

Thinking Through Levees: How Political Agency Extends Beyond the Human Mind

Nicolas T. Bergmann, Jamie McEvoy, Elizabeth A. Shanahan, Eric D. Raile, Ann Marie Reinhold, Geoffrey C. Poole & Clemente Izurieta

To cite this article: Nicolas T. Bergmann, Jamie McEvoy, Elizabeth A. Shanahan, Eric D. Raile, Ann Marie Reinhold, Geoffrey C. Poole & Clemente Izurieta (2020) Thinking Through Levees: How Political Agency Extends Beyond the Human Mind, *Annals of the American Association of Geographers*, 110:3, 827-846, DOI: [10.1080/24694452.2019.1655387](https://doi.org/10.1080/24694452.2019.1655387)

To link to this article: <https://doi.org/10.1080/24694452.2019.1655387>



Published online: 14 Oct 2019.



Submit your article to this journal [↗](#)



Article views: 213



View related articles [↗](#)



View Crossmark data [↗](#)



Citing articles: 1 View citing articles [↗](#)

Thinking Through Levees: How Political Agency Extends Beyond the Human Mind

Nicolas T. Bergmann,^{*} Jamie McEvoy,^{*} Elizabeth A. Shanahan,[†] Eric D. Raile,[†] Ann Marie Reinhold,[‡] Geoffrey C. Poole,[‡] and Clemente Izurieta[§]

^{*}Department of Earth Sciences, College of Letters & Science, Montana State University

[†]Department of Political Science, College of Letters & Science, Montana State University

[‡]Department of Land Resources & Environmental Sciences, College of Agriculture, Montana State University

[§]Department of Computer Science, Gianforte School of Computing, Montana State University

Emerging new materialism scholarship provides an exciting theoretical space not only for challenging traditional conceptions of human agency but also for rethinking the role of the material world in shaping political outcomes. Although a wildly diverse intellectual movement, this scholarship shares the common goal of widening traditional understandings of agency to include nonhuman objects. This article adopts insights from cognitive science to extend the concept of political agency beyond the confines of human intention. Instead of focusing on the constraining material characteristics of the nonhuman within a large-scale relational framework, we argue in support of a distributive understanding of agency based on the co-constitutional essence of the mind itself. Specifically, we integrate insights from embodied cognition grounded in dynamical systems theory into the established framework of the hydrosocial cycle to argue that residents' experiences within an active material world help explain the existence of certain flood risk perceptions. In other words, human intention or agency—as it is commonly understood—comes into existence through a co-constitutional process involving brain, body, and aspects of a wider environment. Using qualitative interview data from two communities along the Yellowstone River in eastern Montana, we support our arguments through an investigation of three types of embodied experiences between residents and the levees that shape risk perception. *Key Words:* embodied cognition, hydrosocial cycle, new materialism, risk perception.

新唯物主义学术思潮的兴起, 不仅为挑战传统的“人类能动性”概念提供了令人振奋的理论平台, 同时还反思了物质世界在塑造政治结果中的作用。尽管这是一场极为多元化的知识运动, 但这一学术研究拥有一个共同目标: 扩大对“人类能动性”的传统解读, 将非人类对象纳入其中。本文采用认知学观点拓展“政治能动性”的概念, 在人类意图的范畴之外对其进行探索。我们没有在更大的关系框架内探索非人类物质特性的局限性, 而是主张意识本身的构成具有共性, 在此基础上对能动性概念进行针对性的理解。具体来说, 我们将动态系统理论为基础的体验认知观点, 整合到水-社会循环的既定框架中, 证明人类在一个活跃物质世界中的经历, 会产生对某些洪水风险感知。换言之, 人们通常理解的人类意图或能动性, 其形成过程涉及大脑、身体以及更广泛环境中的方方面面, 是这些因素共同构成的结果。我们使用来自蒙大拿州东部黄石河沿岸两个社区的定性访谈数据, 通过调查居民与形成风险感知界限有关的三种特定体验, 支持我们的论点。关键词: 具身认知、水文社会循环、新唯物主义、风险感知。

La emergente erudición del nuevo materialismo provee un excitante espacio teórico no solo para retar las concepciones tradicionales de la agencia humana sino también para pensar el papel del mundo material en la configuración de los resultados políticos. Así se trate de un diverso movimiento intelectual rayano en lo salvaje, esta erudición comparte el objetivo común de ampliar los entendimientos tradicionales de la agencia para incluir objetos no humanos. Este artículo adopta perspectivas de la ciencia cognitiva para extender el concepto de la agencia política más allá de los confines de la intención humana. En vez de enfocarnos en las características materiales restrictivas de lo no humano, dentro de un marco relacional a gran escala, nos manifestamos en apoyo de un entendimiento distributivo de la agencia con base en la esencia co-constitucional de la propia mente. Específicamente, integramos perspectivas de la cognición personificada anclada en la teoría de los sistemas dinámicos, dentro del marco establecido del ciclo hidrosocial, para argüir que las experiencias de los residentes dentro de un mundo material activo ayudan a explicar la existencia de ciertas percepciones del riesgo de inundación. En otras palabras, la intención o agencia humanas—como corrientemente se entiende—hace su aparición a través de un proceso co-constitucional que involucra

cerebro, cuerpo y aspectos de un entorno ambiental de mayor amplitud. Usando datos de entrevistas cualitativas en dos comunidades situadas a lo largo del Río Yellowstone, en Montana oriental, reforzamos nuestros argumentos a través de una investigación de tres tipos de experiencias personificadas entre residentes y los diques naturales que configuran la percepción del riesgo. *Palabras clave:* ciclo hidrosocial, cognición personificada, nuevo materialismo, percepción de riesgo.

The rise of postmodernism in the latter decades of the twentieth century allowed little space for substantive discussion about the power of nonhuman objects. However, a turn to new materialism in the social sciences and humanities (Whatmore 2006; Coole and Frost 2010; DeLyser and Greenstein 2017), has provided an exciting theoretical direction for not only challenging traditional conceptions of human agency (Knappett and Malafouris 2008; Bennett 2010; Roberts 2012) but also for realizing the active role of the material world in shaping political outcomes (Braun and Whatmore 2010; Shaw and Meehan 2013; Anand 2017). Although a wildly diverse intellectual movement, new materialism shares the common goal of rethinking traditional understandings of agency to include objects such as lawns, cotton, cellos, and water (Bakker 2004; Ingold 2004; Robbins 2007; Russell 2011). Relying heavily on insights from science and technology studies (Latour 1993) and critical feminist studies (Haraway 1991), new materialism extends poststructuralist relational thinking beyond human institutions (Ash and Simpson 2016). Aside from understanding nonhumans as important “wellsprings” of political power (Meehan 2014), scholars have redefined humans through an emphasis on corporeality that challenges the independence of not only the human body (Bakker and Bridge 2006; Langston 2010; Bauch 2017), but also—more radically—the mind (A. Clark 1998; Shapiro 2011; Malafouris 2013).

Despite new materialism scholars’ success in theorizing agency as distributive,¹ studies grounded in empirical evidence remain limited. Challenges persist in gathering evidence for the existence of an alternative way of being especially when the origins of current knowledge systems can be traced to the dualisms of modernity (Latour 1993). Most new materialism scholarship relies on large-scale relational approaches that weave a narrative of human and nonhuman actors together to support the existence of more-than-human understandings (Whatmore 2002; Bennett 2010; Swyngedouw 2015). The difficulty inherent in

gathering evidence supporting the agency of nonhuman objects helps explain the tendency of scholars to focus on the constraining rather than productive capacities of more-than-human things (Bakker 2004; Braun and Whatmore 2010; Anand 2017).

To strengthen the claim for attributing agency to nonhuman objects, we adopt insights from cognitive science to extend the concept of political agency beyond the confines of human intention. Instead of focusing on the constraining material characteristics of the nonhuman within a large-scale relational framework, we argue in support of a distributive understanding of agency based on the co-constitutional essence of the mind itself (Shapiro 2011). Specifically, we integrate insights from embodied cognition into the established framework of the hydrosocial cycle (Linton and Budds 2014) to argue that residents’ experiences within an active material world help explain the creation of certain flood risk perceptions. In other words, human intention or agency comes into existence through a co-constitutional process involving brain, body, and elements of a wider environment. Throughout the article, we use qualitative interview data from two communities along Montana’s Yellowstone River to provide empirical support for the claim that human cognition and political agency exist as larger conglomerations within a creative material world.

This article begins with a focused literature review of new materialism scholarship. Our case study deals specifically with water–society issues. Therefore, we pay particular attention to a framework known as the hydrosocial cycle. We then review literature that challenges traditional notions of an independent human mind and discuss embodied cognition’s relevance to expanding geographical research on the hydrosocial cycle as well as emotion and risk perception. We then explain our qualitative methodological approach and present our case study analysis of two flood-prone communities—Miles City and Glendive (Figure 1)—that share many political and demographic similarities but have strikingly different

