's behaviours, they may also shape people's self especially as it relates to their doing. Because climate change is an ongoing process continuing into the future, people are likely to anticipate their society too will change in response to the changing climate. It may be this anticipated future society that people try to

be part of. Future dynamic norms capture the aspect of this future society that is most directly relevant for Low Carbon Readiness. Consequently, future dynamic norms may be particularly associated with LCRI.

**Present Research**

We report national telephone surveys conducted once a year from 2015 to 2017 in Australia, concerning attitudes and behaviours about GHG emissions reduction in private households. Using a subset of the surveys designed to tap Low Carbon Readiness and social contextual factors, we report a test of the following hypotheses. Although our theoretical argument is that environmental identity and social context are mutually constitutive, we avoid the causal language and hypothesize associations between central variables below.

Hypothesis 1: Low Carbon Readiness (LCR) is positively associated with supportive factors at Home. Because home is the most immediate social context for environmental identity, it is most likely to have a large impact (Latané, 1981; Latané et al., 1995) on the development of Low Carbon Readiness.

Hypothesis 2: LCR is positively associated with supportive factors in the Community. In particular, social capital – social resources for carbon emissions reduction (i.e., knowledge and expertise to reduce carbon emissions in households) in people's social networks – can contribute to the development of Low Carbon Readiness. For those who live alone, Home is not applicable and instead Community is the most proximal social context and therefore expected to be a strong predictor.

Hypothesis 3: LCR is positively associated with societal descriptive norms, but particularly dynamic norms. Although past dynamic norms (i.e., how descriptive norms have changed from the past to present) may play a role, future dynamic norms (i.e., how descriptive norms are expected to change from the present to future) are likely to be a significant predictor.

## Method

**Participants**

**2015 Sample.** Seven-hundred seventeen (male = 378, female = 339) Australian residents participated in this telephone survey. Age ranged from 18 to 92 (mean = 50.6, SD = 17.5). They reported a wide range of income (asked in five income brackets): under $31,200

= 107, 31,200 to 52,000 = 109, 52,000 to 78,000 = 160, 78,000 to 130,000 = 177, and 130,000 or more = 164. Household size varied from 1 to 19, and so we divided the sample into those who live alone (N = 137) and the rest (N = 580).

**2016 Sample.** Seven-hundred two (male = 395, female = 307) Australian residents participated in a telephone survey. Age ranged from 15 to 94 years old (mean = 48.5, SD = 16.6). Income ranged from under $31,200 = 105, 31,200 to 52,000 = 93, 52,000 to 78,000 = 140, 78,000 to 130,000 = 196, and 130,000 or more = 168. Household size varied from 1 to 22.

**2017 Sample.** Seven-hundred sixty-six (male = 387, female = 378, 1 =refused; we coded the respondent who refused to answer the gender question as male after a coin toss) Australian residents participated in this telephone survey. Age ranged from 15 to 94 years old (mean = 48.5, SD = 16.6; sample mean age was imputed to those who refused to give age), and income varied as follows: under $31,200 = 138, 31,200 to 52,000 = 103, 52,000 to 78,000 = 115, 78,000 to 130,000 = 239, and 130,000 or more = 171. (those who were unsure or refused to answer were coded as the mode from the past studies, i.e., 78,000 to 130,000). Household size varied from 1 to 8.

**Procedure and Measures**

An interviewer rang a household and introduced the survey as being conducted by university researchers about people's attitudes towards climate change. Upon consent, after ascertaining their age, household size, and other demographic characteristics, the interviewer stated that, "The next set of questions is about climate change. When people talk about climate change they are referring to changes in the environment caused by increased greenhouse gas emissions. So when people talk about 'stopping climate change' it normally means doing things to reduce greenhouse gas emissions. With this in mind please tell us to what extent you agree or disagree with the following statements." All responses were reported using a five-point scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, and 5 = Strongly agree. A response option of "Unsure" was also offered, and some refused to answer questions; these cases were recoded as 3).

