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A Spectrum of Violence: The Intersection of Antemortem and Postmortem Embodiment in Migrant Death Investigation at the U.S.-Mexico Border

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The objective of the present literature review is to examine how the humanitarian crisis of migrant death at the U.S.-Mexico border epitomizes the antemortem and postmortem dimensions of structural violence and the lasting effects it can have on the human body. After describing the ongoing migrant death crisis, we review embodiment constructs in biological anthropology pertaining to structural violence and marginalization across the life course. We then survey studies examining skeletal and dental biomarkers of structural violence as embodied in migrant populations, including oral pathology, dental modifications, porotic hyperostosis, cribra orbitalia, enamel hypoplasia, cranial fluctuating asymmetry, vertebral neural canal size, and stature. These studies, conducted in forensic institutions with data collected through casework, provide evidence of structural vulnerabilities faced by different migrant groups, but also suggest that the migrant lived experience is not uniform. After death, the bodies and material artifacts of those who perish while migrating further embody structural violence by reflecting the arduousness of the journey, undergoing taphonomic changes, and receiving treatment that often leads to further erasure. While many migrant decedents are disappeared in desert and ranchland environments, those who are found are often trapped in the medicolegal system, either undergoing further bodily destruction for the purpose of identification or being buried in unmarked graves without proper investigation. To exemplify the various postmortem trajectories of migrant individuals, we provide an account of the investigative experiences of Operation Identification (OpID), a humanitarian forensic initiative in Texas, highlighting the realities of how embodiment principles are incorporated into migrant death casework. Throughout forensic exhumations and the identification process, OpID regularly encounters the biological and circumstantial evidence of violence reviewed throughout the paper. We conclude by discussing future directions for integrating embodiment frameworks into death investigation around the country. The purpose of this review is to 1) expose biological scientists to applied embodiment research in the U.S.-Mexico border context and 2) to further dialogues on the utility of embodiment in medicolegal

spheres.

Characterized as a mass disaster and humanitarian crisis, at least 9,500 people have died crossing the U.S.-Mexico border since 1998 (Kovic 2013; O'Daniel 2018; Soler and Beatrice 2018; Spradley and Gocha 2020; U.S. Customs and Border Protection 2023). One of these individuals is a 19-year-old woman who fled domestic violence and perished in rural Texas ranchland. After being in the elements for two months, her body became a skeleton with mummified tissue and tattered clothing. Her tennis shoes and a necklace were the only recognizable traces of her. Another is a 29-year-old man who attempted to reach his sister and financially support his mother. He also died on a private ranch but was instead buried without investigation. Twenty years later he was exhumed, analyzed, sampled, and curated before ultimately being identified. One woman is a 43-year-old mother who raised her children in the United States but became sick and had to return to her country to afford treatment. She perished on the journey back. A 20-year-old pregnant woman hoped to start her child's life in a safer environment, but she never made it.

These stories are just a few examples of the ways that violence is enmeshed in migration at the U.S.-Mexico border. The death of migrants particularly epitomizes the antemortem and postmortem embodiment of violence and its lasting effects on the human body (Soler et al. 2020). For one, significant disparities experienced in life by individuals, groups, and across generations largely drive clandestine migration and make migrant populations more susceptible to physical harm (Hughes et al. 2017; Kovic 2018; Martínez et al. 2014). U.S. *Prevention through Deterrence* border policies further facilitate physiological suffering on the journey and cause disastrous rates of death and disappearance (De León 2015; Kovic and Canales 2022; Rubio-Goldsmith et al. 2006; Spradley et al. 2016). Finally, how migrant remains are treated postmortem by the physical landscape and the U.S. medicolegal system can reflect and perpetuate further discrimination, stigma, and erasure (Bird and Bird 2022; Goad 2020; Reineke 2019; Soler et al. 2020; Spradley et al. 2019). The interplay between antemortem and postmortem embodiment of violence culminates in the death investigation of unidentified migrants, where the forensic identification process can enact more bodily destruction and be hindered by the very vulnerabilities that contributed to death in the first place (Anderson 2008; Hughes et al. 2017; Kimmerle et al. 2009; Reineke 2019). In the face of this chronic human-

made disaster, anthropologists have worked to apply embodiment frameworks to understand the dimensions of violence inherent to migration and improve identification practices (Anderson 2008; Soler et al. 2020).

The objective of this literature review is to holistically examine the how antemortem and postmortem embodiment of violence impact and are impacted by clandestine migration and migrant death at the U.S.-Mexico border. After briefly summarizing the ongoing migrant death crisis, we review embodiment constructs in biological anthropology pertaining to structural violence and marginalization across the life course. We then survey these constructs throughout studies conducted from forensic casework examining skeletal and dental morphology to highlight contemporary findings of antemortem embodiment in migrant decedents. Next, we elaborate the concept of postmortem embodiment by tracing the violent processes experienced by, and reflected in, deceased migrant individuals. Through an account of the investigative experiences of Operation Identification, a humanitarian forensic initiative in Texas, we demonstrate the realities of how embodiment principles are incorporated into migrant death casework. Our purposes are to 1) expose biological scientists to applied embodiment research in the U.S.-Mexico border context and 2) to further dialogues on the forensic utility of embodiment in medicolegal spheres.

