EXAMINING ILLICIT SUPPLY NETWORKS AND ORGANIZATIONAL MISCONDUCT:
A HOLISTIC PERSPECTIVE

By

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ABSTRACT

Illicit supply networks (ISNs), which "source, transit, and distribute illicitly traded goods" (Magliocca et al., 2021), are exceedingly adaptable and impactful, yielding damaging social, financial, and ecological repercussions on an individual, firm, and global scale. ISNs have become increasingly complex by using more advanced technologies and capitalizing on global uncertainty brought about by pandemics and political conflict. Acknowledging the complexity which increases the difficulty of detection and prediction, this three-essay dissertation strives to develop a holistic approach to understand how: (1) supply chain actors play various roles in the perpetuation or inhibition of illicit supply network operations, and (2) the factors which predispose ISNs to detection and theoretical interdiction.

In the first essay, I employ a scenario-based role-playing experiment to capture consumer perceptions and consequent purchase intentions within the context of illicit wildlife trade. This research reveals a significant relationship between the communication of species illegality with consumer guilt as well as a mediating effect of consumer guilt on reducing future repurchase intentions. However, a moderating effect of health condition criticality (i.e., critical or non-critical) nor the derivation of the species (i.e., plant or animal) exhibited a significant moderating effect.

In the second essay, I leverage secondary data from the DEA's ARCOS the CDC's WONDER database to investigate the relationship between the oversupply of opioids and overdose rates by county. Additionally, I consider the potential moderating effect of measures related to socioeconomic status: educational attainment and unemployment rate by leveraging the USDA's Economic Research Service and U.S. BLS's Local Area Unemployment Statistics, respectively. Relatedly, I explore the potential moderating effects by the presence of high-injury

(i.e., extractive) industries as well as pharmacies and drug stores with the U.S. Census Bureau's County Business Patterns datasets.   The results of this research demonstrate a significant direct effect of both opioid distribution and the presence of pharmacies and drug stores, as well as a moderating effect of both measures of socioeconomic status and the presence of extractive industries on elevated rates of fatal overdose.

In the third essay, I utilize fuzzy set qualitative comparative analysis (fsQCA) to explore the specific elements which predispose illicit wildlife supply chains to a higher prospect of detection. In employing this methodology, this research discovers two solutions, or configurations of conditions, which result in high detectability. Both solutions exhibit the presence of measures with high scores of product and stakeholder recognizability, while the second solution also involves high scores on transportation related measures.

ACKNOWLEDGEMENTS

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CHAPTER 1

ILLICIT WILDLIFE TRADE: AN EXPERIMENTAL INVESTIGATION INTO

CONSUMER GUILT AND PURCHASE BEHAVIOR

1.1 INTRODUCTION

The growing prioritization of supply chain security has prompted firms to explore beyond typical digital and physical (e.g., theft, sabotage, piracy) threats (Gonzalez 2022), and to consider previously lesser acknowledged risks such as illicit supply chains (Congress 2020). As defined by Basu (2013, p. 319), an **illicit supply chain** is "a group of multiple organizations engaging in one or more illegitimate activities pertaining to the sourcing, procurement, production, logistics, or distribution of illegal or prohibited goods and services." While illicit supply chains *can* be comprised of illegal trade, illicit activities could also be entirely legal but deemed unethical, immoral, or socially unacceptable (Cambridge 2024; Collins 2024). For instance, HelloFresh was accused of purchasing coconut milk from companies which relied upon chained monkeys to harvest coconuts (Gibson 2022). However, the established animal welfare laws in Thailand are only applicable to domestic animals, thereby solidifying the practice of "monkey labor" as technically legal (Fobar 2021). Moreover, illicit supply chains can involve products or activities which are illegal in one country or geographic region but considered legal in another (Collins 2024). Differences in the regulations of labor and supply chain operations on a global and local levels can foster varied responses by law enforcement, thereby perpetuating illicit supply chains (Shepherd et al. 2007).

Globally, illicit supply chains account for upwards of $2 trillion USD on an annual basis and are continuing to flourish (UNCTAD 2020). Illicit supply chains are responsible for pervasive social and environmental harms (Magliocca et al. 2021), which pose direct and indirect

hazards to human safety. Along these lines, illicit supply chains simultaneously erode biodiversity, depleting resources, and threatening entire ecosystems (Duffy 2022). Considered economically, illicit supply chains create detrimental impacts to businesses such as dampened growth and elevated security costs (TRACIT 2018). Furthermore, illicit supply chains can yield long-term indirect impacts to licit supply chains in the form of reputational harm and loss of customer loyalty (Giuliani, 2016; Hilend et al. 2023; Strike et al., 2006).

Although some forms of illicit trade operate disparately from legitimate businesses, other forms can infiltrate licit supply chains (Duensing et al. 2023). In doing so, illicit products have the potential to reach the end consumer, posing a variety of threats to consumer safety altered or counterfeit products ranging from airbags (ICE 2022) to prescription medicines (FDA 2023). Although research exploring illicit supply chains is still in its infancy, businesses are taking action against illicit infiltration threats. Specifically, firms are partnering on anti-counterfeiting initiatives such as Amazon's Anti-Counterfeiting Exchange (ACX) or the Alibaba Anti-Counterfeiting Alliance (AACA) and ethical labor initiatives such as the Centre's Joint Action Pledge (The Centre 2021). One area where researchers and businesses are beginning to direct greater attention is to illicit extraction and trade of wildlife, which pose a substantial threat to firm operations and the safety of stakeholders more broadly (Duffy 2022; Hilend et al. 2023).

Illegal wildlife trade (IWT) is defined as "the trafficking in any specimen, knowing that the specimen was taken, possessed, distributed, transported, purchased or sold in contravention of: (a) Any international agreement concerning or relating to the protection, conservation, management, trade or use of wild fauna or flora binding on the State Party; or (b) Any applicable domestic or foreign law concerning the protection, conservation management, trade or use of wild fauna or flora" (End Wildlife Crime 2020, p. 6). Operating on a global scale, IWT inflicts

widespread environmental harm to species and can even result in entire ecosystem collapse (Hilend et al. 2023; World Economic Forum 2023). Although termed *illegal* wildlife trade, the geographic variances in species protections permits *illicit* wildlife trade to be grouped under IWT, often operating alongside and comingled with legal forms of wildlife trade (TRAFFIC 2024). While some forms of wildlife are traded independently and without infiltrating legitimate supply chains, many forms of wildlife are processed into various types of medicines and food products in legitimate supply chains, such as counterfeit food products (e.g., honey, milk, olive oil) (Copeland 2020; TRAFFIC 2024). Relatedly, both licit and illicit wildlife products (e.g., sea cucumbers, ginseng, songbirds) are increasingly entering both brick-and-mortar and e-commerce settings (CITES 2022, USFWS 2021). For example, sea cucumbers, which are often, but not always illicitly harvested (USDOJ 2018), are sold by both Costco and Amazon (Costco 2024; Amazon 2024), representing a supply risk for these retailers.

Considering the influx of licit and illicit wildlife products entering traditional retail spaces, the threats of IWT extend beyond environmental damage and pose a risk to consumer safety. Generally, consumers establish a level of trust when purchasing products such as medicinal or food products from recognizable brands and traditional retail channels and assume that the collective efforts of governance would prevent them from encountering illegal or unsafe items (NSF 2023). Considering that traditional and alternative forms of medicine are a primary driver of demand for IWT (GEF 2024; Izquierdo 2021), wildlife-derived medicinal products are a relevant retail context to examine. Accordingly, guilt and other negative consumer perceptions can arise upon encountering an illicit product in retail settings which are exploited by IWT (Bardey et al. 2022; Lindenmeier et al. 2017). As observed in the contexts of counterfeit products

(Bardey et al. 2022; Peinkofer & Jin 2023) and illicit labor (Lindenmeier et al. 2017), negative consumer sentiments can diminish (re)purchase intentions.

In addition to the legal status of a product, consumers consider a range of product and situational characteristics when considering a potential purchase, which can influence their perceptions and corresponding purchase behavior. Extant consumer-based supply chain research has been largely limited to product factors such as price (Biswas et al. 2008; Mitra & Fay 2010), packaging (Wallenburg et al. 2021), and a product's counterfeit nature (Peinkofer & Jin 2023), as well as situational factors such as brand image (Jeng 2016), inventory levels (Peinkofer et al. 2016), return policies (Oghazi et al. 2018; Rao et al. 2014), and supply chain transparency (Mollenkopf et al. 2022). These studies reveal the effects that product characteristics can impose on consumers in the form of negative consumer sentiments (Peinkofer et al. 2016) and behavioral intentions, such as decreased purchase intentions (Biswas et al. 2008; Peinkofer & Jin 2023) and increased returns (Rao et al. 2014). Yet, studies originating from other disciplines have explored features which are directly relatable to a product's use (e.g., medicinal) or nature (e.g., consumable), such as a consumer's health or health consciousness (Kim & Yoon 2021), as well as the derivation (i.e., plant or animal) of a wildlife-based product (Ghaffari et al. 2022; Mishra & Mehta 2023; Wang & Basso 2019). These studies emphasize how consumer guilt arises from specific product characteristics or a consumer's health conditions (Kim & Yoon 2021; Mishra & Mehta 2023; Wang & Basso 2019).

Consumer guilt has been shown to yield post-purchase behaviors which have detrimental impacts to firms, such as a reduction in both repurchase intentions and customer loyalty (Kazançoğlu et al. 2021; Ki et al. 2017). Nevertheless, research is still burgeoning in the context of other forms of illicit trade, with existing studies being limited to counterfeits (Bardey et al.

2022) and illicit labor (Lindenmeier et al. 2017). Despite evidence of the influential role of product and situational characteristics on shaping consumer feelings of guilt, and consequently purchase behavior, exploration within the context of IWT is nascent. Hence, I pose the following research questions: (1) *How does species' illegality impact consumers' feelings of guilt and consequently influence repurchase intentions?* And (2) *How do the criticality of a health condition and the type of species impact consumers' feelings of guilt and consequently influence repurchase intentions?*

To explore the impact of illicit wildlife related research on consumer sentiments and related behavior, I employ cognitive appraisal theory (CAT) (Lazarus 1991) to develop two scenario-based experiments (Rungtusanatham et al. 2011). Both experiments are centered in a local health food store setting, which is consistent with retail settings where IWT is known to infiltrate. The first study examines how the combined effects of species illegality with the criticality of a health condition diagnosis influence consumer guilt, and consequent intentions to repurchase. In the second study, I similarly evaluate the combined effects of species illegality with product characteristics, but instead explore whether the product's derivation (i.e., plant or animal) influences consumer sentiments of guilt and resulting repurchase intentions. Collectively, my research extends the application of CAT to provide deeper insights into consumer sentiments and behavior in the context of illicit wildlife trade. The findings of this research reveal that species illegality heightens sentiments of consumer guilt, while also maintaining a direct effect on reducing repurchase intentions. I find that consumer guilt mediates the relationship between species illegality and repurchase intentions.

Through this research, I contribute empirically by examining how the illegality of a wildlife product shapes consumer emotions and actions in a retail setting. Moreover, I integrate

CAT to develop middle range theory by employing a consumer-centric perspective in a supply chain context to examine the sentiments and subsequent actions of consumers. I provide managerial contributions by emphasizing the importance for managers to both heighten their awareness of illicit products infiltration throughout their supply chain, as well as to take action to implement safeguards to protect their supply chain from potential infiltration by illicit wildlife trade. In doing so, managers can minimize the potential repercussions stemming from negative consumer emotions and behaviors.

I structure my manuscript to begin by summarizing the literature related to illicit supply chains and consumer guilt. After, I introduce CAT as the theoretical lens through which I develop my hypotheses surrounding consumer sentiments and repurchase behavior. Next, I describe my experimental methodology and present the findings. Finally, I provide the theoretical and practical contributions as well as limitations of my research before offering potential avenues for future research.

1.2 LITERATURE REVIEW

Illicit Supply Chains

Empirically, illicit supply chains have been broadly explored predominantly by researchers in natural sciences (Duffy 2022; Massé & Margulies 2020; Wellsmith 2013), engineering (Anzoom et al. 2021, Najafi et al. 2023), and criminology (Kurland & Pires 2017; Moeller 2018; Schneider 2008). Extant research has focused on quantifying the implications of illicit trade (Massé & Margulies 2020), assessing the tendencies, patterns, and routes (Anzoom et al. 2021; Kurland & Pires 2017; Moeller 2018), as well as developing strategies aimed at thwarting illicit supply chains (Anzoom et al. 2021; Gore et al. 2023; Kurland & Pires 2017; Najafi et al. 2023; Schneider 2008; Wellsmith 2013).

Business research and more particularly, supply chain management (Basu 2013; Basu 2014; D'amato & Papadimitriou 2013) have explored illicit trade to a more limited degree. Despite the diverse range of types of illicit trade, much of the extant research by supply chain and operations scholars have been restricted to the contexts of counterfeiting (Cho et al. 2015; D'amato & Papadimitriou 2013; Peinkofer & Jin 2023), drug trafficking (Pullman et al. 2023), sex trafficking (Keskin et al. 2021), and unethical labor (Bhimani 2019). Existing studies have emphasized the vulnerabilities of supply chains across industries (Bhimani 2019; Cho et al. 2015; Peinkofer & Jin 2023), the vast effects of illicit supply chains and related reactions from stakeholders (Cho et al. 2015; D'amato & Papadimitriou 2013; Keskin et al. 2021; Peinkofer & Jin 2023) and explored strategies to investigate and interdict illicit supply chains (Bhimani 2019; D'amato & Papadimitriou 2013; Keskin et al. 2021; Pullman et al. 2023).

These other contexts of illicit supply chains, such as counterfeiting, drug trafficking, and illicit labor, have revealed that the illegality of products can yield negative sentiments and correspondingly result in reduced intentions to (re)purchase (Bardey et al. 2022; Lindenmeier et al. 2017). However, there has been limited exploration into illicit use of natural resources and wildlife within business disciplines (Berman et al. 2017), and particularly, within the supply chain and operations disciplines (Duensing et al. 2023; Hilend et al. 2023; Keskin et al. 2023). As compared with legitimate supply chains, illicit supply chains are particularly adaptable due to their need to evade detection (Basu 2013). However, acknowledging the pervasive nature and widespread impacts IWT has on biodiversity and ecosystem health, or social impacts to stakeholders (Duensing et al. 2023; Duffy 2022; TACIT 2018), coupled with the upsurge of illicit wildlife products infiltrating retail settings (Guertin 2021), it is crucial to examine the role of consumer perceptions and behavior in this setting. Specifically, it is pertinent to explore how

consumer sentiments can shape future purchase intentions in the presence of illicit wildlife products and the role that this plays for potential demand reduction in the long term.

Consumer Guilt

Exploration of guilt within the context of illicit settings is fundamental to developing a deeper understanding of the potential impacts to consumer behavior. Unlike related emotions such as shame, guilt typically results in induction of reparative behavior and/or discontinuance of the undesirable behavior (Ghingold 1981; Tangney et al. 1996; Tangney & Dearing 2003; Tangney et al. 2014). As this pertains to the consumer experience, unfavorable consumer emotions such as guilt have been shown to yield an adverse impact on post-purchase behaviors (Mano & Oliver 1993; Peloza et al. 2013; Westbrook 1987). Specifically, consumer guilt can result in a reduction of intentions to repurchase in the future as well as long term customer loyalty (Kazançoğlu et al. 2021; Ki et al. 2017), thereby imposing negative repercussions to firms. For example, consumers experiencing elevated levels of guilt are less inclined to purchase luxury products (Ki & Kim 2016; Ki et al. 2017; Minton & Geiger-Oneto 2020) and are more inclined to make more sustainable food purchases (Nguyen et al. 2021) or opt for fair-trade products (Lindenmeier et al. 2017).

Defined as an emotion resulting from failing to achieve or violating internalized personal or social moral standards (Dedeoğlu & Kazançoğlu 2010), consumer guilt typically arises from "self-caused" events (Watson & Spence 2007) relating to consumption decisions. In the extant literature, feelings of guilt have been induced by illicit products in the context of counterfeit (Bardey et al. 2022) and unethical labor settings (Lindenmeier et al. 2017). Most studies on consumer guilt within an illicit retail context (e.g., counterfeiting and unethical labor) exist outside business disciplines (Bardey et al. 2022; Lindenmeier et al. 2017). Acknowledging the

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role guilt plays in reducing repurchase intentions and customer loyalty (Kazançoğlu et al. 2021; Ki et al. 2017) and the effect consumer insights impose on supply chain strategies, there is a pressing opportunity within supply chain management to understand the relationship between the illicit nature of products and consumer sentiments and corresponding behavior. My research addresses this gap by examining how feelings of guilt are elicited by consumers in the context of illicit wildlife products in a retail setting, and how this consequently shapes consumer behavior.

1.3 THEORETICAL FOUNDATIONS

Cognitive Appraisal Theory (CAT)

Within a retail context, existing research has demonstrated that certain product and situational characteristics can influence an individual's appraisal of a given environment (Inman et al. 2009; Jung Chang et al. 2014). Product characteristics can elicit consumer emotions surrounding dissatisfaction (Peinkofer et al. 2016), trust (Chae et al. 2020) and guilt (Bardey et al. 2022; Lindenmeier et al. 2017), consequently influencing consumer behavior such as (re)purchase intentions (Chae et al. 2020; Lindenmeier et al. 2017).

As a core tenet, CAT acknowledges that an individual's evaluation of a given situation or environment elicits a related emotion, and ultimately a corresponding action (Lazarus 1991). Notably, the individual assesses the situation or environment and the potential impacts it has for their own well-being (Lazarus 1991). Based on this appraisal, assuming the potential outcomes are deemed relevant, it will evoke an associated emotion (Conroy et al. 2017). Then, dependent on the emotion and determination of whether a coping behavior is warranted, it will yield a subsequent, corresponding action by the individual (Lazarus 1991; Watson & Spence 2007).

Extant research in supply chain discipline has applied CAT to the contexts of crowdsourcing (Ha et al. 2023), reverse logistics (Jones et al. 2023), last-mile delivery (Masorgo

et al. 2023), and supplier selection (Polyviou et al. 2022). In evaluating the consumer perspective, CAT has been applied in recent studies to examine the impact of various stimuli to consumer appraisals (Ha et al. 2023), consumer sentiments and related behavior (Jones et al. 2023), as well as customer satisfaction and related repurchase intentions (Masorgo et al. 2023). While Jones at al. (2023) and Ha et al. (2023) respectively expound upon the firm policies and product characteristics which positively influence consumers perceptions and corresponding purchase intentions, Masorgo et al. (2023) explores the impacts of negative emotions such as sadness and anger on consumer perspectives and behavior. Moreover, Polyviou et al. (2022) consider the emotion of guilt and elaborate on the role that guilt plays in influencing decision making upstream in the supply chain. Hence, CAT is an appropriate theoretical lens through which to explore how personal or situational factors (health condition criticality) and product characteristics (species legality and species characteristics) can influence consumer emotion (guilt) and consequently, action (intentions to repurchase).

