Communities Living with Chronic Environmental Contamination:

Leveraging Interdisciplinarity to Address Environmental Justice Issues

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Abstract

The experience of long-term exposure to environmental contaminants, or chronic environmental contamination (CEC), is an increasingly common environmental hazard with deleterious physical and mental health outcomes. CEC is also an environmental justice issue, as communities of color and low-income communities disproportionately face such hazards. Research on environmental issues in psychology has largely focused on acute hazards such as natural disasters, and on abstract hazards such as climate change. While there has been limited research on more intermediate hazards like CEC in psychology, we assert that psychological methods and theories have much to add to interdisciplinary collaborations concerning stress, resilience, and collective action in the context of CEC. In the present paper, we first situate CEC relative to other environmental hazards that have received more attention in psychology. We then review literature on the psychological health impacts of CEC, as well as relevant disparities in negative outcomes associated with CEC. We then recommend ways for psychological researchers to engage in interdisciplinary and community-based participatory research on this topic. We finish with suggested future directions for research that documents and intervenes on the impacts of CEC using psychologically-informed interdisciplinary research.

Keywords: *Chronic Environmental Contamination; Environmental Justice; Interdisciplinarity; Stress; Coping*

Public Significance Statement

Communities across the world have increasingly faced long-term exposure to environmental contamination, which can cause serious physical and mental health issues. We argue that psychological research can help us to understand the experiences of such communities, and can also help reduce the negative impacts of these exposures. However, for psychologists to achieve

this, we will need to collaborate with interdisciplinary research teams that include researchers

from fields such as environmental science and public health, and we will need to work directly

with communities impacted by these environmental issues.

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"Darling, down and down I go,
round and round I go in a spin" …
the river, and its sediments
the air, capricious with winds,
the soil column, the ground water,
the vase of wildflowers…
the mosquitoes, for pity's sake,
the farm animals, the farmers living
off the land, the water birds and
the duck hunters, the bottom fish and
the fishermen on Richard dock.
Everything he thinks to test… good god,
the entire food chain contaminated.

-from "Herb Parker Feels Like Dancing" (Flenniken, 2008, p. 41-42)

Imagine a working class family that has lived in the same home in a U.S. metropolitan area for 10 years. Sometimes the color or smell of the water in the home has appeared odd, but in general they have not experienced any major problems with their home. As one of the children in the family advances through elementary school, however, they develop an illness that is unusual for people their age. Their parents, through conversation with neighbors, discover that this illness appears surprisingly common among children in the area. The parents eventually hear a rumor that the apparent illness cluster may be related to the water in their home, stemming from waste disposal practices that were carried out by a major factory years ago. When the parents bring this possibility up with their family physician, they are told that while this is possible, it is not likely, and they should probably stop worrying about it. Eventually, the parents attend a city council meeting to bring up their concern about the water, but their concerns are dismissed by council members, who say that the state department of environmental quality monitors the water and there is no easy way to link the factory's practices with the quality of water in their home. Only

after realizing that many other neighbors in the community share their concern do the parents decide to take action by joining these neighbors in a community group dedicated to water justice issues. After working with federal governmental officials and scientists, the community eventually determines that the water in their homes may indeed have been contaminated for many years due to factory activity, and the contaminants identified can in some instances cause the illness observed in their children. Meanwhile, the child has grown increasingly ill, and the parents begin to feel guilty about the fact that they bathed their child in this water for years. Because their neighborhood is stereotyped as a "working class neighborhood", they also wonder if this would have happened to them if they could afford to live in a different part of town.

This hypothetical experience is increasingly typical for the 73 million people in the United States today who live within 3 miles of a "Superfund Site," an area of land contaminated with hazardous substances that is being actively monitored and cleaned up by the US Environmental Protection Agency (United States Environmental Protection Agency, 2020). Decades of research substantiate the various elements of this hypothetical experience. For instance, contaminated sites are disproportionately located near low-income communities and communities of color (Mohai & Saha, 2015), and when people start to suspect that they have been exposed to contamination, their concerns are often downplayed by doctors and local officials (Calloway et al., 2020; Checker, 2007). It is often primarily through community collective action in the form of "popular epidemiology" that contaminants and their impacts on health are discovered in the first place (Brown, 1992). Parents in these communities often feel a sense of guilt for having inadvertently exposed their families to contaminants (Edelstein, 2018), even though people accurately attribute their exposure to racist and classist siting of toxic waste sites (Clarke & Gerlak, 1998; Muhammad et al., 2018).

These increasingly common experiences have been labeled as chronic environmental contamination (CEC): "living in an area where hazardous substances are known or perceived to be present in air, water, or soil at elevated levels for a prolonged and unknown period of time" (Schmitt et al., 2021, p. 1). CEC has been ubiquitous in the United States and abroad for the past half century as poorly handled toxic substances have been improperly disposed of or released into the environment as the result of natural or technological disasters (i.e., ones caused by a malfunction in human-made technology; Noguera-Oviedo & Aga, 2016; Tucker, 1998). The community experience of CEC has a wide range of negative physical and mental health consequences, stemming from the exposure itself, as well as the often decades-long social processes surrounding remediation and litigation on contaminated sites (Couch & Coles, 2011; McEwen & Tucker, 2011).

