Understanding the psychological impact of unconventional gas developments in affected communities

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Abstract

The rapid growth of unconventional gas developments has created widespread community concerns in many parts of the world. This study adds to the literature on the psychological impact of related developments by drawing upon Conservation of Resources (COR) theory and the concept of place attachment. In providing a holistic framework, it examines community residents' appraisals of and emotional responses to impacts of an unconventional gas development, and establishes heterogeneity in these appraisals and responses among residents. The findings show that perceived negative impact on resources that encompass personal and communal resources due to the development contributes to negative emotions that can lead to deteriorated psychological well-being. Conversely, perceived positive impact on resources is conducive to positive emotions that in turn can foster residents' psychological well-being. The findings further reveal that perceived impact on place attachment partially mediates the relationship between perceived impact on resources and negative emotions. Importantly, these effects differ in strength for residents characterized by different ages, lengths of residence, and distances of their properties from the development. Implications for how this framework can be applied to minimize unwanted impacts and be incorporated into social license that goes beyond the current model of community consultation are discussed.

Keywords: Unconventional gas development; conservation of resources theory; place attachment; psychological well-being

1. Introduction

Developments of unconventional gases such as coal seam gas have expanded in recent decades driven by the increasing global demand for energy, growing concern of global warming and the need to shift from carbon-intensive fuels to more clean energy (De Silva et al., 2016; IEA, 2015). This rapid growth has created widespread community concerns, debates and conflicts over related activities in many parts of the world. In the foreseeable future, the growth in unconventional gas developments (UGDs) is likely to continue before other alternatives to clean energy become technologically possible and socially acceptable, or a global consensus on reducing energy consumption can be achieved and successfully implemented. While there is a growing literature on the environmental (Navi et al., 2015; Vidic et al., 2013) and economic (De Silva et al., 2016; Fleming and Measham, 2015) impacts of related activities, understanding concerning the social and psychological impacts of related activities remains scant (Jacquet, 2012; Popkin et al., 2013).

UGDs present one form of anthropogenic change that can substantially affect the psychological well-being of rural communities adjacent to rich gas reserves (Jacquet and Stedman, 2014). Past research on the impact of anthropogenic changes has focused on associated effects on personal resources (e.g., individual health, private properties), and social resources (e.g., social network membership and involvement) (e.g., Sattler et al., 2006). A social-ecological perspective that views rural communities as interconnected social and ecological systems enables expanding the scope of existing research on the impacts of change. Based on this perspective, well-being is defined as: "(A) state of being with others and the natural environment that arises where human needs are met, where individuals and groups can act meaningfully to pursue their goals, and where they are satisfied with their way of life" (Armitage et al., 2012, p. 3). Well-being in rural communities is highly dependent on rural residents' interactions with the social and ecological systems within the communities,

and the various personal and shared community resources that support the needs and goals of individuals and groups, and their preferred way of life.

Rural residents not only invest in privately owned assets to support their pursuit of needs and goals. They also engage in collective actions to protect shared community resources (e.g., healthy ecosystems, accessible services, desirable economic opportunities) to create a condition conducive to continuing development of their personal assets, and forge a sense of meaningfulness and attachment ingrained in their community (Brehm et al., 2004). A sturdier reservoir of resources and an ability to maintain individuals' relationship with a place of meaning have been shown to contribute to psychological well-being (Hobfoll, 2002; Norris et al., 2008). Conversely, deterioration in psychological well-being can arise from threats and losses to private and community resources that residents endeavor to protect and improve, and that underpin their person-place connection rooted in the community (Cox and Perry, 2011). Rural residents, however, likely respond to anthropogenic changes such as UGDs differently (Jacquet, 2012; Pedersen and Johansson, 2012). Although some residents perceive related developments to benefit their resource reservoir and sense of well-being, others appraise these developments to threaten the same resources, and a meaningful person-place relationship and psychological well-being supported by their community.

As resources and person-place relationships are vulnerable to undesirable changes, and the deterioration of which can adversely affect psychological well-being, Conservation of Resource (COR) theory and the literature in place attachment are drawn upon to provide the theoretical guidance for our study. COR scrutinizes the impact of change in personal and social resources on associated psychological outcomes, while place attachment as one conceptualization of person-place bond examines how place-based relationships can be strengthened or disrupted in the face of change (Hobfoll, 2010; Jacquet and Stedman, 2014; Lai and Kreuter, 2012). By incorporating the two literatures, our goal is to address the lack of

research on the psychological impact of UGDs through the lens of a more holistic framework to explore "what is at stake" when different groups of residents assess related impact and examine subsequent psychological responses based on a UGD project in New South Wales (NSW), Australia.