**Low Carbon Readiness Index (LCRI).** O'Brien et al.'s (2018) three item measure of LCRI was included in all surveys: "I work hard to reduce my greenhouse gas emissions whenever possible", "I feel very good when I am successful in reducing my greenhouse gas emissions", and "I would feel very bad if I failed to reduce my greenhouse gas emissions".

**Home.** For the 2015 survey, we developed a protocol where an interviewer first stated, "The following questions relate to the general goal of reducing greenhouse gas

emissions at home and in travel." Items tapped supportiveness of home context for low carbon transition: "This goal is important in my household", "Members of my household are well-informed about how to achieve this goal", "Members of my household keep track of what is happening in the household to make sure the goal is achieved", "Members of my household remind each other to behave in a way that helps achieve this goal", and "We think of ourselves as a household that works together to achieve this goal." These items were generated based on the requirements for sustainability in a self-organized group (Ostrom, 1990).

However, for the 2016 and 2017 surveys, we needed to reduce the number of items to two because the 2015 survey was too long: "Members of my household keep track of what is happening in the household to make sure the goal is achieved", and "Members of my household remind each other to behave in a way that helps achieve this goal".

**Community.** In the 2015 survey, we included two items: "I have friends and family outside the home who can give me advice about doing things that reduce greenhouse gas emissions", and "I have friends and family outside the home who can give me practical support to do things that reduce greenhouse gas emissions". However, because they were highly correlated (r = .79), we combined them into one item for the 2016 and 2017 surveys: "I have friends and family outside the home who can give me advice about, or practical support for doing things that reduce greenhouse gas emissions". These wordings were informed by a measure of social capital called resource generator (Van Der Gaag & Snijders, 2005).

**Society.** The 2015 survey included two items that tapped descriptive norm – "Most people work hard to reduce their greenhouse gas emissions whenever possible, and "Most people think it is important to reduce their greenhouse gas emissions" – and two items that tapped dynamic norms about the past trend – "Compared to a year ago, more people now work hard to reduce their greenhouse gas emissions" and "Compared to a year ago, more people now think it is very important to reduce their greenhouse gas emissions". From 2016 onwards, two additional items were included to tap dynamic norms about future trends – "By this time next year, even more people will work hard to reduce their greenhouse gas emissions" and "By this time next year, even more people will think it is important to reduce their greenhouse gas emissions". Below, we call them past and future dynamic norms. The wordings were informed by Sparkman and Walton (2017).

## Results

## Preliminary Analyses

After checking the reliabilities, the relevant items were aggregated to compute the means and standard deviations of the scales for LCRI, Home, Community, and Society (descriptive, past dynamic, and future dynamic norms). The descriptive statistics and correlations are reported in Table 1. With the exception of descriptive norms for 2015 and 2016 ($\alpha < .70$), the reliabilities were all adequate.

## Main Analyses

To test Hypotheses 1-3, LCRI was regressed on predictors using hierarchical multiple regression analyses for those who are living with at least one other individual and those living alone separately in each sample. Age, gender, and income were included as control variables in the first step, Home in the second step, Community in the third step, and Society (descriptive, past dynamic, and future dynamic norms when available) in the third step[i]. Table 2 reports the change in $R^2$ from one step to the next, and Table 3 reports the standardized regression coefficients in the last step. In addition, Hayes's (2013) approach was used to examine direct and indirect effects of these variables with the following mediation paths: past dynamic norm → (present) descriptive norm → future dynamic norm → Community → Home → LCRI. In this analysis, demographic variables (age, gender, and income) were treated as covariates.

**2015.** We report the 2015 results separately because future dynamic norm was not available for this year. The hierarchical regression analysis (Table 2) showed that, as expected, for those living with others, the most proximate Home significantly improved the model fit above the demographic variables, Community then further improved $R^2$, and finally Society (both descriptive and past dynamic norms) improved the fit. Figure 1A presents significant direct effects in the mediation analysis. Home was clearly a strong influence on LCRI. So was Community although its effect size was much smaller. Both descriptive and past dynamic norms were significant predictors as well. Reflecting the hierarchical nature of the social context effects, both Community and Society (both norms) significantly predicted Home, and Society (again both norms) predicted Community (Figure 1A). Indirect effects of past dynamic norm on LCRI flowed through Community and Home, separately, and also sequentially through both (Table 3).