Migrant Death Crisis at the U.S.-Mexico Border

An increase in migration along the Central America-Mexico-United States corridor has been driven by environmental disasters, political and cartel violence, family reunification, and extreme economic instability. This instability in Mexico was sparked in large part by the 1994 North American Free Trade Agreement which resulted in the mass displacement of nearly five million Mexican family farmers, over 50% of whom still remain in poverty (Babich and Batalova 2021; Kovic 2018; Martínez et al. 2014; Vogt 2013; Weisbrot et al. 2018). A combination of financial crises, political volatility, and mass disappearances and homicides across Latin America continue to synergistically contribute to the forced displacement of refugees and asylum seekers. Ever-heightening border militarization under *Prevention through Deterrence* policies, implemented under the Clinton administration in 1994 to disrupt border crossing routes, has also made migration to the United States increasingly lethal. For the past two decades, death rates have continued to spike as migrants are denied asylum and forced into ever-more remote, harsh

environments in what is called “the funnel effect” (De León 2015; Kovic and Canales 2022; Rubio-Goldsmith et al. 2006; Vogt 2013). Nearly 3,000 deaths have been logged by Border Patrol in the past five years alone, though this number is considered a drastic underestimate (Binational Migration Institute 2021; Leutert et al. 2020; U.S. Customs and Border Protection 2022; U.S. Customs and Border Protection 2023). Coupled with shifting routes, the diversifying of migrant demographics from Central and South America, as well as countries such as Haiti and India, has led to the Rio Grande Valley in South Texas having the most fatalities since 2012, although western Texas border counties have recently surpassed (Babich and Batalova 2021; Leutert et al. 2020; U.S. Customs and Border Protection 2022; U.S. Customs and Border Protection 2023; U.S. Government Accountability Office 2022).

In addition to extremely high numbers of death, differences in medicolegal systems along the border contribute to distinct challenges in resolving cases of unidentified migrants. In Arizona and Texas, the two states with the most fatalities, differing access to forensic services leads to contrasting death investigation practices. While most unidentified migrant cases in Arizona are managed by centralized medical examiners (MEs) due to the high ratio of MEs to population, cases in Texas are instead overseen by under-resourced and under-trained Justices of the Peace from some of the financially poorest counties in the country (Anderson and Spradley 2016; Fleischman et al. 2017; Kovic 2013; Spradley et al. 2019). With 32 Texas border counties and only two MEs, overwhelmed local authorities often have nowhere to turn and frequently bury unidentified decedents without proper forensic analysis or case tracking, denying them and their families the rights to identification and mourning (Figure 1) (Gaggioli 2018; Gocha et al. 2018; Kovic 2013; Spradley et al. 2019).

{~?~IM: insert Figure 1 here.}

Figure 1. The 32 counties along the Texas southern border. Stars indicate the locations of the two existing medical examiner’s offices.

Both macro- and micro-level forces of violence are indeed imbued in every aspect of irregular migration to the United States. From the push and pull factors of migration, to the clandestine and deadly nature of the journey, and the postmortem treatment of migrant decedents, embodiment plays an integral role in border deaths and death investigation.

The Embodiment of Violence and Marginalization

As an ever-developing concept in biological anthropology, embodiment can also be applied to forensic contexts to address the relationship between structural violence and the bodies of individuals within marginalized segments of the population. The physical reflection of violence through both overt forms (e.g., fractures, gunshot wounds) and ‘hidden’ forms (e.g., skeletal signatures of malnutrition and disease) shows that the body can be subjected to, and is the material manifestation of, larger social structures and processes. This employment of embodiment to illuminate how structural violence affects migrants, and all persons facing inequity, requires the fundamental understanding that the skeleton is mutable and adaptive in life, reflecting an accumulation of events over time as opposed to simply representing a snapshot of an individual’s life at death (Agarwal and Glencross 2011; Krieger 2001; Krieger 2005; Schrader and Torres-Rouff 2020).

Antemortem Embodiment of Structural Violence Across the Life Course

The biomarkers resulting from structural violence provide insight into the lived experiences of decedents across the life course. Antemortem embodiment occurs because the human skeleton is embedded within the whole-body physiology and, as such, interacts with complex regulatory pathways and a range of physiological functions, including the underlying (epi)genetic material, biological processes (e.g., metabolic, endocrine, and immune systems), and intrinsic and extrinsic environmental influences (Berger et al. 2020; Karsenty 2014; Walsh et al. 2018).

Individuals can have varying susceptibility to disease, however, when skeletal biomarkers of stress are contextualized with biosocial stressors, they can collectively convey an individual’s lived experience of marginalization and be utilized as evidence of structural violence.

Antemortem embodiment of violence becomes even more powerful when patterns are reflected at the population level, providing evidence for the existence of systemic marginalization.

In the skeleton, early life adversity is commonly examined through indicators of non-specific stress that result from developmental disruptions, including enamel hypoplasia, small vertebral neural canal (VNC) size, cranial fluctuating asymmetry (CFA), and shortened stature (Figure 2). Linear enamel hypoplasia (LEH) results on the enamel surface when acute stress episodes disrupt amelogenesis, which forms on the anterior dentition between the ages of approximately one and six years (Matalová et al. 2015; Reid and Dean 2006). The VNC

anteroposterior and transverse diameters reach maturation around five and fifteen years of age, respectively, making them ideal candidates to observe stress embodied in early childhood and adolescence (Hinck et al. 1966; Watts 2013). Increased CFA, measured as random deviations from bilateral shape symmetry in the cranium and face, is interpreted as an indicator of developmental instability (DeLeon 2007; Weisensee and Spradley 2018). Shortened adult stature is also generally understood to result under conditions that disrupt growth, although there is uncertainty regarding the potential for catch-up growth in stature from improved environmental conditions (Cardoso et al. 2019).

