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Danger from the Outside

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Danger From the Outside in: Resident Perceptions of Environmental Contamination in Home Environments

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Abstract

Research examining human experiences of environmental contamination highlights the significance of place in influencing responses. However, a dearth of information exists on how indoor contamination affects experiences of living with legacies of land and groundwater pollution. This paper addresses this shortfall by drawing on evidence derived from an online survey, 10 semi-structured interviews, and a focus group to examine factors associated with lifescape change in home environments. The findings suggest that perceptions of the visibility and transferability of contaminants, and whether such contaminants are located in either indoor or outdoor domestic spaces, influence residents' experiences, in turn. Through its focus on interactions between people and pollution, this article makes an original contribution to research on the spatial dynamics of individuals' experiences with contamination. In concluding, this paper highlights the need for public health communication to provide clear guidance aimed at reducing feelings of uncertainty within domestic spheres.

Keywords: environmental contamination, home environment, lifescape change, ontological security, risk perception

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Introduction

Legacies of land and groundwater contamination in urban residential neighborhoods present a significant risk to public health (Fazzo et al., 2017). Australian cities, like many across the globe, are affected by contamination from decades of heavy industrial activity (Landrigan, et al., 2018). Understanding and addressing the effects of environmental contamination on human well-being is essential for improving public health outcomes (Mudu et al., 2014).

The scholarship focusing on human responses to environmental contaminants has increasingly acknowledged the psychological significance of living in contaminated settings (Davidson, 2018; Few & Tran, 2010). Previous research on the human geography of environmental contamination has likewise examined how a wide range of environmental contextual factors, such as sense of place (Bonaiuto et al., 2016; Venables et al., 2012), resident proximity to contamination (Burningham & Thrush, 2004), and type of contaminant present at a site (McIntyre et al., 2018), each affects resident responses to pollution. This has drawn extensive attention to how contamination negatively affects perceptions of security typically associated with the home (Edelstein, 2002, 2004; Prior & Partridge, 2009). However, there remains a lack of information regarding how said experiences of contamination within such domestic spheres affect residential living.

Research on the meaning of home environments emphasizes the importance of such spaces providing a sense of existential security, which is a form of human reassurance through which people gain confidence that their survival is secure enough to be taken for granted (Dupuis & Thorns, 1998). The home environment represents an important feature of human ecology, which is the study of the interactions between humans and the environment. Of particular significance to understanding the sense of security associated with home is the concept of "lifescape." Essentially, lifescape is an abstract notion that represents the intersection of an individual's agency, emotions, health, socioeconomic circumstances, and cultural norms that shape one's life, and that which transpires within specific material and social environmental contexts (Lubkemann, 2008, p. 193). Home environments are fundamental for the production of such a concept, as they enable individuals to realize the livelihoods they seek to pursue.

Change that affects these spaces also affects lifescape and has implications for human well-being (Davidson, 2018). Previous research examining responses to environmental contamination has shown how its presence is associated with experiences of change. According to Edelstein (2002, 2004), lifescape change represents a deep fundamental disruption of underlying ontologies, or the taken-for-granted assumptions upon which societies operate. This means that changes to lifescape can threaten one's sense of order, stability, and predictability, which

otherwise provide humans an ongoing sense of direction or purpose (Edelstein, 2004). Essentially, lifescape change refers to a significant interruption of "normal" patterns of everyday life and sense of security.

According to Edelstein (2004), contamination has been shown to affect five key dimensions of lifescape:

1. Normal optimistic assumptions about life are replaced by a focus on risk and uncertainty.
2. Local environments become perceived as a source of uncertainty and danger.
3. People's trust in social or institutional support systems breaks down.
4. Routine feelings of a sense of control over one's future are replaced with feelings of isolation, threat, insecurity, and a sense of powerlessness.
5. Home environments usually associated with a sense of security, status, and identity instead become viewed as places of danger.

In turn, changes to daily routines are accompanied by critical questioning about their meanings, once people become less likely to take them for granted (Alexander, 2012; Edelstein, 2002, 2004; Davidson, 2018; Prior & Partridge, 2009).