In predicting LCRI, those living alone showed a significant increase in model fit by Community and then by Society, but of those norms deriving from Society, only past dynamic norm had a direct effect on LCRI. No indirect effects were significant. For

comparison, the same predictors were used for those living with others and reported in Table 2. Here, Community would have been the most proximal social context in this case, and therefore was expected to be a strong predictor. This conjecture was supported. Clearly, Community is a significant source of Low Carbon Readiness. The pattern of significant effects were comparable between those living alone and with others.

**2016 and 2017.** In 2016 and 2017, for those living with others, Home, Community, and Society each improved the model fit in the hierarchical multiple regression (Table 2). Significant direct effects on LCRI (Figure 1B) were found only for Home, Community, and future dynamic norm. Remarkably, it was future dynamic norm that had direct effects in 2016 and 2017 not only on LCRI, but also on Home and Community, and other norms had indirect effects through future dynamic norm. It is noteworthy that Society (future dynamic norm) had no direct effect on Community in 2016.

For those living alone, Community and Society each improved the model fit in 2017, and future dynamic norm had a significant direct effect. However, none of these had an effect in 2016. Again, for comparison purposes, we ran multiple regression analyses for those living with others by removing Home. As in 2015, we found a comparable pattern for those living alone and those living with others for 2017; however, the pattern for those living with others was quite different for 2016. When Home was removed, Community and Society improved the model fit for those living with others. In all, we found no social contextual effect on LCRI in 2016 for those living alone.

**Additional Findings.** There are other interesting findings (Table 3). First, gender was a significant predictor of LCRI for those living with others, but not for those living alone. In particular, women were higher on LCRI than men only when they were living with others in a household. Follow-up analyses found that the percentage of females varied somewhat between those living alone and those living with others (Alone vs. 2+: 2015, 52.6% vs. 46.0%; 2016, 47.5% vs. 43.1%; 2017, 52.6% vs. 48.5%); however, this cannot explain the different patterns of gender effects. Likewise, age was at times found to have a significant effect on LCRI, but this tended to hold for those living with others especially when Home was not included in the prediction equation. Again, follow-up analyses found that the standard deviation for age was greater for those living alone than those living with others in two out of three samples (Alone vs. 2+: 2015, 15.0 vs. 16.8; 2016, 17.6 vs. 15.9; 2017, 18.5 vs. 17.5), suggesting that a restriction of range cannot explain the absence of age effects for single person households. These findings suggest that women and older citizens may be

somewhat more Low Carbon Ready, but this is evidently situated in the social context of Home. We will return to this in Discussion.

## Discussion

The three samples of Australian residents provided preliminary support for the Social Context of Environmental Identity model. Micro-, meso-, and macro-level social contexts of Home, Community, and Society play a significant role in shaping Australian residents' willingness to transition to low carbon lifestyle and more broadly environmental identity. This is most obvious for those living with others. Home is a critical influence on their Low Carbon Readiness (LCR), an aspect of environmental identity and personal striving for transitioning to a low carbon lifestyle. The micro-level, proximal social context of Home is most likely to shape LCR. The meso-level Community also supports LCR. By providing access to advice and help, social networks in which oneself and one's home are suspended can upregulate one's LCR. Finally, the macro, Societal context can encourage LCR not necessarily by informing people what a majority is doing now (descriptive norms), but more critically by showing the future direction of where people might be going (future dynamic norms). Nonetheless, the absence of descriptive norm effects may be in part due to somewhat low reliability of their measures (.62 and .68). All in all, the layers of social contexts are interdependent, but each has an independent influence on LCR, suggesting that there may be a potentially complex and dynamic interplay among the layers of social contexts.