2. Conceptual Foundations

COR, as a theory of stress and motivation, has been applied to examine psychological distress resulting from technological or natural disasters, and other stressful person-environment encounters (e.g., Lee and Blanchard, 2012; Sattler et al., 2006). COR's central tenet suggests that "people seek to obtain, retain, and protect resources and that stress occurs when resources are threatened with loss or lost or when individuals fail to gain resources after substantive resource investment" (Hobfoll, 2002, p. 312). Resources are significant because they are valued in their own right or they allow individuals to acquire or protect other important resources, and pursue major goals (e.g., one's self, social relations, preferred way of life). Changes that adversely impact valued resources can become significant psychological stressors, especially when access to resources needed to compensate resource loss, prevent further loss, and forge coping capacity is not available (Hobfoll, 2010).

Unwanted changes can undermine well-being due to their disruptive effects on ability to meet needs and seek goals. Psychological distress is a likely outcome and can become manifested in negative emotions, poor health, and diminished personal functioning and psychological well-being. Conversely, a surplus of resources contributes to positive well-being because it better prepares individuals to cope with adversity, thereby allowing them to continuingly pursue needs and goals beyond meeting basic necessities (Hobfoll, 2002). The resources that have been mostly studied as part of COR can be broadly categorized into resources pertaining to individuals (i.e., personal resources) and to their immediate social

networks (i.e., social resources) (Dekel and Hobfoll, 2007). Examples of personal resources include material resources (e.g., resources that meet daily needs or are obtained through demand and scarcity), psychological attributes (e.g., self-esteem, self-efficacy, optimism), and energy (e.g., time, health, knowledge) (Hobfoll, 2010). Support from family, friends and/or co-workers comprise major social resources that have previously been examined (Hobfoll et al., 2003).

The concept of caravan passageways has recently been developed within COR to explain the environmental conditions within which resources are invested and accumulated (Hobfoll, 2010). It represents a collective pool of resources that creates "the environmental conditions that support, foster, enrich, and protect the resources of individuals, families, and organizations, or that detract, undermine, obstruct, or impoverish people's resource reservoirs" (Hobfoll, 2010, p. 129). COR asserts that individuals with a sturdier reservoir of resources nurtured by a healthy caravan passageway are better equipped to cope (Hobfoll, 2010). A sense of well-being can then be nourished through allocating resources to meet material needs, and invest in human capital and capacity to attain higher needs and goals (Armitage et al., 2012; Hobfoll, 2002). Despite its utility to assist with examining factors that drive stress processes, application of COR to research in the context in which psychological distress arises due to changes that adversely affect residents of a community is limited.

COR contends that individuals have limited control over the social environment into which they were born or raised, the workplace environment in which they labor and, by extension, the passageway through which they develop their resource reservoir (Hobfoll, 2010). However, decentralization of governance in many countries (Costello and Bishop, 2008) has encouraged communities to engage in self-directed community development which provides a platform for residents to invest in and protect communal resources, including economic, social, and environmental resources that are essential to community well-being.

These communal resources, in turn, support the 'caravan passageway' that enables residents to expand and protect their personal assets, and sustain the bond that they develop with their community.

While COR recognizes identity and social relations as important goals that motivate individuals to invest in resources and protect them from threat or loss, how decline in resources affects these goals has not been empirically investigated. Place attachment as one conceptualization of residents' relationship with their community can assist in such an investigation. This is done by taking into account the role a geographic location plays in providing the material, social, and emotional anchors necessary for individuals to seek and attain their goals (Cox and Perry, 2011) through investments in personal and communal resources.

Changes that threaten a person-place relationship that is significant to individuals can drive intentions and behaviors aiming to protect important place-bound resources (Devine-Wright and Howes, 2010; Lai and Kreuter, 2012). Place has been viewed as comprising physical landscapes, social interactions, personal and home experiences, and other human activities and processes attributed to a geographic location (Relph, 1976; Stedman, 2002). These place elements can also be considered as consisting of personal and communal resources that individuals invest in a specific place through various lengths of time, and together they contribute to the symbolic meanings of the place (Stedman, 2002). Different constructs (e.g., sense of place, place identity, place attachment) have been conceptualized to represent meaningful person-place relationships (Devine-Wright and Howes, 2010; Williams and Patterson, 2007). Our study focuses on place attachment since it has been found to account for emotional and physiological responses in individuals who experience place-related changes such as involuntary relocations (Boğaç, 2009; Fried, 2000; Manzo et al., 2008). Research also shows that residents' attachment to their community can substantially

influence their acceptance of energy projects (Devine-Wright, 2011a; Lienert et al., 2015). As place attachment is developed through interactions with a geographic location through time, and underpinned by the symbolic meanings of place and personal and communal resources therein, impacts on place-bound resources due to changes are likely to have an effect on place attachment.

Through repeated interactions, places provide an anchor where individuals develop a sense of self-identity (Proshansky et al., 1983) that is often considered as an essential component of place attachment (Williams and Vaske, 2003). The emotional tie that connects individuals to a geographic location also plays a central role in the development of place attachment (Low and Altman, 1992). Place attachment also becomes evident when individuals develop dependence on places due to their functions to support subsistence, self-enhancement, and recreational needs (Stokols and Shumakers, 1981). Social bonding represents another element of place attachment and arises from meaningful social interactions centering on a specific place (Kyle et al., 2005).