CEC represents a common environmental justice issue, whereby communities of color and low-income communities disproportionately face natural and human-made environmental hazards (Bullard, 1994; Kramar et al., 2018). In spite of how widespread and harmful CEC and environmental justice issues are, psychologists have largely not engaged in research on these topics, with a few notable exceptions (Bonam et al., 2017; Kruger et al., 2017; Perez et al., 2021). This relative inattention by the field of psychology is unfortunate, as CEC represents a pressing social justice issue for which psychological research could have widespread application and societal benefit.

Adequately addressing the impacts of CEC and fostering collective action in response to such events should be a central part of broader policy and research engagement with climate change, for at least two reasons. First, the frequency of community experiences of CEC is historically increasing because of the interrelated rise in technological, natural, and combined

"natech" disasters driven largely by anthropogenic climate change (Aldrich & Meyer, 2015).

Thus, by confronting the unique psychological impacts of CEC, researchers are actually

addressing one of climate change's many effects. Second, for many people (particularly from

underserved or disadvantaged backgrounds), undergoing CEC and/or technological disaster may

be their first, personal experience of the kinds of environmental hazards that are ultimately

implicated in climate change. Thus, as we will argue, CEC is a relatively personal and immediate

threat for some individuals that can, in certain instances, galvanize the kind of collective action

ultimately required to face climate change. However, confronting this issue requires that

researchers engage with issues of environmental science, public health, community-engaged

scholarship, local histories, and matters of power, privilege, and racism. Thus, for psychologists

to contribute to impactful work that addresses CEC, the field must embrace interdisciplinarity

and mixed-method approaches. In the present paper, we briefly review literature on the

psychological impacts of CEC, offer suggestions for psychologists to engage in interdisciplinary

work on such issues, and highlight possible directions for future interdisciplinary work with real-

word impacts in this area.

Situating CEC in a Typology of Environmental Hazards

Important research in psychology has outlined the impacts of natural disasters, and how

psychological research and practice can contribute to recovery and resilience following such

events (see Bonanno et al., 2010). Likewise, recent research in psychology has sought to address

issues of climate change, employing various (social) psychological theories to predict climate

change related attitudes and behaviors (Fritsche et al., 2018; Jugert et al., 2016), and suggesting

ways to involve psychologists in interdisciplinary work that mitigates climate change at

individual, cultural, and social-structural levels (Nielsen et al., 2021). These lines of research

have produced important knowledge and societal benefit in the context of environmental threats that are acute and traumatic, and for threats that are (perceived as) more abstract and distant. However, the psychological impact of CEC may be notably different from these other environmental hazards that have received more attention in psychological literature.

Sullivan et al. (2021) propose a typology of environmental hazards that situates CEC relative to natural disasters and climate change (see Figure 1). Building on classic work in environmental sociology (Kroll-Smith et al., 1991), they suggest that there are two important dimensions on which the impact of environmental hazards can be measured: (1) a *material dimension* which concerns impacts on the physical environment and on physical health, and (2) a *social dimension* which concerns impacts to the psychosocial landscape of an impacted person or community. Natural disasters represent one extreme end of this theoretical continuum, as they are characterized by a concentrated material impact (e.g., property destruction, loss of life) and a greater degree of social consensus in how to define the risk at hand and how to respond to it. Climate change, at the other extreme, is characterized by longer-term, diffuse material impacts (e.g., property devaluation) and a greater deal of social fragmentation in definition and response. CEC, according to Sullivan et al. (2021), exists in the middle, sharing elements with events on either end of the continuum. In terms of the material dimension, CEC often does not have a single triggering event and health impacts tend to unfold over several years. However, CEC events tend to be more bounded in space and concentrated than the looming threat of climate change. In terms of the social dimension, CEC again shares elements of social fragmentation with climate change, and elements of social consensus with natural disasters. Because with CEC there is often not a single initiating event, and because contamination often occurs over a longer period of time due to various technological failures, it is often difficult to assign blame or to

come to consensus in defining the risks associated with the hazard. This can lead to general distrust, alienation, and social conflict in impacted communities (Couch & Mercuri, 2007; Kroll-Smith & Couch, 1990). However, CEC is a more geographically discrete problem compared to climate change, especially with such institutional mechanisms as the Superfund program in place to identify the borders of a contaminated site.

The uniqueness of the material and social aspects of CEC are in large part a consequence of the unique temporal trajectory of this type of environmental hazard (Auyero & Swistun, 2009; Couch & Coles, 2011; Edelstein, 2018). Where recovery from a natural or technological disaster often follows a linear trajectory, from initial warning signs to actual impact to recovery and rehabilitation, CEC is often characterized by cyclicality. Specifically, the community experience of chronic contamination events typically begins with the initial discovery of the contamination and its announcement to the community (e.g., by governmental agencies or local media). This is then followed by various psychosocial processes in response (e.g., stress, anger, indifference, working with local agencies), and some community members may begin to face negative health impacts from exposures (Edelstein, 2018). Whereas during more acute disasters, these initial phases would typically be followed by remediation and recovery phases, CEC events often involve some members of the community getting stuck in a cyclical recurrence of these initial phases (Couch & Coles, 2011).