For those living alone, however, both Community and Society were significant predictors of LCRI at least for 2015 and 2017. In 2016, Community, but none of the norms, had a significant direct association with LCRI. The absence of a direct societal norm effect may point to the importance of historical events for the shaping of LCR, and more generally, environmental identity. It was the year of the Brexit referendum in the United Kingdom (June), the presidential campaign in the United States, when Donald Trump eventually won the election (November), and the United Nations Paris Agreement on climate change (December). When the survey was conducted in September, for Australians living alone, these historical events may have had a significant impact on their perceptions of their societal norms about responses to climate change. Australia has strong historical and cultural ties with both the UK and the US, and Australian residents may have looked to these countries to gauge their societal trends. In contrast, Community effects are based on the respondents' personal social networks. If people's social networks are stable, social capital remains intact regardless of the broader societal trend.

More generally, people living alone seem to be less influenced by broader Society. First, Society effects as measured by norms have no effect on Community, and have a relatively fragile effect on LCRI. Second, a well-known gender effect on climate change (e.g., McCright, 2010) was significant as usual among those living with others, but nonsignificant for those living alone. Women may act out the role of a climate change conscious gender especially in the Home environment where women typically take up the role of wife, mother, or daughter. Third, age showed a similar pattern – older citizens appear to be more ready to transition to low carbon lifestyle in Australia when they are living with others. The stereotypical practices attributed to women and the older may be more saliently activated at home when "home" constitutes a social context, in which those living together in a household interact with each other, potentially reminding and influencing each other, in accordance with the culturally transmitted broader societal worldviews associated with gender and age.

Finally, dynamic norms showed an intriguing pattern. We found no direct effect of past dynamic norms in 2016 and 2017 for either those living alone or with others when future dynamic norms were included, but did find it in 2015 when future dynamic norms were not included. This raises a question about the role of past dynamic norms for the 2015 sample. It is possible that past dynamic norms functioned as a proxy for future dynamic norms in the absence of the latter. This conjecture is further supported by the direct and indirect effects reported in Figure 1 and Tables 4 and 5 as well as the strong correlation between past and future dynamic norms (.70 and .73 for 2016 and 2017, respectively). In line with this reasoning, past dynamic norms emerged as a significant influence when future dynamic norms were removed from the prediction equations (Table 6).

**Limitations**

Although our study provided preliminary support for the SCE model, there are many limitations. First, the current research was conducted in contemporary Australia. It is unclear if the associations between LCR and social contexts generalize to other populations that are faced with different historical trajectories. For instance, although we found consistent associations between future dynamic norms and LCRI, this may be particularly likely when people perceive a social change. When societies are seen to be stable, descriptive norms may be more influential.

Second, although the SCE model is meant to be broadly applicable to environmental identity, the present research is only concerned with a more specific aspect of environmental

identity, LCR. It is unclear whether environmental identity is generally associated with multi-layered social contexts in the same way we found here. For instance, more abstract environmental identity (e.g., Mayer & Frantz, 2004) may show different patterns.

Third, although Home, Community, and Society could account for a sizable amount of variance in LCRI (30~40%), there remains a large amount of unexplained variance. Other factors such as values and past behaviours (Van der Werff et al., 2014) as well as ideologies, worldviews and other relevant knowledge (Guy et al., 2014; Kashima et al., 2014) may play a role. Emotional connection to Community – an aspect of Community context which we did not include in the present research – may also be significant. Similarly, social identification with Home and Community may play a significant role because the mutual social influence in these spheres is likely stronger when they experience a sense of shared self-definition (Fielding & Hornsey, 2016). This also has implications at the societal level, since information about society will be more readily accepted when it is communicated by an ingroup member (Turner & Oakes, 1986).

Finally, it is important to be reminded that the associations between LCR and social contexts are correlations, and not causation. Although social contexts may exert social influences on LCR and environmental identity generally (and we tended to use words that may be seen to imply causality), people's LCR and environmental identity may also affect their perceptions of their social contexts through wishful thinking. We explored these alternative possibilities. Although they could not be ruled out, the alternative models were not consistently supported across years (see Supplementary Material). Furthermore, environmental identity may also shape social contexts. By monitoring and reminding others at home, being a resource person who can provide knowledge and skills to reduce carbon footprints in a community, and by being an active citizen in one's society to engage with relevant societal issues, individuals can in part craft their social environments.