{~?~IM: insert Figure 2 here.}

Figure 2. The most observed biomarkers reflecting antemortem embodiment of structural violence: porotic hyperostosis, cribra orbitalia, linear enamel hypoplasia (LEH), small vertebral neural canal (VNC) size, shortened stature, poor oral health (i.e., carious lesions, antemortem tooth loss), and increasing cranial fluctuating asymmetry (CFA).

These skeletal markers of antemortem embodiment of stress have been studied in a variety of contexts of structural violence. Increased prevalence and severity of LEH have been reported among working-class British women during industrialization (Mathena-Allen and Zuckerman 2020), individuals from lower socioeconomic backgrounds in Antebellum New Orleans (Halling and Seidemann 2020), and racialized individuals in 20th-century America (Yamazaki 2006). Stunted VNC growth has been observed among lower socioeconomic status individuals in 18th and 19th-century England (Newman and Gowland 2017) and 19th and 20th-century Portugal (Amoroso and Garcia 2018). CFA has been observed in groups who experienced early life stress, including a colonial Mexican sample (Moes et al. 2022) and medieval populations from Sypniewo, modern-day Poland (Gawlikowska-Sroka et al. 2017). Chronic stress experienced during adolescence through puberty resulting in shortened stature has been observed among African enslaved children from Lagos, Portugal, (Cardoso et al. 2019) and female victims of interpersonal violence in Ancestral Pueblo La Plata Valley (Martin et al. 2010).

Skeletal development can additionally be influenced by the immune system. Specifically, under adaptive immunity, inflammatory products that promote osteoclast differentiation and bone resorption become more abundant (Charles et al. 2019). While the immune response helps the body fight off infections and heal injury, sustained exposure to disease or stressors can lead to an imbalance between osteoclasts and osteoblasts, the cells responsible for bone formation and

resorption, causing skeletal pathology such as lesions. The immune response associated with chronic inflammation of the gums in periodontal disease, for instance, contributes to alveolar bone resorption and eventually antemortem tooth loss (Dent et al. 2021). Further progressive destruction of the enamel can occur when plaque bacteria disrupt the oral microbiome and produce acids that weaken the enamel resulting in carious lesions and abscesses (Kinaston et al. 2019). Although poor oral hygiene can contribute to this process, so too does inadequate access to oral healthcare, preventative hygiene education, and fluoride-enriched water and foods, which are recognized aspects of socioeconomic marginalization (Kinaston et al. 2019; Patrick et al. 2006). Because the dentition cannot remodel or heal, oral pathology can worsen throughout the life course, reflecting accumulated antemortem embodiment of inequity or stress.

Structural violence therefore presents a range of factors (e.g., poor living conditions, malnutrition, and limited access to resources and healthcare) that limit an individual's ability to maintain health and physiological homeostasis. This physiological instability, such as disease or malnutrition-induced anemia, can lead to additional pathologies in the form of skeletal lesions including porotic hyperostosis and cribra orbitalia (Brickley 2018), which have been repeatedly documented in sites ranging from colonial Peru (Klaus 2014) to Antebellum New Orleans (Halling and Seidemann 2020). In the section that follows, we synthesize the reviewed biomarkers and pathologies associated with structural violence as they pertain to deceased migrant individuals recovered along the U.S.-Mexico border.

Antemortem Embodiment of Structural Violence in Migrant Decedents Recovered Along the U.S.-Mexico Border

In recent years, skeletal traces of marginalization have been consistently observed at the population level among unidentified migrants. These most commonly include porotic hyperostosis, cribra orbitalia, linear enamel hypoplasia (LEH), increased cranial fluctuating asymmetry (CFA), stunted stature, small vertebral neural canal (VNC) size, and especially oral pathology and dental modifications (Figure 2).

Skeletal biomarkers of early life stress among migrants have been reported by various researchers including Birkby, Fenton and Anderson (2008), who first propose the use of a

“cultural profile” in addition to the traditional biological profile (of sex, age, affinity, stature, etc.) to assist in identification efforts at the Pima County Office of the Medical Examiner (PCOME). Incorporating criteria such as geography, personal effects, and cultural accoutrements, as well as indicators such as short stature, poor dental health and/or culturally influenced dental modifications, the authors combine contextual and skeletal clues to distinguish probable migrants among unidentified decedents (Anderson 2008; Birkby et al. 2008). While they do not explicitly engage in a structural violence framework, Birkby, Fenton and Anderson (2008) are some of the first practitioners to operationalize embodiment principles in medicolegal casework. This work has been foundational for triaging forensic cases of individuals from marginalized groups and for accounting for deaths related to various public health concerns around the country.

Addressing unidentified migrants in Arizona, Birkby, Fenton and Anderson (2008) is also one of the earliest studies to discuss poor dental health in association with lower socioeconomic status in Mexico and Central America (Birkby et al. 2008). In particular, the authors report observing a higher prevalence of carious lesions, abscesses, antemortem tooth loss, and occlusal wear among migrants as compared to U.S.-born citizens. However, while deceased migrants have exhibited higher levels of poor oral health, the presence of cosmetic dental modifications, such as stylistic crowns and personal adornments, were noted to be culturally relevant displays of migrant agency (Birkby, Fenton and Anderson 2008).