1.4 HYPOTHESES

A product's illicit nature may pose concerns to consumers and correspondingly incite negative emotions associated with the product, such as guilt (Bardey et al. 2022; Lindenmeier et al. 2017). Thus, I can anticipate that the feelings of guilt arising from these illicit contexts would similarly translate to the context of IWT. In addition to a product's illicit nature, consumers often consider their own attributes when evaluating a potential purchase (Im et al. 2003), including their health (Sabbe et al. 2009). The extant literature on health and health condition criticality shows the tendency for consumers to express reduced feelings of guilt when making a purchase decision which is perceived as beneficial to their health (Kim & Yoon 2021).

Furthermore, an individual's health is taken into consideration when contemplating a potential purchase. According to CAT, individuals (consumers) appraise the *complete* environments, inclusive of situational and product characteristics (Lazarus 1991; Watson & Spence 2007). Hence, these characteristics encompass personal factors and potential impacts to health or well-being (Lazarus 1991; Watson & Spence 2007). These factors and the appraisal of potential outcomes contribute to the elicitation of a corresponding emotion (Lazarus 1991; Watson & Spence 2007). Acknowledging that a product's, or in this case a species', illicit nature might yield detrimental outcomes to a consumer, I would expect the resulting emotion to be negative. Noting that CAT posits that the individual considers the environment holistically, their personal factors (i.e., criticality of health condition(s)) might conflict with product characteristics (i.e., species' illicit nature) when evoking an emotion. In doing so, a product's illegal nature would hypothetically exhibit a moderating effect on the relationship between the criticality of an individual's health condition and the emotions evoked by a product's illegal nature, such as guilt. Specifically, I would anticipate that consumers who have been previously diagnosed with a critical health condition would exhibit lower feelings of guilt as compared to those diagnosed with a non-critical health condition when learning of a product's illegality.

H1: The effect of species illegality on consumer guilt will be lower for the those with a critical health condition, as compared to those with a non-critical health condition.

In addition to the situational characteristics incorporated in the environment with the consideration of health condition criticality, product characteristics can similarly influence consumer sentiments. When considering wildlife-derived products, there is an additional consideration of the plant or animal's once-living state. Whether a remedy is animal or plant derived has the potential to conflict with a consumer's cultural, religious, or personal beliefs and

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consequently yield elevated sentiments of guilt, which has been attributed in the extant literature

to dietary preferences (e.g., veganism) (Ghaffari et al. 2022) or cultural and religious beliefs

(e.g., anthropomorphism) (Mishra & Mehta 2023; Wang & Basso 2019).

Consistent with the logic of CAT, whether a product is derived from an animal or plant,

in addition to its illicit nature, may collectively provide additional information to contribute to a

holistic appraisal of the setting. Consequently, an individual's holistic appraisal of a specific

environment should contribute to the development of an emotional response (Lazarus 1991;

Watson & Spence 2007). Extant research on veganism and anthropomorphism (Ghaffari et al.

2022; Mishra & Mehta 2023; Wang & Basso 2019) has shown a negative emotion of guilt by

some consumers who are presented with an animal-derived product as compared to those

presented with a plant-derived product. I anticipate that consumer guilt exhibited by the illegality

of a species will be exacerbated in contexts involving an animal-derived remedy, unlike contexts

involving a plant-based remedy. Hence, I expect that plant-based remedies will elicit

comparatively lesser feelings of guilt in consumers than an animal-based remedy.

H2: The effect of species illegality on consumer guilt will be lower for the those

purchasing a plant-based remedy, as compared to those taking an animal-based remedy.

Beyond shaping consumer perceptions, evaluations of product and situational

characteristics as part of the purchase scenario can foster various consumers sentiments and

ultimately influence subsequent actions (Chae et al. 2020; Ha 2021). When considered within the

context of guilt, it is important to acknowledge the tendency of increased sentiments of guilt to

promote an increase in reparative behaviors and in a reduction in undesirable behaviors

(Ghingold 1981; Tangney et al. 1996; Tangney & Dearing 2003; Tangney et al. 2014). When

applied to a retail setting, extant research has linked consumer guilt to a reduction in future

purchase intentions (Burnett & Lunsford 1994; Mills & Groening 2021). Moreover, extant research has demonstrated that the consumer's intentions to reduce purchases in the future as a function of guilt holds when the context involves illicit activity (Bardey et al. 2022; Lindenmeier et al. 2017) or violates social norms (Pounders et al. 2018). Accordingly, I would anticipate that this will correspondingly translate to the retail scenario involving IWT products.

The relationship of guilt in reducing repurchase intentions is consistent with the foundational tenet of CAT. Particularly, CAT posits that an individual's appraisal of a given environment or scenario will elicit an apposite emotion, and consequently yield a corresponding action (Lazarus 1991; Watson & Spence 2007). Thus, when applying CAT to the subject context, guilt serves as the mediating emotion through which the appraisal and action relate. Building upon H1 and H2, I anticipate that guilt plays a mediating role between the previously identified product and situational characteristics with repurchase intentions. I expect that a consumer who experiences greater feelings of guilt will exhibit lower intentions to repurchase than a consumer who experiences lesser feelings of guilt. Two conceptual models were developed to illustrate the anticipated relationship between species illegality and repurchase intentions as mediated by consumer guilt, the mediation of which is moderated by either health condition criticality (Figure 1) or the derivation of wildlife product (Figure 2).

H3a: Consumer guilt mediates the relationship between species illegality and health condition criticality, and repurchase intentions.

H3b: Consumer guilt mediates the relationship between species illegality and species derivation, and repurchase intentions.

Health
Condition
Criticality

H1

Consumer
Guilt

H3a

Species
Illegality

Repurchase
Intentions
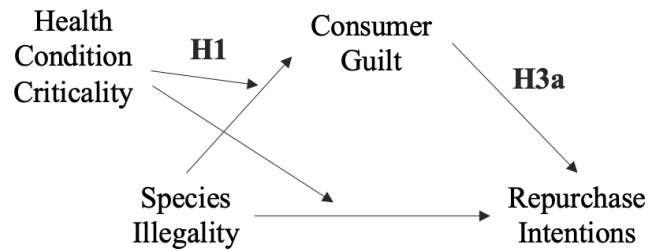
Figure 1. Conceptual Moderated Mediation Model – Health Condition Criticality Moderator

Species
Derivation

H2

Consumer
Guilt

H3b

Species
Illegality

Repurchase
Intentions
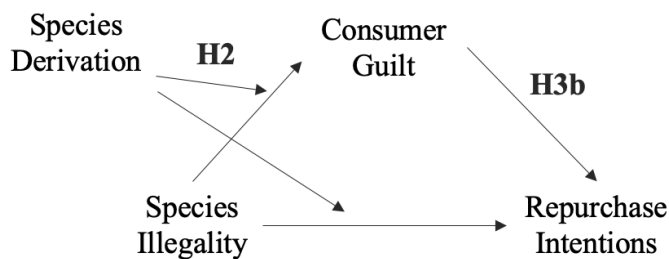
Figure 2. Conceptual Moderated Mediation Model – Species Derivation Moderator

1.5 METHODOLOGY

The experimental procedures are comprised of two pretests and two studies. The two pretests refined the experimental stimuli, health condition criticality and species derivation, respectively corresponding to the first and second studies. Collectively, these pretests ensured appropriate variable manipulation (Knemeyer & Naylor 2011), and isolated causal relationships between predictor and outcome variables (Bachrach & Bendoly 2011; Tokar 2010).

Pretest one: Health Condition Criticality

In establishing the scenario-based experiments in a retail context, I referenced the three-stage process and guidelines of Rungtusanatham et al. (2011). In the pre-design stage, I reviewed the range of retail settings where IWT has been shown to infiltrate. Acknowledging the prevalence of IWT in both the ecommerce and brick and mortar settings (CITES 2022; USFWS

2021), I positioned the scenario within a local health food store environment. To control for brand effects, I relied on an unnamed retailer in the development of the hypothetical retail scenario.

In developing the experimental module conditions and determining suitable experimental stimuli related to health condition criticality (i.e., critical and noncritical health conditions), I conducted an initial review of the literature. Consistent with the health conditions featured in extant research, I established a group of health conditions (i.e., sepsis, allergies, dark under-eye circles, cancer, insomnia, skin rash, multiple sclerosis, arthritis, wrinkles, balding, heart disease, bronchitis, infertility, fibromyalgia, headaches) for which traditional medicine practices have been used to treat (Bradford & Cott 2006, Debjit Bhowmik et al. 2009, Qiu 2007, Song et al. 2023; Trak & Chauhan 2022). These health conditions retain varying levels of criticality, with some of the condition effects being primarily aesthetic. To ascertain the most suitable noncritical and critical health conditions to be included in the first study, I conducted a within-subjects pretest with these 15 health conditions.

To determine which health conditions demonstrated a significant difference in the ratings of perceived criticality, I leveraged a matrix-style set of items in which participants were asked to rate the level of "criticality" for each health condition (i.e., sepsis, allergies, dark under-eye circles, cancer, insomnia, skin rash, multiple sclerosis, arthritis, wrinkles, balding, heart disease, bronchitis, infertility, fibromyalgia, headaches) on a one item 7-point Likert scale (1 = not at all critical, 4 = moderately critical, 7 = very critical). The health conditions were displayed in a randomized order. Congruent with prior procedures, I used Amazon Mechanical Turk (Mturk) via CloudResearch (Litman et al. 2017) to employ quality and safety features and thereby include high-quality participants, as is consistent with extant operations management research

(Cantor & Jin 2019; Peinkofer & Jin 2023; Tokar et al. 2016). To qualify, participants needed to have a minimum HIT approval rate of 95% with at least 100 approved hits. Furthermore, participants with unverifiable locations or duplicate IP addresses were excluded. Finally, I "super-excluded" participants who have participated in another experiment conducted by the same research team. This study took an average of 5.10 minutes to complete, and participants were compensated with $0.50.

I collected an original sample of 41 individuals 18+ years of age using Mturk via CloudResearch (Litman et al. 2017). I employed three attention checks as well as five open-ended questions to aid in identification of suspicious responses to enhance data quality and validity (Abbey & Meloy 2017; Lonati et al. 2018). Of the 41 participants, I removed 11 participants who failed the attention checks (Abbey & Meloy 2017; Wason et al. 2002), thereby yielding a final sample of 30 participants. Table 1 presents an overview of the sample as well as a summary of the experimental procedures.

To determine whether a significant difference in perceived criticality of health conditions existed, I conducted paired samples t-tests in SPSS. I found that skin rash received notably lower ratings of criticality as compared to various health conditions, including cancer (MΔ = 2.27, p < 0.001), sepsis (MΔ = 1.90, p < 0.001), and heart disease (MΔ = -2.03, p = 0.001). Conversely, cancer exemplified a notably higher rating of criticality as compared to other conditions such as balding (MΔ = 3.13, p < 0.001), dark under eye circles (MΔ = -3.00, p < 0.001), and allergies (MΔ = -2.03, p < 0.001). Although skin rash received marginally higher ratings of criticality as compared to two conditions, both balding and dark under eye circles can be considered as purely aesthetic concerns, rather than pertaining to health conditions. Hence, I

selected skin rash and cancer to respectively serve as the non-critical and critical conditions for

the health condition criticality manipulation in the first study.

	Health Condition Criticality	Species Derivation
Consumer Panel	Mturk	Mturk
Compensation	$0.50	$0.50
Average completion time (minutes)	5.10	5.69
Initial sample	41	38
No. of participants that failed the attention check	11	8
No. of outliers removed	0	0
Final sample size	30	30
Age (mean)	39	41
Gender (female/male/other)	47%/48%/5%	42%/55%/3%
Household income (median)	$60,000-69,999	$50,000-59,999
% with at least some college education	84.2%	83.9%

Table 1. Experimental Procedures – Pretests

Study one: Health Condition Criticality

Experimental Design and Sample

The first study is comprised of a 2 (Health Condition Criticality: critical vs noncritical) x 2

(Legality: illegal vs legal) between-subjects design, employing a hypothetical shopping scenario.

All participants were embedded in the shopping scenario with a family member as the referring

party. The complete procedures for this study as well as a summarized version of the

experimental procedures can be found in Appendix 1 and Table 2, respectively.

	Study 1	Study 2
Consumer Panel	Mturk	Mturk
Compensation	$1.00	$1.00
Average completion time (minutes)	6.60	12.16
Initial sample	581	556
No. of participants that failed the attention check	27	17
No. of participants that failed the manipulation checks	23	18
No. of outliers removed	0	0
Final sample size	531	521
Age (mean)	43	48
Gender (female/male/other)	53%/45%/2%	54%/45%/1%
Household income (median)	$60-70k	$50-60k
% with at least some college education	91.1%	91%
Realism check rating (average)	4.76	5.18

Table 2. Experimental Procedures – Study One and Two

Measures

For the first study, I employed two dependent variable measures, guilt and repurchase intentions, which were adapted from Marschall et al.'s (1994) ten-item, seven-point Likert scale and Burton et al.'s (1999) revised three-item, seven-point Likert scale, respectively. To isolate the effects of species illegality and health condition criticality, I held species derivation constant. The original scales and the adapted versions employed for this research appear in Appendix 2.

Attention and Manipulation Checks

I started with an original sample of 581 individuals 18+ years of age using Mturk via CloudResearch (Litman et al. 2017) and utilized the same features as demonstrated in the first pretest. As with pretest one, three attention checks along with five open-ended questions were employed to ensure high data quality and validity (Abbey & Meloy 2017; Lonati et al. 2018). Of the 581 participants, 27 were eliminated for failed attention checks and 23 participants failed a manipulation check (Abbey & Meloy 2017; Wason et al. 2002), resulting in a final sample of

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531 participants. Table 2 presents an overview of the sample as well as a summary of the

experimental procedures. Hawthorne checks were performed to guard against the potential

impacts of unrelated factors and found no impact (Bachrach & Bendoly 2011).

Convergent and Discriminant Validity

To assess convergent and discriminant validity, I conducted a two-factor confirmatory

factor analysis (CFA) on guilt and repurchase intentions with Mplus (Table 3). To conduct the

CFA, I used the WLSMV command rather than ML as an estimator due to the ordinal nature of

the data (Li 2016). The resulting CFA fit statistics are as follow: $\chi 2 = 175.496$, *df* = 41, CFI =

0.998, RMSEA = 0.079 (90% confidence interval: 0.067; 0.091), and SRMR = 0.020. Although

RMSEA exceeds the traditionally preferred threshold of 0.05 (Kenny et al. 2015), RMSEA tends

to be overestimated when employing the WLSMV command for ordinal data (Li 2016) and still

remains within the traditionally accepted threshold of 0.08 (Kenny et al. 2015). Therefore, the

aforementioned fit statistics provide support for the two-factor model (Hu & Bentler 1999).

Moreover, the average variance extracted (AVE) for each factor exceeds 0.5, thereby suggesting

convergent validity (Fornell & Larcker 1981). Correspondingly, the factor pair maintained a

phi-square correlation ($\phi 2$) which was less than the respective AVEs, thereby suggesting

discriminant validity (Fornell & Larcker 1981). Conclusively, I extracted the respective factors

scores for the constructs (Calantone et al. 2017) in Mplus, which I employed in lieu of the

corresponding averages of each construct's scale items. By utilizing factors scores, indictors are

weighted appropriately, thereby apportioning more weight to larger indicators (Edwards & Wirth

2009).

Two-factor CFA

Measure	Items	Standardized Loading	AVE	CR
Consumer Guilt	CG 1	0.954	0.992	0.998
	CG 2	0.961		
	CG 3	0.919		
	CG 4	0.923		
	CG 5	0.957		
Repurchase intention	RPI 1	0.945	0.991	0.997
	RPI 2	0.994		
	RPI 3	0.998		

$\chi 2$ = 175.496, df = 41, CFI = 0.998, RMSEA = 0.079 ($I_{90\%}$: 0.067; 0.091), and SRMR=0.020

Table 3. Study One Confirmatory Factor Analysis

Analysis and Results

H1 and H3a were tested using PROCESS v4.2, Model 8 (Hayes 2012). PROCESS is a set of regression-based macros apposite for testing models ranging from simple mediation and moderation to more complex moderated mediation and mediated moderation models, which has been applied in extant supply chain related research (Abbey et al. 2015; Cantor & Jin 2019). To determine whether mediation exists, PROCESS leverages bootstrap confidence intervals to analyze the potential significance of conditional indirect effects. In this manner, mediation exists if 0 is absent from the indirect effect's estimated confidence interval.

The results fail to demonstrate a significant moderating effect of health condition criticality on the relationship between the predictor of species illegality and the outcome variable of consumer guilt (β = 0.11, p = 0.301). Accordingly, *H1 is not supported*. Relatedly, I cannot infer the existence of moderated mediation, as anticipated, thus *H3a is not supported* (index of moderated mediation = -0.58, CI [-0.72, -0.46]). However, I observe that consumer guilt mediates the relationship between species illegality and repurchase intentions (β = -1.10, p = 0.000). Additionally, species' illegality maintains a positive significant effect on consumer guilt

($\beta = 1.01$, $p = 0.000$) as well as a negative significant effect on repurchase intentions ($\beta = -0.54$, $p = 0.000$). The results for study one are summarized in Table 4.

Dependent Variable	Model 1 Consumer Guilt	Model 2 Repurchase Intentions
Species Illegality (SI)		
Intercept	-0.434 (0.000)**	
Species Illegality (SI)	1.008 (0.000)**	
Health Condition Criticality (HCC)	-0.026 (0.733)	
SI x HCC	0.112 (0.301) **H1**	
Species Illegality (SI)		
Intercept		0.300 (0.000)**
Species Illegality (SI)		-0.544 (0.000)**
Consumer Guilt (CG)		-0.522 (0.000)**
Health Condition Criticality (HCC)		0.153 (0.018)*
SI x HCC		-0.017 (0.849)
R²	.424	.603
F (df)	129.51 (3, 527)	199.52 (4, 526)

Notes: Robust standard errors are reported in parentheses. * $p <.05$, ** $p <.01$

Table 4. PROCESS Model 8 OLS regression estimating the interaction effect of health condition criticality on consumer guilt and repurchase intentions

Discussion

The first finding of this research reveals the absence of a moderating effect of health condition criticality on the relationship between species illegality and consumer guilt (H1). Contrary to extant literature which demonstrates comparatively lower rates of guilt when making a health-conscious decision (Xu & Guo 2018), the findings do not demonstrate that this translates to the context of illicit supply chains. However, Xu & Guo (2018) do not examine the derivation (i.e., animal or plant-based) underlying health-related consumption decisions, which could account for the variance in the findings of this research. Nonetheless, there does appear to

be a significant direct effect of species illegality on elevating feelings of guilt. Consistent with the fundamental rationale of CAT, species illegality elicits a negative appraisal of a situation, thereby elevating negative emotions of guilt. This finding thus extends the literature on consumer guilt by underscoring the detrimental effects illicit wildlife products can impose on consumer emotions.