**Policy Implications of the Current Research**

The current research has public policy implications for climate change mitigation at the institutional level. Many theories of behaviour change (Fishbein & Ajzen, 2010; Michie et al., 2011) point to the importance of three main factors: motivation, capability, and opportunity, i.e., whether someone is motivated to engage in a desirable behaviour, capable of doing so (expertise and skills), and opportunities to carry it out. Given that motivation to mitigate climate change (i.e., reducing GHG emissions) can be gauged by LCRI and it has been shown to predict a number of mitigation behaviours (O'Brien et al., 2018), priorities for public policy interventions can be ascertained by administering LCRI to a target population.

If LCR is low in a population, our research suggests that public policies may be devised to cultivate LCR by intervening into social contexts. Potentially effective means at the Societal level include the use of future dynamic norms if the trend is favorable for a GHG emission reduction. A Community-level intervention is to recruit and nominate a "community expert" who is willing and able to act as a resource person for curtailing GHG emissions. Messages about a need to reduce GHG emissions can be directed to Home. Parents may be persuaded to ensure the viability of the environment for their children and future generations. Children can be taught at school about the science of climate change and the importance of human actions. The present research suggests those living alone need special attention as a demographic category because they may not be as amenable to social contextual interventions.

If LCR is already high, capabilities and opportunities can be further cultivated by public policy interventions. More specifically, public policies may be devised to focus on (a) information campaigns to inform people what behaviours are effective at curtailing greenhouse gasses, and if necessary, educational and capacity building interventions to develop expertise and skills for doing so, and (b) providing opportunities to engage in those behaviours.

**Concluding Comments and Future Directions**

Humans construct their niche to adapt to the rest of nature, but social contexts are a significant part of the human niche. If self and identity are not only shaped by their social contexts, but also actively shape them, environmental identity may be a significant driver of our own social niche construction. Citizens who are ready to transition to a low carbon lifestyle may innovate in low carbon cultural ideas and practices and act on them in our everyday life at home, in community, and our civil society at large. Institutions may then need to be responsive to the citizens and set policies to mitigate and adapt to climate change. Citizens' low carbon readiness may drive the whole of society niche construction to adapt to the ongoing climate change. How best to achieve this combination of citizens' engagement with, and institutional responses to, cultural change awaits further research, and will involve the development of new cultures of sustainability for the construction of a new low carbon niche for humanity.

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**Table 1. Descriptive Statistics of LCRI, Home, Community, and Society Factors (2015, 2016, and 2017)**

| 2015 | alpha | mean | SD | Home | Community | Descriptive | Past Dynamic |
|---|---|---|---|---|---|---|---|
| LCRI | .84 | 3.80 | .90 | .66 | .31 | .27 | .32 |
| Home | .89 | 3.42 | .96 | | .31 | .27 | .28 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Community | .89 | 3.05 | 1.04 | | | .19 | .24 | |
| Descriptive | .68 | 2.91 | .88 | | | | .44 | |
| Past Dynamic | .78 | 3.40 | .83 | | | | | |

| 2016 | alpha | mean | SD | Home | Community | Descriptive | Past Dynamic | Future Dynamic |
|---|---|---|---|---|---|---|---|---|
| LCRI | .82 | 3.78 | .84 | .51 | .24 | .20 | .27 | .28 |
| Home | .85 | 3.41 | 1.01 | | .22 | .20 | .28 | .30 |
| Community | | 3.05 | 1.17 | | | .14 | .19 | .19 |
| Descriptive | .62 | 2.97 | .82 | | | | .47 | .43 |
| Past Dynamic | .79 | 3.36 | .81 | | | | | .73 |
| Future Dynamic | .87 | 3.45 | .84 | | | | | |

| 2017 | alpha | mean | SD | Home | Community | Descriptive | Past Dynamic | Future Dynamic |
|---|---|---|---|---|---|---|---|---|
| LCRI | .85 | 3.76 | .93 | .59 | .35 | .29 | .37 | .44 |
| Home | .85 | 3.27 | 1.07 | | .30 | .21 | .29 | .36 |
| Community | | 3.16 | 1.17 | | | .17 | .24 | .30 |
| Descriptive | .70 | 3.00 | .83 | | | | .50 | .44 |
| Past Dynamic | .78 | 3.33 | .82 | | | | | .70 |
| Future Dynamic | .85 | 3.46 | .83 | | | | | |

**Note:** All correlations are significant at p. < .001. For Home, N is smaller because it is not relevant for single-person households. Community for 2016 and 2017 does not have reliability because it was a single-item measure – see text for explanation.