A pervasive sense of uncertainty and powerlessness often stems from the cyclicality and chronic nature of the CEC experience. Because exposures to toxicants are often invisible and occur over long periods of time, it can be nearly impossible to empirically prove associations between a specific exposure and a specific negative health outcome. This scientific uncertainty often clashes with community perceptions of clear causality between perceived exposure and

health outcomes (Freudenburg, 1997; Vyner, 1988). Such a disconnect between community and

scientific epistemologies can lead to further institutional delegitimization of community concerns

(Edelstein, 2018). This uncertainty is also extended over long periods of time because many

health effects from chronic exposures can take years to develop and can potentially be passed on

to future generations in the case of toxicants with epigenetic effects (Head et al., 2012). This

temporally extended sense of uncertainty can cause impacted communities to experience CEC as

a seemingly endless period of "exposed waiting" (Auyero & Swistun, 2009). Community

members may experience (re)traumatization as slow-onset health impacts develop years later, as

technological advances facilitate the discovery of "emerging" contaminants that the community

was also exposed to, as litigation efforts ensue, and as social conflicts arise within the

community and between community members and institutional officials (Calloway et al., 2020;

Noguera-Oviedo & Aga, 2016). Indeed, this chronic exposed waiting has further downstream

consequences for how individuals construe time in a broad sense. Some CEC-impacted

individuals tend to focus on their catastrophic past that merges with the uncertain and

uncontrollable present, which can then prevent these individuals from planning for the future

(Davidson, 2018; Edelstein, 2018; Kruger, 2018; Sullivan et al., 2020).

Psychological Consequences and Psychosocial Factors in CEC

      Psychological Health Consequences of CEC. The unique material, social, and historical

impacts of the CEC experience contribute to a wide range of negative psychological health

impacts (Edelstein, 2018). A recent meta-analysis of studies revealed that living through CEC

has small, but significant effects on general psychological stress, anxiety, depressive symptoms,

and post-traumatic stress symptoms (Schmitt et al., 2021). Of course, not all community

members in an exposed area will experience these negative psychological health outcomes, with

some impacted individuals exhibiting a "maximalist" response characterized by more severe

distress, and some evincing a "minimalist" response characterized by denial of the threat or

confidence that it could be handled by those in power (Fowlkes & Miller, 1987).

Given that there are divergent psychological outcomes associated with CEC it is

important to highlight certain risk factors that may predict whether exposed community members

evince a minimalist or maximalist response. Sullivan and colleagues (2021) suggest that

important risk factors for experiencing psychological distress in response to CEC include the

extent to which people experience impacts along the material and social dimensions outlined

above. Along the material dimension, the extent to which people perceive that they have

experienced negative health outcomes from exposures is a clear risk factor for psychological

distress (Clapp et al., 2016; Schade et al., 2016). Recent work outlining the concept of allostatic

(over)load further suggests that because the chronic stress associated with exposure to CEC can

cause dysregulation of immune system function (Dhabhar, 2014), the stress of exposure can

interact with the effects of the toxicants themselves to predict even worse health outcomes

(McEwen & Tucker, 2011). Impacted community members may also experience stress in

association with financial concerns that arise from exposures, such as dropping property values

or inability to sell homes that have been "contaminated" (Edelstein, 2018).

Along the social dimension, the extent to which people experience *institutional*

delegitimization of their concerns from representatives of powerful institutions is also an

important risk factor for distress (Sullivan et al., 2021). Institutional delegitimization occurs

when people in positions of power at socially responsible institutions (e.g., EPA, local health

departments) deny, misattribute, or downplay community concerns about health or other impacts

of CEC. For instance, local healthcare providers may be unaware of environmental exposures or

how to diagnose them, and so they may inadvertently engage in victim-blaming of exposed community members by attributing their negative health outcomes to lifestyle choices. Such delegitimizing interactions with people in positions of power contribute to the secondary social impacts of CEC by creating additional stress and reducing community trust in institutions (Couch & Mercuri, 2007; Vyner, 1988). The discovery of contamination and subsequent processes of institutional delegitimization can further result in shattered assumptions about the security of the environment and about the protective role of various institutions (Edelstein, 2018). Classic work in psychology suggests that the shattering of such worldviews may lead to the development of post-traumatic stress disorder (Janoff-Bulman, 2010).