The second finding of this research exists in the lack of significant effect of health condition criticality on consumer guilt, which is contrary to what extant literature suggests. This finding highlights the importance of considering other factors within the retail experience which could attenuate or override the effects of health condition criticality. Reflecting on these results, this outcome could be attributed to the degree to which individuals feel removed from a phenomenon, as explained by Construal-Level Theory (CLT) (Liberman et al. 2007). Under CLT, there is an assumption that more psychologically distant things require construal or appraisal on a higher level (Liberman & Trope 1998; Liberman et al. 2007; Trope & Liberman 2003). As it pertains to this research, the psychological distance could be attributed to the individual's difficulty conceiving a health condition diagnosis or disbelief of likelihood of an illegal product being sold in a retail setting. An additional discovery exists in the extensions of CAT's theorization of emotion resulting in a corresponding action. Specifically, consumer sentiments (i.e., guilt) derived by appraisal of the situation translate into action reduction in the form of reduced repurchase intentions. I discover that consumer guilt mediates the relationship between species illegality and repurchase intentions, such that the latter is reduced. This mediating relationship of consumer guilt on repurchase intentions echoes extant research across disciplines within the context of illicit products in a retail setting (Bardey et al. 2022; Lindenmeier et al. 2017).

Pretest two: Species Derivation

The second pretest and study consider the relationship of a product or species derivation (i.e., plant or animal-based) with the product's illegality and consumer guilt. Building upon the first pretest and study, I endeavored to ascertain which species exhibited a significant difference in the ratings of popular appeal. I developed a within-subjects pretest in which participants were asked to rate the popular appeal of various animals (i.e., glass eels, sea cucumber, rhinoceros, black bear, seahorse, tiger, vaquita, radiated rat snake, pangolin) and plants (i.e., ginseng, honeysuckle flower, licorice root, chrysanthemum, ginger, red sage, ginkgo, goji berry) on a one item 7-point Likert scale (1 = very low popular appeal, 4 = moderate popular appeal, 7 = very high popular appeal). The animals and plants were presented in a randomized order and there was an option for participants to denote that they did not know the species. This study took an average of 5.69 minutes to complete, and participants were compensated $0.50.

As with the prior pretest and the first study, I utilized Amazon Mechanical Turk (Mturk) via CloudResearch (Litman et al. 2017), employing each of the additional features and criteria previously used. An original sample of 36 individuals 18+ years of age was collected. As with the prior pretest and study one, three attention checks and five open-ended questions were included to enhance data quality and validity (Abbey & Meloy 2017; Lonati et al. 2018). Of the 38 participants, eight participants who failed the attention checks were removed (Abbey & Meloy 2017; Wason et al. 2002), thereby yielding a final sample of 30 participants. Table 1 presents an overview of the sample as well as a summary of the experimental procedures.

To determine whether a significant difference in perceived popular appeal existed, I conducted paired samples t-tests in SPSS. The corresponding results indicate a lower popular appeal for glass eels, as compared to all other animals with the most popular animal being black

bear (MΔ = -1.03, p = 0.055). However, there was one exception of animal species who maintained a lower popular appeal yet is not significantly different than glass eels: radiated rat snake (MΔ = 0.17, p = 0.27). Noting the aversion of some individuals to snakes (da Silva et al. 2021), I wanted to avoid any bias which might ensue from including radiated rat snake in the experiment. Licorice root similarly yielded lower ratings for popular appeal as compared to all other plant species, with the most popular being ginger (MΔ = -1.03, p < 0.001). To minimize potential bias from popular animal or plant species, I wanted to select wildlife from the animal and plant groups which retained similarly low levels of popular appeal. Considering the lower popular appeal of both glass eels and licorice root, they respectively serve as the animal and plant conditions for the species characteristic manipulation in the second study.

Study two: Species Derivation

Experimental Design and Sample

  The second study is composed of a 2 (Species Derivation: plant-based vs animal-based) x 2 (Legality: illegal vs legal) between-subjects design. As with the first study, the referring party was presented as a family member across all groups. In the first study I held species derivation constant, where health condition criticality was presented as a specific critical (i.e., cancer) or noncritical (i.e., skin rash) condition. However, in the second study, the health condition is presented as cancer across all groups. Since the first study demonstrated no difference between health conditions, I held cancer constant across all groups to control for the effects of health condition criticality. Furthermore, I present species derivation as either a plant-based or an animal-based species in each group. The specific procedures for this study as well as a summary of the experimental procedures can be found in Appendix 3 and Table 2, respectively.

Measures

As with the first study, I adapted the original scales by Marschall et al.'s (1994) ten-item, seven-point Likert scale to assess guilt, and Burton et al.'s (1999) revised three-item, seven-point Likert scale to assess repurchase intentions. The original and revised scales are provided in Appendix 2.

Attention and Manipulation Checks

I started with an original sample of 556 individuals 18+ years of age using Mturk via CloudResearch (Litman et al. 2017). As with the prior pretests, I employed three attention checks along with five open-ended questions to ensure high data quality and validity (Abbey & Meloy 2017; Lonati et al. 2018). Of the 556 participants, 17 participants failed the attention checks, and 18 participants failed a manipulation check (Abbey & Meloy 2017; Wason et al. 2002), resulting in a final sample of 521 participants. Table 2 presents an overview of the sample as well as a summary of the experimental procedures. Hawthorne checks to diminish the potential impacts resulting from unrelated factors found no impact (Bachrach & Bendoly 2011).

Convergent and Discriminant Validity

As with pretest one and study one, I employed the same outcome variables of guilt and repurchase intentions. The CFA fit statistics support my two-factor model (Hu & Bentler 1999): $\chi 2 = 62.360$, $df = 19$, CFI = 0.999, RMSEA = 0.066 (90% confidence interval: 0.048; 0.085), and SRMR = 0.019. The average variance extracted (AVE) for each factor exceeds 0.5, thereby providing support for convergent validity (Fornell & Larker 1981). The results of the CFA are summarized and presented in Table 5.

Two-factor CFA

Measure	Items	Standardized Loading	AVE	CR
Consumer Guilt	CG 1	0.965	0.991	0.998
	CG 2	0.946		
	CG 3	0.914		
	CG 4	0.916		
	CG 5	0.974		
Repurchase Intention	RPI 1	0.981	0.992	0.997
	RPI 2	0.978		
	RPI 3	0.970		

$\chi2$ = 175.496, df = 41, CFI = 0.998, RMSEA = 0.079 $I_{90\%}$: (0.067; 0.091), and SRMR=0.020

Table 5. Study Two Confirmatory Factor Analysis

As with the first study, the RMSEA exceeds the traditionally preferred threshold of 0.05 (Kenny et al. 2015) but is also within the acceptable threshold of 0.08 (Kenny et al. 2015). Acknowledging that the RMSEA tends to be overestimated when employing the WLSMV command for ordinal data (Li 2016), it suggests acceptable fit. Accordingly, the aforementioned fit statistics yield support for my two-factor model (Hu & Bentler 1999). The average variance extracted (AVE) for each factor exceeds 0.5, implying convergent validity (Fornell & Larcker 1981). As the AVEs were larger than the factor pair's phi-square correlation ($\phi2$), discriminant validity is thereby established (Fornell & Larcker 1981). Finally, I extracted the respective factors scores for my constructs (Calantone et al. 2017) in Mplus, which I used in lieu of the corresponding averages of each construct's scale items. In doing so, I could more appropriately weight indictors, which apportioned more weight to larger indicators (Edwards & Wirth 2009).

Analysis & Results

Following along with study one, I apply PROCESS Model 8 to test H2 and H3b. Species derivation do not exhibit a significant moderating effect on the relationship between the predictor of species illegality and the outcome variable of consumer guilt (β = 0.00, p = 0.976). Thus, *H2*

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is not supported. I cannot infer the potential existence of moderated mediation due to the lack of a significant moderating effect, hence, *H3b is not supported* (index of moderated mediation = -0.42, CI [-0.56, -0.27]). Consumer guilt does demonstrate a significant mediating effect on the relationship between species illegality and repurchase intentions (β = -0.49, p = 0.000). Additionally, there is also a significant direct effect of species' illegality on increasing consumer guilt (β = 0.55, p = 0.000) as well as decreasing repurchase intentions (β = -0.14, p = 0.036). These results align with the findings of study one and are summarized in Table 6.

	Model 1	*Model 2*
Dependent Variable	Consumer Guilt	Repurchase Intentions
Species Illegality (SI)		
Intercept	-0.172 (0.011)*	
Species Illegality (SI)	0.547 (0.000)**	
Species Derivation (SD)	0.001 (0.996)	
SI x SD	0.004 (0.976) **H2**	
Species Illegality (SI)		
Intercept		0.181 (0.002)**
Species Illegality (SI)		-0.145 (0.036)*
Consumer Guilt (CG)		-0.762 (0.000)**
Species Derivation (SD)		-0.113 (0.091)
SI x SD		0.139 (0.144)
R²	.116	.578
F (df)	22.57 (3, 517)	176.65 (4, 516)

Notes: Robust standard errors are reported in parentheses. * p <.05, ** p <.01

Table 6. PROCESS Model 8 OLS regression estimating the interaction effect of species derivation on consumer guilt and repurchase intentions

Discussion

The third finding of this study is the absence of a moderating effect of species derivation on the relationship between species illegality and consumer guilt (H2). Coinciding with the logic

of the second finding, the lack of moderating effect of species derivation on the relationship between species illegality and guilt effectively eliminates the possible existence of moderated mediation (H3b) despite the simple mediation by guilt on species illegality in reducing repurchase intentions. Building upon the findings of the first study, the effects of species derivation, as with health condition criticality, could be attenuated or overridden by alternative product or situational characteristics in a retail setting. Similarly, these findings could also be attributed to psychological distance as presented by CLT (Liberman et al. 2007). Although the second study employed species which maintained low levels of popular appeal to minimize the potential for bias, participants could have exhibited higher psychological distance if they were unfamiliar with the species presented in their scenario.

1.6 CONTRIBUTIONS

Theoretical Contributions

Recognizing the increased infiltration of illicit trade within legitimate supply chains and retail settings, my research delivers meaningful insights related to consumer sentiments and purchase behavior in the context of IWT in a retail setting. Namely this research offers two primary theoretical contributions pertaining to the application of a phenomenon and the introduction of a mediating variable (Makadok et al. 2018). Specifically, I leverage CAT to examine how consumers appraise, emote (i.e., experience guilt), and consequently act (i.e., propensity to repurchase) in response to illegal wildlife in a traditional health foods store setting. Moreover, I explore how the criticality of a health condition diagnosis, and whether the wildlife of focus is a plant or animal can moderate this relationship. In doing so, I contribute empirically by integrating CAT and this research to establish middle range theory (Carter 2011; Craighead et al. 2016).

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This research leverages CAT to develop more comprehensive insights surrounding consumer sentiments and behavior in a novel setting: illicit wildlife trade. In doing so, this research offers a theoretical contribution (Makadok et al. 2018) by introducing the construct of consumer guilt into a lesser explored research context. Although consumer guilt has been examined in a mediating role in other retail settings involving illicit activity including counterfeits (Bardey et al. 2022) and unethical labor (Lindenmeier et al. 2017), this research extends the application of consumer guilt to the context of IWT. This research specifically highlights the mediating role of consumer guilt between the legality of a species and the reduction in future purchase intentions. By revealing the elicitation and mediating role of guilt when consumers are exposed to an illegal wildlife product, this research further bolsters the importance of consumer guilt in dampening future purchase intentions and alludes to the possibility that this relationship could extend even further in the contextual setting of illicit operations. As research has demonstrated a reduction in (re)purchase intentions in retail settings involving corrupt companies (Hamza et al. 2017), unethical labor (Kato et al. 2023; Lindenmeier et al. 2017), and counterfeiting (Bardey et al. 2022; Peinkofer & Jin 2023), the findings of this research emphasize the notable impact of product legality and more broadly, illicit activity in a firm's supply chain on detrimentally shaping consumer emotions and corresponding purchase behavior.

Additionally, this research contributes to theory by applying CAT to a new phenomenon in the distinct research context of illicit supply chains (Makadok et al. 2018). Specifically, this research leverages CAT to integrate a novel, consumer-centric perspective to the literature on IWT. While extant supply chain and operations research has explored IWT and illicit trade of natural resources (Duensing et al. 2023; Hilend et al. 2023; Keskin et al. 2023), the illicit supply

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chain literature exploring consumer perceptions and behavior is largely limited to the contexts of counterfeits (Peinkofer & Jin 2023). Moreover, the extant consumer-centric supply chain literature centered on illicit activity largely considers consumer perceptions and links perceptions with post- and re- purchase behavior, however, it has limitedly considered the impact of consumer emotions explicitly. However, as CAT has posed, consumer emotions and sentiments can pose a powerful impact on subsequent action (Lazarus 1991). Collectively, this research extends this assumption through the application of CAT to the setting of consumer supply chain management, thereby developing middle range theory (Carter 2011; Craighead et al. 2016), with the potential to extend to other consumer-centric supply chain settings.

Managerial Contributions

This research highlights how the importance of protecting a supply chain requires managers to be aware of the threats of illicit trade. As legitimate businesses intersect with illicit products or activities, it can elicit negative consumer sentiments such as guilt and consequently negatively impact repurchase behavior. This phenomenon has been exemplified with firms who have exhibited illicit or socially and/or environmentally unsustainable practices across the fashion (Fashion Law 2019), food (Gibson 2022), and pharmaceutical (Eccles et al. 2007) industries. With more informed consumers than ever, it can be more difficult to overcome reputational harm stemming from interaction with illegal activity. In response, managers should consider implementing solutions to heighten awareness of illicit products entering their supply chain.

To enhance visibility and awareness of the legal status of products in offered in their retail settings, firms should take action to enhance supplier transparency by establishing more stringent standards and conducting regular audits. In addition to enhancing awareness, it is crucial that

managers take steps to protect their supply chain from potential infiltration by illicit products such as increasing safety and security measures. By taking this two-fold approach, managers concordantly reduce the potential for illicit products to negatively impact consumer perceptions and purchase behavior. Importantly, my research accentuates the notable impact of illegal products in the formation of consumer sentiments and behavior, while providing additional nuance to practitioners as it relates to wildlife and IWT.

1.7 LIMITATIONS AND FUTURE RESEARCH

Although my research contributes both empirically and practically, the limitations of this research should be contemplated. Given the dearth of research in consumer guilt research within an illicit context, particularly regarding wildlife, I employed an experimental research design. Leveraging an experimental methodology allowed us to examine the consumer perspective while maintaining robust internal validity but has comparatively weaker external validity when compared to other research methods. As illicit wildlife products infiltrating legitimate retail streams is more broadly considered and data availability is enhanced, other methodologies could offer external validity and augment my findings.

This research concentrated on the moderating relationship of specific factors of interest: health condition criticality and species derivation, specifically whether they are plant or animal based. Though, these factors could be expanded upon to derive additional nuance, such as differentiating non-critical health conditions into aesthetic and non-aesthetic groups. Similarly, additional species characteristics could be explored, such as how the level of species charisma could influence consumer feelings of guilt and consequent repurchase intentions. Alternatively, other factors, such as referent authority could be incorporated to explore consumer behavior more deeply in the illicit wildlife space.

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APPENDIX

Appendix 1: Health Condition Criticality Study

Criticality Conditions:

- Critical: "You have been diagnosed with ***cancer***."
- Non-critical: "You have been diagnosed with a ***skin rash***."
- Illegal: "You learn that glass eels are ***illegal*** to purchase."
- Legal: "You learn that glass eels are ***legal*** to purchase."

Example Scenario:

You have been diagnosed with a ***skin rash***. After discussing treatment options with a family member, they recommend taking glass eels. You decide to follow the recommendation of your family member and try glass eels.

In search of capsules containing glass eels, you visit your local health food store. You find it is available at a price that seems to be about what you expected.

Figure 3a. Hypothetical Scenario Setting

After recently purchasing capsules containing glass eels at your local health foods store and continuing to use them as directed, you come across an article. From this article, you learn that glass eels are ***illegal*** to purchase.

Appendix 2: Measurement Scales

Marschall et al. (1994) State Shame and Guilt Scale (1 = not feeling this way at all, 3 = feeling this way somewhat, 5 = feeling this way very strongly)

1. I want to sink into the floor and disappear.
2. I feel remorse, regret.
3. I feel small.
4. I feel tension about something I have done.
5. I feel like I am a bad person.
6. I cannot stop thinking about something bad I have done.
7. I feel humiliated, disgraced.
8. I feel like apologizing, confessing.
9. I feel worthless, powerless.
10. I feel bad about something I have done.

Revised State Guilt Scale (1 = not feeling this way at all, 7= feeling this way very strongly)
1. I want to sink into the floor and disappear.
2. I feel remorse, regret.
3. I feel small.
4. I feel tension about what I have done.
5. I feel like I am a bad person.
6. I cannot stop thinking about the bad I have done.
7. I feel humiliated, disgraced.
8. I feel like apologizing, confessing.
9. I feel worthless, powerless.
10. I feel bad about what I have done.
* Guilt-based items (2, 4, 6, 8, and 10) were retained for the full experiment analysis

Burton, Garretson, and Velliquette (1999) Scale of Purchase Intentions
1. Would you be more likely or less likely to purchase the product, given the information shown? *more likely / less likely*
2. Given the information shown, how probable is it that you would consider the purchase of the product? *very probable / not probable*
3. How likely would you be to purchase the product, given the information shown? *very likely / very unlikely*

Revised Scale of Repurchase Intention
1. Would you be more likely or less likely to purchase [species] again, given the information shown?
   less likely / more likely
2. Given the information shown, how probable is it that you would consider the purchase of [species] again?
   not probable / very probable
3. How likely would you be to purchase [species] again, given the information shown?
   very unlikely / very likely

Appendix 3: Species Derivation Study

Species Derivation Conditions:

- Animal: "You decide to follow the recommendation of your family member and try glass eels, which are a type of ***animal***."
- Plant: "You decide to follow the recommendation of your family member and try licorice root, which is a type of ***plant***."
- Illegal: "You learn that glass eels are ***illegal*** to purchase."
- Legal: "You learn that glass eels are ***legal*** to purchase."

Example Scenario:

You have been diagnosed with cancer. After discussing treatment options with a family

member, they recommend taking licorice root. You decide to follow the recommendation of your

family member and try licorice root, which is a type of plant.