Lifescape change is also associated with the emergence of ontological insecurity in environments affected by contamination (Edelstein, 2002). As ontological insecurity refers to feelings of existential insecurity that result when emotional needs are not met (Alexander, 2012; Giddens, 1991, p. 55; Herman, 1992), the inverse (ontological security, or purpose in life) becomes enforced through the constancy of daily routine. Research has shown that ontological insecurity following environmental contamination may be reflected in critical questioning of underlying values, social norms, and modes of interaction between social groups; that is, environmental contamination has the capacity to significantly disrupt one's social environment (Edelstein, 2004). In Western societies, underlying ontologies involve taken-for-granted beliefs in humans' ability to ably control their settings, and that the natural environment will always support the human need for food and water (Edelstein, 2004). However, contamination threatens the continuity of these very assumptions, which result in feelings of helplessness and trauma (Davidson, 2018; Edelstein, 2004; Herman, 1992). Lifescape change that occurs from contamination to individuals' home environment can also result in the emergence of a stigmatized identity, by which community members become viewed by others and by themselves as contaminated peoples (Edelstein, 2004; Prior & Partridge, 2009). Most significantly, from a human ecology standpoint, changes to lifescape due to environmental contamination reveal how pollution influences the relationship between humans and environments.

Previous studies focusing specifically on experiences of contamination within home environments conceptualize "home" as consisting of features of the social, natural, and material environment to which people form deep attachments (Edelstein, 2002; Prior & Partridge, 2009). Yet, despite the wealth of research on such spaces, the ways in which individuals' attachments to the interior are affected by contamination has received very limited scholarly attention. One notable exception is Larrea-Killinger et al.'s (2017) examination of how contamination transforms a domestic space into a potentially toxic object. Other research examining its significance for ontological security, lifescape, and human well-being explores how home environments are associated with a sense of personal control, as they offer freedom from public surveillance (Dupuis & Thorns, 1998). Such indoor spaces provide a secure base for identity construction, as notably projected through the ways we fashion our homes (Dupuis & Thorns, 1998). Having a place to call one's own has deep cultural significance in Western society, including in Australia, where colonial histories were rooted in ideas of building a home in new environments (Kearns et al., 2000). Therefore, given the importance of indoor home environments for providing many a sense of security, it follows that examining human responses to contamination therein can aid understanding how aspects of such built spaces help shape human experience, in turn.

Other research focusing on the spatial dynamics of environmental contamination observe how the concept is socially constructed or defined. Studies examining the spatial dynamics focus on the perceived or actual distribution of contamination across particular geographic spaces and at different scales. However, these studies show that not all societies react equally to the presence of the same forms of pollution. A number of these draw upon Mary Douglas's (1966) theory of contamination as consisting of "matter out of place," in that contaminants defy symbolic and socioculturally constructed boundaries of "orderliness" by entering spaces people feel should be free of contamination, such as water supplies (Bickerstaff & Walker, 2003; Davis, 2005; Eakin et al., 2010; Jewitt, 2011; Loyd, 2009; Meade, 1976; Scott et al. 2012; Segrott & Doel, 2004; Sultana, 2012). Several draw on a cultural construction of contamination to explain how certain types of pollutants associated with living in a city are more likely to be accepted by residents, regardless of actual health risk (Cupples, 2007; Eiser et al., 2007), while others measure the significance of subjective perceptions of risk in relation to stress and trauma (Davidson, 2018; Freudenburg, 1997; Luria et al., 2009; Vyner, 1988; Whitmarsh, 2008). Overall, these studies emphasize the importance of the sociocultural environment in shaping responses to contamination.

Understanding how indoor environments affect responses to contamination is of interest to human ecology, as they can reveal how particular features of built environments can affect the interrelationship between humans and their environments. Knowledge about how residents living in areas affected by

environmental contamination is also fundamental to the development of effective public health communication strategies, which can help residents better cope with issues of contamination in their neighborhood surroundings (Mudu et al., 2014). However, the development of guidelines to improve risk communication outputs represents a transdisciplinary research problem that requires input from a variety of stakeholders (including residents, government representatives, environmental agency representatives, and industry personnel) to ensure they meet the needs of both community members and the organizations with which they liaise.

This study was developed as part of a wider transdisciplinary research project that aims to develop new evidence-based guidelines for improving the communication of information about contamination, as well as the engagement of community members in remedial decision-making. The research is transdisciplinary in nature, as it focuses on achieving a collective understanding of experiences with environmental contamination, created from multiple actors within a wide range of institutions (including both scientific and non-scientific communities), who each bring their own unique perspectives, experiences, and contributions for the advancement of knowledge (Brown et al., 2010, p. 4; Schoot Uiterkamp & Vlek, 2007, pp. 176–177). Essentially, the study aimed to examine evidence of lifescape change among residents affected by environmental contamination within home environments around Australia. This was achieved by focusing on two indicators of lifescape change associated with the production of ontological insecurity. The first concerned the emergence of a situation in which home environments became associated with a sense of danger, while the second focused on changes to daily routines, which reflect how normal assumptions about life become replaced by a newfound focus on risk and uncertainty. This contention was selected for the importance of lifescape in influencing human security, and because change to lifescape resulting from contamination can reveal how contaminants deeply alter the relationship between humans and their environments (Edelstein, 2004).