Beatrice and Soler (2016) further expand this biocultural profile of migrant individuals to include additional skeletal biomarkers of early life stress, reporting significant rates of porotic hyperostosis, cribra orbitalia, and LEH. Their analysis of presumed migrants recovered in Arizona and of U.S. nationals in the Maxwell Museum and in the donated skeletal collection at Texas State University revealed higher prevalence of all three skeletal stress markers among migrants (Beatrice and Soler 2016). The migrant sample was significantly more likely to exhibit porotic hyperostosis and LEH, nearly eight and three times more so than their American counterparts, suggesting that they were exposed to early life stressors such as infections and malnutrition at higher rates (Beatrice and Soler 2016).

Beatrice et al. (2021) more recently examined porotic hyperostosis, cribra orbitalia, and LEH among migrants recovered in both Arizona and Texas while also considering sociodemographic risk factors in Mexico and Central America. Although they failed to find

significant associations with sociodemographic variables aside from age among identified migrant decedents, the patterns of skeletal stress markers are still informative for interpreting lived experiences. Overall, porotic hyperostosis had the highest crude prevalence, affecting nearly half of the sample, followed by LEH and cribra orbitalia. Porotic hyperostosis had a significantly higher likelihood of affecting males, the unidentified, and those recovered in Arizona than females, identified persons, and those recovered in Texas. Although the patterns of skeletal stress markers found by Beatrice, Soler, Reineke, et al. (2021) are consistent with the sociodemographic risk factors and epidemiological concerns present in Mexico and Central America, these results further illustrate the need for an intersectional perspective within the structural violence framework that avoids a monolithic grouping of migrants and considers the interplay between various components of identity and structural influences. The aforementioned patterns in skeletal pathology support that the migrant antemortem experience is not homogenous but rather that migrant decedents represent diverse groups with various lived experiences (Beatrice et al. 2021).

Other researchers have investigated patterns of cranial fluctuating asymmetry (CFA) among migrants as a skeletal indicator of socioeconomic status. Weisensee and Spradley (2018) examined levels of CFA in Mexican residents, U.S.-born residents, and Mexican migrants recovered in Arizona to test whether differences in developmental stability associated with socioeconomic status were embodied and reflected skeletally. Their results indicated a significant difference in CFA between migrants and U.S. residents, with migrants showing higher rates of CFA. Interestingly, Mexican residents were not significantly different from the other groups and showed intermediate levels of CFA. This suggests that migrants represent some of the most marginalized individuals within Mexican society and that they experience environmental factors associated with lower socioeconomic status at higher rates than those who do not migrate (Weisensee and Spradley 2018). Here, it is again important to note that sample-level patterns of skeletally embodied stress do not directly correspond with individual experiences, as variation in both biological responses and lived experiences contributes to heterogeneous groups (Gravlee 2009). However, these significant CFA results support that varying living conditions become differentially embodied in the skeleton.

In another study, Medrano (2020) further examined patterns of CFA among migrants from both Mexico and Central America and U.S.-born residents. The author also found that

Mexican migrants exhibited significantly higher levels of CFA than the other groups. While the Central American sample had significantly lower levels of CFA than the Mexican migrants, Central American migrants did not significantly differ from the American-born sample. These results support those found by Weisensee and Spradley (2018) in that Mexican migrants may experience the most CFA, although the levels of CFA among Central American migrants are intriguing. Medrano (2020) discusses the possibility that while the most marginalized migrants from Mexico are crossing the border, the most marginalized in Central America may be unable to make the journey due to economic constraints. Political violence impacts persons of all socioeconomic statuses, but it may be that an intermediate group of Central Americans with more economic means to migrate may be more likely to be recovered at the border. Another explanation for these differences could be the use of CFA as a metric of stress, which reflects a wider window of developmental instability than other skeletal indicators such as LEH. Perhaps the forms of structural violence in Central America, which have been documented to be highly sociopolitical in nature, occur in more acute episodes than the chronic stressors associated with poverty in Mexico (Babich and Batalova 2021; Martínez et al. 2014; Medrano 2020).

In terms of the postcranial skeleton, Znachko et al. (2020) explored patterns in vertebral neural canal (VNC) anteroposterior (AP) and transverse (TR) size variation among migrants recovered in both Arizona and Texas, as well as U.S.-born residents. Their results indicate that migrants recovered in Arizona had significantly smaller AP and TR diameters than migrants recovered in Texas and U.S. residents of lower and upper self-reported socioeconomic status. The Texas migrant group showed intermediate VNC sizes that were significantly smaller than those of the U.S. residents with higher socioeconomic status but were not significantly different from the U.S. residents with lower-socioeconomic status. Overall, the authors report that smaller AP and TR diameters among migrant samples indicate that exposure to sustained stress was embodied across the developmental period, but that differences between the Arizona and Texas samples further reveal heterogeneity in the migrant experience (Znachko et al. 2020).

As one of the earliest studies of secular change in stature, Bogin et al. (2002) observed the statures of 431 Maya and Maya-American children aged five to twelve years between 1999 and 2000 and found that Maya-American children were on average 11.54cm taller than the Mayan children. The authors interpret these results as supporting the hypothesis that height and body proportions are reflective of environmental conditions during the developmental period.

Mayan children, who presumably experienced environmental stressors associated with lower socioeconomic status more so than their Maya-American counterparts, experienced stunted growth and shorter height and body proportions on average (Bogin et al. 2002).