Change can disrupt place attachment and lead to psychological distress due to interruptions to feelings of continuity, self-efficacy, distinctiveness and self-esteem ingrained in a place, that in turn impairs a sense of well-being (Twigger-Ross et al., 2003). By drawing on COR and place attachment literature, we examine the impact of UGDs on emotions as a momentary measure of psychological well-being (Folkman and Lazarus, 1986) through three hypotheses that are illustrated in Figure 1 and described below.

3. Hypotheses

Hypothesis 1: In consideration of UGDs, a negative (positive) evaluation of related impact on resources contributes to negative (positive) emotions. We argue that a negative appraisal of UGD impact on resources (IR) or perceived resource loss contributes to negative

emotions (NE) (β_1) due to negative implications for psychological well-being. Conversely, a positive appraisal of IR or perceived resource gain leads to positive emotions (PE) (β_2) because it aligns with individuals' aspiration for resource investment and accumulation to support goals and improve well-being. While our study expands COR's resource concept to encompass personal and communal resources, both resource categories are mutually reinforcing as communal resources form the caravan passageway that supports personal resource development. Meanwhile, a sturdier reservoir of personal resources allows individuals to allocate resources to invest in forging shared communal resources. Consequently, perceived impact on one resource category tends to concur with perceived impact on the other resource category. Hence, IR is conceptualized as reflecting both perceived UGD impact on communal resources (ICR) and perceived UGD impact on personal resources (IPR).

Hypothesis 2: In consideration of UGDs, a negative (positive) evaluation of related impact on resources contributes to a negative (positive) evaluation of the impact on place attachment that, in turn, leads to negative (positive) emotions. We suggest that perceived impact of related developments on place attachment (IPA) mediates the relationship between IR and NE, and between IR and PE. Adverse impacts on the resource base bounded within an attached place (i.e., negative IR) can disrupt the attached place's function to support place-based goals (β_3). In return, deteriorated place attachment (i.e., negative IPA) and subsequent negative emotions (i.e., NE) (β_4) are likely to occur. Conversely, positive change that facilitates this resource base to support place-based goals (i.e., positive IR) is likely to strengthen place attachment (i.e., positive IPA) that, in turn, contributes to positive emotions (i.e., PE) (β_5).

Hypothesis 3: In consideration of UGDs, the extent to which the impact on resources (IR) relates directly or indirectly to emotions through the impact on place attachment (IPA)

varies between different groups of community residents. Emotional responses to changes are likely to differ between residents as impacts of changes on resources that underpin place meanings and place attachment are likely variously perceived (Devine-Wright & Howes, 2010). COR suggests that how well one's resource reservoir is developed is partly affected by his/her socio-demographic characteristics such as gender, age, education and income, that, in turn, influence the extent to which the person is sufficiently equipped to cope and how he/she responds to changes emotionally (Hobfoll, 2010). Place attachment literature reveals that individuals with different ages and lengths of residence likely vary in the meanings and values they ascribe to different aspects of the resource base underpinning their place attachment (Hernández et al., 2007). Additionally, proximity to proposed/existing sites of developments has also been shown to affect residents' perceptions (Jacquet, 2012; Popkin et al., 2013). Thus, Hypothesis 3 examines whether heterogeneity characterizes communities in how residents perceive and react to an existing or proposed UGD, and what factors may account for such differences.

4. Research Approach

4.1. Study area

Gloucester Shire encompasses a rural area of 3,000 km^2 with approximately 5,000 residents. Agriculture, along with forestry and fisheries, serves as the largest source of local employment. The area's natural amenities and small-town atmosphere have attracted amenity migrants (Campbell and Gedye, 2013). Gloucester also supports a mining industry that provides an important source of direct employment, and bolsters local accommodation, food and construction businesses. Residents' involvement in protecting their personal and communal resources in Gloucester is evident in a controversy surrounding a UGD project to extract coal seam gases that was proposed in 2010 and started operations in 2014. The initial

approval from the state government in 2011 resulted in mounting community concerns followed by a series of challenges and protests. A survey conducted by Gloucester Shire Council (GSC) reveals that perceptions of related issues vary in the community (GSC, 2011); while some welcome the mining industry for its employment opportunities, others express concern about its effects on property values, and social and ecological environments.

4.2. Data collection

The residents of the Gloucester Shire comprise the target population of our survey. Posters at local gathering places and an advertisement in a local newspaper created awareness about the survey. The multiple-contact survey procedures recommended by Dillman (2000) with appropriate adjustments to suit our study context and maximize the response rate were adopted. In total, 2,164 questionnaires were distributed. One member from each household was asked to complete and return the questionnaire along with the participant's informed consent. After excluding 176 undeliverable and 80 returned questionnaires in which responses to more than 15% of the survey questions were missing (Hair et al., 2014), 572 cases were retained for subsequent analysis yielding a response rate of 29%.