From this, the following research questions were defined:

- RQ1. Are residents' perceptions of their abilities to personally control exposure to contamination at a site reflective of losses of trust in the safety of their home environments? If so, why?
- RQ2. Do any changes to residents' daily habits resulting from learning about contamination in their home environment indicate that taken-for-granted assumptions about the constancy of daily routines had been replaced by a focus on risk and uncertainty? If so, which ones and why?

Methodology

This study was a cross-sectional analysis that collected online questionnaire responses from 496 adults living in 13 contaminated urban sites across Australia, including the Australian Capital Territory, New South Wales (NSW), Queensland, South Australia, Tasmania, and Victoria. Purposive sampling was used to select the sites, with suitable locations being identified through consultation with the Australian Remediation Industry and each state's Environmental Protection Agency. A range of environmental contaminants, including heavy metals, chemicals, and chlorinated solvents, were known to have affected each location. As such, the University of Technology Sydney's (UTS) Human Research Ethics Committee provided ethical approval to commence research.

As this study aimed to achieve a collective understanding of experiences of environmental contamination, a mixed-method, combined quantitative and qualitative approach was chosen. This offered an inclusive approach that enabled an extensive number of stakeholders to participate in a variety of manners. The sample size and breadth of the study across 13 Australian case study sites was also designed to ensure that findings were not isolated to a specific region. However, this likewise meant the findings may not be generalizable beyond an Australian context.

1. Survey Questionnaire and Measures

A mixed quantitative and qualitative approach was applied to gather data. A structured online survey was conducted between 2014 and 2015, as designed through engagement with remediation experts. Two questions within the online survey were designed to assess issues pertaining to lifescape change:

1. Question 3. How much personal control do you feel you have over your own contact with the contamination at [name of neighborhood site], with 0 being no control and 10 being total control?
2. Question 6. Have you changed any daily habits since becoming aware of the contamination at [name of site] in your suburb?

Residents who answered "yes" to Question 6 were subsequently asked in Question 7 to briefly describe what daily habits they had changed. Questions about feelings of a lack of control over exposure can be used to enquire if home environments are viewed as a source of danger, while questions about changes to daily routines can help determine if residents have become disconnected from their daily routines.

2. Semi-structured Interviews and Focus Group Workshop

The online survey was followed in 2017 by ten 90-minute, semi-structured interviews with selected residents, and environmental contamination and remediation experts from NSW. Two interviews contained more than one participant, with 12 applicants participating overall. The interviews were conducted to elicit further information regarding how residents experienced a sense of danger in their home environments as a result of a lack of control over exposure to contaminants. This also concerned if changes to their daily routines reflected disconnection associated with lifescape change.

The semi-structured design of the interviews allowed researchers to enquire on the reasons why residents felt they had experienced factors associated with lifescape change. Each interview participant was asked the following questions:

1. Which types of contaminants concern you the most and why?
2. How has contamination affected your livelihood or routine?

These queries enabled participants to respond in their own words, and recognized their agency for guiding the interpretation of the results (Ozerdem & Jacoby, 2006). Participants were sourced through recommendations from remediation experts, from a remediation community action group, and upon recommendation by members of community action groups. All participants provided full informed consent prior to participation.

A focus group workshop was subsequently conducted in September 2017. This involved government, industry, environmental agency personnel, and residents, and explored how official communications about contaminants could be improved.

3. Data Analysis

Descriptive statistics frequency analyses were used to develop findings from the questionnaire, and were performed using SPSS Statistics 23.0. This helped illustrate both the frequency of responses to Question 3 on each position on the Likert scale, and the number of participants answering "yes" or "no" to Question 6. Coding of both interview and focus group data pertaining to the question "Which types of contaminants concern you the most and why?" involved initially scanning the transcripts for evidence suggesting that perceptions of a lack of control over exposure to contaminants resulted in a loss of trust in one's environment. This was achieved by highlighting statements that indicated uncertainty, distrust, confusion, and perceptions of danger or risk of harm from such settings. Three key themes were also identified: visibility and contamination, contamination within indoor

environments, and changing meaning of an indoor environment. These themes were subsequently used to create a conceptual framework through which the data were organized into headings.