Finally, poor oral health among migrant decedents has recently been studied in further depth by Soler et al. (2022), who specifically investigate dental caries, periapical lesions, and antemortem tooth loss as embodiments of structural violence. Nearly 20% of individuals in their Arizona migrant sample exhibited large unrestored carious lesions, significantly more than the 7.2% observed among the Texas sample. Interestingly, while more non-indigenous individuals exhibited carious lesions than those from indigenous communities, only the non-indigenous individuals had cosmetic dental modifications (in this study, indigeneity was inferred based on the place of birth of identified persons). The authors note that the reasons for poor oral health are multifold and emphasize the need for intersectional perspectives to understand the various factors contributing to dental pathology. These include structural limitations associated with lower socioeconomic status, such as diets of processed foods and a lack of access to oral healthcare and education on preventative measures. While Soler, Beatrice and Martinez (2022) note the difficulty in differentiating between antemortem tooth loss associated with pathology and medical intervention, the extent and progression of disease indicate the chronic nature of marginalization across the life history. According to the authors, the presence of cosmetic modifications may indicate more resources devoted to dental care, but it may also reflect differences in cultural preferences (Soler et al. 2022). A study by Fancher and Hampl (2018) further supports these findings by reporting that over half of the observed presumed migrants recovered in Texas exhibited active caries and over a fifth experienced considerable periodontitis, a severe gum infection that can signal a whole-body inflammatory response (Fancher and Hampl 2018).

Although more work is needed to understand how migrants compare to their non-migrating communities, together these studies contribute mounting evidence that migrants systematically exhibit skeletal evidence of structural violence embodied throughout their lives. Importantly, these studies also show variation in the experiences faced and embodied across different migrant groups, reinforcing that the lived experience of migrants is not uniform. It is critical to emphasize that migration status is not interchangeable with biological affinity or genetic disposition, and that migrants are not more likely to exhibit skeletal markers of

marginalization by virtue of being migrants. Rather, social processes of inequity differentially affect migrant persons in ways that differentially impact biological processes of embodiment (Gravlee 2009). The patterned skeletal evidence of stress and marginalization among migrant decedents, however, reinforces the structural nature of this inequity. Continuing to study the reviewed skeletal markers will further refine understandings of embodied marginalization across different developmental periods and populations. Other potential skeletal markers affected by degenerative processes, such as bone mass density and fracture risk, also merit examination and will lead to a deeper appreciation of antemortem embodiment (Bonetto and Bonewald 2019).

Postmortem Embodiment of Structural Violence in Migrant Death and Death Investigation

Anthropologists have increasingly recognized that structural violence does not cease to impact bodies after death and that the postmortem experiences of bodies both reflect and perpetuate the sociopolitical marginalization of groups and individuals (Goat 2020; Parra et al. 2020). In the context of migration at the U.S.-Mexico border (and along the entire American migration corridor), postmortem embodiment among migrant decedents provides insight into the final moments of life while also being an active process that has the potential to extend further violence or reestablish personal identity (Soler et al. 2020). When someone perishes while migrating, it is their human remains and material artifacts that attest to the arduousness of the journey, undergo taphonomic changes, and receive treatment that may constitute care or lead to further disappearance. Death itself is a violent product of *Prevention through Deterrence* policies that seek to control migration by making the process treacherous and inhospitable. As many scholars have highlighted, death along the border is not just an outcome of militarized security, but a punitive consequence meant to maintain the illegality of immigrant populations, as well as instill fear and place onus on individuals for putting themselves in danger (Kovic 2018; Kovic and Canales 2022; Martínez et al. 2014; Reineke 2019).

Beyond the loss of life, the postmortem loss of identity further separates decedents from their humanity, fragmenting their social ties and connections, leading to not just physiological death, but social death—in addition to the suffering and ambiguous loss experienced by loved ones (Crocker et al. 2021; Nystrom 2014; O’Daniel 2018; Parra et al. 2020). The postmortem embodiment of violence is therefore paradoxically enacted in many ways by the *disembodiment*

of the deceased; through the physical dismemberment, destruction, or concealment of bodies in such a way that dehumanizes them or makes them unrecognizable (De León 2015; Nystrom 2014; Reineke 2019). Expanding on scholars such as Foucault (2010), Agamben (1998), and Mbembe (2003), De León (2015) uses the term *necroviolence* to describe how violence and power are politically exercised against both the living and the dead through the culturally disrespectful or offensive treatment of the deceased. While in cases of genocide or armed conflict, this violence may take the form of mutilation, cremation, or clandestine burial, in other contexts it can also be much more passive and indirect.

Reineke (2019) in particular articulates how, along the U.S. southern border, necroviolence primarily takes the form of *erasure*, both in terms of natural taphonomic processes of the landscape and inaction to mitigate death and disappearance (Reineke 2019). Once someone dies, scavengers are quick to act on their remains. Vultures and coyotes dismember and scatter bodies far distances, breaking and puncturing bone, while rodents gnaw on skeletal elements and carry them to their burrows (Beck et al. 2015; De León 2015; Spradley et al. 2012). Fluctuating temperatures and humidity work in tandem with insects to quickly decompose tissues, and the sun and wind cause further bone bleaching, cracking, and flaking (Anderson 2008; Beck et al. 2015; Galloway et al. 1989). As De León (2015), Reineke (2019), and colleagues emphasize, these destructive postmortem processes are just as much a part of the weaponization of the desert through *Prevention through Deterrence* as the threat to life and safety (De León 2015; Martínez et al. 2014; Reineke 2019).