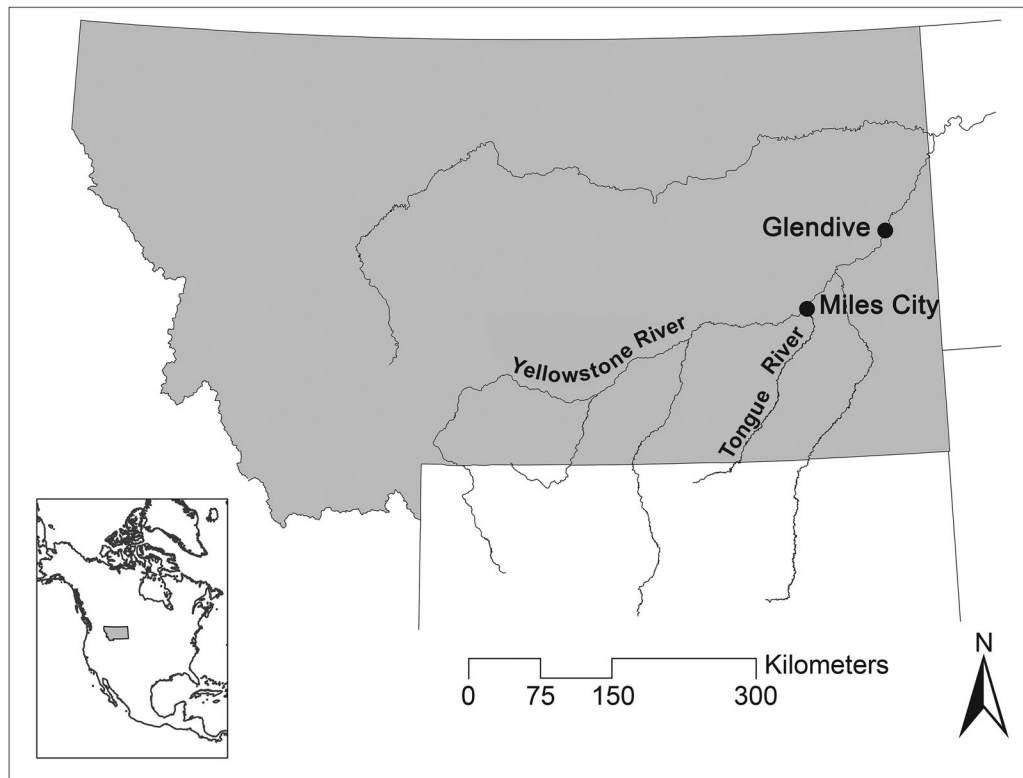


Figure 1. Map of the study site.

attitudes toward flood risk associated with their levee systems. We build our analysis and discussion around three categories of embodied experiences between the levee and each community. We conclude this article with a summary of our analysis and briefly suggest how geographers might continue productive research engagements with embodied cognition.

Literature Review: Hydrosocial Cycle and Embodied Cognition

Contemporary hybrid approaches to sociomaterial relations have roots in the critique of the modernist dualism that separates “human” (social) and “nature” (material) into discrete categories. During the late twentieth century, nature became widely accepted as, at least in part, a social construction (Smith 1984; Cronon 1995; Castree and Braun 2001). As a result, many objects once thought of as completely natural began to be theorized as also social, and human bodies and systems once thought to be completely social were also recognized as, in part, material (Haraway 1991; Latour 1993). Hybridity

emerged as a popular term to describe these permutations of the social and the material (Whatmore 2002; Bakker and Bridge 2006; Sutter 2013). One influential frame that emerged within critical human geography to theorize about hybridity relied heavily on the relational approaches from poststructuralism combined with a Marxist perspective deeply rooted in a tradition of dialectical materialism (Swyngedouw 1999; Bakker 2004; Kaika 2005). Because this approach developed largely in concert with studies focused on the role of water in developing political and social power, it has coalesced into its own distinct body of analytical scholarship known as the hydrosocial cycle (Linton and Budds 2014; Swyngedouw 2015).

The theoretical core of hydrosocial cycle scholarship rests on the idea that water and social institutions are internally related. As Linton and Budds (2014) write, “Understanding things as related internally ... implies a shift from thinking of relations *between* things—such as the impacts of humans on water quality—to the relations *constituting* things—such as the cultural, economic, and political processes that constitute the particular character of desalinated water, treated drinking water, or holy

water” (173). Essentially, this approach argues that nature and humans are not discrete entities but instead co-constitutions created through an active and dynamic process of becoming. Bakker’s (2004) work on water privatization in England and Wales illustrates how the physical properties of water—both its weight and liquid state—constrain neoliberalization of the region’s water systems. Furthermore, Anand’s (2017) monograph on water infrastructure in Mumbai, India, uses water leakages in pipes as a way to rethink political agency. For Anand, infrastructure creates “political effects” not simply because it fails to adhere to “a human-centered politics of measurement and control,” but also because it is “an accretion of human and nonhuman relations that make it extremely difficult and inconvenient for engineers to regulate leakage” (230–31). In other words, Anand argues that infrastructure has political agency—despite being incapable of intention—because it is not only material, but also social.

Although hybridity provides scholars with a relational framework to move beyond simple binaries and to rethink the agentic capacities of various sociomaterial assemblages, research within this framework largely accounts for the material through its entanglement in a social world outside the human body (J. Clark et al. 2017; Cousins 2017; Williams 2018). As a result, hydrosocial cycle scholarship neglects to examine how nonhuman objects relationally co-constitute the human mind. Other scholars of new materialism working outside the hydrosocial cycle paradigm, however, engage with emerging evidence from evolutionary biology, cognitive science, and even quantum theory to challenge the modernist definition of culture and agency as the product of a disembodied human mind (Ingold 2004; Barad 2007; LeCain 2017; Simandan 2017). Whereas scholars have long emphasized the role of structural forces in limiting human agency, commonly defined as the “ability of people to act, regarded as merging from consciously held intentions, and as resulting in observable effects in the human world” (Gregory et al. 2009, 347), the emergence of posthumanistic perspectives that aim “to put the human mind back in the world” challenges this conventional definition of agency through a radically different understanding of what constitutes the human mind (Nash 2005, 69).

Integrating emerging insights from the embodied cognition research program offers a way to examine the importance of the more-than-human world

within cognitive processes and expand the conceptual scope of the hydrosocial cycle. Although itself a disparate body of research, certain aspects of embodied cognition further break down the human–environment ontological boundary and support the relational view of distributive agency through a distributed cognition framework in which the brain, body, and environment co-constitute the mind. Specifically, Portugali (2018) defines embodied cognition as a research program in which “mind, body, and environment are not independent from each other as implied by classical cognitivism, but form an integrated cognitive system in which bodily experience in the environment gives rise to a variety of linguistic and behavioral cognitive capabilities” (28). Unlike standard cognitive science, which is grounded in a computational understanding of cognition as “algorithmic processes upon symbolic representations” (Shapiro 2011, 2), embodied cognition has a more flexible set of ontological commitments and methodologies that often reject computational approaches to cognition. Although geographers occasionally engage with embodied cognition (cf. Butcher 2012; Jones 2017; Portugali 2018; Pykett 2018), those working within the hydrosocial cycle have yet to draw on strains of embodied cognition that theorize the distributed existence of the mind beyond the boundaries of the human nervous system and thus align productively with the hydrosocial cycle’s grounding in relationality and materiality.

One specific hypothesis within embodied cognition—grounded in dynamical systems theory—argues that the brain (nervous system), body, and environment form a “circle of causality” from which cognition emerges (Shapiro 2011, 124; van Gelder 1998). In other words, cognitive behavior emerges “from continuous interaction between brain, body, and world” (Shapiro, 2011, 127). Specifically, the nervous system is dynamically embodied within the human body, and the human body itself is situated or dynamically embedded within a wider environment (Beer 2003). In this sense, the embodiment of the nervous system and the embeddedness of the body in an environment extend the boundaries of the cognitive system beyond human brain and nervous system.² In this model, environment, body, and nervous system are conceived as dynamical systems that have coupling relationships with each other and thus constitute one overarching cognitive system (Beer 2003; Shapiro 2011).

Embodied cognition also provides a conceptual framework for deepening geographical understandings of emotion and risk perception. As a topic of geographical study since at least the 1970s, emotions have gained greater prominence in recent years (Bondi 2005; Pile 2010). This “emotional turn” has brought a much-needed focus onto the spatiality of where emotions reside and emphasis on their relational constitution, however, scholars have only recently explicitly acknowledged the importance of an active, more-than-human world in shaping political outcomes through emotion (González-Hidalgo and Zografos 2019). Although certainly a welcome addition to the geographical literature, this relational approach has yet to investigate how nonhuman objects shape emotions at an individual scale. A dynamical systems approach to embodied cognition offers a conceptual framework for understanding the role of the material world in shaping individual human emotions.

Specifically, enactivism—a form of embodied cognition that also draws from dynamical systems theory—conceptualizes emotions as dynamical patterns (Colombetti 2014). Broader in scope than the hypothesis previously explained, enactivism does view cognitive systems as embodied, situated, and involving simultaneous interactions between brain, body, and environment (Thompson 2007; Colombetti 2014). Unlike most approaches to embodied cognition, enactivism incorporates emotions into the cognitive process through a dynamical approach to affective science. As Thompson and Stapleton (2009) state, “the enactive approach does not view cognition and emotion as separate systems, but treats them as thoroughly integrated as biological, psychological, and phenomenological levels” (26). Admittedly speculative in character, this approach makes space for events in the body and the environment to shape emotions (Colombetti 2014). Thus, despite only being a hypothesis, a dynamical systems approach to emotion offers insights into the inseparability of emotions from cognition and provides a space for more-than-human objects to actively influence emotional episodes.

Emotions also have an emerging role in the study of risk perception. In fact, some scholars have shifted from conceptualizing risk through rational choice models to thinking about risk-as-feelings (Loewenstein et al. 2001). Emotions such as sadness, fear, anger, joy (Lerner et al. 2015), and positive or negative feelings about objects (Slovic et al. 2007) often drive

perceptions and behavior more than cognitive assessments of risks (Leiserowitz 2006). Within the discipline of geography, there exists a long tradition of risks and hazards research (Gaillard and Mercer 2012). Whereas geographers initially viewed risks and hazards as simply interactions between “man and nature” (Kates 1971) or technology, society, and the environment (Cutter 1993), Watts (1983) importantly argued for an epistemological exploration of the concept of nature itself as the “proper starting point for the study of environmental hazards” (233). Specifically, he drew on Marx’s theory of metabolism to argue for more sophisticated explanations grounded in a materialist conceptualization of nature–society relations as dialectical. Although Watts (1983) eschewed cybernetic models of cognition in favor of political economy approaches, the emergence of embodied cognitive understandings of the human mind necessitate renewed ontological and epistemological attention from geographers. Specifically, an embodied cognition perspective requires scholars to more fully account for the political agency of nonhuman objects on an individual scale, while still conceptualizing risk perception through a relational-dialectical framework.