Beyond conflicts that arise between community members and institutions, past literature on CEC has documented intracommunity conflicts with detrimental impacts on mental health (Cline et al., 2014; Kroll-Smith & Couch, 1990). In some cases, contradictory collective narratives can form about the causes and consequences of a given CEC event. The proliferation of such contradictory narratives within a community – even within the same family – can result in the erosion of networks of social support that could have been a protective factor against the stress of CEC (Cline et al., 2010, 2014; Davidson, 2018). Conflicts in CEC-impacted communities may also depend on whether one is excluded from litigation efforts, whether one is employed by the polluting party, and whether one experiences illness-related stigma (Adams et al., 2020; Cline et al., 2010; Picou et al., 2004).

Disparities in Exposure and Impact. The unfortunate reality of CEC is that it is most often experienced by low-income communities and communities of color, making it an important environmental justice issue (Bullard, 2018; Kramar et al., 2018). Though a full discussion of the origins of environmental racism and injustice is outside the scope of the present paper, it is

important to acknowledge the vast literature on this topic (e.g., Bullard, 1994; Taylor, 2014). In the United States, intersecting histories of racism and capitalism have produced the current state of environmental injustice by shaping dominant perceptions of both people and the environment (Bullard, 2004). Centuries of colonization, slavery, and racist oppression and dehumanization have produced devalued and otherized perceptions of people of color – particularly among (white) people in power – and has maintained the political disenfranchisement of these groups (Pulido, 2017). Simultaneously, capitalism has produced commodified conceptions of the environment which encourage corporations to maximize short-term profits at the expense of both people and the environment (Foster, 2002). The resultant system of racial capitalism thus facilitates the disproportionate placement of environmental risks on "dispossessed peoples of color, industrial laborers, the underemployed and the working poor (especially women), rural farmers and farm workers, and undocumented immigrants…" who are "*selectively victimized* to the greatest extent by corporate practices" (Faber & McCarthy, 2012, p. 39). More proximally, several interlocking factors facilitate this disproportionate victimization: ongoing racial segregation due to redlining, residential immobility for disadvantaged individuals confronted with environmental hazards and "white flight" from such spaces, and routine practices by corporations that routinely site hazardous activity in communities from which they expect less pushback (e.g., McAdam & Boudet, 2012; Mohai & Saha, 2015; Pauli, 2019).

Indeed, people impacted by CEC often explicitly attribute their exposures and subsequent treatment by institutional and industry representatives to classism or racism (Checker, 2007; Muhammad et al., 2018). Such disparities do not only exist in terms of the likelihood of exposure, but also in the outcomes associated with exposures. For instance, Downey and Van Willigen (2005) found that there tended to be more potentially hazardous industrial activity in

areas with more Latinx residents, and that the amount of industrial activity in these areas

predicted worse psychological health outcomes among Latinx respondents when compared to

non-Latinx respondents. Similar disparities have been found for Black communities exposed to

contaminated drinking water in Flint, Michigan (Cuthbertson et al., 2016), and for Navajo and

other Native American communities in the Western US who have been exposed to soil and water

contamination as a result of extensive mining practices (Lewis et al., 2017; Markstrom &

Charley, 2003). These disparities in the impacts of exposure to environmental contamination

may stem in part from interactions between the environmental exposures themselves and the

stress of experiencing poverty or racist and classist discrimination. Thus, some scholars have

proposed a "double jeopardy" hypothesis in this context: that people who face environmental

hazards and systemic discrimination (e.g., communities of color, low-income communities,

women) may face compounding effects of these different stressors (Morello-Frosch & Shenassa,

2006).

One reason that members of disadvantaged groups face worse psychological health

outcomes as a result of CEC is an increased likelihood of experiencing impacts along both the

material and social dimensions (Sullivan et al., 2021). This includes higher likelihood of

experiencing or perceiving health impacts from CEC and a higher likelihood of experiencing

institutional delegitimization. For instance, when women express concerns about health impacts

from exposure, their concerns are more likely to be written off as irrational or hysterical by

institutional representatives (Brown & Ferguson, 1995). Likewise, institutional representatives

often dismiss health concerns voiced by low-income communities and communities of color by

attributing poor health outcomes to "lifestyle choices," which are often racially coded (Checker,

2001, 2007). In spite of such institutional delegitimization of the concerns of disadvantaged

communities, there is a strong tradition of such communities persevering and engaging in popular epidemiology to identify disease clusters and advocate for community needs outside of traditional academic and institutional routes, which is a convincing testament to the importance of collective action in coping with CEC (Brown, 1992; Gibbs, 2002; Mix & Shriver, 2007; Moreno Ramírez, 2020).

Collective Efficacy and Action to Cope with CEC. Collective efficacy involves the shared beliefs of a given group that they can work together to achieve common goals (Bandura, 2000). A tradition of research in psychology suggests that collective efficacy is important for how individuals cope with environmental issues, particularly because it has downstream potentialities for collective action (Fritsche et al., 2018; Jugert et al., 2016). Research from the broader social sciences has further highlighted that in CEC-impacted communities, higher collective efficacy and more engagement in collective action predict positive material and psychological outcomes (Baum et al., 1983; Stone & Levine, 1985; Tierney, 2014). For instance, in classic work by Stone and Levine (1985), community members who had engaged in activism following the discovery that toxic chemicals were leaching from a dump site in Love Canal reported less negative psychological impacts than did non-activist community members. Thus, one important direction for research in psychology is to find ways to increase collective efficacy and action among CEC-impacted communities.