Coupled with the physical elimination of bodies, the inability to generate accurate counts of death conceals ongoing mass fatalities and suffering at the border (Kovic 2013; Kovic 2018; Leutert et al. 2020; Reineke 2019). According to Reineke (2019), to allow—or fail to prevent—disappearance in one of the most heavily surveilled and militarized regions of the country is a clear extension of necroviolence that perpetuates the disposability of migrants and displaces responsibility away from state actors. Beyond a lack of infrastructure for search and rescue of the missing, no mechanisms apart from volunteer humanitarian efforts exist to recover migrant decedents (Kovic and Canales 2022; Spradley et al. 2016). While Arizona is comprised of mostly public land, Texas land is 95% privately owned, making search and recovery logistically complex (Kovic 2013; Spradley et al. 2019). In Brooks County, Texas, alone, which has a major checkpoint over 60 miles north of the border, the Sheriff estimates that for every one body found,

there are five more that will never be. Additionally, persons who drown in the Rio Grande River may vanish altogether, although those whose remains are found on the Mexico side of the border are not counted by U.S. Border Patrol (Leutert et al. 2020). The failure to provide sufficient resources or systems to manage, track, and record border deaths thus furthers the postmortem (dis)embodiment of migrant decedents as outsiders who can be forgotten (Reineke 2019).

Yet, for decedents who are recovered, their partial, fragile, or damaged remains and material belongings are often the only available evidence to speak to their final life experiences, embodying the physicality of migration and death. De León (2012) vividly describes how personal effects encapsulate the clandestine mobility required to cross the border and the extreme harshness of the environment. While practical travel items, such as toothbrushes, medications, and consumables mirror those of hikers and backpackers, sewn hidden pockets, alias ID cards, and shoe wrappings to wipe footprints reflect the criminalized and stigmatized nature of the journey (De León 2012). Even when remains are skeletal, one can infer blistered feet, chapped lips, and sunburns from the worn, taped sneakers, cut-off jeans, and make-shift head coverings recovered with decedents. Ironically, many of the items meant to help migrants survive contribute to their suffering and death. Black clothing, worn to camouflage at night, causes heat retention, increased heart rate and ultimately hyperthermia (De León 2012). Dehydration, a major cause of death while migrating, is symbolized by empty water jugs found with the deceased. De León (2012) also explains how black jugs heat water to undrinkable temperatures and that use-wear on water jugs can indicate drinking from contaminated sources.

Although in the U.S. migration context locating decedents and their belongings is a desired step to identify the missing, processes of postmortem examination of the dead can further contribute to their embodiment of necroviolence. Reineke (2019) elaborates that, for many mourners, the physical undertaking of forensic analyses on the dead can be construed as violating, brutal, or culturally offensive. Autopsy, tissue slide preparation, and genetic or chemical sampling for determining identity and cause and manner of death all lead to the further destruction and fragmentation of the body (Jones 2020; Nystrom 2014; Reineke 2019; Rosenblatt 2015). Under most medicolegal systems, those who die unidentified or in suspicious or violent ways are more likely to be subjected to this invasive and objectifying postmortem treatment (Anderson 2008; Jones 2020; Rosenblatt 2015). Because increased exposure of remains to the elements destroys distinguishing features and fingerprints, the often-decomposed condition of

migrant decedents necessitates many undergo genetic testing (Anderson 2008; Hughes et al. 2017). Obtaining DNA from the body then requires submitting entire skeletal elements, pulling teeth, or cutting sections of bone. The more degraded the remains, the more samples are needed to yield sufficient genetic profiles, leading to even more bodily fragmentation and disembodiment (Anderson 2008; Jones 2020). Even when exhaustive investigative efforts have been afforded to migrant decedents, they still may remain in limbo indefinitely as the long-term unidentified due to the transnational nature of their cases (Anderson and Spradley 2016; Gocha et al. 2018; Soler et al. 2020).

Other challenges to identifying and repatriating unidentified migrants are also deeply enmeshed in structurally violent forces—the very vulnerabilities embodied by migrants in life also limit the ability to identify them after death. Practitioners have repeatedly documented that marginalized populations disproportionately represent unidentified decedents due, in part, to a lack of comparative antemortem data resulting from limited access to services, housing, resources, citizenship, or support networks (Anderson 2008; Goad 2020; Hughes et al. 2017; Kimmerle et al. 2009; Paulozzi et al. 2008). Because migrants often lack access to sufficient health or dental care, identifications using medical records or dental or skeletal radiographs are rarely feasible even for individuals whose remains are well preserved (Anderson 2008; Hughes, Algee-Hewitt, Reineke, et al. 2017). For families, a lack of clear reporting mechanisms, language barriers, or the inability to travel, coupled with distrust of local and international authorities, all challenge the linking of missing and unidentified persons (Goad 2020; Kovic and Canales 2022; Spradley and Gocha 2020; Spradley et al. 2016). The same poverty, hardships, and fears that cause people to seek migration therefore also inhibit them from being found.

However, long-term unsolved cases also result from much more blatant discrimination. Recent literature in anthropology and criminology calls attention to the heterogeneous, political, often inequitable nature of death investigation that contributes to what Bird and Bird (2022) call *identification disparities* (Bird and Bird 2022; Goad 2020; Jones 2020; O’Daniel 2018; Soler et al. 2020). In the way that necroviolent alteration of remains dehumanizes decedents, the denial of adequate death investigation differentially values who is worthy of identification or postmortem care (Bird and Bird 2022; Parra et al. 2020; Reineke 2019; Rosenblatt 2015; Soler et al. 2020). Well-documented disparities in the allocation of investigative resources and media coverage for deceased people of color or of lower socioeconomic status in the United States

speak to how implicit and explicit bias extends antemortem inequities into the postmortem (Jeanis and Powers 2017; Moss 2019). As Bird and Bird (2022) describe, stigma pertaining to houselessness, addiction, sex work, mental illness, and migration consistently slows or prevents investigations into missing and unidentified persons around the country and can lead to dehumanizing treatment of remains (Bird and Bird 2022). Acting as an additional sociopolitical consequence and deterrent, the withholding of forensic attention for certain populations is thus another dimension of how violence is enacted after death.