The qualitative evidence presented in this article neither proves nor disproves a dynamical systems conceptualization of embodied cognition. It does, however, support a relational approach to cognition (and emotion) that favors a distributive view of agency and emphasizes the importance of certain nonhuman objects or things (e.g., levees and rivers) in the shaping of flood risk perceptions. From a hydrosocial cycle perspective, a dynamical systems approach to embodied cognition provides opportunities for understanding water–society relations through a deeper engagement with human cognition and risk perception. The interview data presented in the two cases studies are suggestive of agentic capacity of nonhuman objects to shape human cognition and risk perception.

Method

As part of a larger project centered on capturing how individuals narrate their perception of flood risk, the qualitative data used in this article came from semistructured interviews of residents in two river communities along Montana’s Yellowstone River.³ We selected Miles City and Glendive based on the commonalities of proximity, flood infrastructure (i.e., levees), a history of flooding, and flood-

related community conflict. To capture risk narratives, the researchers employed elements of the Narrative Policy Framework (NPF) to create an interview protocol (Shanahan et al. 2018). The NPF provides a conceptual and methodological basis from which to empirically capture how narratives influence individual decisions and perceptions. For this study, we used the NPF's focus on narrative structure to develop interview questions aimed at eliciting residents' responses to flood risk.

We used a purposive sampling approach and snowballing technique to recruit individuals from across a range of affected sectors, including riverfront homeowners, business owners, government officials, and other interested citizens who had experience with flooding, flood risk, or both. We conducted eighteen interviews in Miles City and thirteen interviews in Glendive between February and March 2017. With the exception of one interview, all interviews were digitally recorded and transcribed. The length of the interviews ranged from about a half-hour to over two hours.⁴ We used NVivo 11 (2017) and a validated NPF codebook to analyze the data. We then iteratively developed an inductive coding scheme (Cope 2016).

During the coding process, the first author observed contradictory views toward flood risk and levee infrastructure in Miles City and Glendive as well as the important role more-than-human objects (i.e., levee and river) played in each community. Informed by new materialism, the hydrosocial cycle, and embodied cognition, the first author created a supplementary codebook through an additional round of indicative coding focused on interviewees' different embodied experiences with the levees and river. Three themes emerged through this: (1) levee construction, (2) river recreation, and (3) high-water experiences. Ultimately, this analysis represents how residents from two communities describe their embodied experiences with their community's levee and the Yellowstone River.

Case Studies

The degree to which people perceive flood risk depends not on some disembodied rationality apart from the environment, but instead on the ways in which dynamical relationships between brain, body, and environment create thought. In the following section, we support our claim that political agency

extends beyond the human with empirical evidence from two communities in eastern Montana—Miles City and Glendive. Although located less than 160 km apart on the lower Yellowstone River, we find that the residents of these two communities have substantially different perceptions of flood risk grounded in different material experiences with their levees and river systems.

The Case of Miles City, Montana

Situated at the confluence of the Tongue and Yellowstone Rivers, Miles City—population 8,500—functions as Custer County's commercial center (Figure 1). Growth and expansion of the city as well as construction of a levee during the late 1930s facilitated increased building in the geologic floodplain. The levee or dike—as it is colloquially termed—is a long embankment that follows the east bank of the Tongue River and the south bank of the Yellowstone River (Figure 2). Functioning as a barrier that keeps the river from entering Miles City during high water, the levee is a collection of socio-material components including clay, sand, gravel, automobiles, concrete, trees, and insects, and is also a product of human labor, leisure, and other experiences (Figure 3). Originally constructed by the Works Progress Administration between 1936 and 1939, the levee underwent additional expansion and improvements under local efforts in 1950 and again in 1974 (KLJ 2015).

As part of the National Flood Insurance Program (NFIP), the Federal Emergency Management Agency (FEMA) first issued a flood insurance rate map for Miles City in 1979 (KLJ 2015). This map designated 35 percent of the structures in Miles City as being within the 100-year floodplain. In 2007, the U.S. Army Corps of Engineers (USACE) completed an updated flood model for the Tongue and Yellowstone Rivers. Three years later, FEMA used these data to revise and expand Miles City's flood insurance rate map. As a result, the number of structures within the 100-year floodplain increased from 35 to 69 percent (Thackeray 2010b). The main reason for the drastic increase in the number of properties came from the USACE's determination that the city's levee had significant design flaws, such as trees growing out from the levee and unknown substrate materials. As a result, the levee no longer met FEMA's requirements and was judged to provide zero

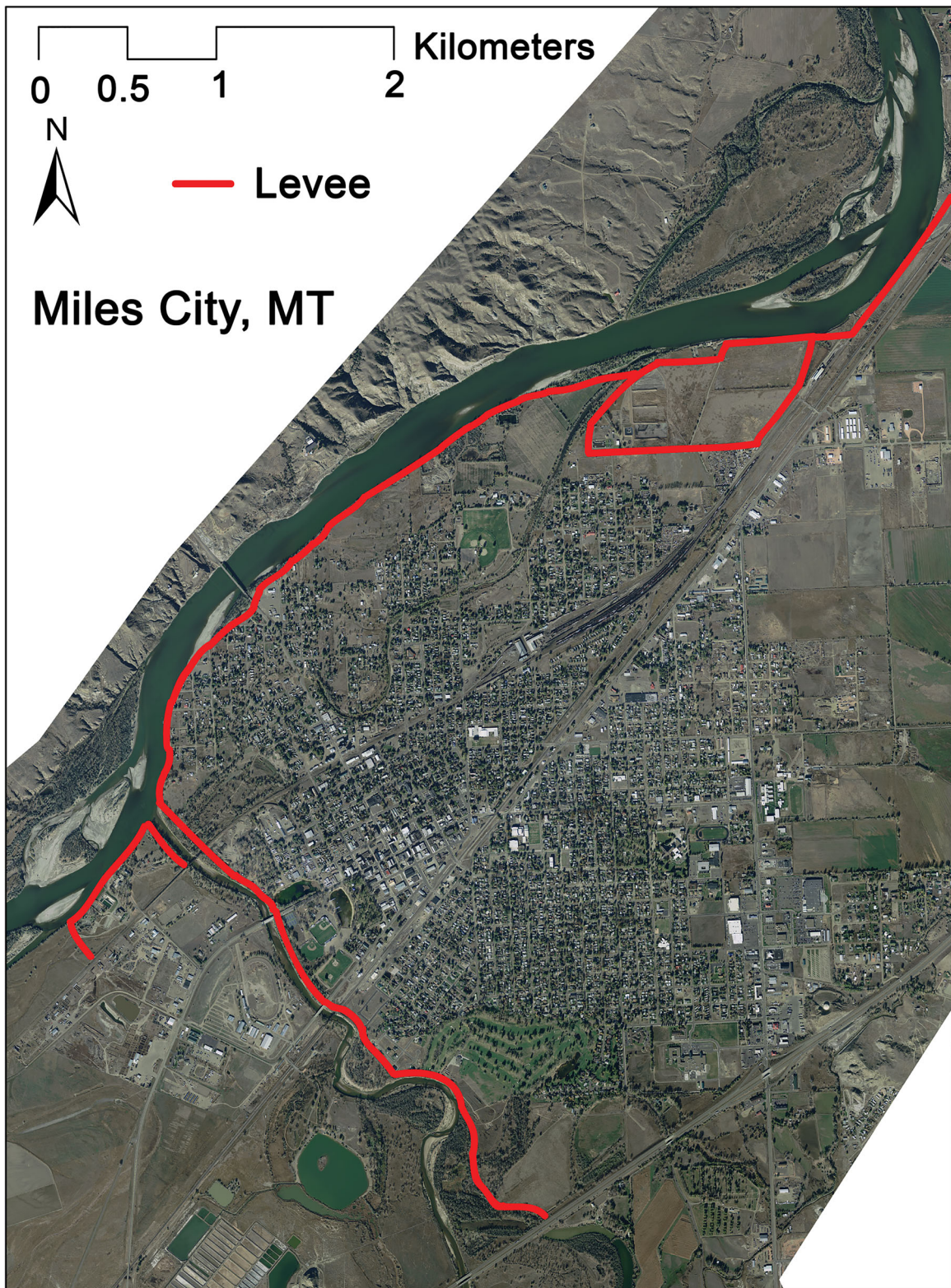


Figure 2. Aerial photograph of Miles City. Note the location of the river in relation to the city and the proximity of the levee to the Tongue and Yellowstone Rivers. Source: http://geoinfo.msl.mt.gov/data/yellowstone_river/GISData.



Figure 3. Miles City levee just downstream from the Tongue and Yellowstone Rivers' confluence. The view is looking upstream. Note the proximity of the levee to the Yellowstone River, the gravel roadbed on top of the levee, the tree growing out of the levee's side, and the structures near the levee. *Source:* Kirsten Bergmann.

protection from the base flood (KLJ 2015). Thus, the levee disappeared from FEMA's 2010 flood insurance rate map (Thackeray 2010a).

The impact of the USACE's determination is significant because a suite of restrictive regulations pertains to structures located within the newly defined 100-year floodplain. For example, regulations limit the ability for structures to undergo expansion or renovation. Also, homes and businesses must carry flood insurance if the property has financing through a federally backed mortgage. Thus, the number of people required to purchase flood insurance rose dramatically as a result of the new map. Furthermore, during the time when many residents were coming to grips with the additional cost of flood insurance, Congress passed the Biggert–Waters Act in 2012, thereby lowering federal subsidies for flood insurance as part of a larger effort to make the NFIP more financially sound. This caused substantial rate increases for flood insurance premiums not only in Miles City, but across the country (Collier 2014). As of December

2013, Miles City was Montana's largest holder of flood insurance policies (23 percent of the state total) and collectively spent approximately \$625,000 annually on flood insurance premiums (KLJ 2015).