We followed Hair et al. (2017), Kraemer and Thiemann (1987), and Cohen (1988) to examine whether the size of our sample would produce estimations that yielded sufficient statistical power— the likelihood that a study can detect an effect when there is an effect there to be detected. The software G*Power 3.1.3 (Faul et al., 2009) was adopted to estimate the minimum required effect size levels that would produce sufficient statistical power for all estimates. The results suggest that sample estimations yielded sufficient statistical power; except where noted in the results. As such we only interpret the estimated parameters that have produced sufficient statistical power.

4.3. Sample characteristics

The respondents, on average, have resided in Gloucester for 26 years (SD=22). They are comprised of slightly more male (54%) than female (46%). Less than one-third (32%) of them are younger than 55 years old, 28% between 55 and 64, and 40% at least 65. Moreover, 42% of them are retired. The relatively high proportion of older respondents and retirees in the sample resembles the recent trend experienced by many rural communities with natural amenity values in Australia and other Western countries (Winterton and Warburton, 2012). About one-quarter (28%) of the respondents attained a bachelor degree or above, and 53% had an annual household income below AUD$50,000. Most respondents report ownership of a residential (77%), agricultural (37%) and/or commercial property (7%).

4.4. Measurement

The scales that measure the latent variables examined in this study (i.e., IR, IPA, NE, PE) primarily build on existing scales that have been previously examined in COR and place attachment research. These scales are adapted to fit our study context. All scales and questions were reviewed by a number of experts and Gloucester residents to improve the relevance of the survey questions and associated wording and clarity.

Eighteen items relating to perceived impact of UGD on personal resources, including material resources, health and energy, and self-efficacy, most relevant to our study context are adapted from Hobfoll and associates (Hobfoll et al., 2003; Hobfoll, 2010) and used to construct the IPR scale. Thirteen items are used to construct the ICR scale that gauges perceived impact of UGD on Gloucester's natural, social and economic attributes. These items relate to the area's attributes and qualities that its residents strive to sustain; based on Gloucester's community strategic plan (GSC, 2012). A five-item scale serves to measure perceived UGD impact on place attachments (IPA) that encompasses the common

components measuring place attachment (i.e., self-identity, social bonding, dependence, a sense of belonging) (Kyle et al., 2005; Williams and Vaske, 2003). Collectively, the IPR and IPA scales comprise questions that ask respondents to indicate "to what extent do you believe you may gain or lose the following resources you posses or have invested in due to having CSG activities in the Gloucester LGA" using a five-point scale (1: substantial loss; 3: neither gain nor loss; 5: substantial gain). The resources included in the questions contain personal and communal resources and elements of place attachment as described above.

The measurement scales of positive and negative emotions are adapted from Folkman and Lazarus (1986)—only items most relevant to our study context are adopted—with reference to the common emotional expressions identified from the aforementioned council report on mining. Both positive emotions (PE; three items: hopeful, eager, pleased) and negative emotions (NE; four items: anxiety, fear, frustration, anger) are measured using a five-point scale (1: never; 3: sometimes; 5: very often). Respondents are asked to indicate "how often you have experienced each of the following feelings since you became aware that CSG activities would be introduced to the Gloucester LGA."

4.5. Measurement evaluation

Internal consistency, convergent validity and discriminant validity of the scales are examined following Hair et al. (2014). Internal consistency is assessed using composite reliability (CR>=.70). Outer loadings (>=.70, p<.05) and average variance extracted estimates (AVE>=.50) serve to examine convergent validity. Discriminant validity is assessed using the Fornell-Larcker criterion, which requires the square root of a construct's AVE to exceed its highest correlation with an opposing construct tested in the model.

Missing values of the measurement items are replaced before proceeding to the data analysis. Due to the exploratory nature of the present study, steps are taken to improve

measurement performance. Items that loaded very low (<.40) on their respective construct or cross-loaded on an unintended construct are excluded when it leads to improved reliability, and convergent and discriminant validity without compromising content validity. Consequently, 11 items are retained to measure ICR and 12 for IPR. The numbers of items remains unchanged in the other scales (See Table 1 for items and associated descriptive statistics).

The items that measure each dimension of ICR (i.e., natural, social, economic) are averaged to create an index that is then used to measure ICR. This approach is recommended to reduce model complexity when the internal consistency of the items comprising the index is high and cross-loading is not a concern (Little et al., 2013), as is evident in our study. The index of perceived impact on the natural environment is created by averaging four items that assess the effect of UGD on the area to support scenic quality, healthy ecosystem, productive agricultural land and nature-based tourism and recreation. The mean value of perceived impact on three social characteristics—friendly local people, community cohesiveness and accessibility to services—is used to represent the social impact. The index pertaining to the economic environment is derived from averaging four items—perceived impact on local infrastructure, labor availability, employment opportunities and overall economic prosperity.