One important limitation of psychological work on collective efficacy and action, however, has been the predominant focus on proximal social psychological variables (e.g., perceived efficacy, social identity, perceived injustice), at the expense of considering broader social, cultural, and structural forces which may also influence collective efficacy and action (e.g., Thomas et al., 2020; Van Zomeren et al., 2008). This may mean that psychological

research in this realm has missed out on important phenomena that exist at levels of analysis that are beyond the typical inquiry of the field. Indeed, interdisciplinary work in sociology and public health has revealed that effective collective action and mobilization in the wake of CEC often involves affordances that extend beyond the realm of the (social) psychological, such as experiences with systemic racism and poverty, power relations in communities dependent on employment from polluting parties, networks of social capital within communities and between communities and powerful institutions, and the (non)presence of political allies (Almeida & Stearns, 1998; Bell, 2016; Davidson, 2018). Thus, it is important that future work on collective efficacy and action in CEC-impacted communities employ interdisciplinary approaches, methods, and theories.

Overcoming Barriers to Interdisciplinary Research

Addressing chronic environmental contamination, as well as other pertinent environmental issues such as climate change, will require substantial interdisciplinary and applied research efforts that engage diverse theories, methods, and stakeholders (Hoover et al., 2015; Nielsen et al., 2021). Such approaches are important because they can work to paint a more complete picture of the impacts of events like CEC, by highlighting environmental, physiological, psychological, social, and political implications of exposure, as well as conceptually linking these local events to broader forces involved in capitalism and global climate change. However, interdisciplinary research can be a challenging endeavor. Scholars have identified common barriers, including those at the individual level (e.g., attitudinal and communication barriers) and those at the institutional level (e.g., departmental structures, access to funding; Pellmar & Eisenberg, 2000). Attitudinal barriers to interdisciplinary research involve tacit assumptions of the superiority of methods and theories in one's own field, while

communication barriers involve the more practical difficulties of learning the jargon of other disciplines. Working across departmental boundaries can be difficult as well, depending on one's institutional context. Likewise, funding can be difficult to attain for explicitly interdisciplinary projects, though interest in funding such research has certainly grown among both federal and private sector funders (e.g., various NIH institutes, Russell Sage Foundation, Robert Wood Johnson Foundation; Maton et al., 2006).

Many scholars have outlined best practices for overcoming the barriers to interdisciplinary research (e.g., Cummings & Kiesler, 2005). We point readers specifically to writings on interdisciplinarity from community psychology – a subfield that has long valued the combination of psychological and interdisciplinary methods with a focus on action, application, and social justice (Maton et al., 2006). One way of overcoming individual-level barriers to interdisciplinary collaboration is to approach research from a problem-focused, rather than a predominantly theory-focused, lens. When scholars from different disciplines agree on the problem being addressed by the collaboration, then "the disciplines mostly melt away" as methods are combined in the interest of mitigating a specific social issue, rather than appeasing the theoretical dogma of any one discipline (Shinn, 2006, p. 27). The benefits of this approach are readily apparent in the context of CEC research, because the problem is inherently interdisciplinary, requiring the work of environmental scientists to understand the nature of the contamination, epidemiologists to understand exposure pathways, social scientists to understand the necessary political solutions, and public health and psychological professionals to understand the human impacts. For psychologists seeking to conduct research with interdisciplinary teams working to address environmental issues, Clayton and colleagues (2016) suggest that individuals approach such efforts with *humility*, including admissions of ignorance about topics outside of

one's specialty, recognition of the limitations of the methodologies of any one discipline, and the construction of shared vocabulary and values between team members across disciplines.

Beyond overcoming individual-level barriers to interdisciplinary work, barriers at the institutional level may be more difficult to overcome. Still, many graduate training programs in psychology allow students to pursue minors in different disciplines, and some explicitly center interdisciplinarity in their core training requirements (Clay, 2012). Likewise, training programs in community psychology have long encouraged and trained scholars in interdisciplinary approaches (Dalton & Wolfe, 2012). These programs may provide models for other departments and training programs to incorporate support for interdisciplinary research. Importantly, institutional support for interdisciplinarity may help individuals overcome their own attitudinal and communication-related barriers to pursuing such research. Another way to overcome structural and institutional barriers to interdisciplinary and applied research has to do with cultural shifts in the academy, including changing incentive structures, redefining "success" in research, and shifting toward the valuation of collaborative, team, and community-engaged science (Bracken et al., 2015; Clayton et al., 2016).