During our fieldwork we observed that Miles City residents perceived FEMA's new flood insurance rate map as a greater threat to community well-being than flooding. Whereas mobilizing political and economic rationalities is one common approach to explain such thinking, we rely instead on the embodied relationships between Miles City residents and the levee. Specifically, we apply an embodied cognition framework to better understand how experiences between residents and the levee forged a deep faith in its ability to prevent flooding. We argue that various embodied experiences that engage brain, body, and elements of the riverscape (levee and river) shape Miles City residents' flood risk perceptions. Although scientific studies indicate the levee has structural flaws (cf. KLJ 2015), residents maintain a high level of trust in the levee. We offer

three categories of embodied experience to help explain most interviewees' "irrational" trust in the levee: (1) levee construction, (2) river recreation, and (3) high-water experiences.

Levee Construction. The federal government's decision to erase the levee from Miles City's flood insurance rate maps because of its structural flaws sparked outrage across the community. As one resident succinctly stated:

FEMA does not recognize it. The Corps of Engineers does not recognize it as a levee. They no longer call it a dike. As a levee, as far as they're concerned it is nonexistent. (Interview 9)

The reason for this outrage runs deeper than frustration with increased flood insurance costs and asymmetrical power relations. For local residents, FEMA's nonrecognition of the levee denies both historical experience and physical reality. As one individual said:

[What] really irritates this community and has irritated the leadership of this community for years, is that our effort was wasted. Because all of this dike that's here was built by people. ... There were locals that came in and went out and picked up the gravel and the dirt and whatever, and they went up there and they dumped it and then it was sculpted and it was turned into the dike. (Interview 5)

Although the federal government did facilitate the construction of the original levee system in the late 1930s, local government oversaw additional construction and maintenance. This has relevancy because it meant that local organizations and peoples had more opportunities to forge embodied relationships with the levee. As one resident recalled:

[In the early 1970s] the [Miles City] Jaycees came in and they raised that dike three feet, so it's never been a problem ever since they raised it. So, people in Miles City feel like they've got a very good dike. Well, the Corps of Engineers will say the dike will never last. You get a twenty-five-year storm, and it's going to wash out. ... You're saying the dike won't do the job, and the people in Miles City are saying yes it will. It's been there. It's been doing the job since 1939. (Interview 6)

For more than seventy years the Miles City community has forged connections with its levee through the process of its construction and maintenance. Although typically viewed as a unidirectional process in which people build and repair a levee, the

embeddedness of the human body in the environment allows for a more dynamic understanding of this relationship. Specifically, this evidence suggests that the levee's causal role in cognition (along with brain and body) shapes Miles City residents' trust in the levee and their corresponding low level of flood risk perception. As a result, many locals find the levee's erasure from the updated flood maps unfathomable.

River Recreation. One positive outgrowth of the levee's ad hoc construction and management is its emergence as a significant de facto public space where residents exercise, socialize, and experience the aesthetic beauty of the Tongue and Yellowstone Rivers. In particular, walking is one of the most popular levee activities. As one individual conveyed:

I like our dike because I'm a diabetic, so I walk every day I can, and where I walk is always on the dike. I can look into the river. I can look across the river and see the coyotes. I can look across the river and see the deer, and I can talk to the fishermen along the river. (Interview 6)

Interviewees also commonly cited their use of the levee as a source of entertainment. For example, one interviewee stated:

I'm not big into fishing, but I grew up here and going down to the bridge to look at the river, walking along the dike, watching the ice go out, that's just part of what you do around here. Entertainment is sometimes rather thin, so we go down and watch the river flow by. (Interview 3)

The embodied practice of walking in these passages is of particular importance. Noting performative activities (e.g., walking) as a useful space to recognize the relationality between humans and nonhumans (Wylie 2005; Waitt, Gill, and Head 2009), geographers have turned to the "body" and the concept of "embodied experience" to make sense of the agential capacity of more-than-human entities (Bakker and Bridge 2006; Stanes and Gibson 2017). Despite this engagement with embodied and relational practices, geographers have yet to integrate valuable insights from embodied cognition to explain how and why "human consciousness" does not take place 'in' the bodies of the human but 'with' the dense scaffolding of things that enables and shapes human thought" (Ash and Simpson 2016, 63). Although walking is undoubtedly a relational

experience, a dynamical systems approach to embodied cognition provides an even deeper mechanism through which to understand the way brain, body, levee, and river—as part of the embodied experience of walking—shape residents' perceptions and attitudes toward flooding.

A major reason for the levee's recreational popularity stems from its location. Unlike many river levees that are set back hundreds if not thousands of feet from the river channel, the Miles City levee system remains very close to the river in most places. Although this does threaten the structural integrity through a higher potential for erosion from high water (U.S. Army Corps of Engineers, Omaha District 2007), it makes the levee an integral part of the landscape and a place to experience the rivers' dynamism and aesthetic beauty. The embodied connection between the levee and the people of Miles City grows even deeper when one takes into account its role in facilitating interactions between people. One person shared:

I value the fact that I like to walk down there by it and go fishing and take my grandson there. ... I like to walk at noon from where I work. I actually go down the dike at the Tongue River and then I walk down to the Yellowstone. ... I just enjoy it, and it's beautiful. (Interview 11)

During the same interview, the individual later elaborated on the levee's social value:

So people will go down there and they'll be on the dike or they'll go over the bridge and then they'll pull over. You'll see somebody and you'll start visiting. (Interview 11)

Because of its public access, close proximity to the river, and aesthetic value, it is difficult to overstate the levee's recreational significance.

From a hydrosocial cycle perspective grounded in embodied cognition, it is crucial to conceptualize this infrastructure as not simply providing a stage for residents' experience, but as an active participant in creating and shaping their thoughts. The USACE's refusal to fix the existing structure undermines more than just the levee from the standpoint of the interviewees. This decision also undermines the legitimacy of their own embodied recreational experiences through which their identity becomes constructed. According to one resident:

Well, picture this. You put up a fence around your house, right? And you live in your house for forty-six years, and all you'd ever done was painted that fence.

And the posts are still hard, the slats are still good, paint's sticking to it. Somebody comes and tells you that fence isn't any good. I mean it's been a part of your life. You painted it. You know, in our case we walked on it, we fish from it, we've driven on it. We drove on it a lot when we were in high school when we had to drink beer. ... Yeah I mean a lot of stuff. A lot of lives have changed on that dike. (Interview 17)

High-Water Experiences. During late winter and early spring, ice jams provide Miles City residents with an opportunity to gather and watch the river. However, their occurrence is not stress free and can elicit negative emotions. As one resident recalled:

The only stories we hear is when the levees are getting close to flood stage, people start getting nervous. But that's the only negative part of any flooding issue that we've ever heard of. (Interview 2)

High water showcases the raw power of rivers and momentarily makes many residents of Miles City anxious. These types of embodied emotional experiences related to fear and anxiety are of particular importance. They provide a window into the dynamic relations between river, levee, body, and brain that shape individual human emotions and that as part of the cognitive process help shape attitudes toward flood risk.

Since the levee was expanded during the 1970s, it has successfully shielded Miles City from numerous flood events. As a result of this historic success, interviewees generally minimized the town's risk of flooding. Referencing a high-water year in 2010, one individual recounted:

We had the wettest year we've ever had. One hundred and thirty-five percent more rain, snow, moisture, [and] runoff ... we had springs out in the mountains that came alive that hadn't been alive in twenty years, and the [levee on the] Yellowstone held. Everybody's watching it. Everybody was holding their breath. Is it going to hold? Is it going to hold? Well the Tongue [River]'s putting a lot of weight on it, too. Is it going to hold? Is it going to hold? And everything held fine. They say we had a five-hundred-year flood in a hundred-year time, and everything held fine. (Interview 4)

It is these embodied experiences between people, levee, and river during high water that create positive emotional responses through which the levee becomes viewed as a community hero.

Even when Miles City has flooded, recollection of these experiences has served to strengthen—not weaken—the relationship between the residents and

the levee. This apparent paradox occurs because the levee bears no responsibility in the residents' memories. As one person recounted:

I've been here since 1960, and I've never seen the dike fail. You keep reading in the paper that there have been failures. I have yet to see a failure since I've been here. We had one. In 1971 we had a failure—a little failure right down next to the bridge. But that was because a man decided he wanted to put his boat in the river, so he cut a hole through the dike. So consequently, it ran through his hole, and it flooded houses around where he lived. So, nobody was really happy with the man. (Interview 6)

Importantly, these flood events from the 1970s do not undermine the success of the relationship between the levee and the people but instead serve as the exceptions that prove the rule—the levee has succeeded in preventing river flooding.

High water from ice jams and spring runoff showcases some of the raw and visceral power of the Yellowstone and Tongue Rivers. The levee, however, has successfully shielded Miles City residents from the potential for a more negative affective experience—that of a significant flood event. Some Miles City residents admit some anxiety and nervousness during high water. Our interviews suggest, though, that these negative emotions are overshadowed by the presence and historic success of the levee. Furthermore, these periodic high-water episodes have provided opportunities for the levee to protect Miles City residents. Our interviews indicate that because residents perceive that the levee has a strong record of success in these moments, a shared feeling of safety from flooding exists throughout the community. We argue that residents' various embodied emotional experiences with the levee in Miles City play an important role in the construction of their thought process. This helps explain not only the residents' faith in the levee but also their belief that Miles City currently has a low degree of flood risk.

The Case of Glendive, Montana

Located 145 km upriver from the Yellowstone River's confluence with the Missouri River in western North Dakota, Glendive is the economic hub of Dawson County (Figure 1). Although its population fluctuates considerably based on changes in regional energy development, the Glendive area has a population of approximately 7,000 (GreatWest

Engineering 2016). The Yellowstone River splits the community into West Glendive and Glendive proper. Glendive typically faces its greatest flood risk as a result of ice jams (U.S. Army Corps of Engineers, Omaha District 2014). Because the majority of Glendive's structures exist on elevated land adjacent to the Yellowstone River, most of the community does not require levee protection, and most home and business owners are not required to carry flood insurance.