Similarly, three composite indices are computed to represent IPR. The index pertaining to material resources is derived from averaging the value of perceived impact on property value, housing, land/property/built improvements, financial stability and retirement security (five items). Responses to perceived impact on personal health, and time for adequate sleep, leisure, work and loved ones (five items) are averaged to create the index of health and energy. The mean value of two items showing UGD's impact on ability to manage respondents' daily life in the area and ability to exercise control over local issues is

representative of self-efficacy. All measurement scales show satisfactory internal consistency and convergent validity (Table 1).

The repeated indicator approach (Becker et al., 2012) is adopted to measure IR as a second-order model where the same indices to measure its lower order constructs (i.e., ICR and IPR) are used to measure IR. Following Hair et al. (2014), the Fornell-Larcker criterion supports the discriminant validity for IR, ICR and IPR as shown in Table 2.

4.6. Estimation procedure

Since our data do not conform to the normality assumption required for covariance-based structural equation modeling, partial least squares structural equation modeling (PLS-SEM) as a nonparametric statistical method is adopted to assess our hypotheses using the SmartPLS software (Ringle et al., 2005). Different from CB-SEM, the R^2 value is used as the accuracy measure for PLS-SEM (Hair et al., 2014).

5. Results

5.1. Descriptive statistics of the constructs

Table 1 presents the descriptive statistics of the refined scales, and estimates of reliability and convergent validity for all the latent variables embedded in our study. Overall, respondents perceive that the area's natural environment (Mean=1.63, SD=.80) will suffer the most due to UGD, followed by its social (Mean=2.35, SD=.79) and economic (Mean=2.89, SD=.99) environment. Self-efficacy (Mean=2.28, SD=.83) is the personal resources perceived to be most damaged, followed by material resources (Mean=2.38, SD=.93) and health and energy (Mean=2.63, SD=.58). UGD is also perceived to negatively affect respondents' attachment to Gloucester (Mean=2.37, SD=1.04) reflected in its impaired function to support self-identity, a sense of belonging, functional dependence and social

bonding. Overall, negative emotions (Mean=3.09, SD=1.36) are experienced more often than positive ones (Mean=1.96, SD=1.09).

5.2. Hypotheses assessment

The examination of Hypotheses 1 and 2 corresponds to the steps that enable the evaluation of the mediation effect of IPA. A full mediation effect is evident when a previously significant relationship between an independent variable and a dependent variable becomes insignificant after a mediator is introduced (Baron and Kenny, 1986). A partial mediation effect occurs when the relationship between the independent and dependent variable becomes attenuated while remaining significant after controlling for the mediator (Hair et al., 2014). Two steps are taken to assess the mediation effect.

Step 1 involves assessing the direct effect of the independent variable (i.e., IR) on the dependent variable (i.e., NE and PE) prior to introducing the mediator (i.e., IPA) into the model. The results show that IR significantly influences NE (β_1=-.70, p<.001) and PE (β_2=.63, p<.001) (Table 3). That is, a negative evaluation of the impact of UGD on resources contributes to negative emotions, while a positive evaluation leads to positive emotions. The mediator is introduced during Step 2. The results reveal that IR significantly contributes to IPA (β_3=.76, p<.001); suggesting that perceived impact on resources significantly contributes to perceived impact on place attachment (Table 3). However, while IPA has a significant effect on NE (β_4=-.18, p<.001), its effect on PE is not statistically significant (β_5=.02, p=.324) and also fails to obtain sufficient statistical power. That is, when a loss to place attachment is perceived, negative emotions are also more likely to be experienced. Nonetheless, this study cannot establish whether perceived impact on place attachment has a significant bearing on positive emotions or not. This finding suggests a partial mediation effect of IPA, as the relationship between IR and NE (β_1=-.57, p<.001) remains significant

after IPA is introduced. Consequently, Hypothesis 1 is substantiated as IR has a significant contribution to NE and PE regardless of IPA's presence in the tested model. Additionally, Hypothesis 2 is partially supported by the partial effect of IPA that mediates the relationship between IR and NE. Overall, our conceptualization performs well and explains 58.4% of the variance in IPA, 50.4% in NE, and 39.7% in PE (Table 3).

Hypothesis 3 is assessed drawing on finite mixture PLS modeling (FIMIX-PLS) (Sarstedt and Ringle, 2010; Sarstedt et al., 2016). FIMIX-PLS provides a clustering method based on the estimated relations between latent variables instead of solely relying on observable characteristics (e.g., demographic variables) that may fail to uncover the true sources of heterogeneity (Sarstedt et al., 2016). This method helps identify subgroups within a sample based on the differences in the estimated parameters (i.e., β_s) across the subgroups[1]. In other words, subgroups are established given identification of significantly different parameters across subgroups.