In search of capsules containing licorice root, you visit your local health food store. You find it is

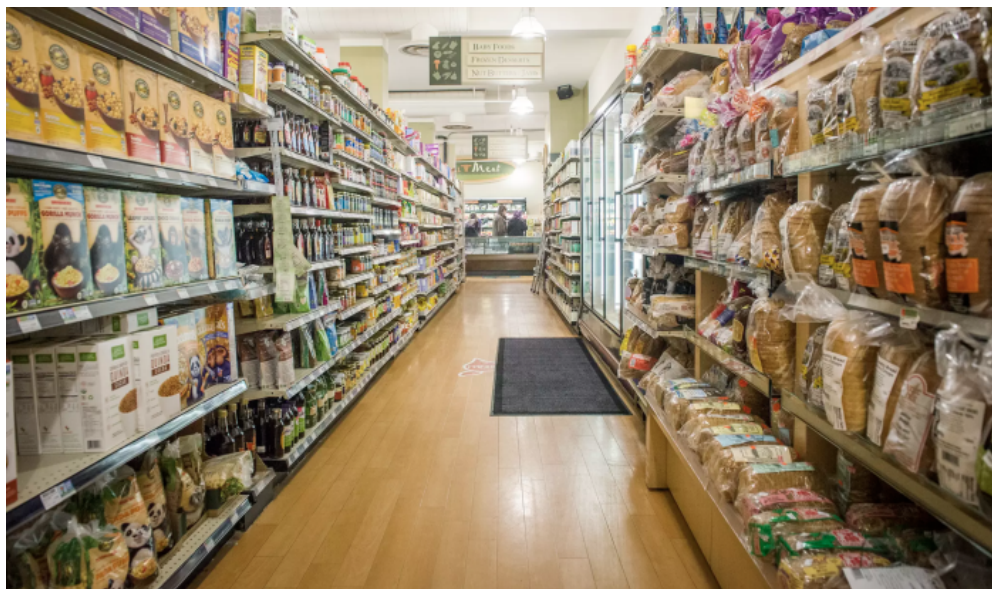available at a price that seems to be about what you expected.

Figure 3b. Hypothetical Scenario Setting

After recently purchasing capsules containing licorice root at your local health foods store and

continuing to use them as directed, you come across an article. From this article, you learn that

licorice root is ***legal*** to purchase.

CHAPTER 2

EXPLORING THE IMPACT OF ILLICIT OPIOID DISTRIBUTION AND LOCATION-BASED FACTORS ON OVERDOSE MORTALITY

2.1 INTRODUCTION

Recent examples of normalized organizational misconduct (NOM) range from sexual misconduct at the World Health Organization (Vanham 2023) and bribery by pharmaceutical companies, Novartis and Alexion (USAO-NJ 2020; SEC 2020), to counterfeiting and noncompliance respectively sweeping the ecommerce and healthcare industries (Suthivarakom 2020; Norris 2023). These examples and others emphasize normalized, omnipresent threat that NOM and illicit activity more broadly pose to firms across industries (Hilend et al. 2023; Palmer 2012; Skilton & Bernardes 2022). Organizational misconduct refers to illicit activity "in or by an organization that a social-control agent judges to transgress a line separating right from wrong; where such a line can separate legal, ethical, and socially responsible behavior from their antitheses" and is conceptualized independently from the actor's intent (Greve et al. 2010, p.56). Beyond its impact on firms' productivity and profitability, NOM on an industry level has been shown to result in detrimental impacts to stakeholders across populations and geographic locations (Hersel et al. 2019; Palmer 2012).

NOM has been studied in a variety of contexts spanning industries including energy (White 2014), food and beverage (Chan et al. 2021), manufacturing (Conrad & Holtbrügge 2021), pharmaceutical (Skilton & Bernardes 2022), and beyond (Palmer 2012). However, acknowledging that organizational misconduct is assumed to occur within or by organizations (Greve et al. 2010), the extant research on the topic has been largely limited to the individual or firm level. Accordingly, extant research overlooks forms of organizational misconduct which

have become *normalized* across an industry (McKendall & Wagner 1997; Palmer 2012). Specifically, research has considered the internal predispositions, motivations, and impacts of an illicit actor's (e.g., counterfeiter, trafficker) behavior independently or within an organization (Greve et al. 2010; Palmer 2012). By employing this perspective, considerations of external factors underlying illicit activity are lesser acknowledged.

The popularization of whistleblowing is particularly problematic for industries which are more closely associated with corruption and unethical or illicit behavior and become stigmatized, such as the pharmaceutical industry (Kohler et al. 2016; Kottasova 2014; OECD 2016; Salvioni et al. 2015). The pharmaceutical industry's illicit practices, which perpetuated the opioid epidemic, serves as a primary factor in earning it a top spot among the most corrupt industries (Kottasova 2014; OECD 2016). Opioid manufacturers and distributors have been blamed for exacerbating the opioid crisis through unethical marketing of opioids including minimizing the risks and overstating the benefits of opioids (ABA 2019). As a result, settlements for opioid related lawsuits have piled up over the past two decades, with the largest coming in July 2021 when manufacturer Johnson & Johnson and distributors Amerisource Bergen, Cardinal Health, and McKesson were ordered to pay a collective $26 billion to affected states (State of California Department of Justice 2023). However, there are many actors beyond manufacturers and distributors across a typical opioid supply chain (e.g., manufacturers, distributors, retailers, and healthcare providers). Given the breadth of the supply chain coupled with the normalization of the misconduct on an industrial scale poses a challenge in pinpointing illicit actors, thereby perpetuating the practice.

In addition to certain industries being more closely associated with misconduct, there are factors which facilitate the occurrence of misconduct, and thus for individuals to fall victim to

the misconduct (Stark 1987). Various demographic characteristics such as gender, age, social status, marital status, race, and ethnicity, have all been linked to varied rates of victimization by illicit activity (Balogun et al. 2021). In addition to intrinsic, individual characteristics, external or situational factors can also predispose misconduct, and therefore victimization by the misconduct (Balogun et al. 1987; Stark 1987). For instance, factors which are reflective of a location and its inhabitants, including socioeconomic status and broader measures of risks, can similarly yield a higher potential for misconduct or illicit activity to occur (Stark 1987). In considering misconduct on an industry level, these location-based factors are of notable interest, particularly in the pharmaceutical industry which operates in a wide array of locations. By examining these factors in the context of NOM throughout the pharmaceutical industry, there is the possibility to highlight the factors of interest for pharmaceutical professionals to be aware of in preventing the victimization of stakeholders.

The dearth of research coupled with the pervasive nature of NOM plaguing the pharmaceutical offers an opportunity to investigate location-based factors which have permitted, and even exacerbated the opioid epidemic in specific locations. Accordingly, this research strives to develop a holistic perspective to address the following question: (1) *How is the number of fatal overdoses because of pharmaceutical industry's misconduct in the form of opioid distribution on a population exacerbated by location-based factors: (a) socioeconomic status, (b) proximity to hazardous industries, and (c) proximity to pharmacies?*

To address these research questions, I leverage Deviant Place Theory and aggregate opioid transaction-level data (DEA ARCOS) from 2006-2019 on a county level with four other datasets measuring educational attainment (USDA ERS), unemployment (BLS LAUS), industry establishments (Census CBP), and mortality (CDC WONDER) to operationalize the moderators

and dependent variable of interest. The findings presented in this manuscript demonstrate a significant moderating relationship rooted in socioeconomic status and the presence of high-injury (i.e., extractive) industries as well as significant direct effects for both variables as well as the presence of pharmacies and drug stores, yielding interesting theoretical and practical contributions.

This manuscript provides three meaningful theoretical contributions (Makadok et al. 2018). First, this research introduces the new causal mechanism of opioid distribution which has been limitedly evaluated (Skilton & Bernardes 2022). Second, this research extracts socioeconomic measures to investigate their distinct moderating effects, thereby extending extant research on the influence of socioeconomic measures (Dean & Kimmel 2019; Hollingsworth et al. 2017; Langhorn 2021; Venkataramani et al. 2020). Third, this research considers the effect of location-based variables, including the presence of high-injury industries (Karriker-Jaffe et al. 2011; Lee et al. 2015; Melchior et al. 2015) as well as pharmacies and drug stores (Shaw et al. 2020). This research also has implications for practice in the way in which it (1) emphasizes the vulnerabilities of certain populations, and (2) highlights opportunities for extractive and pharmaceutical industries to play a proactive role in protecting stakeholders against the repercussions of misconduct and illicit activity more broadly.

In the remainder of the manuscript, I begin with a review of the extant literature pertaining to NOM and healthcare supply chains. In the following section, I introduce Deviant Place Theory to provide the theoretical foundation prior to introducing my hypotheses. Next, I introduce the empirical setting, describe the datasets and methodology employed, and ultimately present the findings of this research. Finally, I expound upon the empirical and practical implications contributed by this research before proposing potential avenues for future inquiry.

2.2 LITERATURE REVIEW

Normalized Organizational Misconduct

There are three key elements required for NOM to occur: *motive*, *choice*, and *opportunity* to engage in the activity (McKendall & Wagner 1997). These elements have been examined in various forms and contexts to investigate the propensity to result in organizational misconduct (Gottschalk 2021; Lefkowitz 2009; McKendall & Wagner 1997). These elements have been implemented in the development of predictive misconduct and rational choice models (Anand et al. 2023; Naumovska 2023; Palmer 2012).

Motive is encompassed by "processes and factors that arouse behavior," (p. 625) and serves as the purpose for engaging in misconduct, such as for industry or organizational profit (McKendall & Wagner 1997). A commonly identified motivation to engage in misconduct, specifically in organizational settings, exists in the form of loss aversion or financial gain (Davis et al. 2021; Palmer 2012). With an individual or organization as the illicit actor, both have the propensity to be motivated by necessity, where they have limited alternative resources, (Palmer 2012) or by sheer greed (Anand et al. 2023; Szwajkowski 1992).

Choice generally results in an affirmative decision to engage in misconduct if the favorable potential outcomes outweigh the unfavorable potential outcomes (Palmer 2011; McKendall & Wagner 1997). *Choice*, sometimes termed as "personal willingness" to engage in deviant, or illicit activity (Gottschalk 2021, p. 45), is largely driven by ethical values and moral reasoning (Lefkowitz 2009). These values or reasoning are considered in conjunction with the risks and potential rewards of scenario at hand (Lefkowitz 2009; Naumovska 2023). When the rewards outweigh the moral or social conflicts and possible risks, illicit actors, whether organizations or individuals, will theoretically choose to engage in the misconduct (Palmer 2012).

Opportunity exists whereby the means or resources for the activity to occur are present, such as an environment in which illicit actors could feasibly evade detection (McKendall & Wagner 1997). While motive and choice are applicable across industries and contexts with comparable outcomes, opportunity encompasses a multitude of factors which increase the complexity of NOM scenarios and warrant further examination. For instance, Stark (1987) acknowledges that certain characteristics of locations and their populations have the potential to predispose individuals to commit or be victimized by illicit activity. Specifically Stark (1987) identified five factors: "density, poverty, mixed use, transience, and dilapidation" (p. 895), which serve as precursors of the opportunity to engage in misconduct. Nadelson (2007) similarly identified external, environmental factors relating to pressures and opportunity of misconduct, including social norms, possible sanctions, codes of conduct. Moreover, Balogun et al. (2021) extends locational factors to include demographic characteristics of a location's population, to include but not be limited to: gender, age, social status, marital status, race, and ethnicity. Collectively, these external factors demonstrate how illicit activity often occurs in areas which share certain characteristics and how the pattern can persist over time (Balogun et al. 2021). However, the location and context of misconduct, such as industries involved, can create a notable variance in the propensity for misconduct to occur (MacLean 2008; Palmer 2012) and is pertinent to explore more deeply.

Despite the variance in opportunity, and thus organizational misconduct, much of the existing research on organizational misconduct and illicit activity has examined the phenomena at only an individual or organizational scale (Greve et al. 2010). While individual motives, deliberation regarding the choice, and the opportunity to engage in misconduct are comparable to those of another individual, these antecedents function differently than those at a firm level. As

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organizational misconduct continues to become more normalized across organizations in the same industry, it is plausible to assume that these antecedents would similarly differ from those at an individual or firm level when examined at an industry level. According to the theoretical tenets of organizational misconduct (McKendall & Wagner 1997), however, these industries likely exhibit comparable motives, opportunities, and choices to engage in misconduct. Hence, industries which retain stronger associations with organizational misconduct and illicit activity, such as extractive (e.g., mining, oil, gas) and pharmaceutical, would be anticipated to retain comparable antecedents to misconduct (Kohler et al. 2016; Kottasova 2014; OECD 2016).

Misconduct in Pharmaceutical Supply Chains

Named as a sector with a "high risk of corruption" (Salvioni et al. 2015, p. 63), the pharmaceutical industry has been notably impugned for engaging in illicit and unethical business practices (Kohler et al. 2016). The pharmaceutical industry has been widely studied by business journals in examination of various forms of illicit activity, including counterfeiting (Rullani et al. 2021; Stevenson & Busby 2015; Verma et al. 2014), compliance (Altamuro et al. 2017; David-Barrett et al. 2017), and organizational misconduct (Arnold et al. 2022; Salvioni et al. 2015; Tan & West 2023). Collectively, this research has largely examined misconduct by individuals and firms operating within the pharmaceutical industry, rather than exploring a phenomenon which the public blames the entire industry for and encompasses illicit activity which has become normalized (ABA 2019).

Despite the exploration of illicit activity in the pharmaceutical industry, business journals have nascently examined this topic at the nexus of the pharmaceutical industry and the opioid crisis. Specifically, the focus has been fundamentally limited to how marketing (Tan & West 2023) and media (Sillup & Porth 2019) have negatively impacted stakeholders by leading to

elevated rates of fatal and non-fatal overdose. However, only one supply chain manuscript examines stakeholder impacts in the context of opioid distribution and corresponding mortality rates (Skilton & Bernardes 2022). Specifically, Skilton & Bernardes (2022) determined that pressures exerted by suppliers, competitors, and market characteristics positively influence retailer (i.e., pharmacy) participation in oversupplying opioids. Although there is no supply chain management and operations literature examining the distribution and corresponding societal impacts of opioids, there is existing research by the medical discipline examining the factors which perpetuate this relationship, including socioeconomic (Adewumi et al. 2021; Hollingsworth et al. 2017), and proximity related factors (Asfaw et al. 2022; Blanch et al. 2018; Venkataramani et al. 2020), as well as placing collective blame on industry-wide factors (Hirsch 2017). However, while this research links socioeconomic and proximity related factors, it overlooks the connection between opioid distribution and fatal overdoses which emerging research in the supply chain discipline has recently identified (Skilton & Bernardes 2022). Collectively, there is an opportunity to further explore the influence of opioid distribution on fatal overdoses, while considering the factors which moderate this relationship. Although the focus of stakeholder safety and opinion is of utmost importance, there is a shortage of research which examines the explicit distribution and corresponding stakeholder interaction with opioids, as well as the factors which exacerbate this exposure.

As existing supply chain research has revealed, illicit activity can persist across distribution networks and be perpetuated over time (Hilend et al. 2023). Moreover, misconduct literature highlights the crucial role of factors or characteristics which precede illicit activity, such as those related to the internal characteristics of the actor and external characteristics of the scenario (Palmer 2012). Thus, there is an opportunity to extend the research on opioid-related

illicit activity within the pharmaceutical industry by exploring the moderators which can exacerbate the detrimental impacts of opioid distribution.

2.3 THEORETICAL DEVELOPMENT

As extant research has exposed, there are underlying factors which can intensify the propensity and impact of opioid distribution on stakeholder mortality (Karriker-Jaffe et al. 2011; Lee et al. 2015; Melchior et al. 2015). Some criminological theories, such as Victim Precipitation Theory (Gobert 1977) pose that these factors are largely the fault of the individual (Meier & Miethe 1993; Siegel 2018). Acknowledging the movement underlying the distribution of opioids, the final location or "node" of the supply chain (Craighead et al. 2007), where the end consumer purchases the product, and its corresponding environmental characteristics are chiefly relevant in this research setting. Thus, Deviant Place Theory (DPT), which considers the external, situational, location-based factors which precede misconduct is an appropriate lens to apply to this research. The *place* element of DPT refers to settings, environments, neighborhoods, areas, or geographic locations of the event (Helle 2014; Lee & Yu 2010; Stark 1987; Weisheit et al. 2005) and will hereby be referred to as **location**.

Originating from Social Distance Theory (Shaw & McKay 1942), which posits that these antecedents are structurally or culturally rooted, DPT expounds on the characteristics of an explicit location which predispose an individual to become victimized (Gaetz 2009; Turner et al. 2018). Converse to other victimization theories and in alignment with underpinnings of organizational misconduct (Greve et al. 2010; McKendall & Wagner 1997; Palmer 2012), DPT poses that individuals are victimized due to their existence in a physical location which increases their exposure to crime risks, and in which they do not possess the means to relocate (Siegel 2018; Turner et al. 2018). Under DPT, crime originates from the traits of the place and its

collective population, rather than traits or factors under the control of the individual and is applicable to locations where crime is consistent over time (Helle 2014; Stark 1987).

While Stark (1987) introduced five preliminary location-based precursors to deviance and crime: density, poverty, mixed use, transience, and dilapidation (p. 895), more recent research has expanded upon these factors to explore additional antecedents of illicit activity (e.g., gender, age, social status, marital status, geographical location, race and ethnicity). Extant research applying DPT extends the consideration of location-based factors which precede illicit activity in various contexts to include sub- and associated factors such as absence of cultural values and social control mechanisms (Balogun et al. 2021). Foundationally rooted in DPT, location-based characteristics which consider the socioeconomic status through various measures and proximity to crime or misconduct have been brought to the foreground (Balogun et al. 2021; Sampson & Lauritsen 1990; Sanson 2014; Siegel 2018). Although research employing DPT and considering location-based characteristics has traditionally concentrated on explicitly illegal activity or crimes (Balogun et al. 2021), there is an opportunity to extend the application of DPT to illicit activity which might not be explicitly illegal, such as the distribution of opioids.

Socioeconomic Status

Socioeconomic status is a multidimensional construct referring to the collective economic resources, power, and prestige of an individual (Braveman et al. 2006; CDC 2024a; Havranek et al. 2015). Extant research operationalizes socioeconomic status with a variety of factors, regularly encompassing poverty, marital status, employment status, educational attainment, and occupational prestige among others (Shavers 2007). In employing DPT, prior research initially identified a connection with deviant places and the prevalence of poverty (Stark 1987), while extending this consideration with recent studies to examine analogous factors which

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are traditionally encompassed within socioeconomic status, including unemployment or education (Balogun et al. 2021; Siegel 2018). In extending this consideration to the context of substance use, or illicit opioid use more specifically, education and unemployment as factors of socioeconomic status have been linked as influential factors but for distinct reasons (Karriker-Jaffe et al. 2011; Lee et al. 2015; Melchior et al. 2015).