Although the physical geography of the Yellowstone's southeast bank minimizes a large part of the city's flood risk, a low-lying area along Marsh Road between downtown and the Cottonwood subdivision does experience periodic flooding from ice jams. Furthermore, there are other isolated low-lying areas on the southeast bank—especially along North River Road—that have experienced occasional flooding. Therefore, the USACE sanctioned the construction of two levees in Glendive. The longer levee—built in 1959—protects a large portion of the floodplain in West Glendive from flooding. The shorter levee—built in 1969—protects the Cottonwood subdivision south of downtown on the river's southeast side (Figure 4).

The West Glendive levee—approximately 3 km in length—is composed of foundation materials like silty gravels and sands. Consisting of a 10-foot crown with a gravel roadway, the dike is a formidable structure that partners with railroad, bridge, and road embankments to constrain the natural migration of the Yellowstone River across the floodplain (Figure 5). Despite documented federal construction of the levee, FEMA's 1980 Flood Insurance Study judged it as inadequate to prevent a 100-year ice jam event from flooding West Glendive. Thus, FEMA included a significant portion of West Glendive within its flood insurance rate map (U.S. Army Corps of Engineers, Omaha District 2014).

When the community failed to approve floodplain building restrictions, FEMA suspended Dawson County from the NFIP. Furthermore, local government allowed additional commercial development within the floodplain during the 1980s. As a result, the town sited its grocery stores and many of its restaurants within the 100-year floodplain. These structures do not comply with the NFIP. When the county requested reinstatement to the NFIP, FEMA granted acceptance on the condition that it addresses noncompliant structures in the

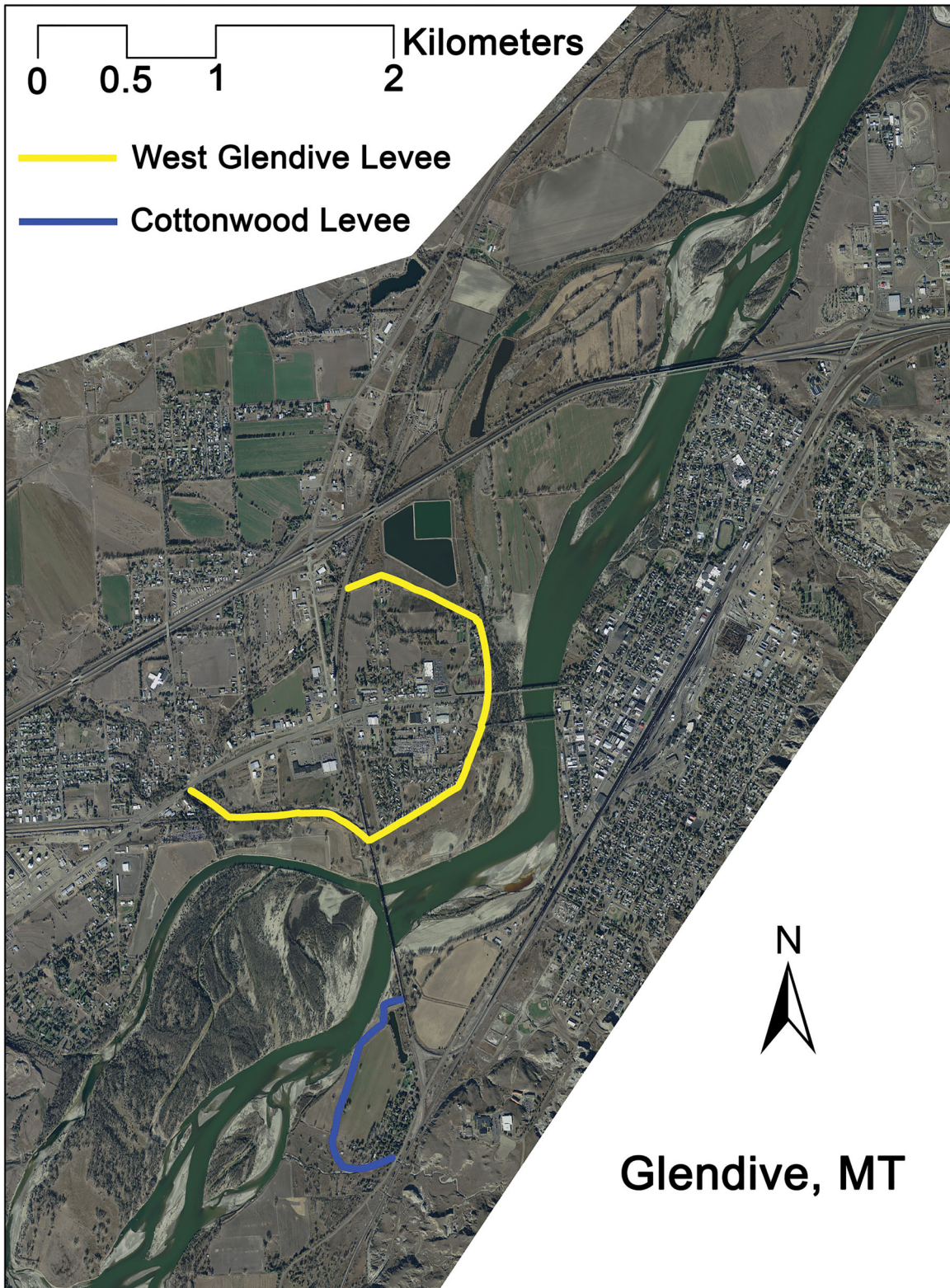


Figure 4. Aerial photograph of Glendive. Note the location of the West Glendive levee and the distance between the levee and the Yellowstone River. Source: http://geoinfo.msl.mt.gov/data/yellowstone_river/GISData.



Figure 5. West Glendive levee near the western terminus of the Towne Street Bridge. The view is looking downstream. Note that no vegetation is growing on the levee and that the river is not visible. *Source:* Elizabeth A. Shanahan.

floodplain (U.S. Army Corps of Engineers, Omaha District 2014). Because of these restrictions against building improvement and expansion, several businesses—most notably a beloved McDonald’s—have left the community. Thus, Glendive residents disdain FEMA and blame the federal agency for its stagnant economy.

Despite residents’ scorn toward FEMA and the West Glendive levee’s historic success in holding back floodwaters in 1969, 1986, and 1994, Glendive residents generally found the levee inadequate. In fact, the people of Glendive—especially in West Glendive—perceived ice jam flooding as a real threat even though the levee, with the exception of its height, is structurally sound (U.S. Army Corps of Engineers, Omaha District 2014). In this section, we examine how a dearth of embodied experiences with the West Glendive levee facilitated a set of relationships between the residents and the Yellowstone River that elevated the perception of flood risk across the community. To provide a comparison with Miles City, we again present three categories of embodied experience that help explain most interviewees’ skepticism toward the West Glendive levee’s ability to prevent future flooding: (1) levee construction, (2) river recreation, and (3) high-water experiences.

Levee Construction. Our Glendive interviewees exhibited little pride in the construction and

maintenance of the West Glendive levee. This should come as little surprise because the USACE designed and oversaw the levee’s construction (U.S. Army Corps of Engineers, Omaha District 2014). When asked about the construction of the levee in Glendive, the majority of interviewees responded with comments such as these:

Gosh, I don’t remember. I think I looked at one time. It might have been in the sixties or the late sixties. (Interview 33)

Or more definitively:

I really don’t know. The only thing I can say is maybe asking one of the county commissioners. (Interview 29)

Our interviewees in Glendive had minimal memories and very little embodied connection to their levee’s construction.

Out of the thirteen semistructured interviews conducted in Glendive, only two residents had any definitive knowledge about the construction process. As one resident recalled:

It’s just compacted soil and all that soil was picked up right there alongside the dike when it was built. ... They use[d] just scrapers and big packers. ... There are absolutely no car bodies or any foreign material. There are no trees or anything that can rot out or cause some type of a defect in the dike. The big thing is when they built the dike. They came in.

They scraped all of the grass and topsoil off of it before they started, so they had a nice clean deal. (Interview 26)

Although clearly adhering to a high engineering standard and possessing credible structural integrity, the lack of automobiles and trees in the West Glendive levee indicates a construction process that had fewer embodied opportunities for the levee and local residents to forge cognitive and emotional relationships.

Despite the desire to raise the height of the levee, Glendive residents failed to gain the necessary level of public support. This is not entirely from a lack of effort. One interviewee recalled his personal crusade to facilitate levee expansion:

[I was] looking out, and I see something move by ... it was a three-foot-thick ice cake. [A] foot of it was over top the height of the levee, when I was looking at the level of the levee. That's how close it came to going over. I told my mother-in-law. I said, "I am going to work to get this levee raised. I'm going to work. This is not high enough. If the river's that high now, it could get higher, and we're going to raise this levee." I have worked since that period of time (late 1950s) to raise the West Glendive levee. And I've failed all the time. (Interview 34)

This excerpt is indicative of the community's historical inability to raise the levee's height, which has deprived Glendive residents of additional opportunities to forge embodied experiences with the levee. As a result, the West Glendive levee construction process did not facilitate the creation of embodied relationships between residents and the levee system and played little role in shaping their perceptions of flood risk.

River Recreation. Glendive's levee system is not a significant medium through which people recreate and experience the Yellowstone River. Despite the presence of a "walking path" on the dike's crown, its substantial setback from the river—over 500 feet at its closest point—reduces its recreational importance. Instead, various other sites around the city serve as focal points for recreation along the river. The Black Bridge Fishing Access Site—located in West Glendive between the levee and the Yellowstone River—is among the most popular access points for river recreation. Featuring not only a boat ramp, but also a hiking trail along the river, users can fish, boat, drive, walk, and engage with wildlife at this site. As one Glendive resident extolled,

There's a public access fishing site here, right in Glendive, right across the river. ... You can drive down on the river bottom to the fishing access site. (Interview 20)

Although part of the levee is included as a recommended walk at the Black Bridge Fishing Access Site, its proximity to a trailer court and distance from the river are suggestive of its diminished recreational utility.