Following Sarstedt and Ringle (2010), a four-subgroup solution was selected after applying FIMIX-PLS. The hypothesized model is then assessed for each subgroup. The results reveal satisfactory model performance, except for Subgroup 3, where IR's discriminant validity is unattainable because its square root of the AVE estimate (.89) does not exceed its correlation with IPA (.89). However, attempts to delete any IR indicator to improve its discriminant validity would adversely affect its content validity. In light of the exploratory nature of the study and the satisfactory performance of the measurement model of IR in the aggregate sample and other subgroups, all IR indicators are retained. The hypothesized model for each subgroup is then assessed and subgroup-specific path coefficients are compared. The findings are presented in Table 3. Additionally, Figure 2 is

[1] Readers interested in the technical details of this segmentation approach are encouraged to review the work of Sarstedt and associates (Sarstedt and Rinle, 2010; Sarstedt et al., 2016).

used to visually illustrate the coefficients and correspondent paths for the four subgroups. Overall, the R^2 value of NE (R^2_{NE}) in Subgroup 1 (55.4%), Subgroup 2 (48.1%) and Subgroup 3 (70.7%) is improved relative to the one in the aggregate sample (50.4%) (Table 3). The reduced explanatory power in Subgroup 4 (30.8%) is primarily due to the decreased effect of IR on NE (β_1=-.31, p<.01) from the aggregate sample (β_1=-.57, p<.001). This effect also becomes significantly smaller in Subgroup 4 than the one in Subgroups 1, 2 and 3 (Table 3). Meanwhile, the mediation effect of IPA is enhanced in Subgroup 4 and accounts for 37.6% of the explained variance in NE—an increase from 19.2% in the aggregate sample. Subgroup 3 exhibits the highest increase in R^2_{NE} where IR directly and indirectly contributes to NE through IPA which accounts for almost a quarter (23.5%) of the explained variance in NE. Conversely, IPA does not significantly mediate the relationship between IR and NE in Subgroups1 and 2. Consequently, IR alone largely explains the variance in NE in both subgroups.

R^2_{PE} is improved in Subgroup 1 (47.3%), Subgroup 2 (49.6%) and Subgroup 4 (49.8%) compared to the aggregate sample (39.7%), but it is substantially reduced in Subgroup 3 (19.7%) from the aggregate sample. The reduction is mostly a result of the initially significant effect of IR on PE in the aggregate sample (β_2=.61, p<.001) turning insignificant in Subgroup 3 (β_2=.19, p=.10) while β_2 remains significant in all other subgroups (Figure 2). Consistent with the aggregate sample, no significant effect of IPA is found to mediate the relationship between IR and PE in all subgroups. Therefore, IR is primarily responsible for R^2_{PE} in all subgroups; except Subgroup 3. In summary, Hypothesis 3 is supported by the differential strengths exhibited by some of the path coefficients across subgroups.

To better understand how the four subgroups differ from one another, Kruskal-Wallis tests are applied to compare the mean differences in IR, IPA, NE and PE between all subgroups. Table 4 shows that significant differences exist across subgroups (p<.05).

Subgroup 1 appears to be least impacted by UGD as it reports the lowest level of loss to resources (Mean=2.61, SD=.81), place attachment (Mean=2.54, SD=1.08) and negative emotions (Mean=2.59, SD=1.44), but the highest level of positive emotions (Mean=2.42, SD=1.23). Conversely, Subgroup 3 reports the highest level of loss to resources (Mean=2.16, SD=.66), place attachment (Mean=2.05, SD=.79) and negative emotions (Mean=3.48, SD=1.36), but lowest level of positive emotion (Mean=1.72, SD=.86). Subgroup 2 resembles the other subgroups in its responses to perceived impacts on resources (Mean=2.41, SD=.65) and place attachment (Mean=2.41, SD=1.18), but experiences less positive emotions (Mean=1.84, SD=.92) than Subgroup1 and less negative emotions (Mean=2.94, SD=1.27) than Subgroup 3. Subgroup 4 differs from Subgroup 1 in its more negative evaluation of perceived impacts on resources (Mean=2.36, SD=.67), higher level of negative emotions (Mean=3.11, SD=1.21) and lower level of positive emotions (Mean=1.93, SD=1.18). Based on these results, Subgroup 1 is most optimistic, Subgroup 2 somewhat pessimistic, Subgroup 4, more pessimistic, and Subgroup 3 most pessimistic about the UGD project. Socio-demographic factors—gender, age, education, income, length of residence—and distance from the UGD project to the subgroup membership are then examined to explore how these variables may explain subgroup membership based on multinomial logistic regression (Table 5). The application of multinomial logistic regression requires the designation of one subgroup as a reference group. Here we use Subgroup 1 as the reference group since it appears to be least impacted by UGD. Overall, age (p=.010), length of residence (p=.007), and distance from UGD (p=.038) significantly predict the subgroup membership (Model $\chi^2_{(27)}$=55.04, p=.001). Collectively, these three variables explain between 12.6% and 13.5% of the variance in membership allocation. The regression model also obtained a good fit evident in the insignificant Pearson (p=.210) and Deviance (p=1.000) statistics. The Wald criterion indicates Subgroup 2 is more likely to age between 45 and 64 than S1 (p=.039).