Extending these considerations to the research setting of illicit opioid use, extant research has identified an increased risk for both extended (i.e., more than 4 months) and elevated use of opioids for individuals of the lowest socioeconomic status (Adewumi et al. 2021). Van Draanen et al. (2020) extended this exploration to consider 37 studies between 2000 and 2018 which examined the relationship between socioeconomic status and both fatal and non-fatal overdose. In doing so, they unveiled a significant relationship between one or more socioeconomic factors with opioid overdose (Van Draanen et al. 2020). Specifically, indicators of low socioeconomic status, including education and (un)employment, were some of the most strongly linked factors to opioid fatality (Altekruse et al. 2020). As extant research has demonstrated a relationship between socioeconomic indicators and opioid overdose at a neighborhood level, there is the implication that there are location-based factors at play which inflate the potential for individuals to become victims (Stark 1987), thus exacerbating the anticipated outcome.

Unemployment

In extant research employing DPT, locations experiencing high rates of unemployment correspond to higher rates of illicit activity across both violent and non-violent crimes (Balogun et al. 2021). This relationship has been attributed to the lack of opportunities for occupational success (Shelley 2010), paired with the elevated rate of vulnerability (Langhorn 2021; Yea 2004) and economic distress (Dean & Kimmel 2019; Hollingsworth et al. 2017; Venkataramani et al.

2020) exhibited by unemployed victims. As posed by extant research employing DPT, these characteristics of unemployment heighten the motivation and opportunity for misconduct, thereby serving as factors of a location which increase the population's risk of exposure to crime and can exacerbate the negative repercussions exhibited by deviance or illicit activity (Balogun et al. 2021; Stark 1987). Thus, according to DPT, the factors underlying elevated rates of unemployment would not only create an environment for actors to engage in illicit activity, but also for individuals to be victimized in the location (Balogun et al. 2021). As considered in this research setting, I anticipate that the lack of occupational opportunities, elevated vulnerability, and economic distress collectively lead to elevated rates of opioid misuse in the same location.

Education

Contrary to high rates of unemployment, prior research has drawn a relationship between low rates of educational attainment and crime (Hjalmarsson & Lochner 2012). As extant research has posed, education plays a crucial role in discouraging illicit activity by providing legitimate opportunities for work (Lochner & Moretti 2004; Hjalmarsson & Lochner 2012). By decreasing eligible opportunities for work for the proportion of a location's population with lower educational attainment, these individuals can be motivated to engage in misconduct or other illicit activity (Palmer 2012; Stark 1987). Therefore, in locations where rates of educational attainment are depressed, illicit activity would theoretically be elevated, according to DPT (Balogun et al. 2021). Extended to this research setting, individuals in locations which exhibit low rates of educational attainment would theoretically perceive less opportunities for meaningful work, resulting in opioid misuse. In either case, a combined lack of social controls and lack of occupational opportunity associated with locations of high unemployment or low educational attainment are to blame for crimes, rather than the people within the place (Balogun

et al. 2021; Shaw & McKay 1942). Accordingly, I would anticipate this relationship to extend to individuals in counties which exhibit low socioeconomic status, as indicated by high unemployment and low educational attainment, correspond to the highest rates of overdose related deaths.

> **H1a:** Unemployment moderates the relationship between opioid distribution and fatal overdoses such that fatal overdoses will be higher for those in counties with high rates of unemployment.

> **H1b:** Education moderates the relationship between opioid distribution and fatal overdoses such that fatal overdoses will be higher for those in counties with low rates of educational attainment.

High-Injury Industries

When considering the elements of a location under DPT, the source of employment and potential for occupational hazards can similarly serve as precursors for illicit activity (French et al. 2001). While factors such as firm size (Holmes et al. 1997; Oleinick et al. 1995) and demographic characteristics (Tessier-Sherman et al. 2014) are linked to elevated rates of injury, extant research has revealed that injury rates also vary by location-based factors such as geographic setting (Larsson & Field 2002; Neff et al. 2008) and industry type (Hull et al. 1996; Karra 2005; Smith et al. 2006).

Considering the lattermost factor, there are some industries (e.g., construction, agriculture and fishing, manufacturing, extractive, and transportation) which exhibit comparatively higher rates of work injury than average (BLS 2024a). Poor workplace safety, intense occupational pressures, and exposure to or use of hazardous materials or heavy machinery all contribute to elevated rates of occupational hazards resulting in employee injury (Abdalla et al. 2017). In

organizational scenarios where employees fall victim to occupational hazards, opioids are commonly prescribed for pain relief, even more so than for non-work-related injuries (Asfaw et al. 2022). Consequently, the pain incurred from these occupational injuries, illnesses, and stress have been linked to illicit or disordered use of opioids (LEAD 2020), with industries exceeding four injuries per 100 employees yielding the highest rates of opioid overdose deaths (Shaw et al. 2020).

Correspondingly, the presence of high-injury industries is evidently relevant to the characteristics of a location. As theorized by DPT, the proximity to elevated risk, such as high-injury industries, and the corresponding lack of resources to evade victimization by the risk of illicit activity or misconduct (Siegel 2018; Turner et al. 2018) poses a comparatively greater threat for individuals to be victimized and intensifies the corresponding negative effects on individuals in these locations (Balogun et al. 2021). When extended to this research context, elevated exposure to potential occupational injury induces a heightened risk for the individual to be victimized and engage in misuse of opioids while simultaneously heightening the negative effects of the related illicit activity (Abdalla et al. 2017; LEAD 2020; Shaw et al. 2020). Thus, in locations with a higher proportion of hazardous or "high-injury" industries, and accordingly a higher rate of occupational injuries, illnesses, or stress tends to be higher, I would anticipate an elevated level of opioid-related overdose deaths.

H2: The presence of high-injury industries moderates the relationship between opioid distribution and fatal overdoses such that fatal overdoses will be higher for those in counties with a higher number of extractive industries.

Pharmacy Proximity

Proximity to crime has been shown to correspond to lower perceptions of safety and higher rates of victimization (Sanson 2014). As it pertains to drug and alcohol use, the presence of illicit activity results in a direct increase in the potential for victimization (Sampson & Lauritsen 1990). Therefore, when individuals are exposed to locations which place them near potential offenders with guardians or social control agents simultaneously absent, illicit activity such as misuse of drugs is more likely to occur (Sanson 2014).

This notion is largely rooted in a key element of misconduct: opportunity. Enhanced accessibility to the resources required to engage in illicit activity provides individuals greater opportunity to perpetuate and thus, be victimized by misconduct (Palmer 2012). As extant research has purported, locational proximity to crime increases the potential for individual exposure to and experience the negative repercussions of illicit activity, either directly or indirectly (Brown et al. 2010; Fisher et al. 2002). Taken in conjunction with a foundational theoretical tenet of DPT, opportunity or accessibility to illicit activity increases the propensity for deviant behavior to occur (Lee & Yu 2010; McKendall & Wagner 1997), and therefore a greater opportunity for individuals in that location to be victimized (Stark 1987).

Extending this phenomenon to the research setting of the pharmaceutical industry, we presume that the notion of proximity to resources (i.e., opioids) would perpetuate engagement in use would similarly extend to proximity of the vendors of resources (i.e., pharmacies). As existing research on pharmacy deserts has indicated, increased access to pharmacies corresponds to elevated use of prescriptions (Pednekar & Peterson 2018; Qato et al. 2014). In extending this notion to the context of opioid use, Blanch et al. (2018) revealed that increased access to opioids is associated with routine or habitual use of opioids. Consequently, greater access to pharmacies,

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primary retailers of opioids, would be expected to result in elevated use and exposure to negative impacts, according to DPT. Thus, I anticipate that a higher concentration of pharmacies will correspond to elevated overdose deaths.

> **H3:** The presence of pharmacies moderates the relationship between opioid distribution and fatal overdoses such that fatal overdoses will be higher for those in counties with a higher number of pharmacies and drug stores.

2.4 METHODOLOGY

Data

To conduct the analyses, I leveraged datasets from five sources: The Drug Enforcement Administration's (DEA) Automation of Reports and Consolidated Orders System (ARCOS) opioid distribution data from the Washington Post (Rich et al. 2023), the Wide-ranging Online Data for Epidemiologic Research (WONDER) data from the Centers for Disease Control (CDC) (CDC WONDER 2024), Local Area Unemployment Statistics (LAUS) from the U.S. Bureau of Labor Statistics (BLS 2024b), County Business Patterns (CBP) data from the U.S. Census Bureau (Census 2024c), and Educational Attainment data from the U.S. Department of Agriculture's (USDA) Economic Research Service (ERS) (USDA 2024). A sixth dataset which provided the codes corresponding to the Federal Information Processing Standards (FIPS) was employed to aid in the merging of data. FIPS codes serve as unique identifiers for state and county or county-equivalent pairings (Census 2024a), thereby offering a primary key to identify unique records when merging the datasets.

ARCOS is a system which aids in monitoring the flow of controlled substances by the DEA (DEA 2024). Manufacturers and wholesale distributors of controlled substances are required to provide transactional records of controlled substances, which are then compiled into a

summarized format by the DEA to aid in the determination of quotas, distribution trends, and internal audits (DEA 2024). The summarized reports are publicly available, however, the Washington Post obtained the transaction-level data from 2006-2014 through a Freedom of Information Act ruling (Rich et al. 2023). In 2019, upwards of 350 million records of ARCOS data was publicly released, and as of late 2023, transaction-level data up to 2019 has been released by the Washington Post (Rich et al. 2023).

CDC WONDER serves as an integrated information and communication public health system with the intent of improving access to CDC information for health practitioners, researchers, and the public (CDC 2024b). CDC WONDER's online databases offer publicly available health data pertaining to mortality, cancer incidence, HIV/AIDS, tuberculosis, vaccinations, natality, as well as other conditions via query (CDC 2024b).

LAUS is a program which provides employment, unemployment, and labor force related statistics monthly for upwards of 7,600 areas, including but not limited to census regions, states, counties, cities with at least a population of 25,000 (BLS 2024b). LAUS provides the estimates which function as key indicators of local economic conditions for federal, state, and local governments as well as private industry, researchers, the media, and individuals (BLS 2024b).

The *USDA's ERS* is comprised of county-level data on socioeconomic indicators, including poverty rates, unemployment rates, and education levels (USDA 2024). The ERS compiles the data on a county and state level, with ranges from an annual, 5-year, and 10-year basis (USDA 2024). ERS data is intended to aid public and private decision making with the provision of economic research (USDA 2024).

CBP provides economic data for establishments by industry and employment size for the majority of North American Industry Classification System (NAICS) industries on a subnational

scale, dating back to 1964 (Census 2024b). CBP data is extracted from the Business Register

(BR), which is a database of the most "complete, current, and consistent data" encompassing the

number of establishments, employment during the week of March 12, first quarter payroll, and

annual payroll for businesses across the U.S. (Census 2024b). CBP datasets can be used to

examine economic activity over time, in limited geographic areas, and to serve as a benchmark

for other statistics series, surveys, and databases (Census 2024b).

Data Cleaning

In preparing the datasets to be analyzed, the merging of five datasets made it crucial to

begin by cleaning the combined data. I began by aggregating the ARCOS data, which was

provided at a transaction-level, to an annual level. In doing so, the variables corresponding

weight of the base drug ingredient (*calc_base_wt_in_*gm) or dose quantity (*dosage_unit*) of

opioid products were respectively summated, while daily morphine milligram equivalents (*mme*),

the conversion factor for the "base" drug ingredient (*mme_conversion_factor*), and strength

(*strength*) were all respectively averaged on an annual level by FIPS code.

While FIPS codes were originally provided in the WONDER and ERS datasets, it was

integral to assign FIPS codes to the corresponding state and county combinations provided in the

ARCOS, CBP, and LAUS datasets. Given the 14-year timespan, the names of some counties had

changed or been otherwise modified over time but had otherwise retained the same FIPS code.

To ensure continuity, these were manually merged in each of the three observed instances where

the county names had changed over the time period.

For the purposes of this research the CBP data, which retains information for industries

corresponding to the vast majority of NAICS codes, was reduced to only contain data for

extractive industries (NAICS codes beginning with "21") and pharmacies and drug stores

(NAICS code "446110"). This reduced the data to a more manageable set of information to be focused on only the industries which were hypothesized about.

In addition to eliminating irrelevant industry information, data not relevant to the scope of the research question were also removed prior to merging the data. Upon merging the datasets, the resulting aggregated dataset was unbalanced. This was anticipated as the origin datasets included missing values to reflect a lack of opioid distribution (ARCOS), mortality deaths under an annual total of ten (WONDER), and missing data corresponding to educational attainment (ERS) or unemployment (LAUS) in counties which were particularly small. Though, in the other aforementioned scenarios, these values were removed to avoid misrepresenting and potentially negatively skewing the mortality, education, and unemployment related variables in these cases.

Upon merging the five datasets, the complete sample is composed of 32,228 observations on a county-level, ranging from 2006-2019. These observations are provided on a county-level, delineated by FIPS codes, and aggregated on an annual basis. Although CDC WONDER, LAUS, and CBP all retain more recent data, the FOIA-obtained ARCOS data as released by the Washington Post is limited to 2019, thereby limiting my examination to the range of dates covered by the Washington Post data.

Measures

Dependent Variable

As the hypotheses in this research examine the moderating effects on the dependent variable of opioid overdose mortality (*deaths*). *Deaths* represents the number of fatal overdoses per county on an annual basis, a variable provided by the CDC WONDER data (CDC WONDER 2024). In utilizing CDC WONDER data, it is vital to note that in counties where there were less than 10 deaths for a given cause in a single year, the data is omitted to protect the identities of

the population (CDC 2024b). To account for the notable skew of the *deaths* variable across the counties encompassed in the observations, the natural logarithm of *deaths* was employed. By taking the natural logarithm of the variable, this accounts for the skewness of the variable and presents more normally distributed data (Higgins et al. 2008).

Independent Variables

The independent variable of interest in this research is the supply of opioids, as operationalized as *supply,* which was created through the combination of distribution measures available via the DEA's ARCOS dataset via the Washington Post (Rich et al. 2023). Specifically, the number of opioid units, in the form of pills, tablets, or otherwise, which were delivered to the pharmacy for that transaction (*dosage_unit*), as Adewumi et al. (2021) operationalized the variable. However, this research considers dosage units in conjunction with the supply of opioids was operationalized by using the weight of the base drug in the product as measured in grams (*calc_base_wt_in_gm*), thereby considering the strength of the prescription pills distributed as *supply* rather than presenting this as *over*supply (Skilton & Bernardes 2022). Acknowledging that the ARCOS data released from the Washington Post and employed in this manuscript is at the transaction level (Rich et al. 2023), *calc_base_wt_in_gm* and *dosage_unit* were respectively summed up to create *calc_sum* and *dose_sum.* After transforming the unit of analysis to an annual level, the data was aggregated with the other datasets, which retain annual level data. Finally, the total annual weight (*calc_sum*) and amount (*dose_sum*) were multiplied to create the variable of interest for this research (*supply*). In alignment with *deaths*, *supply* was similarly transformed by taking the natural logarithm of the variable to account for the skewness of the variable and present more normally distributed data, thereby resulting in an elasticity interpretation (Higgins et al. 2008).

Socioeconomic Status

The moderators which encompass socioeconomic status are unemployment rate (*unemployment*) and educational attainment (*education*), which both account for the total population of a given FIPS state and county combination, thereby controlling for counties which are particularly large or small. Unemployment rate indicates the percentage of a population's labor force on a county-level, as denoted by the corresponding FIPS state and county codes, which does not retain employment at the time of data collection (LAUS 2024). Although LAUS (2024) provides the total number of unemployed individuals as a proportion of the total labor force in each FIPS county, *unemployment* accounts for the varied population sizes of counties. Educational attainment represents the percentage of adults aged 25 or older which have completed at least a bachelor's degree (Census 2023). Educational attainment is represented by *education,* originally extracted from the USDA ERS datasets, and is measured by county (USDA 2024). Although measures of socioeconomic status vary widely in extant research, factors corresponding to (un)employment, and individual or parental education are traditionally accepted as key measures (Karriker-Jaffe et al. 2011). The natural logarithms for both *unemployment* and *education* were extracted to provide more normally distributed data by accounting for the skewness of the variable (Higgins et al. 2008).

High-Injury Industries

The moderator which represented the number of establishments engaged in extractive industries, which historically maintains a high rate of injury in each county was operationalized as *n_extract.* The number of establishments rather than the number of employees is employed in this research as the latter data is not available for counties with less than three establishments (Census 2024d). *N_extract* was created using two primary variables which indicated the 6-digit

NAICS code (*naics*) and the total number of establishments in a specific county (*est_n*), as summarized in the CBP datasets (Census 2024d). The variables were limited to the NAICS codes which reflect extractive industries, as indicated by NAICS codes beginning with "21". This includes extractive industries such as oil and gas, crude petroleum extraction, natural gas extraction, as well as mining, quarrying, and support activities for each (Census 2024c). Upon restricting the variables to extractive industries, the measure to represent the total number of establishments in extractive industries in each county was created (*n_extract*).

Proximity to Pharmacies

To represent the total number of pharmacies and drug stores in each county, the moderating variable of *n_pharma* was created. As with the measure to represent the presence of extractive industries by the number of establishments, the measure to exemplify the number of pharmacies in a given county was created in a similar manner. Specifically, the variables were reduced be the 6-digit NAICS code to only include end consumer retailers such as pharmacies and drug stores (446110), by using (*est_n*), the variable reflecting the total number of establishments in a county, as provided in the CBP datasets (Census 2024b). Based on this, a measure was created to represent the total number of pharmacies and drug stores in each county (*n_pharma*).

Control Variable

Recognizing the wide range in county size by population, it is crucial to consider and control for the potential effects this may yield for other variables of interest. For instance, we can anticipate a related disparity in multiple variables of interest across counties, including the volume of opioid distribution (*dosage_units)* as well as the number of establishments for both extractive industries (*n_extract*) and pharmacies or drug stores (*n_pharma*). Accordingly, we

take the natural logarithm of the population measure provided by the CDC WONDER datasets to control for population size in this manuscript (*population*).

Analyses & Results

Analysis

To test the hypotheses presented in this manuscript, this research employs a generalized linear mixed effects model to fit the panel data. A generalized linear mixed effects model is suitable, as it captures random in addition to fixed effects, thereby overcoming the heterogeneity concerns with panel data which are unable to be addressed with ordinary least square regression (Kennedy 1998). Additionally, a generalized linear mixed model allows for both between- and within-variances (Bell et al., 2019; Ketokivi et al., 2021) while addressing econometric challenges such as heteroskedasticity or autocorrelation. Although a fixed effects model might be suitable for addressing these and similar concerns, it absorbs time-invariant, unobserved characteristics which are of particular interest in this manuscript (Certo et al., 2017; Deb et al., 2023). Table 1 displays the correlations among the dependent variable, independent variables, and control variable.