**Table 2. $R^2$ Change in Hierarchical Multiple Regression for LCRI (2015, 2016, and 2017)**

| | 2015 | | | 2016 | | | 2017 | | |
|---|---|---|---|---|---|---|---|---|---|
| Model step | 2+[a] | Alone[b] | C 2+[c] | 2+ | Alone | C 2+ | 2+ | Alone | C 2+ |
| 1. Demographics | .065*** | .089** | .065*** | .031*** | .073 | .031*** | .059*** | .035 | .059*** |
| 2. Home | .376*** | - | - | .252*** | - | - | .295*** | - | - |
| 3. Community | .009** | .104*** | .080*** | .020*** | .035 | .061*** | .029** | .074*** | .104*** |
| 4. Society | .010** | .120*** | .054*** | .036*** | .050 | .094*** | .051*** | .121*** | .121*** |

**Note.** **P. < .01; *P. < .05; ^ p. < .10; a: 2+ means households with two or more people. b: Alone means single occupant households. c: C2+ means the results of households with two or more people while removing Home as a predictor. Demographics entered in Step 1: Gender 1 = male, 2 = female; Income 1 = ~31,200, 2 = 31,200~52,000, 3 = 52,000~78,000, 4 = 78,000~130,000, 5 = 130,000~.

**Table 3. Simultaneous Multiple Regression for LCRI (2015, 2016, and 2017)**

| | 2015 | | | 2016 | | | 2017 | | |
|---|---|---|---|---|---|---|---|---|---|
| Household Size | 2+[a] | Alone[b] | C 2+[c] | 2+ | Alone | C 2+ | 2+ | Alone | C 2+ |
| Gender | .07** | .12 | .13** | .10** | -.02 | .11** | .11** | .08 | .15** |
| Age | .03 | .07 | .11* | .13** | .25* | .14** | .04 | .04 | .08* |
| Income | -.05 | -.11 | -.09** | .02 | -.06 | -.02 | -.01 | -.07 | -.06 |
| Home | .57** | | | .42** | | | .43** | | |
| Community | .08** | .26* | .22** | .11** | .20* | .18** | .13** | .18* | .22** |
| Descriptive Norm | .04 | .08 | .12** | .06 | -.08 | .07^ | .06^ | .06 | .08* |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Past Dynamic Norm | .09* | .31** | .17** | .07 | -.06 | .11^ | .06 | .11 | .08 |
| Future Dynamic Norm | | | | .11* | .04 | .19** | .17* | .25* | .27** |
| N | 580 | 137 | 580 | 603 | 99 | 603 | 610 | 156 | 610 |
| $R^2$ | .46** | .31** | .20** | .34** | .12 | .19** | .43** | .24* | .29** |
| F | 29.75 | 9.85 | 23.64 | 37.99 | 1.73 | 19.50 | 57.71 | 6.69 | 34.57 |

**Note.** **p. < .01; *p. < .05; ^ p. < .10; a: 2+ means households with two or more people. b: Alone means single occupant households. c: C2+ means the results of households with two or more people while removing Home as a predictor. Gender 1 = male, 2 = female; Income 1 = ~31,200, 2 = 31,200~52,000, 3 = 52,000~78,000, 4 = 78,000~130,000, 5 = 130,000~.