The presence of two working boat ramps in Glendive makes the Yellowstone River readily accessible to watercraft. According to one resident:

We do have a boat ramp in town here, and people do launch their boats and they will go as far upstream as Terry. They'll fish for walleye up there, or they'll go downstream and fish for catfish, or they'll go a little further and fish for paddlefish before they get to the intake. (Interview 29)

Fishing, boating, and most other recreational experiences in Glendive remain disconnected from the levee. Thus, the levee essentially plays no part in fostering embodied recreational relationships between Glendive residents and the Yellowstone River and consequently does not significantly influence the residents' flood risk perceptions.

High-Water Experiences. Although Glendive experiences high water from ice jams, the West Glendive levee has always succeeded in keeping floodwater out of its designated area. According to one resident who lives in West Glendive:

Anything that was damaged by the floods was on the outside of the dike. It was actually in the floodway. I've seen some houses out here on the Marsh Road and on the other side of the dike that had ice chunks up against them or took out a corner of a house but nothing within the dike. There's never been any water in the dike or over the dike. (Interview 26)

Despite its successful record of flood protection, residents interviewed had little trouble imagining a scenario in which the West Glendive levee overtopped. As the same interviewee later stated:

Now I have seen it within eighteen inches of the top of the dike. That will make you nervous. ... The river will come up three feet on the dike within a matter of minutes. They had an evacuation order one time. They blew their sirens and basically everybody left West Glendive. But then the river [ice jam] broke, and they were all back in their homes within a couple hours. They're not going to stay, because it's in a bowl. You're going to get wet if it comes over the dike. (Interview 26)

A major reason for this lack of faith in the West Glendive levee comes from residents' embodied experiences from previous floods. Because levees and topography only partially shield Glendive from high water, all Glendive interviewees had experienced river flooding. Whether along the southeast bank of the Yellowstone near Marsh Road, on the northwest bank in between the river channel and the levee, or on agricultural land upstream or downstream from the city itself, these areas have undergone periodic flooding and formatively shaped interviewees' perceptions. As one resident recalled:

The worst I have seen any flooding, I can't give you the year, it came within eight inches of overtopping the dike. The year before I came here in the spring of '74, the guys that I worked with in the [redacted] told me that was the worst they had ever seen it, and it came within four inches of overtopping the dike. On Marsh Road there were chunks of ice that were as big as cars and pickups. (Interview 29)

Emotions such as fear—experienced as part of an embodied flood event—also have a powerful effect on risk perception through embodied cognitive processes. One interviewee described flooding this way:

Scary. It really is scary. Especially here in town it's scary because there [are] so many people that stand and watch it. It's just so dangerous. I grew up next to a creek that flooded like that, and it would come up. I just know it's dangerous. (Interview 22)

A significant rationale for Glendive residents perceiving the Yellowstone River as scary and dangerous, especially at flood stage, comes from embodied experiences of death. One popular story, recounted by many interviewees, involved a rancher downstream from Glendive who had the misfortune to leave around 100 cattle grazing on a river island during flood season. When the river rose rapidly, the cattle drowned and were swept downriver. Specifically, one interviewee recalled:

We have a neighbor. He did have a disaster and didn't have his cattle off the river bottom, and he lost a lot of cows. That stays in your mind for a long time, and you don't ever want to become one of them people that has that happen to them. (Interview 21)

Aside from animals, flooding on the Yellowstone River over the years has claimed the lives of sixteen Glendive residents (U.S. Army Corps of Engineers, Omaha District 2014). These tragedies made many

of the interviewees acutely aware of the river's power. One resident told the story of lives claimed by a flood in the early 1900s:

They were having a party over there at the barn. There was like six [or] ten people over there ... and the river came up, and the ice started flowing. ... That barn is the highest point on that land over there. When they left to walk back to Glendive from there, they walked into deeper water as they left. ... [The men] pushed the ladies up into the trees—cottonwood trees—and gave them their suspenders to tie themselves off into the trees with, and they tried to get up. I think there was three people drowned here and the family drowned on the other side of the river. (Interview 34)

Historic embodied experiences between the Yellowstone River and its residents help create emotions and a way of thinking about flood risk in Glendive that contributes to the residents' questioning of their existing levee system. Because Glendive's levees do not eliminate flooding from the town, its residents—especially those who have lived through flooding—take the power of the Yellowstone very seriously. As one member of the community stated:

A lot of these guys along the river now that have experienced that, you know, they know. They don't even want to take a chance. It's some of the newer ones that aren't as familiar with it. [They take] a little more risk and don't think something like that really can happen. (Interview 23)

The peripheral character of the Glendive levee system minimized the number of possible embodied experiences and its corresponding influence on Glendive residents' risk perceptions. The diminished importance of the Glendive levee system, however, does not necessarily negate the power of nonhuman objects. Instead, it simply changes the calculus. In Glendive's case, the minimal influence of levees provides a greater opportunity for the Yellowstone River itself to co-constitute the residents' perceptions of river flooding. As one Glendive interviewee declared:

The Yellowstone River is basically, if you've lived in Glendive all your life like I have, just part of you. (Interview 20)

Discussion

Despite a mutual dislike of federal control and regulation of floodplains, Miles City and Glendive

Table 1. Case study summary

	Miles City, Montana	Glendive, Montana
Flood risk perception	The community does not perceive ice jam flooding as a substantial threat. They maintain a high level of trust in the levee system.	The community perceives ice jam flooding as a significant threat. They do not maintain a high level of trust in the West Glendive levee.
Levee construction	The community has significant positive embodied connections to the process of levee construction and maintenance.	The community has few embodied connections related to levee construction and maintenance.
River recreation	The levee is located close to the river and serves as a central community site for positive embodied experiences related to recreation.	The levee is set back from the river and does not serve as an important community site for embodied experiences related to recreation.
High-water experiences	Although high water creates feelings of anxiety, the levee system's historic success in protecting the community from flooding makes it a hero to the people of Miles City and high-water a positive embodied experience.	Although the West Glendive levee has never failed, the community has experienced negative embodied flooding events. Glendive residents have a deep appreciation for the destructive power of the Yellowstone River and remain distrustful of the levee's integrity.

have drastically different views toward flood risk. We have argued that these attitudes emerge not simply because of political and economic reasons, but because of the communities' embodied experiences with their respective levee and river systems. Specifically, the material agency of these more-than-human systems co-constitutes the cognitive and emotional composition of these communities' flood risk perceptions. As a result of three different types of embodied experiences—levee construction, river recreation, and high-water—the two communities diverge significantly in their respective trust for their levee systems and corresponding perceptions of flood risk (Table 1).

Unlike in Miles City, where residents spearheaded expanded construction and maintenance of their levee system, Glendive's local efforts failed to raise the height of the levee. Consequently, Glendive residents historically had less of an embodied connection to the levee than their counterparts in Miles City. Recreationally, Glendive and Miles City residents engage in similar types of pursuits. From fishing and boating to walking and agate hunting, both communities enjoy spending time in and around the Yellowstone River. When it comes to river recreation, the main difference between the two communities is the importance of their levee systems. Unlike in Glendive, the levee in Miles City is located very close to the river. There is little space on the east bank of the Tongue or south bank of the Yellowstone for parks, boat ramps, or fishing access sites. Thus, the levee serves as a central site of river recreation in Miles City and provides its residents

with embodied opportunities to build a more personal relationship with their levee.

Although Miles City and Glendive have both experienced historic flooding, the levee system in Miles City has largely shielded residents from harm. Whereas some interviewees did report anxiety around high-water events, the repeated success of the levee during these embodied events has built a high level of emotional faith and trust in the levee. Like in Miles City, the Glendive levee system has historically held during high water. Because the levee system does not entirely protect the town, however, interviewees frequently experienced flooding events. The fact that these embodied flood events have taken both bovine and human life creates a substantial level of fear within the community. When combined with the decreased embodied connections residents have to their levee system through construction and recreation, one can better understand why Glendive residents have a lower level of faith in their levee and higher perception of flood risk than their counterparts in Miles City.

Conclusion

Throughout this article we have argued that political power extends beyond humans through a distributive understanding of agency that rests on the idea that brain, body, and elements of the environment co-constitute human thought and emotion (Bennett 2010; Colombetti 2014). Although geographers have long theorized agency as dispersed through relational networks (Swyngedouw 1999; Whatmore 2002), this

article takes the position that the human mind—the traditional locus of agency—is itself a distributed phenomenon (Shapiro 2011). In response to existing relational approaches such as the hydrosocial cycle that rely on the constraining effects of nonhuman objects at a scale well beyond the mind (J. Clark et al. 2017; Williams 2018), we use insights from embodied cognitive science to support the idea that certain nonhuman objects actively help produce human cognition (Beer 2003; Shapiro 2011).

To substantiate our argument, we analyzed qualitative interview data regarding flood risk perception from two eastern Montana communities. Empirical evidence from Miles City suggests the existence of relations between levee and residents in which the more-than-human world (levee)—through different types of embodied experiences—takes an integral role in the construction of flood risk perceptions. Conversely, interview data from Glendive illustrate the presence of fewer embodied experiences between levee and residents, which in turn diminishes the levee's importance in the creation of cognition and emotion. As a result, the river in Glendive plays a more active role in the creation of flood risk perceptions.

This article cannot definitively prove conceptual frameworks from embodied cognition such as the causal role of nonhuman objects in the production of cognition and emotion. However, the qualitative interview data from Miles City and Glendive are suggestive of the agential capacity of levees and rivers to co-constitute human thought and risk perception. Because embodied cognition rescales framings of nonhuman agency and emphasizes the spatial importance of nonhuman objects to cognitive processes, we encourage geographers and other scholars to explore further theoretical engagements with it and develop additional methodologies for operationalizing its components. In particular, we find researchers studying risk perception—because of the field's close engagement with both affect and the environment—advantageously positioned to empirically verify and further develop existing understandings of embodied cognition and more-than-human agency.