This manuscript employs a hierarchical approach to compose three models in total (Lynch 2003). Model 1 included only the control variable (population). Model 2 encompassed the direct effects of opioid distribution as operationalized as the summed weight of the base ingredient of the opioid product multiplied by the summed dosage units (*supply*). Model 3 included the four moderators corresponding to measures of socioeconomic status proposed in H1a (*unemployment*) and H1b (*education*), the number of establishments related to high-injury, extractive industries noted in H2 (*n_extract*), and the number of pharmacies and drug stores

propositioned in H3 (*n_pharma*). The complete hierarchical approach model is shown in the

following equation:

$$deaths_{tj} = \beta_0 + \beta_1 population_{tj} \tag{1}$$

$$+ \beta_2 supply_{tj}$$

$$+ \beta_3 unemployment_{tj}$$

$$+ \beta_4 education_{tj}$$

$$+ \beta_5 n\_extract_{tj}$$

$$+ \beta_6 n\_pharma_{tj} \tag{2}$$

$$+ \beta_7 supply_{tj} \times unemployment_{tj}$$

$$+ \beta_8 supply_{tj} \times education_{tj}$$

$$+ \beta_9 supply_{tj} \times n\_extract_{tj}$$

$$+ \beta_{10} supply_{tj} \times n\_pharma_{tj}$$

$$+ U_j + \varepsilon_{tj} \tag{3}$$

In employing the hierarchical approach to develop a generalized linear mixed model, the

natural logarithm of the dependent variable and independent variables are all employed in

capturing the direct and moderating effects. In this model, the subscript t denotes time, j

expresses the county-level of the variables. Additionally, U_j represents the random effects, and ε_t

serves as the error term. Equation 1 captures the control variable of population with β_1.

Equation 2 represents the second model, which captures the direct effects of the hierarchical

model. β_2 represents the outcome resulting from distribution of opioids, which is anticipated to

yield a positive coefficient. β_3 and β_4 collectively encompass the influence of socioeconomic

status and are anticipated to respectively yield positive and negative coefficients. β_5 signifies

the effect resulting from the number of establishments in extractive industries and is anticipated

to yield a positive coefficient. β_6 represents the effect that the number of pharmacies and drug stores has on the outcome variable. Equation 3 assesses the moderating effects of the four interactions captured in Model 2. β_7 and β_8 collectively encompass the moderating effect of socioeconomic status on opioid supply. H1a predicts that β_7 will be positive while H1b anticipates that β_8 will be negative. β_9 represents the interaction between opioid supply and the presence of extractive industry establishments, which H2 expects to be positive. β_{10} displays the interaction between opioid supply and the presence of pharmacies and drug stores, which H3 similarly predicts to be positive.

	deaths	population	supply	unemployment	education	n extract	n pharma	supply x unemployment	supply x education	supply x n extract	supply x n pharma
deaths	1.000										
population	-0.390	1.000									
supply	-0.030	0.329	1.000								
unemployment	-0.007	-0.041	0.036	1.000							
education	-0.081	0.274	-0.017	-0.225	1.000						
n extract	0.061	0.087	0.019	-0.220	0.117	1.000					
n pharma	0.028	0.110	0.045	-0.115	0.111	-0.163	1.000				
supply x unemployment	-0.032	0.086	0.203	0.206	-0.044	-0.056	0.036	1.000			
supply x education	-0.001	-0.036	-0.591	-0.071	0.217	0.025	0.008	-0.502	1.000		
supply x n extract	0.004	0.110	0.321	-0.039	0.008	0.187	-0.058	-0.133	-0.075	1.000	
supply x n pharma	-0.009	0.080	0.194	0.015	-0.001	-0.026	0.403	0.081	-0.098	-0.150	1.000

Table 1. Correlations among variables

Findings

In examining the results of Model 1, which includes only the control effect it is evident that the coefficient estimates of *population* are consistent across the three models. Logically consistent, a higher population would correspond to a higher number of deaths, as is exhibited in Model 1 of Table 2.

The direct of effect of *supply* exhibits a small, yet significant positive direct effect on *deaths* (β_1= 2.28e-19, *p = 0.00*). The elasticity of 2.28e-17 is indicative of a 1% increase in the distribution of opioids corresponding to a rate of fatal overdoses elevated by a percentage of

2.28e-17 in the same county, as indicated by the analogous FIPS code. The results displaying the direct effect of Model 2 can be found in Table 2.

In H1, two critical factors of socioeconomic were extracted from the measure which has been traditionally examined to have a combined effect (Adewumi et al. 2021; Hollingsworth et al. 2017): unemployment and educational attainment. Specifically, H1a anticipated higher rates of unemployment would correspond to elevated rates of overdose mortality in the same location, attributed to a lack of opportunities for occupational success (Shelley 2010), as well as both heightened vulnerability (Langhorn 2021; Yea 2004) and economic distress (Dean & Kimmel 2019; Hollingsworth et al. 2017; Venkataramani et al. 2020). As displayed in Model 3 of Table 2, the third model exhibits a significant moderating effect of unemployment rates (β_6= -0.002, $p = 0.00$), however, it is a negative effect which is converse to H1a, thereby lacking support. H1b involves the second measure of socioeconomic status presented in this manuscript, educational attainment. H1b predicted that lower rates of educational attainment would correspond to elevated rates of overdose mortality in the same location due to the lack of occupational opportunities available for individuals with lower educational attainment (Lochner & Moretti 2004; Hjalmarsson & Lochner 2012). As displayed in Model 3 of Table 2, the third model also demonstrates a significant moderating effect of educational attainment (β_7= 0.048 $p = 0.00$), which is also in the opposite direction of H1b, thus failing to provide support. Collectively, these findings support a significant moderating effect of socioeconomic status, namely the factors of unemployment and educational attainment, on the relationship between opioid distribution and fatal overdose. However, acknowledging that both effects are in the opposite direction anticipated, as proposed in H1a and H1b, there are likely additional factors which contribute to this effect.

Shifting to the next moderating relationship, H2 expected that a greater number of high-injury industries would correspond with higher rates of overdose mortality due to heightened individual exposure to hazardous environments and occupational pressures (Abdalla et al. 2017; Shaw et al. 2020). Accordingly, testing showed a significant effect of the number of establishments in extractive industries (β_4= 0.001, *p = 0.00*), thereby providing support for H2. The results of this analysis can be found in Model 3 of Table 2.

Variables	Model 1		Model 2		Model 3	
	Est	*SE*	*Est*	*SE*	*Est*	*SE*
population	0.788**	0.002	0.539**	0.005	0.535**	0.005
supply			0.012**	0.0002	0.003**	0.001
unemployment			-0.051**	0.007	0.289**	0.046
education			1.391**	0.068	-6.755**	0.459
n_extract			0.092**	0.003	0.010	0.016
n_pharma			0.065**	0.002	0.136**	0.014
supply x unemployment					**-0.002** **H1a**	0.0002
supply x education					**0.048** **H1b**	0.003
supply x n_extract					**0.001** **H2**	0.0001
supply x n_pharma					**-0.0003** **H3**	0.0001
Log likelihood	-2137.28		-15548.815		-15190.572	
Wald chi² (*df*)	116436.51 (*1*)		124932.70 (*6*)		129039.92 (*10*)	
Note: *natural logarithm taken of each variable; p* < 0.05, p** < 0.001*						

Table 2. The moderating effects of socioeconomic status, high-injury industries, and pharmacy proximity on the relationship between opioid distribution and fatal overdoses

The final hypothesis, H3 proposed that greater numbers of pharmacies or drug stores correspond with a higher rates of overdose mortality rates in the same county. However, as depicted in Model 3 of Table 2, the third model did not demonstrate a significant moderating effect by the number of pharmacies (β_5= -0.0003, *p = 0.76*), thereby lacking support for H3.

Although extant research has identified a positive relationship between the number of pharmacies and the number of prescriptions (Pednekar & Peterson 2018; Qato et al. 2014) as well as a link between access to opioids and increased opioid misuse (Blanch et al. 2018), these data suggests that the relationships identified in extant research cannot be generalized to assume a relationship between the number of pharmacies and opioid misuse resulting in fatal overdose.

2.5 CONTRIBUTIONS

Theoretical Contributions

By considering the potential for location-based factors to impose a moderating role on the relationship between opioid distribution and opioid overdose mortality, this research offers meaningful theoretical contributions to the literature surrounding the opioid epidemic. In alignment with the outline provided by Makadok et al. (2018), this research contributes theoretically in the following ways: (1) introduces the causal mechanism, opioid distribution, to this research setting involving the outcome of fatal overdoses (2) expounds upon the boundary conditions of DPT by extracting previously examined factors, (un)employment and education, from the previously studied collective measure of socioeconomic status, and (3) importing the distinctive proximity based variables relating to the presence of (a) extractive industries as well as (b) pharmacies and drug stores.

First, this research presents the causal mechanism of opioid distribution to opioid overdose mortality. Although extant research by medical journals has linked a wide range of factors to both fatal and non-fatal opioid overdoses, these factors are largely related to individual characteristics (e.g., race, gender, marital status) (Balogun et al. 2021), thereby overlooking the environment which misconduct occurs. Acknowledging the dearth of literature in business journals exploring this setting, there has been limited consideration explicit to the supply of

opioids within geographic locations and their corresponding populations. As Skilton &

Bernardes (2022) provided an initial examination of the relationship between opioid distribution

or "oversupply" (p. 7) with opioid misuse, this research extends the examination to consider the

possible existence of moderating variables which could exacerbate this relationship. In doing so,

this integrates a supply chain perspective to investigate and provide further nuance to this

relationship.

This research provides a second contribution by shifting the examination of factors to

explore their potential moderating roles. Notably, extant research has considered the collective

effect of socioeconomic status (Adewumi et al. 2021; Hollingsworth et al. 2017). This research

extends the exploration of socioeconomic status by considering two key measures:

unemployment and educational attainment. While medical journals have examined the direct

effect of socioeconomic status (Adewumi et al. 2021; Hollingsworth et al. 2017), there is a

dearth of examination on the moderating role of socioeconomic measures independently. Thus,

by importing socioeconomic measures (i.e., unemployment and educational attainment) as

moderators, this research offers a more nuanced view into the independent direct and indirect

effects each variable inflicts on the relationship between opioid distribution and fatal opioid

overdose and extends the boundary conditions of DPT (Makadok et al. 2018). In doing so, this

research emphasizes how both unemployment and education (Dean & Kimmel 2019;

Hollingsworth et al. 2017; Langhorn 2021; Venkataramani et al. 2020) influence the relationship

between opioid supply and fatal overdose, albeit in a direction inverse to the expected

relationship.

This research offers a third theoretical contribution in exploring the influence of

proximity related variables on fatal overdoses. Reflecting on extractive industries, which retain

notably higher rates of workplace related injury (BLS2024a), the findings of this research emphasize a clear link between the existence of establishments in these industries and the number of fatal overdoses. Specifically, the findings demonstrate a direct effect of the proximity variable relating to high-injury, extractive industries as well as a moderating effect by the proximity variable on the relationship between opioid supply and fatal overdoses. Theoretically, this research bolsters the understanding of psychological and physiological pain resulting in illicit or disordered opioid use (LEAD 2020) and consequently fatal overdose (Shaw et al. 2020), while specifically emphasizing the impact of geographic proximity on this relationship.

In addition to examining the influence of the proximity to high-injury, extractive industries, this research explores the effect of the number of pharmacies and drug stores on the number of fatal overdoses. In doing so, the findings of this manuscript emphasize the direct positive effect that the presence of pharmacies have on fatal overdoses. However, the findings do not demonstrate a significant moderating effect by the number of pharmacies on the relationship between opioid supply and fatal overdoses. Hence, this research broadens the comprehensive understanding of the role of pharmacies in this research context by unveiling the significant relationship between the presence of pharmacies and drug stores with fatal overdoses. Thus, this research offers an alternative perspective to extant research in criminological and medical fields which link heightened availability to illicit substances or resources to an increase in illicit use (Karriker-Jaffe et al. 2011; Lee et al. 2015; Melchior et al. 2015).

Practical Contributions

In addition to offering theoretical contributions, this research offers three primary practical implications. Foremost, this research provides an initial contribution by emphasizing the vulnerabilities of certain populations and the underlying location-based factors which

predispose victimization of the corresponding populations. Although previously identified by extant research employing socioeconomic status in the research context of illicit opioid or substance use (Adewumi et al. 2021; Hollingsworth et al. 2017), distinctive factors of socioeconomic status relating to a specific location, such as unemployment and educational attainment, exhibited a significant effect. In emphasizing the exacerbating effect of these factors, it communicates the necessity of supply chain actors involved in the distribution, namely those in the healthcare industry, to be more cognizant of this relationship. By acknowledging these factors, supply chain actors responsible for distribution in the pharmaceutical industry can recognize the effects of their distributive practices and consider modifying their practices to reduce potential negative repercussions on vulnerable populations.

As an additional contribution, this research reveals a significant moderating effect of the proximity of extractive industries on fatal overdoses, thereby emphasizing the detrimental effects of high-injury industries' establishments on a location's population. There is ample pressure and rising standards to proactively ensure a safe workplace to prevent illness and injury (OSHA 2023), especially in the years following the COVID-19 pandemic (Igoe 2022). However, there is limited attention paid to an employer's involvement in the successful recovery of injured employees. Employers who provide resources and a concerted effort to support the employee's return to work can yield more successful long-term outcomes for themselves as well as employees. Specifically, the most positive outcomes for employees returning to work involved instances where employers engage in "return-to-work coordination" (Cancelliere et al. 2016; Gray et al. 2019; Sheehan et al. 2019). Accordingly, this research offers an initial exploration into the potential role of high-injury extractive industries in the illicit use of opioids, which could be extended to other high-injury industries.

As a final contribution, this research extends the extant research on pharmacy deserts and related findings on the presence of pharmacies. Specifically, prior research has posed that increased access to pharmacies yield heightened use of prescriptions (Pednekar & Peterson 2018; Qato et al. 2014), and more specifically habitual or illicit use of opioids (Blanch et al. 2018), the direct effect of which is further supported by this manuscript. Although the findings of this manuscript exhibit a non-significant moderating effect of the number of pharmacies and drug stores, there is a clear relationship between the number of pharmacies and fatal overdoses. Correspondingly, this highlights the importance of organizations to engage in preventative action to safeguard populations from negative repercussions in locations with high numbers of pharmacies and drug stores.

2.6 LIMITATIONS & FUTURE RESEARCH

As with any research, this manuscript possesses limitations which should be considered. The use of secondary datasets limits the type, unit of analysis, and frequency of the measures collected. First, the release of ARCOS distribution data via a FOIA obtained by the Washington Post limited the transaction level data to 2019 (Rich et al. 2023). Thus, the nuanced information provided by transaction level data, such as manufacturer and distributor identifying information, exhibits a 5-year lag, limiting the potential for exploration as it pertains to exogenous events (e.g., COVID). Second, the USDA ERS county-level education data is averaged on a 5-year or 10-year basis. Acknowledging that educational attainment is generally stable over time (Mare 1981), this data was viable for our purposes, but should be contemplated for future research purposes which examine a shorter time period and therefore might require annual data. Third, CDC WONDER omits mortality data in a given county if deaths reach less than 10 for a single

cause in a given year (CDC 2024b). Thus, this overlooks relevant data when examining counties with smaller populations, which is problematic when investigating rural areas.

In addition to limitations posed in utilizing secondary data, this research restricts the variables of interest to location-based factors. As acknowledged by criminological research employing DPT, certain location-based factors can yield a heightened threat of victimization of a location's population (Stark 1987; Balogun et al. 2021). However, as other criminological theories (e.g., Victim Precipitation Theory) have posited, individual characteristics or other factors due to the fault of an individual can place them at a higher risk of victimization (Gobert 1977). Thus, future research should consider adopting the VPT lens, and extend this research to examine the potential moderating roles of individual characteristics and other demographic related factors to deepen the understanding of the relationship between opioid distribution and overdose mortality. As well as non-location-based factors, it might be relevant for future research to tease out some additional nuance from the factors posed in this manuscript. Specifically, future research could expand the examination of high-injury industries to include other industries which OSHA (2024) has identified as retaining comparatively elevated rates of employee industry such as agriculture and fishing, logging, construction, or manufacturing. Future research could also go a step further to consider employee factors such as the type of injury, duration of opioid use succeeding the injury, and ratio of injuries in the industry which result in opioid prescriptions. Finally, future research could consider employing a methodology which relies upon primary, rather than secondary data. In doing so, this research has the potential to supplement studies using secondary data to extract additional detail pertaining to the individual experience, and thereby aid in developing a holistic perspective of the phenomenon.

Reflecting on the findings of this manuscript, the direct effects of socioeconomic measures are revealed in a direction which is converse to the expectations presented in the hypotheses. Although it was anticipated for unemployment to impose a moderating effect resulting in heightened overdose mortality, the inverse was found. Extant research suggests that unemployment is linked to resulting heightened economic distress (Dean & Kimmel 2019; Hollingsworth et al. 2017; Venkataramani et al. 2020) and vulnerability (Langhorn 2021; Yea 2004), thereby yielding greater motivation and opportunity to engage in illicit activity (Balogun et al. 2021; Stark 1987). However, the negative moderating effect demonstrated in this research could potentially be explained by the associated reduction in economic resources to purchase opioids (Pavlova 2021). Additionally, educational attainment was anticipated to negatively moderate the relationship between opioid distribution or supply, with fatal overdoses due to the greater opportunities for work reducing motivation to engage in illicit activity (Lochner & Moretti 2004; Hjalmarsson & Lochner 2012). However, the findings reveal a positive effect, which could be explained by the connection between the opioid epidemic and white-collar users (Patrick 2018), which often retain elevated levels of educational attainment (Fang & Saks 2021). Collectively, this research provides an initial exploration of the moderating effects of distinct socioeconomic measures. Future research could expound upon these findings to consider both the direct and moderating effects of other socioeconomic measures, including but not limited to poverty, marital status, occupational prestige, the effects of which have largely been examined conjunctively (Shavers 2007).

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CHAPTER 3

UNVEILING THE DETECTABILITY OF ILLICIT WILDLIFE TRADE NETWORKS:

A QUALITATIVE COMPARATIVE ANALYSIS

3.1 INTRODUCTION

As supply chain operations continue to grow on a global scale, the potential risks to firms continue to proliferate beyond previously anticipated threats (OECD 2024). New supply chain risks that have emerged and evolved in recent years, yielding examples ranging from a cyber-attack on major port operator DP World Australia (Reuters 2023), to counterfeited and other illicit items entering ecommerce and brick-and-mortar settings (OECD 2024), as well as heighted costs for businesses globally as they continue to recover from supply chain disruptions from the COVID-19 pandemic (NBER 2024). Each of these supply chain disruptions and more specifically, the threat of illicit supply chains in various forms is omnipresent and, on the rise, (ICE 2024; OECD 2024). Ranging from counterfeiting to trafficking of humans, drugs, arms, and wildlife, many forms of illicit supply chains pose a threat to firms and stakeholders more broadly (OECD 2016).