With reference to Subgroup 1, Subgroup 3 tends to age between 45 and 64 (p=.019), reside in Gloucester for a shorter time (p=.019), own a property closer to UGD (p=.005). A summary of each subgroup's age, length of residence and distance from UGD is presented in Table 4.

6. Discussion

Our study proposes a framework of psychological impact assessment drawing on the literatures of COR and place attachment to examine rural residents' impact appraisals and emotional responses when faced with UGDs by testing three hypotheses. Consistent with COR's key tenet (Hobfoll, 2002), our findings support Hypothesis 1 and show that negatively perceived impact of UGD on resources (i.e., perceived resource loss) contributes to negative emotions that can potentially lead to deteriorated psychological well-being. Meanwhile, positively perceived impact (i.e., perceived resource gain) is conducive to positive emotions that help maintain and forge a sense of psychological well-being. The results also reveal that perceived UGD impact on place attachment absorbs some of the effect of perceived impact on resources on negative emotions and, therefore, partially support Hypothesis 2. In other words, negative emotions are not only a direct result of perceived impact on resources. They also arise from negatively perceived impact of UGD on place attachment likely because the place-bound goals that rely on the continuity of person-place relationship as captured in place attachment are adversely affected due to the perception of deteriorating resources. This finding aligns with place literature that changes contradictory to the desired place attributes (i.e., person and communal resources) underlying individuals' place attachment can lead to unfavorable psychological consequences as they can impede individuals' pursuit of their goals supported by an attached place (Cox and Perry, 2011; Twigger-Ross et al., 2003). However, a positive evaluation of the impact on place attachment does not significantly lead to positive emotions. This finding substantiates COR's tenet that resource loss is more salient

than resource gain (Hobfoll, 2010) and suggests that different mechanisms may underpin the psychological processes driving positive and negative emotions. Further research is needed to uncover the mechanisms.

In our study context, some Gloucester residents have been involved in various activities to express their concern about the UGD project since it was proposed. Ongoing participation in these activities could have gradually drained the resource reservoir of those actively involved through investments of material and energy resources. Meanwhile, the lack of success to stop the project until early 2016 when the company operating the UGD project announced that related activities were to be withdrawn from Gloucester could have also harmed self-efficacy as another resource essential to residents' psychological well-being. Additionally, community cohesion has also been adversely affected as the community has been divided into proponent and opponents of the UGD project—76% of our respondents consider that the UGD is not in the best interest of the community, while the remaining 24% hold an opposite view. This can negatively impact the social aspect of communal resources (Cox and Perry, 2011).

The attrition of residents' resource reservoirs and their supportive caravan passageways has significant implications for the well-being of rural communities, where government-funded or industry-supplied services and opportunities may not be readily accessible (Milbourne, 2012). These communities often rely on various community networks, which are in part reflected in our conceptualization of place attachment and the social aspect of communal resources to supplement such shortage. Adverse impacts of UGDs on communal resources and place attachment that help define the central values treasured by a community can generate communal stress, interrupt community networks, and reduce community capacity to cope and buffer themselves from further resource loss and undesirable outcomes for psychological well-being (Cox and Perry, 2011; Norris et al., 2008).

Hypothesis 3 is supported by the differential strengths of the hypothesized relationships across the four FIMIX-PLS-derived subgroups. The application of multinomial logistic regression suggests that the heterogeneity within the sample is explained by length of residence, age, and distance from the UGD when using Subgroup 1 as the reference group and provides further insight into the differences across subgroups. Our findings indicate that the three variables explain the differences between Subgroup 2 and Subgroup 1, and between Subgroup 3 and Subgroup 1. Subgroup 2 that is somewhat pessimistic about the UGD than Subgroup 1—the group most optimistic about the development— is more likely to comprise respondents aged between 45 and 64. From COR's perspective, this can be attributed to that respondents in this age bracket are striving to fortify their resource reservoir before they reach their retirement age, and, therefore, this group can become more concerned about resource loss due to the UGD.

Compared to Subgroup 1, Subgroup 3 (i.e., residents who are most pessimistic) are more likely to comprise amenity migrants due to their shorter length of residence in Gloucester. This is also inferred from the recent population trend in the area showing that Gloucester hosts a higher number of amenity migrants who moved to the area for lifestyle reasons compared to other areas in the state (Campbell and Gedye, 2013). Past research (e.g., Brehm et al., 2004) suggests that amenity migrants are drawn to amenity-rich areas often due to these areas' communal resources that support their development of personal resources and pursuit of a sense of identity, emotion, bonding and dependence bounded within the locales, and, therefore, contributes to their place attachments. As UGD is perceived by Subgroup 3 to be most detrimental to the personal and communal resource base that motivated their initial investment in Gloucester, a negative evaluation of UGD's impact on resources not only directly contributes to negative emotions. It also affects negative emotions indirectly through impact on place attachment as place-based goals are likely to be highly valued by this