Responses pertaining to the second interview question, "How has contamination affected your livelihood or routine?", involved repeating the same procedure for evidence of changes to daily routines, and evidence that these changes reflected disconnection from individuals' habits. Statements pertaining to a loss of taken-for-granted assumptions about daily activities were highlighted. Three themes were identified and used to draw a conceptual framework to organize the responses: change to thought, change to action, and change to action in indoor environments.

Responses to Question 7 were manually coded according to whether respondents reported changes to indoor or outdoor daily activities, routines and habits, according to the themes that emerged from interviews and focus group data. This method of analysis follows the basic principles of grounded theory (Strauss & Corbin, 1998), and was chosen for its useful and flexible approach to exploratory studies in social science, which requires a continual interplay between data collection and analysis to develop theory (Bowen, 2008, p. 2).

Findings

Control Over Exposure to Environmental Contaminants

Responses to Question 3 in the online survey revealed that 156 of the 496 (31.4%) respondents felt they had no control over their own contact with contaminants at their given sites, while only 23 (4.6%) felt they had maximum personal control over contact with contaminants. A summary of the frequency of resident responses to the survey question "How much personal control do you feel you have over your own contact with contamination at your site?" is provided in Table 1.

Table 1. Descriptive statistics frequency analysis of online resident survey (Question 3).

Frequency statistics Question 3: How much personal control do you feel you have over your own contact with contamination at your site?					
	Likert scale response	Frequency	Percent	Valid percent	Cumulative percent
Valid	0	156	31.5	34.8	34.8
	1	59	11.9	13.2	48.0
	2	32	6.5	7.1	55.1
	3	24	4.8	5.4	60.5

Frequency statistics Question 3: How much personal control do you feel you have over your own contact with contamination at your site?				
Likert scale response	Frequency	Percent	Valid percent	Cumulative percent
4	29	5.8	6.5	67.0
5	37	7.5	8.3	75.3
6	13	2.6	2.9	78.2
7	19	3.8	4.2	82.4
8	31	6.3	6.9	89.3
9	25	5.0	5.6	94.9
10	23	4.6	5.1	100
Total	448	90.3	100	N/A
Missing	48	9.7	N/A	N/A
Total	496	100	N/A	N/A

Over 60% of respondents answered 0–4 on the Likert scale, which suggests that more than half the residents experienced attributes associated with lifescape change. Essentially, this is because one's lack of control over exposure is indicative of a situation in which home environments become perceived as a source of danger (Edelstein, 2002, 2004).

Overall, the semi-structured interview and focus group responses provide a wealth of information regarding why residents felt they lacked control over pollutant exposure. They also indicate that such powerlessness resulted in perceptions of a lack of trust in the safety of one's home environment. However, responses to the interview question "Which types of contaminants concern you the most and why?" revealed that residents were more concerned about exposure to certain forms of contaminants compared to others.

Perceived Invisibility and Intangibility of Contaminants Within Home Environments

Certain forms of contaminants were associated with increased concern about the dangers of exposure and lower abilities to control such risks compared to others. Residents were more likely to associate concerns about this lack with invisible forms of old legacy contamination—or, those that were intangible, did not have a distinct smell, and were visibly undetectable. Essentially, legacy contamination refers to pollution from historic waste associated with former industrial activity in the area, before special environmental statutes were enforced (Brand et al., 2017). These undetectable contaminants were thought to be more dangerous and more difficult for residents to control than those that were more visible, regardless of their specific type (i.e., chemical or heavy metal). Invisibility was also associated

with greater anxiety over control of exposure than more visible forms of industrial pollution associated with heavy industrial activity, which occurred on these same sites throughout previous decades:

> If we smelt anything strange or anything unusual in the way of the environment, we'd just sniff the air. Then we could get in touch with State's pollution control. That was the sort of guide we had to contamination … Now it's a worry that we are breathing things in that could have toxins in them … You worry because it's a long-term thing. (Female resident, 70, 7009)[2]

This suggests that invisible forms of legacy contaminants were more likely to be associated with an inversion of the assumed safety of an environment, as is characteristic of lifescape change (Edelstein, 2002, 2004). Several interviewees also emphasized that this was the case, even when industrial pollutants were known to pose a serious health risk:

> I used to work in the public works and everything, and I used to bite my fingernails all the time. I got lead poisoning from down there. Back in those days you used to test for lead poison all the time … The danger is when you can't see anything … it could be sterility, you could go blind or different things … I know one person, he got testicular cancer and he blamed it on there, but I don't know how. (Male resident, 85, 7001)

Contamination in Indoor Home Environments

Another reason invisible contaminants were perceived as more harmful and associated with greater environmental distrust concerned their potential to spread undetected into residents' homes. Both residents and members of official organizations reported they perceived those who spent greater amounts of time at home were more likely to be vulnerable to harm from exposure than other members of the population: "Children, the elderly, those who are already sick. Those who spend the majority of their time in the area [are more vulnerable than others]" (Female resident, 63, 7008).