Finally, in certain Texas jurisdictions, investigative inaction goes a step further by actively disappearing remains in local cemeteries. Resulting from multi-tiered marginalization in which resources, personnel, training, and facilities are severely lacking for border counties, most unidentified decedents in South and West Texas do not receive proper identification efforts or curation. Although Texas law mandates inquests and DNA submission for all unidentified persons, local authorities are both incapable of, and sometimes unwilling to, provide adequate services (Kaplan et al. 2022; Spradley et al. 2019). With limited funding for autopsies or transport to the distant ME office, the response is instead to bury decedents in unmarked graves wherever there is space in county cemeteries (Kovic 2013; Spradley et al. 2019). Rarely are records maintained or case numbers or dates associated with remains to facilitate tracking over time (Kaplan and Spradley 2022; Spradley et al. 2019). In the very environments meant to foster dignity in death, dehumanizing treatment is thus projected onto unidentified remains, leading to secondary and permanent forms of erasure that are equivalent to, if not worse than, disappearance in the desert (Reineke 2019). The inability to relocate burials of individuals who may eventually be identified also undermines the entire investigative process and deprives families of the ability to mourn the death of their loved ones.

The Intersection of Antemortem and Postmortem Embodiment in the Identification of Migrant Decedents in Texas

This uniquely obstructive medicolegal environment along the Texas-Mexico border necessitates specific responses for investigating the deaths of unidentified presumed migrants. It is here where antemortem and postmortem embodiment coalesce in the recovery and identification of

unknown decedents, as well as in attempts to change the systems that lead to embodied violence in the first place. Here we discuss the casework experience of Operation Identification (OpID), a humanitarian initiative of the Forensic Anthropology Center at Texas State University, to highlight how embodiment frameworks are applied to migrant death investigation in Texas. At the date of writing, OpID has received 536 cases and facilitated 140 identifications since the project's inception in 2013.

In order to locate and recover unidentified migrant decedents from unmarked or poorly marked graves, OpID and partners first carry out extensive searching, excavation, and analysis of remains (Kaplan and Spradley 2022; Spradley, Herrmann, Siegert, et al. 2019). In addition to conducting community outreach, records searches, and pedestrian and geophysical survey, OpID triages all individuals encountered in forensic excavations to ensure that those being exhumed are in need of case management. Adapting the cultural profile developed by Anderson (2008) and Birkby, Fenton and Anderson (2008), OpID utilizes similar antemortem and postmortem evidence of embodied marginalization to recognize unidentified individuals in Texas cemeteries.

Beyond assessing the biological profile, OpID team members document postmortem contextual clues during case intakes conducted on site, recording the burial containers, body positioning, grave contents, and the condition of remains to help target migrant decedents (Spradley et al. 2019). Whereas county burials of U.S. citizens typically contain inexpensive coffins or wood boxes, burials of unidentified migrant individuals often have more varied and often disrespectful containers, such as trash bags, biohazard bags, airline cargo boxes, and Styrofoam coolers (Kaplan, Siegert, Moe, et al. 2022; Kaplan and Spradley 2022). As partial remains beget more destructive forensic analysis, so too do they elicit less humane or equitable treatment in the grave, with unidentified skeletonized individuals particularly interred as biohazardous waste in non-funerary containers (Kaplan and Spradley 2022; Anderson and Spradley 2016). For migrant decedents in more traditional boxes or body bags, many have been found tossed in the grave in careless, strewn positions, such as head-first at sharp angles, facedown, or with splayed limbs, while local citizens are typically supine with crossed arms (Kaplan, Siegert, Moe, et al. 2022; Kaplan and Spradley 2022). While clothing and personal items on and with the body, such as backpacks, helps distinguish migrating persons from those formally dressed for burial, the disproportionate presence of trash and nitrile gloves in the burials of probable migrants further illustrate how violence is both passively and actively carried out in

cemeteries (Kaplan, Siegert, Moe, et al. 2022; Kaplan and Spradley 2022).

Unlike gloves used for burying remains, perimortem signs of medical intervention, such as hospital gowns, intubation tubes, or electrodes, may or may not indicate an unidentified migrant individual. In OpID's experience, however, evidence of life saving measures mostly coincides with skeletal or contextual indicators of advanced age, such as full dentures, suggesting persons are elderly locals not in need of identification—although the violence embodied by being buried with medical equipment is discussed further in Kaplan, Siegert, Moe et al. (2022). The prevalence and distribution of postmortem cut marks also distinguish probable unidentified persons. Inspired by Nystrom (2014), who originally used evidence of cut marks to document the discriminatory anatomical study of indigent persons from 19th-century almshouses, OpID documents these same cut marks on the ribs, crania, and long bones as evidence that an individual requires further forensic services. Specifically, in Texas border counties, cut marks indicate previous autopsy and genetic sampling, suggesting that the decedent previously entered the medicolegal system unidentified (Kaplan and Spradley, 2022). Unfortunately, however, most unidentified persons exhumed in South Texas show no evidence of postmortem forensic examination, further exemplifying systemic necroviolent inaction (Kaplan and Spradley 2022; Soler, Beatrice, Reineke et al. 2020; Reineke 2019). Although paradoxically serving to help locate remains in need of case management, this overall haphazard and neglectful postmortem treatment of migrant decedents perpetuates erasure and disembodiment at the individual and population level (Kaplan and Spradley 2022; Reineke 2019; Soler et al. 2020).