subgroup. However, positive emotions is poorly explained in Subgroup 3, partly because very few residents in this subgroup (10.1%) rate UGD impacts positively, as the proposed change is mostly incompatible with the needs and goals that initially drove their resource investment in Gloucester. That Subgroup 3 comprises a higher proportion of respondents aged between 45-64 also plays a significant role in differentiating this subgroup from Subgroup 1 likely due to the reason described earlier. As this subgroup is reaching the age of its retirement coupled with the investment involved in relocation, Subgroup 3 is likely to respond to UGD more negatively. Additionally, Subgroup 3's pessimism is in part explained by its possession of a property closer to the designated site for UGD activities, a finding consistent with other studies (e.g., Popkin et al., 2013). From COR's perspective, the closer an individual and his/her resources are to an identified stressor, the more likely he/she is to apprise the stressor to impose an immediate threat and incur psychological distress. While not significant, distance also plays a weak role in differentiating Subgroup 1 from Subgroup 4 that is more pessimistic about UGD (p=.064) and possesses a property closer to the designated UGD site.

7. Conclusion and Policy Implications

Research has only recently started to pay more attention to communities' psychological responses to UGDs due to the widespread perception of risk and uncertainty concerning related activities (e.g., Boudet et al., 2014; Wagner, 2014). To address these concerns, technical solutions to UGD impacts on the environment have been suggested (IEA, 2012). Additionally, ensuring a social license to operate—an informal social contract between the unconventional gas industry and key stakeholders—remains important for major gas producing countries (APPEA, 2013; IEA, 2012). To forge such a relationship, the industry and other responsible entities need to gain a comprehensive understanding of key stakeholders' concerns about what is to be impacted by UGDs and how such concerns may

vary among stakeholders that comprise heterogeneous groups (IEA, 2012; Moffat and Zhang, 2014).

Our study extends this emerging body of work by providing support for the utility of COR and place attachment as foundations for understanding the heterogeneous psychological processes involved in different community residents' reactions to change associated with UGDs. Our study findings reveal that the perception of resource loss or gain due to UGDs affects emotions, and this relationship is mediated through perceived impact on place attachment. Moreover, experienced or anticipated losses are more salient than experienced or anticipated gains in terms of associated effects on emotional outcomes, and these relationships are likely to vary between different groups of community residents.

Based on these findings, we suggest that industry and other responsible entities wishing to establish a social license to operate UGDs need to understand how proposed developments may affect rural residents' personal assets and shared communal resources that collectively contribute to a healthy social-ecological system in which the residents and their community flourish together. Considering both types of resources simultaneously will enable development of policies that surround unconventional gas projects in ways that any adverse effect on residents' psychological well-being can be minimized. Moreover, as the concern about the impact of UGDs on resources is likely to be more evident among residents who are approaching their retirement age and who own a property close to related activities, more support in the form such as access to needed resources may be provided to forge their capacity to cope and adapt.

Responsible entities also need to consider how residents' place attachment may be influenced, such as the place attachment of those residents who were motivated to move to the area due to its amenity values. The emotional bonds that residents develop with their community through interactions over time have been shown to play a critical role in

residents' acceptance of energy projects (Devine-Wright, 2011a; Lienert et al., 2015). Scholars have stressed the importance of public participation in the planning of related projects to provide a venue where residents can voice their concern about associated impacts on their place-bound goals (Devine-Wright, 2011b; Wheeler et al., 2015). The planning process also needs to ensure that interactions between all involved entities are sincere and mutually respectful, and that procedural fairness—a perception that such participation allows residents to meaningfully voice their concerns about impacts on resources and person-place relationships—is prevalent (Lienert et al., 2015; Moffat and Zhang, 2014).

Furthermore, planners should not assume that the characteristics that help distinguish different subgroups of community residents who respond to related changes differently can be applied consistently across different unconventional energy developments. Instead, they are urged to invest adequate effort in determining at a fine grained level the characteristics of heterogeneity so targeted and differentiated energy policies can be developed to communicate to and provide support for different community subgroups. This effort should aim to minimize perceived impacts on various aspects of resources and place-bound goals, and forge an adaptive capacity to better cope with changes resulting from related activities.

If negative emotions are left to brew, they may reinforce the stereotype that interest groups develop towards one another and motivate concerned residents to seek information that further forges their initial position towards and resistance to proposed developments (Buijs and Lawrence, 2013), that can jeopardize any effort to establish a trustworthy and sustainable relationship—an element essential to establish a social license—between the industry and residents. Conversely, residents' place attachment and commonly valued resources that are supported by the affected community can be harnessed as a common ground to bring residents together for consensus building and enhancing community capacity to address unwanted changes collectively (Manzo and Perkins, 2006; Norris et al., 2008). At

minimum, thorough processes of community consultation need to be implemented well in advance of future developments to give voice to multiple perspectives.

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