Interviewees also emphasized how the risk of exposure to invisible forms of contamination within homes were especially traumatic, as well as being associated with prolonged worry and uncertainty over the health risks associated with exposure:

> Dust containing lead particles was especially worrying. Parents were encouraged to wash their children's hands and not let them out barefoot, and to wipe down surfaces to limit exposure inside. But even though they were doing this they didn't know what to do when the kids still showed high blood lead readings. (Female remediation expert, 40, 7005)

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2   The four-digit number included in the bracket after the age of the participant refers to survey and interview numbers. These have been included throughout this paper.

Others described how a lack of perceived safety from domestic exposure led to several local residents deciding to move away: "If you really feel bad about this … [it's] going to destroy you. A lot did sell up and move away because … I wouldn't want children to breathe in stuff from an early age that you don't know if it's harmful" (Male resident, 68, 7000).

This reveals how the perceived presence of invisible legacy contaminants within the home was associated with a lack of trust and certainty about the safety of such environments. Both residents and remediation experts also expressed concern about domestic exposure as being associated with greater insecurity than that of outdoor contaminants:

> I think the greatest worry is a trauma; the worry that you don't know about—not know whether or what can invade your home. Old soil from the gardens was taken away, and new, clean soil brought in, but people were scared about the roof cavities and where the dust might have settled on the homes over the years and what could have crept in. (Remediation expert, 50, 7002)

Invisible legacy contaminants within homes were perceived by residents as being more difficult to control in terms of exposure than contamination from active industry during previous decades. The perceived visibility and tangibility of these older forms of pollution deemed them more controllable, as residents could take direct personal action to prevent them from entering their home environments:

> You'd do your washing at night and bring it back in, and have to do it again because it stank of whatever it was. So you did your washing at other times … If you knew there was a problem you could shut your door, whereas now you don't know; it's hidden. (Male resident, 68, 7000)

The attribution of personal responsibility to control exposure to previous forms of industrial contamination within domestic spaces also influenced if living in such affected areas became associated with any form of stigma. Residents explained this sense of shame that accompanied life with contamination from heavy industry activity during previous decades, as it meant they could not afford to reside elsewhere. As such, pollution within the home was perceptibly associated with the presence of dust, to which many felt they could control their exposure by adopting rigorous cleaning practices that were considered an expected social norm at the time:

> There was a stigma because if you lived in [place name] you didn't live there because you wanted to, you lived there because couldn't afford anywhere else. You were working class. But if your home was contaminated, it meant it was dirty. That was a stigma. You didn't want a dirty home … It's pride. (Male resident, 68, 7000)

Conversely, residents did not believe the same stigma existed for those living in the same areas today. This was attributed to the rising cost of property prices in Australian cities, the closure of heavy industry, and the gentrification of these spaces. They also described how exposure to legacy contaminants was more likely to lie beyond a resident's personal control:

> I'd say that the house prices mean there isn't the same sort of stigma nowadays … You don't know what's there or how to prevent kids ingesting it or breathing in something then. I'd say its unavoidable … it's the nature of the legacy. (Female resident, 70, 7009)

Changing Significance of Indoor Home Environments

Residents also emphasized the importance of having a clean and safe neighborhood environment, as well as living in an area marked by a close-knit sense of community. They also stressed the significance of having a safe indoor environment as being an integral aspect of their well-being: "Your home was important; it was your home. It's the place where you raised your family and stayed until you died. It's that whole security thing of being at home" (Female resident, 83, 7001).

Residents spoke about how the meaning of one's domestic space had changed since the closure of industry within these areas, particularly explaining how the majority of new residents commute to work within city centers. Many of these new inhabitants are less likely to get involved in local community activities because their lives tend to be constructed around activities that transpire across a much wider geographic area than the neighborhood in which their home is located. Others explained how longer working hours means people are more likely to keep to themselves and spend greater amounts of time indoors: "People do their own thing more now. They spend more time at home and are less involved with others nowadays" (Female resident, 70, 7009).

A number of participants also explained that changes to working patterns resulted in enhancing the significance of indoor environments for providing a sense of security to residents; hence, the indoors became perceived as increasingly meaningful for providing a sense of well-being: "I think now home is more important than before. It's where you relax, with the family, uninterrupted, almost like a kind of sanctuary—a place to recuperate from the stresses of modern life" (Female resident and remediation expert, 45, 7003).