**Table 4. Indirect effects for 2015**

| | 2015 | |
|---|---|---|
| Indirect Effects | $2+_a$ | $Alone_b$ |
| Past→Present→LCRI | .016 | .036 |
| Past→Community →LCRI | .015* | .042 |
| Past→Home →LCRI | .079* | |
| Past→Present→Community→LCRI | .004* | .009 |
| Past→Present→Home→LCRI | .037* | |
| Past→Community→Home →LCRI | .027* | |
| Past→Present→Community→Home→LCRI | .007* | |

**Note.** **p. < .01; *p. < .05. a: 2+ means households with two or more people. b: Alone means single occupant households.

**Table 5. Indirect effects for 2016 and 2017**

| | 2016 | | 2017 | |
|---|---|---|---|---|
| Indirect Effects | 2+[a] | Alone[b] | 2+ | Alone |
| Past→Present→LCRI | .026 | -.034 | .029 | .024 |
| **Past→Future→LCRI** | **.075*** | .023 | **.107*** | **.121*** |
| Past→Community →LCRI | .011 | .022 | .000 | .036 |
| Past→Home →LCRI | .035 | | .013 | |
| **Past→Present→Future→LCRI** | **.006*** | .000 | **.008*** | **.028*** |
| Past→Present→Community→LCRI | .003 | .008 | .003 | .005 |
| Past→Present→Home→LCRI | .007 | | .008 | |
| Past→Future→Community →LCRI | .009 | -.004 | .023* | .006 |
| **Past→Future→Home →LCRI** | **.053*** | | **.068*** | |
| Past→Community→Home →LCRI | .006 | | .001 | |
| Past→Present→Future→Community→LCRI | .001 | .000 | .002* | .000 |
| **Past→Present→Future→Home→LCRI** | **.004*** | | **.005*** | |
| Past→Present→Community→Home→LCRI | 002 | | .002 | |
| Past→Future→Community→Home→LCRI | 005 | | .016* | |
| Past→Present→Future→Community→Home→LCRI | 000 | | .001* | |

**Note.** **p. < .01; *p. < .05. a: 2+ means households with two or more people. b: Alone means single occupant households.

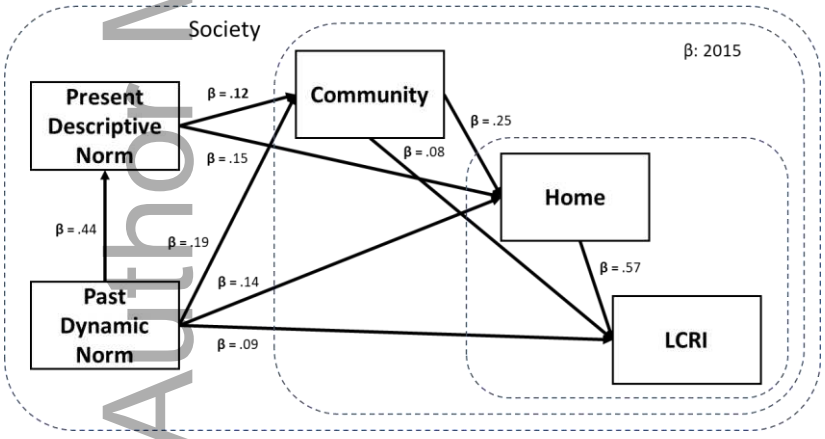
**Table 6. Multiple Regression for LCRI (2016 and 2017) without Future Dynamic Norms**

| | 2016 | | | 2017 | | |
|---|---|---|---|---|---|---|
| Household Size | 2+ | Alone | 2+ | 2+ | Alone | 2+ |
| Gender | .10** | -.02 | .11* | .11** | .09 | .16* |
| Age | .12** | .01* | .14* | .02 | .02 | .04 |
| Income | .02 | -.06 | -.02 | -.01 | -.10 | -.07^ |
| Home | .43** | | | .45** | | |
| Community | .12** | .20* | .19** | .15** | .19* | .26** |
| Descriptive Norm | .07^ | -.08 | .09* | .08* | .12 | .10* |
| Past Dynamic Norm | .14** | -.03 | .23** | .17** | .24** | .25** |
| N | 603 | 99 | 603 | 610 | 156 | 610 |
| $R^2$ | .33** | .06 | .16** | .43* | .20* | .29* |
| F | 42.50 | 2.03^ | 20.53 | 84.55 | 6.37 | 34.57 |