Although the hydrosocial cycle already conceptualizes agency as a distributive phenomenon, extending this framework to the mind rescales the ontological inseparability of the human and nonhuman in the creation of political effects. Ultimately, we believe that bringing theoretical and empirical discussions back down to the individual mind furthers understanding

of distributive and nonhuman agency and opens novel pathways for geography's continued engagement with new materialism scholarship.

Acknowledgments

The authors extend their gratitude to Dr. James McCarthy and the three anonymous reviewers. Their incisive feedback substantially strengthened this article. The Human Ecology Learning and Problem Solving (HELPS) Lab at Montana State University supplied transcription services. We would also like to thank Dr. Richard Ready and Mr. Henry King for their collaboration. Ms. Kirsten Bergmann assisted with editing, Mr. Robert Briwa provided thoughtful feedback on an earlier draft, and Dr. Timothy LeCain provided neo-materialist inspiration. Suggestions from Dr. Katharine Rankin and other participants during the Social Relations of Infrastructure paper session at AAG 2018 helped strengthen an earlier iteration of this article. Finally, we would like to extend our heartfelt appreciation to the Yellowstone River and its human residents living in Miles City and Glendive. We could not have conducted our research without assistance from those individuals who generously shared their perceptions, passions, and homes.

Funding

This research was primarily funded by the National Science Foundation (NSF Award CMMI-1635885). A student research travel grant through Montana State University's College of Letters & Science and a faculty writing award from the Ivan Doig Center for the Study of the Lands and Peoples of the North American West at Montana State University provided additional financial support.

ORCID

Nicolas T. Bergmann  <https://orcid.org/0000-0002-0850-0021>

Jamie McEvoy  <https://orcid.org/0000-0001-7762-619X>

Elizabeth A. Shanahan  <https://orcid.org/0000-0002-1074-5570>

Eric D. Raile  <https://orcid.org/0000-0002-4860-2081>

Ann Marie Reinhold  <http://orcid.org/0000-0003-0411-3486>

Geoffrey C. Poole  <https://orcid.org/0000-0002-8458-0203>

Notes

1. Political theorist Bennett's theory of distributive agency offers a useful heuristic to conceptualize political power in a more-than-human reality. To make sense of the 2003 North American power blackout that affected more than 50 million people, Bennett (2010) argued for an understanding of agency "distributed across an ontologically heterogeneous field, rather than being a capacity localized in a human body or in a collective produced (only) by human efforts" (23).
2. Debate continues within embodied cognition about the degree to which the boundaries of the mind extend beyond the human brain. The dynamical systems approach should not be confused with extended cognition, which also pushes the boundary of the human mind outward from the brain to include wider parts of the environment. According to extended cognition, however, certain aspects of the body and wider environment actually perform "the kind of work that cognitive science has typically assigned to the inner workings of the brain" and thus constitute an extension of the mind itself (A. Clark 1998, 268).
3. Although semistructured interviews provided the bulk of the data for this article, document analysis of pertinent secondary source material (government documents, consultant reports, and newspaper articles) also contributed to the authors' findings.
4. This range of interview length is due to many factors, such as diversity in interview settings (outside, in a vehicle, inside, or some combination), interviewing couples versus individuals, and differences in participant personality, knowledge, and experience with flooding.

References

- Anand, N. 2017. *Hydraulic city: Water and the infrastructures of citizenship in Mumbai*. Durham, NC: Duke University Press.
- Ash, J., and P. Simpson. 2016. Geography and post-phenomenology. *Progress in Human Geography* 40 (1): 48–66. doi: [10.1177/0309132514544806](https://doi.org/10.1177/0309132514544806).
- Bakker, K. 2004. *An uncooperative commodity: Privatizing water in England and Wales*. Oxford, UK: Oxford University Press.
- Bakker, K., and G. Bridge. 2006. Material worlds? Resource geographies and the "matter of nature." *Progress in Human Geography* 30 (1):5–27. doi: [10.1191/0309132506ph588oa](https://doi.org/10.1191/0309132506ph588oa).
- Barad, K. 2007. *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Durham, NC: Duke University Press.
- Bauch, N. 2017. *A geography of digestion: Biotechnology and the Kellogg Cereal enterprise*. Berkeley: University of California Press.
- Beer, R. 2003. The dynamics of active categorical perception in an evolved model agent. *Adaptive Behavior* 11 (4):209–53. doi: [10.1177/1059712303114001](https://doi.org/10.1177/1059712303114001).
- Bennett, J. 2010. *Vibrant matter: A political ecology of things*. Durham, NC: Duke University Press.
- Bondi, L. 2005. Making connections and thinking through emotions: Between geography and psychotherapy. *Transactions of the Institute of British Geographers* 30 (4): 433–48. doi: [10.1111/j.1475-5661.2005.00183.x](https://doi.org/10.1111/j.1475-5661.2005.00183.x).
- Braun, B., and S. Whatmore, eds. 2010. *Political matter: Technoscience, democracy, and public life*. Minneapolis: University of Minnesota Press.
- Butcher, S. 2012. Embodied cognitive geographies. *Progress in Human Geography* 36 (1):90–110. doi: [10.1177/0309132511412997](https://doi.org/10.1177/0309132511412997).
- Castree, N., and B. Braun, eds. 2001. *Social nature: Theory, practice, and politics*. Malden, MA: Blackwell.
- Clark, A. 1998. Where brain, body, and world collide. *Daedalus* 127 (2):257–80.
- Clark, J., P. Gurung, P. S. Chapagain, S. Regmi, J. Bhusal, T. Karpouzoglou, F. Mao, and A. Dewulf. 2017. Water as "time-substance": The hydrosocialities of climate change in Nepal. *Annals of the American Association of Geographers* 107 (6):1351–69. doi: [10.1080/24694452.2017.1329005](https://doi.org/10.1080/24694452.2017.1329005).
- Collier, S. 2014. Neoliberalism and natural disaster. *Journal of Cultural Economy* 7 (3):273–90. doi: [10.1080/17530350.2013.858064](https://doi.org/10.1080/17530350.2013.858064).
- Colombetti, G. 2014. *The feeling body: Affective science meets the enactive mind*. Cambridge, MA: The MIT Press.
- Coole, D., and S. Frost, eds. 2010. *New materialisms: Ontology, agency, and politics*. Durham, NC: Duke University Press.
- Cope, M. 2016. Organizing and analyzing qualitative data. In *Qualitative research methods in human geography*, ed. I. Hay, 4th ed., 373–93. Oxford, UK: Oxford University Press.
- Cousins, J. 2017. Structuring hydrosocial relations in urban water governance. *Annals of the American Association of Geographers* 107 (5):1144–61. doi: [10.1080/24694452.2017.1293501](https://doi.org/10.1080/24694452.2017.1293501).
- Cronon, W. 1995. The trouble with wilderness; or, getting back to the wrong nature. In *Uncommon ground: Rethinking the human place in nature*, ed. W. Cronon, 69–90. New York: Norton.
- Cutter, S. 1993. *Living with risk: The geography of technological hazards*. London: Edward Arnold.
- DeLyser, D., and P. Greenstein. 2017. The devotions of restoration: Materiality, enthusiasm, and making three "Indian motorcycles" like new. *Annals of the American Association of Geographers* 107 (6):1461–78. doi: [10.1080/24694452.2017.1310020](https://doi.org/10.1080/24694452.2017.1310020).
- Gaillard, J., and J. Mercer. 2012. From knowledge to action: Bridging gaps in disaster risk reduction. *Progress in Human Geography* 37 (1):93–114. doi: [10.1177/0309132512446717](https://doi.org/10.1177/0309132512446717).
- González-Hidalgo, M., and C. Zografos. 2019. Emotions, power, and environmental conflict: Expanding the