Greater significance was also attributed to indoor home environments for the safety and well-being of children compared to previous decades:

> Children spend more time indoors. You don't see kids playing out on the street anymore like you used to. There's more of that fear of crime or accidents, or what could happen, so people keep their kids indoors more. (Female resident, 70, 7009)

Hence, considering such changes to the significance of interior domesticity, it follows that if the safety of these spaces becomes threatened due to actual or perceived contamination, it may result in greater insecurity today compared to in the past.

Changes to Daily Activities and Routines as a Result of Contamination

Answers to the second survey question (Question 6), which was designed to elucidate information about residents' lifestyle change and changes to daily activities, suggested that, despite concern about exposure to contaminants at nearby sites, few residents changed their daily habits since becoming aware of contamination. The frequency analysis revealed that only 46 of the total 496 participants (9.3%) had made changes to their daily habits, while an overwhelming 421 (84.9%) said they made no changes. The full details of the responses are provided in Table 2.

Table 2. Descriptive statistics frequency analysis of online resident survey (Question 6).

Frequency statistics Question 6: Have you changed any daily habits since becoming aware of the contamination at your site?					
	Response	Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	46	9.3	9.4	9.4
	No	421	84.9	85.7	95.1
	Unsure	24	4.8	4.9	100
	Total	**491**	**99**	**100**	**N/A**
	Missing	5	1	N/A	N/A
	Total	**496**	**100**	**N/A**	**N/A**

Changes to daily routines can be associated with lifescape change. This is because variations in one's habits can be reflective of a situation in which residents become disconnected from normal activities that provide a sense of purpose. The survey findings suggest that the majority of residents did not make any changes to their daily habits associated with lifescape change.

Changes to Assumptions About Mundane Daily Activities

While responses indicated that the majority of residents did not alter their lifestyle habits upon discovering contamination, answers to the interview and focus group workshop question "How has contamination affected or changed your livelihood or routine?" suggested that evidence of lifescape change involving disconnection from normal routines was experienced. The findings likewise imply that disconnection occurred, even in instances in which contamination did not alter participants' daily habits.

Some residents reported feelings of disconnect from the typical taken-for-granted assumptions about life embedded in daily activity, despite not altering any of their activities upon believing change would not help reduce the risk of harm from invisible forms of legacy contamination: "If you don't know how far they have actually spread, you really don't know if there is anything you can do" (Female resident, 70, 7009). Others described their awareness of the need to consider taking precautions to prevent exposure, but could not readily apply this advice to their own lives: "People … they used to come to me and say we've got to protect the children. I thought, okay, what do I need to do … I don't understand a lot of it … There was a panic" (Male resident, 85, 7001).

This suggests that although people were not actively changing their activities, they were questioning taken-for-granted assumptions about their routines due to concerns of exposure. It also reveals how the use of very technical language in official communications advice hindered residents' ability to apply guidance effectively.

Changes to Daily Routines Within Home Environments

Forty-five of the 46 respondents who answered "yes" to having changed any of their daily habits in the online survey provided a response to the open-ended survey question "Can you briefly describe what daily habits you have changed?". Thirty-four of these responses described changes made to activities that transpired in outdoor home environments, with 27 including descriptions of avoiding exclusion zones, and not allowing children to play near affected sites. Five respondents explained that learning about contaminants affected their gardening practices, and described how they stopped growing vegetables and using bore water to hydrate their gardens. One described how they chose to cease their environmental volunteering pursuits after learning about the contaminants, while another explained how they made extra effort to actively pursue information about activities happening within their area to help manage and remediate the contaminants.

The semi-structured interview and focus group responses from participants who were asked how contamination affected their livelihoods or routine also highlighted changes to bore water use, gardening practices, and outdoor pursuits as being key lifestyle modifications made upon learning about contamination: "Some residents had filled their swimming pools with groundwater, so there was a whole lot of things they had to change" (Female resident and remediation expert, 45, 7003).

Information elicited during the interviews illuminated residents' emotional attachment to some of these activities. For example, one remediation expert (45, 7003) noted "a lot of homes had installed bores. People were upset when they lost that amenity." Another explained that having a vegetable garden in Australia has

a strong cultural meaning for some, which can be a defining aspect of their sense of home: "Veggie gardens. I think it's a cultural thing as well. It's very important to them" (Female remediation expert, 40, 7005).