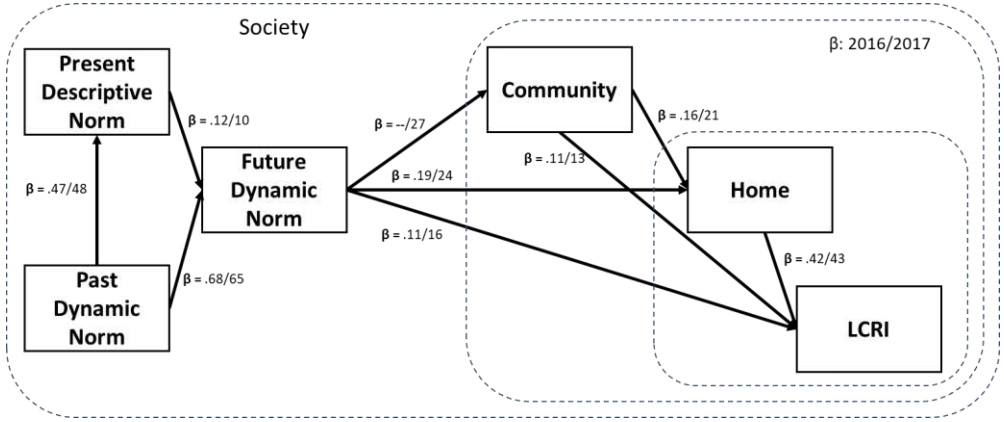
**Note.** **P. < .01; *P. < .05; ^ p. < .10; Gender 1 = male, 2 = female; Income 1 = ~31,200, 2 = 31,200~52,000, 3 = 52,000~78,000, 4 = 78,000~130,000, 5 = 130,000~.

**Figure 1. Significant direct effects**

**A. Those living with others (2015)**

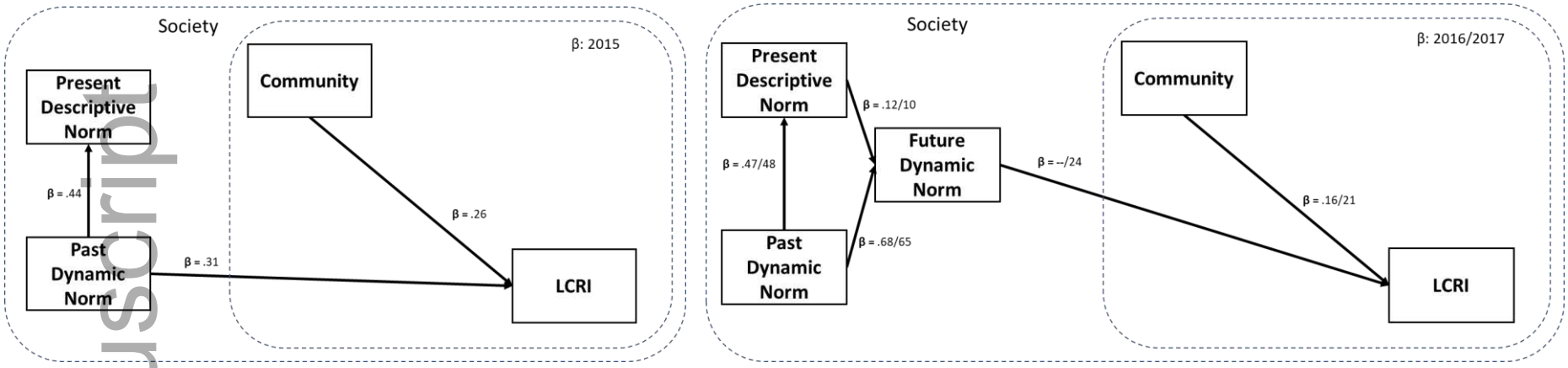



**B. Those living with others (2016, 2017)**




**C. Those living alone (2015)**

**D. Those living alone (2016, 2017)**




**Note.** For Panel B and D, the first beta coefficient reported is for 2016, and the second value is for 2017. ".." means nonsignificant.

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