Adequately addressing an issue like CEC through research requires more than collaboration across academic disciplines. It also requires collaborations between the academy and impacted communities themselves. Literature on Community-Based Participatory Research (CBPR), or Participatory Action Research (PAR) as it is sometimes referred to, encompasses a wide range of methodological considerations that scholars may consider when working directly with communities to address environmental justice issues. There are several key elements of community-based participatory research that are vital to successful and fruitful collaboration between academic researchers and impacted community members (for review, see Israel et al.,

1998). These may include (1) collaboration in all phases of the research process, including the construction of the basic research questions, (2) power sharing between stakeholders so that research decisions are made with community input, (3) validation and honoring of ways of knowing that may conflict with positivistic, scientific, or empirical ways of knowing, (4) dissemination of research findings back to the community and other stakeholders, (5) an acknowledgment of researchers' relative power, privilege, and positionality, and (6) the use of multiple and mixed-methods, including qualitative and quantitative approaches, in order to both describe and intervene on the issue at hand (Cruz, 2008; Israel et al., 1998; Muhammad et al., 2015; Watkins, 2015).

Community-based participatory research approaches are particularly important in the context of CEC for a number of reasons. At a basic level, impacted communities in this context are often highly motivated to pursue the knowledge and social capital potentially offered by research, insofar as individuals often want data concerning the extent of their exposure and communities often seek exposure evidence as a basis for political or legal action (Judge et al., 2016; Pauli, 2019). By working with community members to gather the data that is most relevant for them, researchers go beyond "basic" interdisciplinary research and apply their efforts with sensitivity to a community's lived experience and local history. Communities impacted by environmental justice issues are historically over-researched with little to show for it, meaning that over the decades of cyclical processes surrounding CEC, impacted community members may participate in dozens of studies on which they gave no input, whose results they never hear about, and which do not result in tangible benefits for the community (Castleden et al., 2015; Chen et al., 2010; Davis & Ramírez-Andreotta, 2021). This hegemonic way of conducting research can exacerbate the stress that a community experiences from CEC by creating distrust in

academic institutions, further isolating impacted communities from potentially beneficial networks of social capital. Indeed, practitioners of Community-based participatory research often describe the benefits of these approaches that stem not only from the "results" of a given study (e.g., reducing health disparities), but also from the process of partnering in and of itself by increasing community trust in institutions, empowering community members to ask their own questions, share their own stories, and design their own research, and honoring local histories and ways of knowing (Hoover et al., 2015; Wallerstein & Duran, 2010).

Future Directions for Applying Interdisciplinarity to Address CEC

There are several promising avenues for future research employing psychological theories and methods – alongside those from other disciplines – to investigate and address CEC. We base our recommendations for potential productive research on both our own work with CEC-impacted communities, as well as past interdisciplinary research efforts among such communities that have been documented in the literature. Our recommendations for future interdisciplinary research fall into two broad categories: (1) recommendations for outlining the (psychological) experience and impact of living through CEC, and (2) recommendations for research that intervenes on the material, social, and historical processes that occur in the wake of CEC, with the caveat that research on (1) and (2) often can and should be conducted in tandem. For many of these recommendations, principles of community-based participatory research should be applied when possible in order to strengthen ties between impacted communities and local institutions.

Research outlining the experience and impact of CEC. We echo recommendations from recent reviews of the literature on the psychological impact of CEC by an interdisciplinary team of researchers working with the Agency for Toxic Substances and Disease Registry

(ATSDR), a federal public health agency tasked with researching and protecting the public from the harmful effects of hazardous substances (see Gerhardstein et al., 2019; Schmitt et al., 2021; Sullivan et al., 2021). For instance, Schmitt and colleagues (2021) suggest that future research on the impacts of CEC should simultaneously assess objective and subjective exposures to a given hazard, as well as psychological and physical health impacts using self-report and physiological measures. This has largely not been done in past literature, though such considerations will help to paint a fuller picture of the health consequences of CEC. By assessing exposures, psychological health, and physical health, researchers can begin to document the possible synergistic or additive effects of exposure to toxicants with the psychological stress impact of those exposures on poor physical health outcomes, in line with research on allostatic overload (McEwen & Tucker, 2011). Such work may require interdisciplinary partnerships between environmental health scientists, psychologists, public health researchers, and other community-engaged scholars (Hoover et al., 2015).

Along with assessing these multiple pertinent variables to document the impact of CEC, future research should also employ a greater diversity of study designs. For instance, in their meta-analysis of studies on the psychological health impacts of CEC, Schmitt and colleagues (2021) identified that the majority of such studies were cross-sectional, only looking at a CEC-impacted population at one point in time. Given that CEC has a unique temporal and historical trajectory, it follows that future work should document longitudinal processes in a community's experience, something that psychologists may be particularly well-suited to handle in terms of quantitative methods and analysis (e.g., Bonanno et al., 2008). Future work should also continue to employ a variety of qualitative approaches (e.g., interviews, focus groups, photovoice, oral histories) to not only document local experiences and understandings of a given CEC event, but

also to empower impacted communities to voice their own account of pertinent events and experiences in line with community-based participatory research principles (Bell, 2016; Moreno Ramírez, 2020; Sullivan et al., 2020, 2021).