A third interviewee suggested that having a garden to tend is important for a person's identity, which she thought to be rooted in Australian culture as a result of its colonial history:

> It's the whole having a house, a garden … It gives people the sense that if they have that, they have somehow made it, made a success of their lives … It's very important here in Australia … I think it's part of that old colonial idea that you build yourself up, make a home. (Remale resident, 70, 7009)

This suggests that changes to gardening routines and activities not only disrupt residents' lifestyles, but lead to emotional responses that are likely to involve questioning one's identity and embedded culturally constructed assumptions about the purpose of one's life. Meanwhile, other residents described feelings of sadness about being restricted from entering areas they had formed long-held attachments to, which, as one female resident (63, 7008) explained, "are is now fenced off. I've been here for years and you sort of have this nostalgia for the area." Again, this suggests that changes to daily practices are accompanied by feelings of loss for a sense of security associated with the maintenance of meaningful activities.

Changing Routines Within Indoor Environments

Participants also described changes to their daily practices within indoor environments. Seventeen of the 45 residents who responded to the open-ended question about changes to their daily habits explained how they had altered their indoor habits, activities, and routines after discovering the presence of contaminants. Three respondents described how they now try to keep their windows closed to prevent pollutants from entering their homes, while two changed their indoor cleaning practices. One stated they now use a mask when cleaning their house, while another described how they now boil water to wash dishes. One respondent also explained how they changed their personal care practices by no longer rinsing their mouth with tap water. Further, six participants stated how they modified their food and drink preparation and consumption practices, while another became more conscious of how they disposed of household waste.

Responses to the interview questions also revealed concern about preparing and consuming food products they perceived were contaminated. Avoidance of bringing such items into one's home was also identified as an important change to daily practices:

> They said don't fish from the area … You were going to be eating the fish and swallowing all that mercury and maybe it's doing you harm. Then, the concern was bringing back in fish caught in the bay. You aren't just eating it if you bring it indoors, whatever's there you could be spreading everywhere. (Male resident, 68, 7000)

This indicates lifescape change, in that it reflects both loss of belief that the natural environment will always support the human need for food and water, and critical questioning of "normal," taken-for-granted daily routines. Hence, another resident said many changed their normal food preparation practices for fear of exposing children to contaminants, explaining, "people were asking, is it safe to feed my kids? Is the water safe for them to drink?" (Female resident, 63, 7008). This likewise reveals evidence of lifescape change, in that routinized daily activities were replaced with a focus on risk and uncertainty.

Participants' responses also highlighted how changes to daily practices due to increased awareness of legacy contaminants differed to the daily practices used to deal with industrial contamination throughout periods of industrial activity. As residents associated these older types of pollution with visual cues (such as smoke emitting from industrial chimneys), they explained many would shut their windows and doors, and ensure their homes were clean, rather than change their food preparation practices. One resident explained that if heavy soot was visible, residents throughout that period may have increased their cleaning efforts but were unlikely to have adopted any new practices as a result: "If there was some heavy soot … maybe [I] cleaned more" (Female resident, 83, 7001).

Further, many also emphasized how daily practices performed to prevent exposure in one's home were, themselves, taken-for-granted activities that were embedded within the social norms of the time: "You'd take overalls off inside, but you'd do that anyway. It wasn't a nice area but people didn't want their houses to be dirty. You'd want to be respectful" (Female focus group participant, 63, 7014). This suggests that changes made to daily routines due to exposure from industrial contaminants in the past did not represent the same break from taken-for-granted daily routines as changes made due to legacy forms of contamination.

Discussion

Lifescape Change from Contamination to the Home Environment

The findings from the survey, interviews, and focus group suggest that residents experienced lifescape-suggestive change after being exposed to environmental contamination. The number of residents reporting a lack of personal control over exposure to such pollutants reflects a situation in which home environments, once

associated with protection and security, became associated with a sense of harm and danger (Edelstein, 2004). Changes to individuals' daily routines and thoughts about their safety reveal that normal assumptions about daily life were replaced by a focus on risk and uncertainty (see Davidson, 2018; Edelstein, 2004), and a loss of belief that the natural environment will always support the human need for food and water. This reflects a loss of connection to the predictable flows and patterns of life, which provide residents a sense of existential security (Alexander, 2012; Giddens, 1991).

The study findings also suggest the presence of ontological insecurity among residents. Feelings of a loss of control over the environments in which they reside clarify in responses to questions about ability to limit contact with legacy contaminants. Arguably, this not only indicates a loss of security, but also implies a loss of deeply embedded, taken-for-granted, Western philosophical beliefs in the human ability to control the environment (Edelstein, 2004). Responses also reflect a sense of helplessness associated with ontological insecurity (Edelstein, 2004; Herman, 1992).