Illicit supply chains vary widely, from explicitly illegal products in wholly illicit supply chains (e.g. human trafficking), to legitimate supply chains infiltrated by illicit actor(s) engaging in unethical or illegal activities (e.g., organizational misconduct) (Anzoom et al. 2021; Basu 2014; Cho et al. 2015). Although wholly illicit supply chains pose serious economic, social, and environmental risks to firms and stakeholders more generally (Hilend et al. 2023), some forms of illicit supply chains or activities capitalize on, and thus, directly target legitimate firms (Duensing et al. 2023). Specifically, illicit actors exploit the vulnerabilities of legitimate supply chains to facilitate the movement and trade of illicit products (Duensing et al. 2023). In most

cases, the trafficking of weapons (Markowski et al. 2009) and drugs (Jensen & Dignum 2019; Sánchez-Pérez et al. 2023) are more likely to operate independent of licit supply chains, while other forms of illicit trade, such as counterfeits and wildlife products, are more likely to comingle with and infiltrate a legitimate firm's operations (Duensing et al. 2023; Hilend et al. 2023).

Defined as "the illegal exploitation of otherwise legal supply chains," (D'Amato & Papadimitriou 2013, p. 988) **supply chain infiltration** is a common approach illicit actors engage in to perpetuate their supply chain (Duensing et al. 2023), such as concealing illicit goods in legitimate shipments. Accordingly, illicit trade infiltrating supply chains can yield detrimental direct impacts to consumers and other supply chain actors (Carter & Jennings 2004) as well as indirect impacts to supporting actors such as policymakers and enforcement agencies (Duensing et al. 2023; Freeman 1984). Moreover, supply chain infiltration can disproportionately affect legitimate firms' supply chains by risking suspension or seizure of their products, legal repercussions, or even imposition of reputational harm resulting in loss of customer loyalty and revenue (Hilend et al. 2023).

Acknowledging the potential legal, reputational, and overall economic risks of illicit supply chains, researchers are beginning to address them in various forms and industries. Specifically, there is a developing body of literature on illicit supply chains, including the contexts of counterfeit products (D'Amato et al. 2019; Peinkofer & Jin 2023; Yi et al. 2020), food supply chains (Smith & McElwee 2024), conflict minerals (Hofmann et al. 2018), human trafficking (Gold et al. 2015; Keskin et al. 2021), illicit labor (Handfield et al. 2020; Short et al. 2016; Simpson et al. 2021), illicit harvesting of natural resources (Hilend et al. 2023), and wildlife trafficking (Duensing et al. 2023). Extant research has identified key drivers yielding

initial and persistent involvement in illicit activity (Smith & McElwee 2024), including natural

resource scarcity (Hilend et al. 2023). Moreover, existing studies have considered the impacts

which illicit activities pose to supply chains (Duensing et al. 2023; Yi et al. 2020), including

consumer perceptions and corresponding behavior (Peinkofer & Jin 2023). The related

challenges of detecting and interdicting illicit activity is evident in prior research (Gold et al.

2015), with research efforts to introduce interdiction efforts (Keskin et al. 2021) in conjunction

with proactive strategies (Handfield et al. 2020; Hofmann et al. 2018; Short et al. 2016) which

firms can take to mitigate negative repercussions.

Although some forms of illicit supply chains have been studied more thoroughly, there is

a notable dearth of research on illicit or illegal wildlife trade (Duensing et al. 2023; Gore et al.

2023; Griffin et al. 2024; Keskin et al. 2023, Hilend et al. 2023). I adopt the following definition

of illegal wildlife trade (IWT):

> "the trafficking in any specimen, knowing that the specimen was taken,
>
> possessed, distributed, transported, purchased or sold in contravention of: (a)
>
> Any international agreement concerning or relating to the protection,
>
> conservation, management, trade or use of wild fauna or flora binding on the
>
> State Party; or (b) Any applicable domestic or foreign law concerning the
>
> protection, conservation management, trade or use of wild fauna or flora," (End
>
> Wildlife Crime 2020).

Although termed *illegal* wildlife trade, geographic differences and varying species protections

permit *illicit* wildlife trade. The distinction between these two is that illicit activity includes acts

which might be considered unethical or morally or socially unacceptable (Cambridge 2024;

Collins 2024) but in some jurisdiction not illegal, whereas illegal acts are viewed as illegal in all

jurisdictional settings. For example, while African grey parrots are listed under CITES Appendix I, the highest level of protection and thereby illegal to capture in the wild and sell, they are permitted to be sold legally if captive bred (Dale 2016; USFWS 2021).

To date, existing supply chain studies have assessed the range of impacts and challenges associated with IWT (Duensing et al. 2023; Keskin et al. 2023) and proposed prospective interdiction strategies (Gore et al. 2023; Griffin et al. 2024). Explicitly, Keskin et al. (2023) acknowledges the limited understanding of IWT supply chain structures and highlights the difficulty of detecting these supply chains due to explicit factors. Keskin et al. (2023) suggests the use of multiple small financial transactions, volume of products, cultural or geographic variance of opinions towards wildlife, disparity in geopolitical interest, as well as the switching of origin, destination, or species traded as factors contributing to detection evasion. To develop a more comprehensive understanding of the intricacies of IWT from a supply chain perspective, understanding the complexities of an illicit supply chain and the factors which aid in detection is a fundamental step in devising and enacting effective supply chain interdiction strategies (Bell et al., 2015). To date few studies have attempted to conceptualize these key factors of illicit wildlife supply chains. Thus, I pose the following research question: *What determinants contribute to the likelihood of detecting an illicit wildlife supply chain?*

To address this research question, I conducted semi-structured interviews with a set of 26 participants with expertise in protecting specific wildlife species as well as IWT across academic, non-profit/NGO, and government sectors. Specifically, the interviews were centered on the factors of *governance*, *transportation*, *product*, and *recognizability* which contribute to the detectability of an illicit wildlife supply chain. Subsequently, fuzzy-set qualitative comparative analysis (fsQCA) was employed (Ragin 2000). Developed by Ragin (1987), QCA

serves as a method for analyzing configurational data. Then, I contribute empirically and practically. Empirically, this research applies new institutional theory to the novel setting of illicit wildlife supply chains, expounds upon situational factors considered by environmental criminology, and extends the application of QCA methodology at the nexus of supply chain, conservation, and criminology. Practically, this research highlights key factors of illicit wildlife supply chains which firms, governmental, and non-governmental organizations should consider within their strategies for addressing IWT.

The following section presents new institutional theory (Meyer & Rowan 1977; Tolbert & Zucker 1999) and environmental criminology literature (Bottoms et al. 2002; Sidebottom & Wortley 2015) as the theoretical foundations for this study. Then, I explore various factors of illicit wildlife supply chains while describing their relationship with supply chain detectability. Next, I introduce the QCA methodology (Ragin 1987) and describe the specifics of my empirical approach. Following, I present the specific conditions encompassed in the two solutions and corresponding five cases which yield elevated rates of detectability. I conclude by describing the theoretical and practical contributions of this study prior to discussing the limitations and areas for future research.

3.2 THEORETICAL FOUNDATIONS

To effectively address or interdict the trade of illicit commodities, it is fundamental to be able to *detect* the movement of these commodities (Griffin et al. 2024; Keskin et al. 2023). However, there are many elements which contribute to the clandestine transport of illicit products and aid in detection evasion (Keskin et al. 2023). In examining the detectability of an illicit wildlife supply chain, it is crucial to consider the specific external and internal factors which influence the supply chain (i.e., *governance*, *transportation*, *product*, and *recognizability*).

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To explore the factors which can heighten detectability, I ground my study in the fundamental arguments of new institutional theory (Meyer & Rowan 1977; Tolbert & Zucker 1999) and the environmental criminology literature (Bottoms et al. 2002; Sidebottom & Wortley 2015). At the intersection of new institutional theory and environmental criminology literature is the notion that external, situational factors play an integral role in shaping individual behaviors (Sidebottom & Wortley 2015). These external factors exist in the form of legal, political, cultural and social institutions which exert control via direct supervision or surveillance (Sidebottom & Wortley 2015). Within the context of illicit supply chains, these factors influence the decisions made by illicit supply chain actors and can correspondingly enhance the visibility of illicit activity (Keskin et al. 2023), consequently contributing to the detectability of illicit wildlife supply chains.

New Institutional Theory (NIT)

NIT assumes the existence of institutions which establish restrictions on certain behaviors (Scott 2008) either formally by legal means (e.g., established laws or regulations) or informally (e.g., social norms or customs) (DiMaggio & Powell 1983; Oliver 1997). Core to NIT is the notion that external pressures influence an organization or actor's decision-making and behavior processes (Tate et al., 2014). When applied to criminological contexts, NIT poses that organizational structure and compliance systems work in tandem to detect and counter illicit activity (Gottschalk & Hamerton 2023; Sudibyo & Jianfu 2015). Consistent with NIT, organizational structures leverage a "bottom-up" approach to induce cultural and behavioral change (Ashforth & Humphrey 2022). Moreover, compliance systems reduce the opportunity for, and thus deter, illicit activity (e.g., corruption) (Kostova et al., 2008; Pinto et al., 2008; Rodriguez et al., 2005).

Within the context of supply chain management, NIT (Meyer & Rowan 1977; Tolbert & Zucker 1999) has been applied to explain how institutions regulate various parts of a supply chain, including transportation (Dadzie 1998; Darkow et al. 2015). Specifically, extant research explains how institutions serve to influence behavioral decision-making to comply with established laws as well as social norms and expectations (Caprar & Neville 2012; Kent et al. 2014; Tolbert & Darabi 2019).

Environmental Criminology

In addition to NIT (Meyer & Rowan 1977; Tolbert & Zucker 1999), it is important to draw from the environmental criminology literature (Bottoms et al. 2002; Sidebottom & Wortley 2015). In comparison to theoretical models used to explain IWT originating from other disciplines which employ dispositional factors to explain illicit activity, environmental criminology emphasizes exploring contextual factors related to wildlife crime (Hitchens & Blakeslee 2020). As with NIT, environmental criminology poses that an actors' behavior is driven by external factors (Sidebottom & Wortley 2015). While extant literature in environmental criminology has considered dispositional factors with motivations largely rooted in opportunity when exploring a contextual setting of trade (Hitchens & Blakeslee 2020; Boratto & Gibbs 2021), it is crucial to consider situational factors related to the supply chain or product itself.

In the remainder of the section, I describe how NIT (Meyer & Rowan 1977; Tolbert & Zucker 1999) and environmental criminology (Bottoms et al. 2002; Sidebottom & Wortley 2015) jointly explain how certain external, situational factors (*governance*, *transportation*, *product*, and *recognizability*) ultimately influence the detectability of an illicit supply chain. Specifically, I

elaborate on how these four factors and corresponding behaviors relate to the detectability of an illicit wildlife supply chain.

Governance

The first characteristic of illicit wildlife supply chain detectability which I explore is governance, or the establishment and enforcement of laws and regulations (Fukuyama 2013), regarding IWT. As extant research applying NIT has demonstrated, formal institutions such as laws and law enforcement have been shown to deter illicit activity (Palmer et al. 2017). However, how the laws are defined and enforced can impact how successfully illicit activity is identified on various scales. Regulating IWT has been integrated into international, national, and local policy (Hitchens & Blakeslee 2020). While international regulations are defined by the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), laws and other restrictions on IWT vary across and within countries (Hitchens & Blakeslee 2020) and IWT related transgressions are often perceived as a less serious crime (Nijman et al. 2022). This variance in laws and regulations can consequently yield differing responses by law enforcement officers to take action to interdict IWT (Shepherd et al. 2007).

In addition to institutional pluralism (Kraatz & Block 2008) in the form of varying legal definitions among multiple jurisdictions (i.e., international, national, and local), the illicit nature of wildlife trade is further complicated by situations where legally protected species are authorized to be sold under certain conditions (e.g., legitimate trade allowed from captive bred animals). By permitting the legal trade of vulnerable species under specific pretenses, this facilitates the use of false documentation by allowing traffickers to illegally disguise wild-caught specimens as bred from captive stocks, thereby representing them as legal (Nijman et al. 2022; Rosen & Smith 2010). This practice aids in the perpetuation of IWT by allowing poachers to

transport protected species without the need to physically conceal them while still evading detection (Shepherd et al. 2007). As NIT poses, institutions responsible for the implementation and enforcement of regulatory systems jointly influence the development of behavioral guidelines and decision-making (Tate et al. 2014). Regulatory systems set a standard for acceptable behavior, thereby deterring misconduct or illicit activity that contradicts the expectations of society (Palmer 2012). Enforcement of legal or regulatory systems can more easily detect illicit activity (Scott et al. 2021), as well as deter it when made aware to supply chain actors (Balthrop et al. 2023). The ability to detect non-compliant behavior is consequently elevated in environments where regulations are established and well-enforced (i.e., a system of governance is in place).

Transportation

The second characteristic of interest in contributing to illicit wildlife supply chain detectability is transportation. It is common for illicit actors to alter the modes, means, and routes of trafficking (Schloenhardt 1999). While extant supply chain research employing NIT has been applied to the context of transportation to explore how institutions reduce or deter non-compliant behavior (Balthrop et al. 2023; Scott et al. 2021), there are other transportation related decisions which warrant examination. Accordingly, I consider the external or situational factors which NIT (Meyer & Rowan 1977; Tolbert & Zucker 1999) and environmental criminology (Bottoms et al. 2002; Sidebottom & Wortley 2015) both pose as influencing the decisions and behavioral patterns related to transportation as part of an illicit wildlife supply chain.

Specifically, the stability and length of the route, and the size and identifiability of the mode of transportation should be considered. Foremost, as illicit activity is deliberately clandestine, actors in these supply chains conduct additional precautions not exhibited in

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traditional supply chain transportation activities, such as frequently modifying their trade routes (Eventon & Bewley-Taylor 2016; Salt & Stein 1997). Although the origin point and destination may largely remain the same, altering the route taken through the supply chain can thwart detectability (Skeldon 2000), which is particularly advantageous when engaging in illicit or combative activity, such as in times of war (Guilmartin 1991). Moreover, supply chains spanning greater distances, and thus retaining longer lengths, will typically possess a higher number of total nodes (Craighead et al. 2007), and thus a greater number of checkpoints at air and seaports, including border crossings. Consequently, route length can increase the exposure to enforcement officials, thereby elevating detectability of the supply chain (Phelps et al. 2016).

When considering the characteristic of transportation, size and identifiability of transportation mode ownership exist as sub-characteristics which can correspond to the length which an illicit wildlife supply chain spans from its origin to destination point. When illicit wildlife supply chains span greater distances, or route lengths, from the poaching site to the end market, they require more efficient transportation modes, such as road transport for hardier species and air transport for more fragile species (Shepherd et al. 2007). However, institutions influence what types of transportation mode will facilitate trade while evading detection. When transporting mass quantities of products, illicit SC decision makers might be expected to opt for a larger mode of transportation for reasons related to efficiency and economies of scale (Hawken & Prieger 2013). Although a larger mode of transportation is more visible, and thus detectable, the identifiability of transportation mode ownership is also pertinent. Specifically, private modes of transportation (e.g., car, motorbike) with a license plate that can be linked to an individual poses a risk to traffickers by increasing the risk of detection. Therefore, there has been a rise in popularity of public transportation (e.g., bus, train) or hired couriers to disconnect the

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transportation asset from the traffickers (Hübschle 2016), thereby enhancing anonymity and reducing the risk of detection.

Product

Another fundamental characteristic contributing to IWT detection is species type (Nijman et al. 2022). Extant research on IWT has identified the following characteristics of interest: (1) the size or quantity of the product transported, (2) the fragility of the species, (3) the extent to which the product is processed, (4) how concealable the product is (Bright & Delaney 2016).

Logically, larger quantities or volumes of illicit products increase their visibility, thus elevating their likelihood of detection. Concordant with other forms of illicit trade (e.g., drugs), we would anticipate that moving greater sizes or quantities of wildlife and/or wildlife products to be comparatively more likely to be detected (Bright & Delaney 2016). However, the size and quantity of the wildlife itself will vary based on the actual species being traded as well as the modes which are available to facilitate transportation.

While most species in IWT are transported throughout the supply chain in a dead, often processed form (e.g., elephant ivory, rhino horn) (Hitchens & Blakeslee 2020), international pet and live consumption trade make up a notable portion of IWT (UNODC 2020). As part of the pet trade, diverse groups of birds (e.g., parrots, songbirds), reptiles (e.g., iguanas, turtles), and primates (e.g., chimpanzees, marmosets) are traded. However, these species all have diverse requirements to transport while keeping them healthy. Certain taxonomic groups, namely birds, which are prone to stress, exhibit elevated rates of mortality when transported for extended (i.e., more than four hours) periods (Knowles et al. 2014). Conversely, reptiles maintain the lowest rates of mortality across the board despite long route lengths and condensed spaces and are a comparatively more durable category of species to transport (Robinson et al. 2015). Accordingly,

less durable species (e.g., birds and primates) are typically transported using faster transportation modes and in higher quantities to offset the high mortality rates. This assumption is generalizable to durable, or conversely fragile products where more efficient transportation modes will be employed to reduce the risk or cost of perishability (Harrigan 2010; Hummels & Schaur 2010; Kulpa et al. 2024). On the other hand, while reptiles are considered more durable, traffickers are restricted in the climates and times of day they are moved due to the temperature constraints of cold-blooded species (Essner et al. 2012). Correspondingly, these distinctions could theoretically allow for officials to pinpoint certain transportation modes, size of packages, and timing of shipments to target their searches, thereby heightening the detectability of live animals in IWT.

In addition to species' fragility, the extent to which they are processed can impede the ability to detect or test the genetic basis of a given species (Yeo et al. 2024). Processing requires the species to be deceased and they are then commonly disguised as a legitimate product (Wyatt et al. 2018). For instance, rhino horn and pangolin scales are commonly processed into a powder and disguised as legitimate powders (World Customs Organization 2013). Wildlife products can be effectively disguised even in a partially processed form, such as ivory which has been carved into a simple bangle, which can appear indistinguishable from a simple resin bangle. Hence, higher rates of processing facilitate the disguise of IWT products, thereby reducing detectability.

Related to the fragility of a species and the extent of processing, the concealability of a species can enable transport of illegal species. For instance, it can be more difficult for a variety of reasons to transport live animals (e.g. potential noise, movement, biologic needs in transit) (Knowles et al. 2014; Robinson et al. 2015). Alternatively, wildlife carcasses or even parts of the animal can retain a strong odor (e.g., rhino horn, shark fin), thereby requiring them to be concealed in an olfactory manner (Maleknia 2020). Accordingly, concealment strategies vary

broadly from simply storing the wildlife in a bag or box to using false doors and secret

compartments (e.g., hiding iguanas in a prosthetic leg) (NBC 2007), or altering the product to

blend in with other products (e.g., painting ivory to blend in with wood) (Rosen & Smith 2010).

However, as concealment strategies are discovered by enforcement officials, they are more

vigilant and more likely to detect wildlife products utilizing these tactics in the future (Dalberg

2012). Additionally, strategies which only partially conceal wildlife products (i.e., only visually

or olfactorily) are less effective and correspondingly more likely to be detected (World Customs

Organization 2013). Thus, the concealability of the species or wildlife product involved in IWT

can contribute to detectability.