Research intervening on the material, social, and historical impacts of CEC. In order to intervene on and mitigate the impacts of CEC, we present a non-exhaustive list of potential future directions for interdisciplinary research. These include research efforts and interventions on phenomena related to psychoeducation and risk communication, community conflict, and collective efficacy and action. We also direct readers to other reviews on best practices for implementation science (e.g., Bauer et al., 2015; Meyers et al., 2012; Moir, 2018), which can be applied to enhance and assess the effectiveness of various interventions in the context of CEC.

Because institutional delegitimization of community concerns is a major secondary source of stress in the context of CEC, one important direction for applied research involves educating medical professionals, public health professionals, environmental scientists, and other institutional representatives that may regularly interface with impacted communities. Specifically, research could employ educational efforts that inform professionals about the mental health impacts of living through CEC, so that professionals may legitimize and validate the concerns of impacted community members, without further exacerbating stress. In recent years, efforts have already been made in psychology to aid primary care providers in their understanding and handling of patients' mental health concerns (Beacham et al., 2012; Porcerelli & Jones, 2017), and such efforts could be extended to representatives of other public-facing institutions. More basically, applied research efforts should be made to educate primary care providers about the existence of and possible health concerns associated with CEC in a given community, as past studies have indicated that primary care providers may be unaware of local

contaminant exposures, resulting in frustrating interactions with patients who suggest that their

health concerns may stem from such exposures (Calloway et al., 2020).

Along with educational outreach, future applied research may seek to develop and teach

effective risk communication strategies that are specific to long-term, uncertain, and invisible

threats like CEC. Some literature has outlined CEC-specific risk communication needs

(Ramirez-Andreotta et al., 2014; Van Der Pligt & De Boer, 1991), and other literature has

outlined the importance of cultural context for understanding how risks are defined, understood,

and effectively communicated (Douglas, 2013; Lindell & Perry, 2003). Indeed, there is a strong

tradition of research in health psychology on how to effectively communicate various risks

(Berry, 2004). However, environmental (health) scientists who may be tasked with

communicating CEC-related risks often do not receive adequate training in this area, particularly

when it comes to contentious issues where community members may be particularly angry or

scared (Ramirez-Andreotta et al., 2014; Sandman, 1993). One promising direction for related

research involves community-based participatory research approaches that involve community

stakeholders in the definition, analysis, and dissemination of risk communication materials in

order to maintain community confidence in the risk-related information and to ensure the

relevance and congruence of materials with local cultures (Claudio et al., 2018; Ramirez-

Andreotta et al., 2014).

ATSDR has recently released the Community Stress Resource Center

(https://www.atsdr.cdc.gov/stress/), which provides fact sheets, trainings, and general

information about the stress impact of CEC, ways for professionals to address stress, and how

professionals can communicate risks effectively. Many of these materials could be used to design

applied research for educational outreach. Such approaches should emphasize the importance of

legitimizing the community stress experience of CEC, communicating risk effectively, building lasting relationships between an impacted community and institutions, and attending to the chronic nature of the CEC experience (Sullivan et al., 2021).

The social impacts of CEC occur not only between community members and institutional representatives, but also within communities themselves (Cline et al., 2014; Kroll-Smith & Couch, 1990). There is a rich history of research in psychology on conflict resolution in the context of various politically contentious or violent issues using, for example, the interactive problem-solving method (Fisher, 1997; Hicks & Weisberg, 2004). Future research efforts could adapt these approaches by employing community-based participatory research principles to work with CEC-impacted community groups that may be in conflict (Brummans et al., 2008; Dean & Bush, 2007).

Given that collective efficacy is an important driver of collective action in the face of environmental threats and stressors (Fritsche et al., 2018), it follows that future research should apply psychological theories on collective efficacy and action to increase these variables to encourage adaptive community responses to CEC. Future studies should focus not only on the proximal variables typically investigated by psychological inquiry into collective action (e.g., perceptions of efficacy, injustice, norms, and social identity; Barth et al., 2021; Van Zomeren et al., 2008), but should also investigate various social-structural phenomena that may play a role in encouraging or quelling collective action. For instance, research suggests that social capital – the economic, social, political, and other resources available to individuals as a function of their social networks – is a vital aspect of community resilience and collective action in the wake of CEC and other environmental issues (Adger, 2003; Couch & Coles, 2011; Hawkins & Maurer, 2010). Thus, future interdisciplinary research should seek to combine insights from psychology

on the proximal and psychological variables associated with collective efficacy and action, with insights from the broader social sciences on influences from higher levels of analysis.

For instance, our recent research concerning chronic water contamination in Tucson, AZ, USA employed geographical, qualitative, and experimental methods to investigate the role of social capital in coping with CEC in a largely low-income, Latinx community (Schmitt et al., under review). We were able to explore these phenomena at broad, structural levels of analysis using county-level geographical data, and then explore them in-depth using qualitative methods that situated these abstract variables within the lived experiences of impacted community members. Finally, based on materials and insights gleaned from our qualitative work, we developed an ecologically valid experimental manipulation of perceptions of social capital that resulted in increased efficacy and decreased defensive denial of the threat of CEC among Tucson residents. Such efforts demonstrate the potential for psychologists to contribute to research on environmental justice issues like CEC by engaging with diverse methods and levels of analysis, while situating research within a local historical and cultural context.