The study builds upon previous research in residents' responses to contamination within an Australian context (Edelstein, 2004; Prior & Partridge, 2009). This is conveyed through participants' perceptions that the visibility of contaminants may influence the degree to which one's exposure may yield lifescape change. Resident beliefs that invisible and intangible legacy contaminants were more difficult to limit exposure to than visible contaminants associated with former industrial production suggests that legacy contaminants are more likely to become linked with perceptions of environmental distrust, regardless of specific type (e.g., heavy metal, chemical, or solvent). This lends support to studies that emphasize an association between invisible contaminants and higher levels of residential uncertainty (Davidson, 2018; Dosman et al., 2001; Freudenberg, 1997; Vyner, 1988; Whitehead et al., 2011), and those that highlight the importance of subjective perceptions of risk in influencing individuals' subsequent responses (Luria et al., 2009; Slovic, 1987; Whitmarsh, 2008).

The findings differ from previous research that suggests residents affected by contamination experience the emergence of a stigmatized identity due to such instances of chemical exposure (Edelstein, 2004; Prior & Partridge, 2009). Instead, the findings suggest that visible forms of industrial pollutants, which individuals believed they could control, were more likely to be associated with stigmatization than legacy forms of contamination. As such, the evidence reveals that shame over industrial pollutants resulted from cultural norms concerning cleanliness in one's home, rather than exposure to contaminants themselves.

Lifescape Change in Responses to Indoor and Outdoor Contamination

The findings offer an original contribution to the body of knowledge examining responses to environmental contamination within home environments. This was achieved by highlighting how residents respond differently to the presence of contamination within domestic indoor and outdoor spaces. In particular, the findings reveal that evidence of pollution within the former is more likely to be associated with lifescape change compared to outdoor contamination. Features of lifescape change were also more likely to be associated with invisible forms of legacy contaminants within indoor home environments than more visible forms of industrial impurity, particularly as the latter were linked to resident perceptions of domestic spaces. This suggests that only when such contaminants entered one's home did they become perceived as "matter out of place" (Douglas, 1966, p. 36; Eakin et al., 2010; Hinchcliffe, 2001; Loyd, 2009; Meade, 1976; Scott et al., 2012; Smallman-Raynor & Cliff, 2008). However, despite this factor, these same pollutants were perceived as easier to control in terms of exposure than invisible legacy contaminants. This lends support to previous research that suggests certain types of pollutants associated with living in a city are more likely to be accepted by residents, regardless of health risk (Cupples, 2007; Eiser et al., 2007). Conversely, invisible legacy contaminants in both contemporary indoor and outdoor environments were rendered "matter out of place" (Douglas, 1966, p. 36), and perceived to threaten the sense of safety associated with domesticity.

The study also highlights how the increased importance attributed to indoor home environments within contemporary city life results in greater potential for lifescape change within the context of legacy contamination (Dupuis & Thorns, 1998; Giddens, 1991). This supports the theory that perceptions of contaminated spaces are socially constructed and fluid over time (Bickerstaff & Walker, 2003, p. 46; Davis, 2005).

Conclusion

This study builds on previous research examining human responses to environmental contamination at home by revealing how differences in residents' perceptions of contaminants result in differences in lifescape change (Edelstein, 2004; Freudenburg, 1997; McIntryre et al., 2018; Prior & Partridge, 2009). It also offers an original contribution to the existing body of scholarship exploring the spatial dynamics of responses to environmental contamination (Edelstein, 2002). This is primarily achieved through an exploration of how lifescape change relates to indoor and outdoor home environments, and how changes to the symbolic value attached to such spaces affect resident responses.

From a human ecology perspective, the study offers new insights into how the presence of environmental contamination in both indoor and domestic spheres influences human behavior, as well as how socioculturally constructed norms about home environments and different types of contaminants affect the interrelationship between humans and their surrounds. It also reveals the merits of a transdisciplinary and mixed-methods approach for understanding the extent to which contaminants affect human experience.

Overall, this study presents important implications for the development and implementation of strategies for public health hazard-risk information. Awareness of the factors that contribute to lifescape change can help guide the development of strategies to improve the relevance and communication of information outputs. Given the extent to which subjective perceptions of contaminants influence resident responses, it is vital that these outputs seek to remedy incorrect assumptions to restore a sense of security. Public health information should also focus on providing specific information about the risks present within indoor environments, particularly considering the significance of such settings for human security. However, further transdisciplinary research involving multiple stakeholders needs to be undertaken to better investigate what the information outputs should include and how best to communicate these to ensure they reach different audiences, especially those most marginalized within communities. This could involve researching how demographic factors, such as age and disability status, influence responses to contamination.

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