Once decedents are recovered, antemortem and postmortem embodiment differentially impact the identification process. On the one hand, in line with the literature from the PCOME, many cases at OpID show evidence of poor oral health and lacking access to dental care, including antemortem tooth loss, LEH, caries, periodontitis, and abscesses (Beatrice and Soler 2016; Birkby et al. 2008; Fancher and Hampl 2018; Soler et al. 2022; Spradley and Gocha 2020). Although all individuals are examined by a forensic odontologist, antemortem radiographs have yet to be available to facilitate positive identification. On the other hand, like previous investigators have found, OpID cases, particularly from Central American countries, also have a high prevalence of culturally relevant dental modifications, including gold caps, windows, decorative partial dentures, and embedded metallic designs in both natural teeth and pontics (Beatrice et al. 2021; Soler et al. 2022). While not singularly conclusive enough to confirm

identity, these modifications are very recognizable to families, lending strong contextual support to identifications. Similarly, skeletal markers of marginalization such as evidence of repetitive trauma or improperly healed fractures, can be uniquely identifiable to families, even if comparative medical records are lacking.

As discussed by De León (2012) in the Arizona desert, personal effects recovered with decedents in Texas reflect the peri and postmortem violence experienced by the body, but also powerfully contribute to identifications. In general, OpID encounters three broad categories of personal effects: necessities, personal objects, and portable religious (Catholic) items (Jasinski et al. 2021). While the necessities, including clothing, toiletries, money, and cellphones speak to the clandestine migration experience, the personal and religious items embody traces of the individual's identity. Throughout the process of handwashing, photographing, and inventorying all objects, these personal items play an important role in humanizing the deceased. Families regularly recognize items such as jewelry, photographs, letters, prayer cards, and bibles to help identify their loved one. Several OpID cases have been resolved due to family members recognizing objects on online missing persons databases. Mourners also report that it is the personal effects that most facilitate their acceptance of a loved one's death and ask about these items frequently. Although some might claim that the intimate handling of human remains and personal items by OpID is an extension of necroviolence (García-Deister and Smith 2020), this treatment arguably constitutes a form of postmortem care that contrasts or alleviates the destruction of forensic analysis (Cook 2020; Parra et al. 2020; Reineke 2019; Rosenblatt 2015). Until systems for disaster management at the border can be improved, it is this level of physical and material interaction with the bodies of the deceased that maximizes the chance of return to their loved ones.

Yet, the structural vulnerabilities that contribute to lacking antemortem biometric data also prevent the swift resolution of transnational cases in terms of genetic comparisons. Currently, most families outside of the United States face a multitude of barriers to providing DNA to the national database, the Combined DNA Index System (CODIS), while those who reside in the country may be fearful to submit to law enforcement (Kovic and Canales 2022; Gocha, Spradley and Strand 2018; O'Daniel 2018). Approximately one third of OpID's resolved cases have been those of persons attempting to re-enter the United States for the sake of family reunification after being deported. It is therefore only through extensive multi-agency

collaboration, particularly with nongovernmental organizations, that OpID and other agencies have created alternative pathways for identification (Budowle et al. 2020; Spradley and Gocha 2020).

Future Directions for Embodiment Frameworks in Death Investigation

A suite of characteristics signaling antemortem and postmortem embodiment of violence can be used to inform decisions regarding the forensic recovery, triage, and identification of probable migrant decedents in the context of the U.S.-Mexico border. Practitioners and scholars working in this and other medicolegal arenas continue to emphasize the role that anthropologists should play in death investigation and how embodiment frameworks might be expanded to have broader impacts (Anderson and Spradley 2016; Goad 2020; Soler and Beatrice 2018; Winburn et al. 2022). Soler et al. (2020) especially articulate that it is the forensic anthropologist's job not just to identify the deceased, but also to shed light on the profound humanitarian consequences of migration. Recognizing these consequences and the ways that unidentified decedents reflect and undergo structural violence is urgent for improving both forensic practices and border policy. In the same vein, Winburn, Miller Wolf and Marten (2022) are developing a much-needed Structural Vulnerability Profile (SVP) to operationalize the type of biocultural profile originated by Birkby, Fenton and Anderson (2008) across medicolegal offices. Critically, the SVP would allow practitioners to document the biomarkers and biocultural evidence of the quotidian violence experienced by numerous marginalized persons in the United States, not just unidentified migrants (Winburn et al. 2022; Znachko et al. 2023). As highlighted through the applied practice of OpID, the documentation of various embodied forms of evidence is useful in adapting the forensic process to specific contexts in which the recognition of structural violence can improve practitioners' efforts. It is precisely through embodiment frameworks, holistically assessing both antemortem and postmortem indicators of violence, as well as resilience, that anthropologists refine investigative trajectories and spread awareness of public health and human rights issues across the country (Goad 2020; Winburn et al. 2022). Although advancing embodiment research can be difficult when navigating case backlogs and disastrous numbers of death, having applicable standards such as the SVP will help entities such as OpID and many others track embodied phenomena through casework to hopefully effect real change.

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