Conclusion

Chronic environmental contamination is a widespread and detrimental experience for the largely low-income communities and communities of color that are typically exposed. With the impacts of climate change likely to ramp up in the next decades (Masson-Delmonte et al., 2021), the tools gained from interdisciplinary work on CEC in the present may be applicable to the looming threat of climate change. Indeed, as the typology of environmental hazards presented earlier suggests, CEC exists on a spectrum of material and social impact that also includes climate change, ambient pollution, and natural disaster – problems that are all increasing in severity largely due to the same underlying anthropogenic processes (e.g., unchecked growth,

production, and consumption). To fully understand and combat these "wicked problems", they need to be examined and confronted in each of their major manifestations. The field of psychology has already begun major efforts to confront the abstract threat of climate change and the highly proximal threat of natural disaster, but has remained limited in its past research efforts on the "intermediate" problem of technological disaster and CEC. Yet as this paper has demonstrated, psychology has much to offer interdisciplinary investigations into CEC and related environmental justice problems. The barriers to conducting interdisciplinary and community-engaged research are not insignificant, but efforts made by psychologists to overcome these barriers can produce novel and justice-oriented research with tangible benefits for communities facing environmental injustices.

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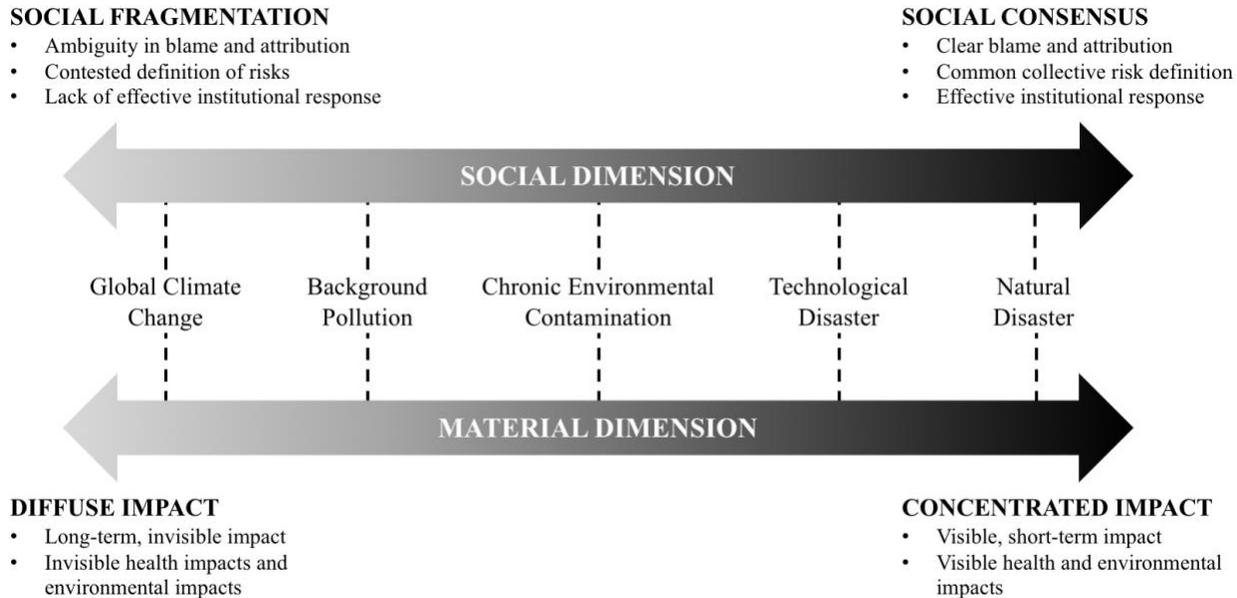
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Figures

Figure 1. *Situating CEC on a typology of environmental hazards (adapted from Sullivan et al., 2021).*

SOCIAL FRAGMENTATION
- Ambiguity in blame and attribution
- Contested definition of risks
- Lack of effective institutional response

SOCIAL CONSENSUS
- Clear blame and attribution
- Common collective risk definition
- Effective institutional response

SOCIAL DIMENSION

Global Climate Change | Background Pollution | Chronic Environmental Contamination | Technological Disaster | Natural Disaster

MATERIAL DIMENSION

DIFFUSE IMPACT
- Long-term, invisible impact
- Invisible health impacts and environmental impacts

CONCENTRATED IMPACT
- Visible, short-term impact
- Visible health and environmental impacts

Note. Reprinted from *Social Science & Medicine*, 276, Sullivan, D., Schmitt, H.J., Calloway, E.E. Clausen, W., Tucker, P., Rayman, J., & Gerhardstein, B., Chronic environmental contamination: A narrative review of psychosocial health consequences, risk factors, and pathways to community resilience, 113877, Copyright (2021), with permission from Elsevier.