- “emotional turn” in political ecology. *Progress in Human Geography*, 1–21. Advance online publication. doi: [10.1177/0309132518824644](https://doi.org/10.1177/0309132518824644).
- GreatWest Engineering. 2016. *Glendive-Dawson County: 2016 growth policy*. Billings, MT: GreatWest Engineering.
- Gregory, D., R. Johnston, G. Pratt, M. Watts, and S. Whatmore, eds. 2009. *The dictionary of human geography*. 5th ed. Malden, MA: Blackwell.
- Haraway, D. 1991. *Simians, cyborgs, and women: The reinvention of nature*. London: Free Association Books.
- Ingold, T. 2004. Beyond biology and culture. The meaning of evolution in a relational world. *Social Anthropology* 12 (2):209–21. <https://onlinelibrary.wiley.com/doi/10.1111/j.1469-8676.2004.tb00102.x>.
- Jones, D. 2017. Embodied cognitive ecosophy: The relationship of mind, body, meaning and ecology. *Geografiska Annaler: Series B, Human Geography* 99 (2):156–71. doi: [10.1080/04353684.2017.1306971](https://doi.org/10.1080/04353684.2017.1306971).
- Kaika, M. 2005. *City of flows: Modernity, nature, and the city*. London and New York: Routledge.
- Kates, R. 1971. Natural hazard in human ecological perspective: Hypotheses and models. *Economic Geography* 47 (3):438–51. doi: [10.2307/142820](https://doi.org/10.2307/142820).
- KLJ. 2015. Flood mitigation feasibility report: Prepared for Miles City, MT. KLJ Project #2409116.
- Knappett, C., and L. Malafouris, eds. 2008. *Material agency: Towards a non-anthropocentric approach*. New York: Springer.
- Langston, N. 2010. *Toxic bodies: Hormone disruptors and the legacy of DES*. New Haven, CT: Yale University Press.
- Latour, B. 1993. *We have never been modern*. Cambridge, MA: Harvard University Press.
- LeCain, T. 2017. *The matter of history: How things create the past*. Cambridge, UK: Cambridge University Press.
- Leiserowitz, A. 2006. Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climate Change* 77 (1–2):45–72. doi: [10.1007/s10584-006-9059-9](https://doi.org/10.1007/s10584-006-9059-9).
- Lerner, J., Y. Li, P. Valdesolo, and K. Kassam. 2015. Emotion and decision making. *Annual Review of Psychology* 66:799–823. doi: [10.1146/annurev-psych-010213-115043](https://doi.org/10.1146/annurev-psych-010213-115043).
- Linton, J., and J. Budds. 2014. The hydrosocial cycle: Defining and mobilizing a relational-dialectical approach to water. *Geoforum* 57:170–80. doi: [10.1016/j.geoforum.2013.10.008](https://doi.org/10.1016/j.geoforum.2013.10.008).
- Loewenstein, G., E. Weber, C. Hsee, and N. Welch. 2001. Risk as feelings. *Psychological Bulletin* 127 (2): 267–86.
- Malafouris, L. 2013. *How things shape the mind: A theory of material engagement*. Cambridge, MA: The MIT Press.
- Meehan, K. 2014. Tool-power: Water infrastructure as wellsprings of state power. *Geoforum* 57:215–24. doi: [10.1016/j.geoforum.2013.08.005](https://doi.org/10.1016/j.geoforum.2013.08.005).
- Nash, L. 2005. The agency of nature or the nature of agency? *Environmental History* 10:67–69.
- NVivo for Mac (version 11). 2017. Melbourne, Australia: QSR International.
- Pile, S. 2010. Emotions and affect in recent human geography. *Transactions of the Institute of British Geographers* 35 (1):5–20. doi: [10.1111/j.1475-5661.2009.00368.x](https://doi.org/10.1111/j.1475-5661.2009.00368.x).
- Portugali, J. 2018. History and theoretical perspectives of behavioral and cognitive geography. In *Handbook of behavioral and cognitive geography*, ed. D. Montello, 16–38. Cheltenham, UK: Edward Elgar.
- Pykett, J. 2018. Geography and neuroscience: Critical engagements with geography’s “neural turn.” *Transactions of the Institute of British Geographers* 43 (2):154–69. doi: [10.1111/tran.12213](https://doi.org/10.1111/tran.12213).
- Robbins, P. 2007. *Lawn people: How grasses, weeds, and chemicals make us who we are*. Philadelphia: Temple University Press.
- Roberts, T. 2012. From “new materialism” to “machinic assemblage”: Agency and affect in IKEA. *Environment and Planning A: Economy and Space* 44 (10):2512–29. doi: [10.1068/a44692](https://doi.org/10.1068/a44692).
- Russell, E. 2011. *Evolutionary history: Uniting history and biology to understand life on earth*. Cambridge, UK: Cambridge University Press.
- Shanahan, E., M. Jones, M. McBeth, and C. Radaelli. 2018. The narrative policy framework. In *The theories of the policy process*, ed. C. Weible and P. Sabatier, 4th ed., 173–213. Boulder, CO: Westview.
- Shapiro, L. 2011. *Embodied cognition*. London and New York: Routledge.
- Shaw, I., and K. Meehan. 2013. Force-full: Power, politics and object-oriented philosophy. *Area* 45 (2):216–22. doi: [10.1111/area.12023](https://doi.org/10.1111/area.12023).
- Simandan, D. 2017. Demonic geographies. *Area* 49 (4):503–09. doi: [10.1111/area.12339](https://doi.org/10.1111/area.12339).
- Slovic, P., M. Finucane, E. Peters, and D. MacGregor. 2007. The affect heuristic. *European Journal of Operational Research* 177 (3):1333–52. doi: [10.1016/j.ejor.2005.04.006](https://doi.org/10.1016/j.ejor.2005.04.006).
- Smith, N. 1984. *Uneven development: Nature, capital, and the production of space*. Oxford, UK: Blackwell.
- Stanes, E., and C. Gibson. 2017. Materials that linger: An embodied geography of polyester clothes. *Geoforum* 85:27–36. doi: [10.1016/j.geoforum.2017.07.006](https://doi.org/10.1016/j.geoforum.2017.07.006).
- Sutter, P. 2013. The world with us: The state of American environmental history. *Journal of American History* 100 (1):94–119. doi: [10.1093/jahist/jat095](https://doi.org/10.1093/jahist/jat095).
- Swyngedouw, E. 1999. Modernity and hybridity: Nature, regenerationismo, and the production of Spanish waterscape, 1890–1930. *Annals of the Association of American Geographers* 89 (3):443–65. doi: [10.1111/0004-5608.00157](https://doi.org/10.1111/0004-5608.00157).
- Swyngedouw, E. 2015. *Liquid power: Contested hydro-modernities in twentieth-century Spain*. Cambridge, MA: The MIT Press.
- Thackeray, L. 2010a. Flood plain pains: As FEMA redraws maps, Miles City faces huge loss of property valuation. *Billings Gazette*, May 9. Accessed January 19, 2018. http://billingsgazette.com/news/state-and-regional/montana/flood-plain-pains/article_8bdff7ac-5b31-11df-bc7c-001cc4c03286.html.
- Thackeray, L. 2010b. Remapping doubles Miles City floodplain: Hundreds of residents, businesses may have to buy flood insurance. *Billings Gazette*, February 19. Accessed January 19, 2018. <http://billingsgazette.com/news/state-and-regional/montana/remapping->

- doubles-miles-city-floodplain/article_014ae018-1d27-11df-8694-001cc4c03286.html.
- Thompson, E. 2007. *Mind in life: Biology, phenomenology, and the sciences of mind*. Cambridge, MA: Harvard University Press.
- Thompson, E., and M. Stapleton. 2009. Making sense of sense-making: Reflections on enactive and extended mind theories. *Topoi* 28 (1):23–30. doi: [10.1007/s11245-008-9043-2](https://doi.org/10.1007/s11245-008-9043-2).
- U.S. Army Corps of Engineers, Omaha District. 2007. *Flood insurance study: Yellowstone River and Tongue River at Miles City, Custer County Montana*. Omaha, NE: U.S. Army Corps of Engineers.
- U.S. Army Corps of Engineers, Omaha District. 2014. *Section 22, planning assistance to states study: Yellowstone River, City of Glendive/Dawson County, Montana*. Omaha, NE: U.S. Army Corps of Engineers.
- van Gelder, T. 1998. The dynamical hypothesis in cognitive science. *Behavioral and Brain Sciences* 21 (5):615–65. doi: [10.1017/S0140525X98001733](https://doi.org/10.1017/S0140525X98001733).
- Waitt, G., N. Gill, and L. Head. 2009. Walking practice and suburban nature-talk. *Social & Cultural Geography* 10 (1):41–60. doi: [10.1080/14649360802553186](https://doi.org/10.1080/14649360802553186).
- Watts, M. 1983. On the poverty of theory: Natural hazards research in context. In *Interpretations of calamity: From the viewpoint of human ecology*, ed. K. Hewitt, 231–62. Boston: Allen & Unwin.
- Whatmore, S. 2002. *Hybrid geographies: Natures, cultures, spaces*. London: Sage.
- Whatmore, S. 2006. Materialist returns: Practicing cultural geography in and for a more-than-human world. *Cultural Geographies* 13 (4):600–609.
- Williams, J. 2018. Assembling the water factory: Seawater desalination and the techno-politics of water privatization in the San Diego–Tijuana metropolitan region. *Geoforum* 93:32–39. doi: [10.1016/j.geoforum.2018.04.022](https://doi.org/10.1016/j.geoforum.2018.04.022).
- Wylie, J. 2005. A single day's walking: Narrating self and landscape on the South West Coast Path. *Transactions of the Institute of British Geographers* 30 (2):234–47. doi: [10.1111/j.1475-5661.2005.00163.x](https://doi.org/10.1111/j.1475-5661.2005.00163.x).

NICOLAS T. BERGMANN is a PhD Candidate in the Department of Earth Sciences at Montana State University, Bozeman, MT 59717. E-mail: nicolas.bergmann@montana.edu. His research interests lie at the intersections of political ecology, historical geography, and environmental history.

JAMIE McEVOY is an Associate Professor in the Department of Earth Sciences at Montana State University, Bozeman, MT 59717. E-mail: jamie.mcevoy@montana.edu. Her research interests include nature–society relations, science technology studies, political ecology, and water resource planning.

ELIZABETH A. SHANAHAN is an Associate Professor in the Department of Political Science at Montana State University, Bozeman, MT 59717. E-mail: shanahan@montana.edu. As one of the architects of the Narrative Policy Framework, her research is focused on the role of narratives in the policy process at the individual, community, and governmental levels.

ERIC D. RAILE is an Assistant Professor in the Department of Political Science at Montana State University, Bozeman, MT 59717. E-mail: eric.raile@montana.edu. His research focuses on political will and public will for social change, governance issues, and the environment.

ANN MARIE REINHOLD is a Research Scientist in the Department of Land Resources and Environmental Sciences at Montana State University, Bozeman, MT 59717. E-mail: annmarie.reinhold@montana.edu. She specializes in developing quantitative methods, firmly rooted in ecological theory, to understand the mechanisms underpinning some of Earth's most pressing environmental problems.

GEOFFREY C. POOLE is a Professor in the Department of Land Resources and Environmental Sciences at Montana State University, Bozeman, MT 59717. E-mail: gpoole@montana.edu. His research emphasizes the application of quantitative techniques and spatial analysis to generate knowledge in the fields of river ecology, fluvial geomorphology, and landscape ecology.

CLEMENTE IZURIETA is an Associate Professor of Computer Science in the Gianforte School of Computing at Montana State University, Bozeman, MT 59717. E-mail: clemente.izurieta@montana.edu. His research focuses on software architecture, quality assurance, and software evolution and maintenance.