Stakeholder Recognizability

The final factor to consider is the recognizability of both species' vulnerability and

legality by both stakeholders, such as consumers and enforcement officials. As acknowledged

earlier, there is an incongruence of international conventions (i.e., CITES) with national and

local regulations, which can create confusion among both consumers and law enforcement

(Shepherd et al. 2007). Confusion among consumers can result in individuals unknowingly

purchasing illicit wildlife products (World Customs Organization 2013). However, awareness

can serve as a powerful tool for the purposes of IWT demand reduction (ICE 2024). When

implemented on a local scale, educational campaigns have empowered individuals to invest in

and protect their natural resources, while concurrently successfully reducing demand for IWT

(Rosen & Smith 2010). This phenomenon is consistent with consumer behavior change exhibited

in other illicit trade contexts (e.g., counterfeits), demonstrated by the reduction in consumer

intention to (re)purchase upon learning of a product's illegal status (Peinkofer & Jin 2023).

Turning to law enforcement officials, recognizability of a species' vulnerability and/or legal status is foundational in their ability to identify and enforce the law. This need is exacerbated in environments which are more biodiverse, as there is a wider range of species which enforcement officials are required to be familiar with. Unlike comparatively more identifiable mammals, it is more common for protected, illegally traded species of reptiles and birds to be intermixed with legally traded species (Nijman et al. 2022). However, there is a notable deficit in resources and training of enforcement officials working to combat IWT (Runhovde 2017). Taken collectively, nebulous regulations, species diversity, and a lack of enforcement resources pose a notable impediment to the detection of the product, thereby highlighting the cruciality of awareness in combatting IWT.

Taken collectively, there are a wide array of situational factors which can promote or limit detection, thereby perpetuating IWT. However, as introduced above, there are four prominent factors relating to the detectability of illicit wildlife supply chains that are identified above: *governance, transportation*, *product*, and *stakeholder recognizability*. While each of these factors are anticipated to be a key component of detectability, as extant research employing QCA poses, various combinations of conditions can yield comparable outcomes (Ragin 1999; Rihoux 2016; Rihoux et al. 2021). Accordingly, I anticipate that these factors, while critical, are individually insufficient to result in elevated detectability of IWT as well as that various combinations of these factors will yield similar levels of the anticipated outcome.

> **Proposition 1.** An individual factor related to the *governance*, *transportation*, *product*, or *stakeholder recognizability* of an illegal wildlife supply chain can be deemed essential, yet deficient to achieve high levels of detectability.

Proposition 2. Distinct combinations of factors related to the *governance*, *transportation*, *product*, or *stakeholder recognizability* of an illegal wildlife supply chain yield comparably similar levels of detectability.

Legal Definition and Enforcement ⟩ Governance

Route Length
Route Stability
Identifiability of Mode Ownership
Mode Size ⟩ Transportation

Extent of Processing
Species Fragility
Concealability
Quantity
Size ⟩ Product

Consumer Awareness
Enforcement Familiarity ⟩ Stakeholder Recognizability

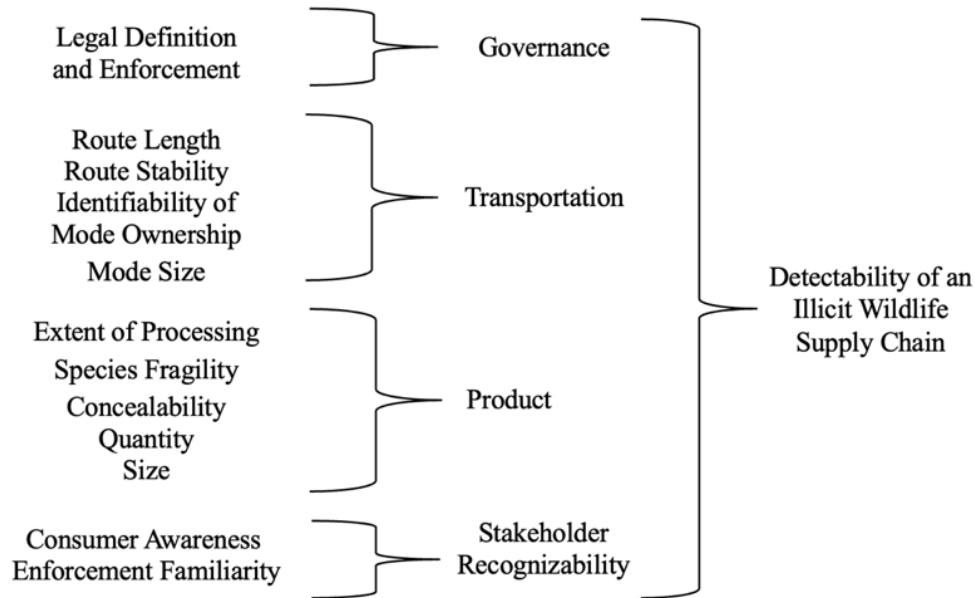⟩ Detectability of an Illicit Wildlife Supply Chain

Figure 1. A configurational model of illicit wildlife supply chain detectability

3.3 METHODOLOGY

Illicit wildlife supply chains are complex with a range of factors that can be aggregated to identify specific patterns of operation. Thus, to assess the conditions that contribute to the detectability of an illicit wildlife supply chain it is critical to leverage a methodology that can consider a configurational perspective. Configurational approaches examine combinations of factors and their corresponding patterns associated with specific outcomes within a sample (Ketchen et al. 2022; Meyer et al. 1993). While typologies and taxonomies via cluster analyses are well-established configurational approaches, new methods are being adopted by supply chain research (Ketchen et al. 2022). While mirroring the main benefits of cluster analysis, QCA provides deeper insights by revealing the relationship between certain combinations of variables

and the outcome of interest (Haynes 2014; Ketchen et al. 2022). Thus, QCA is particularly advantageous when applied to illicit activity and other research contexts which involve a more complex phenomena for which archival data is scarce and it is a prevalent concept for which the findings of targeted qualitative methods (e.g., case studies) could not be adequately generalized (Befani 2013; Hanckel et al. 2021).

In employing the QCA approach, both quantitative and qualitative data can be used to identify patterns in the outcome of interest (Russo & Rihoux 2023). Qualitive approaches are more suited to research contexts which have been explored less, as well as contexts which have a smaller knowledge base or sample size (Moore 2007). QCA is applicable to very large sample sizes but is unique in its capability to also handle small sample sizes (Fainshmidt et al. 2020). Accordingly, I employ a QCA approach to the examine the qualitative data collected in this study.

Qualitative Comparative Analysis

Developed by Charles Ragin (1987), QCA utilizes extant theory in combination with Boolean algebra[1] to identify configurations of explanatory conditions which yield a specified outcome (Ragin 2008; Schneider & Wagemann 2013). QCA considers cases with different configurations of conditions to understand specific combinations of conditions that are necessary and/or sufficient to produce the outcome of interest (Arellano et al. 2021). Specifically, QCA is utilized to determine the membership of cases in sets across a combination of conditions in a dichotomous manner (i.e., 0 = no membership, 1 = full membership) (Ragin 2009). In this way, researchers employing QCA can classify observations to be "in" (i.e., 1) or "out" (i.e., 0) of sets

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[1] Boolean refers to "algebra of two-valued logic with only sentential connectives, or equivalently of algebras of sets under union and complementation." (Monk, 2022).

(Kosmol et al., 2018; Misangyi et al., 2017). Moreover, QCA constitutes a neo-configurational perspective due to its unique focus on causal complexity (Misangyi et al. 2017). The capabilities of QCA surpass those of traditional configurational methods (e.g., cluster analysis) by allowing researchers to reveal how multiple combinations of variables can lead to an outcome of interest (i.e., equifinality) (Gligor et al. 2020; Kosmol et al., 2018; Misangyi et al., 2017). In its ability to consider the influence of multiple variables simultaneously, QCA overcomes the limitations of other methods such as multiple regression and SEM approaches (Cragun et al. 2016). Accordingly, QCA allows for the simultaneous exploration of multiple combinations of variables which correspond to a related outcome of interest. This is unlike correlational analysis, such as regression analysis, which assess correlation symmetrically, by examining the influence of both the presence and absence of a variable on the outcome. Thus, QCA can provide more insight into variables' relationships, thereby rendering it useful for studying particularly complex phenomena (Fiss 2011; Woodside 2014). Acknowledging the aforementioned propositions and the functionality of QCA, this methodology is a suitable approach for exploring the configurations of this study's causal factors (i.e., *governance*, *transportation*, *product*, and *stakeholder recognizability*) which I anticipate correspond to a common outcome of interest (i.e., detectability).

Fuzzy-set Qualitative Comparative Analysis

This research leverages a variant of QCA: *fuzzy-set* QCA (*fs*QCA). fsQCA allows a range of membership in sets of cases sharing a common factor (Ragin 2000). Unlike traditional (i.e., crisp-set) QCA, which requires cases to maintain either full or no membership in a set, fsQCA allows conditions which constitute membership to exist on a comparative spectrum, ranging from 0 to 1 with 0.5 serving as a crossover point, at which the case is no more in than

out of a set (Ragin 2000; Ragin 2009). For instance, a case in research employing fsQCA could exhibit lower or higher membership of education, wealth, or any other number of comparatively ranked (i.e., more/less), non-discrete groupings. By allowing for a varied range of membership, fsQCA permits degrees of freedom within a case, thereby yielding more potential combinations of conditions (Ragin 2000). Thus, fsQCA allows for superior examination of causal complexities or interactions where relevant cases are combined to produce the outcome of interest (i.e., conjunctural causation) (Lee et al. 2014; Ragin 2000). This research leverages fsQCA to identify combinations of conditions related to the outcome of detectability of an illicit wildlife supply chain (i.e., governance, transportation, product, and stakeholder recognizability). The specific measures captured within each condition are displayed in Table 1.

Sample

Considering the multifaceted and complex nature of illicit wildlife supply chains, I recruited a participant pool with knowledge on diversity of species and trade related expertise as well as across countries and continents. To ensure the development of a comprehensive perspective, I targeted participants who operated in multiple and varying geographic regions with distinct expertise on a wide range of IWT species (Table 2). This diversity in experience and perceptions fostered a deeper understanding of the variances in illicit wildlife supply chains across multiple geographic regions, species, and use cases. To ensure suitable participants were included in the study, I required participants to have the following qualifications: currently studying or employed by an organization focused on studying or conserving species involved in illicit wildlife trade, at least 18 years of age, and able to be contacted via digital communications. Based upon these criteria, I identified 52 suitable individuals able to be recruited for my study. To recruit participants, I sent invitations to participate via email and LinkedIn direct messages. If

I did not receive a response within two weeks, I followed up with a second message to confirm receipt of the initial message with the same thread and form of communication. Three messages failed to be delivered, 24 recipients did not respond, three declined to participate due to lack of perceived relevance or background in the context of study, and one was unable to participate due to lack of permission from their employer and NDA in effect.

Conditions & Measures	Anchor Points
Detectability of an Illicit Wildlife Supply Chain	**0.0** Mildly detectable **0.5** Moderately detectable **1.0** Highly detectable
Governance	
Legal Definition and Enforcement	**0.0** There are no national or local laws or ordinances to protect vulnerable wildlife **0.33** There are international protections, but are considered legal to trade under certain cases (e.g., captive-bred) are subject to differences in local/national interpretations **0.66** There are international protections, but are subject to differences in local/national interpretations **1.0** There are *both* national laws or ordinances to protect vulnerable wildlife and they are regularly enforced
Transportation	
Route Length	**0.0** Local **0.33** National **0.66** International **1.0** Intercontinental
Route Stability	**0.0** Changes frequently **0.33** Sometimes changes **0.66** Rarely changes **1.0** Never changes
Identifiability of Mode Ownership	**0.0** Maintains complete anonymity **0.33** Moderately difficult to identify **0.66** Mildly difficult to identify **1.0** Easy to identify
Mode Size	**0.0** Individual transport **0.33** Fits up to 2-5 people **0.66** Fits 6-10 people **1.0** Fits 10+ people

Table 1. Measures used to determine the detectability of an illicit wildlife supply chain (outcome) and the corresponding characteristics related to governance and transportation (conditions)

Table 1 (cont'd).
Measures used to determine the detectability of an illicit wildlife supply chain (outcome) and the corresponding characteristics related to product and stakeholder recognizability (conditions)

Product	
Extent of Processing	**0.0** Powdered, Capsules or Liquid **0.33** Pieces or Chunks **0.66** Whole (Dead) **1.0** Whole (Alive)
Species Fragility	**0.0** Highly durable **0.33** Durable in short distances/timelines **0.66** Durable under specific conditions (temperature/space constraints) **1.0** Fragile in most circumstances
Concealability	**0.0** Species can be transported on its own without being concealed **0.33** Species can be concealed by similar products **0.66** Species must be visibly concealed **1.0** Species must be transported with other products and both visibly and either audibly or olfactorily concealed
Quantity	**0.0** Single **0.33** Few **0.66** Multiple **1.0** Mass quantities
Size	**0.0** Fits in pocket **0.33** Fits in single hand or small bag **0.66** Must be carried in large bag **1.0** Must be carried by multiple people
Stakeholder Recognizability	
Consumer Awareness	**0.0** Not aware of species vulnerability nor legal status **0.5** Familiar with *either* species' vulnerability or legal status **1.0** Familiar with *both* species' vulnerability and legal status
Enforcement Familiarity	**0.0** Unfamiliar with species' legal status and unable to identify them **0.5** Familiar with species' legal status but unable to identify them **1.0** Familiar with species' legal status and able to identify them

Upon receiving an affirmative response, interviews were scheduled to be conducted in a face-to-face format, or by video or phone call (i.e., Zoom or Whatsapp). I conducted 24 interviews with 26 key informants (two interviews included two participants each) virtually and in-person across South Africa, Zambia, Botswana, and Rwanda between May and August 2023. The 26

participants had a mean age of 37, with two who did not provide their age. Participants are

experts across academia, government, and NGOs, with an array of titles and roles (Table 2).

Sector	Role	Gender	Age	Origin Nation	Interview Location
Non-profit/NGO	Consultant	Female	39	US	Zoom
Academia	Post-Doctoral Research Associate, Environmental Systems	Male	34	Colombia	Zoom
Non-profit/NGO	Environmental Crimes Analyst	Female	32	Italy	Zoom
Non-profit/NGO	Executive Director	Male	52	Canada	Zoom
Non-profit/NGO	Board Member	Female	62	US	Zoom
Non-profit/NGO	Senior Researcher	Female	40	South Africa	South Africa
Law Enforcement	Conservation Officer, Rhino	Male	27	Zambia	Zambia
Law Enforcement	Conservation Officer	Male	31	Zambia	Zambia
Law Enforcement	Program Manager	Female	-	Botswana	Botswana
Law Enforcement	Technical Coordinator	Male	-	Botswana	Botswana
Non-profit/NGO	Field Guide	Male	32	Zambia	Zambia
Non-profit/NGO	Field Guide	Male	25	South Africa	South Africa
Law Enforcement	Executive Director	Male	56	Zambia	Zambia
Academia	PhD Candidate, Conservation Ecology	Female	28	US	Rwanda
Academia	PhD Student, Conservation Science	Female	27	UK	Rwanda
Academia	PhD Student, Biodiversity	Female	27	UK	Rwanda
Law Enforcement	Lawyer	Female	30	India	Rwanda
Academia	Associate Professor, Conservation Biology	Male	46	Italy	Rwanda
Academia	Post-Doctoral Research Associate, Ecology & Evolutionary Biology	Male	32	Costa Rica	Rwanda
Law Enforcement	Senior Field Officer	Male	25	India	Rwanda
Law Enforcement	Wildlife Biologist	Male	43	Trinidad	Zoom
Law Enforcement	Game Warden	Male	55	Trinidad	Zoom
Non-profit/NGO	Director	Female	42	US	Zoom
Non-profit/NGO	Environmental Crimes Analyst	Female	36	Italy	Zoom
Non-profit/NGO	Environmental Crimes Analyst	Female	27	US	Zoom
Non-profit/NGO	Lawyer	Male	32	Kenya	Whatsapp

Table 2. Participant Demographics

Procedures

Acknowledging the exploratory nature of this study combined with the dearth of secondary data pertaining to illicit wildlife trade, there is an opportunity to develop a novel data collection instrument. Although QCA has been widely applied to conservation and wildlife topics (Akhshik et al. 2023; Basurto 2013; Zavaleta Cheek et al. 2023; Zhang et al. 2022), to date, QCA has yet to be utilized to study IWT specifically. Moreover, the application of QCA is burgeoning in supply chain research, with recent calls to apply QCA to additional research settings (Ketchen et al. 2022). Extant supply chain research employing QCA methodology has leveraged surveys and questionnaires (Arellano et al. 2021; Gligor et al. 2020; Gligor et al. 2022). However, consistent with QCA research in other fields (Basurto 2013), this study leverages a semi-structured interview approach. By employing a foundationally qualitative data collection method, such as interviews, I am able to extract additional nuances unattainable by strictly quantitative methods. Moreover, I used a semi-structured interview with open-ended questions to allow for elaboration on focal topics and limit the potential for researcher-induced bias (Shaheen et al. 2022).

I employed a semi-structured interview guide (Appendix A) which was reviewed and refined by a cross-disciplinary research team versed in interview development. To ensure adequate evaluation of the variables of interest, the interview guide was pilot tested with six participants and modified to address the identified gaps before continuing to conduct interviews. Acknowledging the illicit nature of the supply chains of focus, participants were assured confidentiality to allow for candid and complete responses. Consistent with Eisenhardt (1989), I proceeded to interview participants until theoretical the point at which the addition of novel insights ceased to emerge.

Throughout the interviewing process, I recorded notes digitally. Additionally, the interviews were audio recorded and transcribed using Cockatoo, an AI-powered transcription service. I manually cleaned and coded the transcripts based on the group assignments and using the values defined in the fuzzy-set scale outlined in Table 1 which were then reviewed by a methodological expert for verification.

When employing QCA, secondary data should be integrated to develop an inclusive evaluation of the research context of interest where applicable (Rihoux et al. 2021). As is common with QCA-based studies, my research leveraged additional sources to ensure a complete, comprehensive perspective (Basurto 2013; Rihoux & Ragin 2008). Specifically, there were two cases (Case 2 and Case 18) in which there was nebulous or incomplete information related to the transportation condition, so I supplemented missing data for Case 2 with Kamins et al. (2011) and Reuters et al. (2016), and for Case 18 with Alvarado Martínez & Martínez (2018) and Boilevin et al. (2023).

Analytical approach: fuzzy-set qualitative comparative analysis

To evaluate my propositions, I employed the four steps of QCA as identified by Ordanini et al. (2014), Ragin (2009), and Russo et al. (2019), and demonstrated in extant research by operations and supply chain disciplines (Arellano et al. 2021; Gligor et al. 2020; Gligor et al. 2022; Russo et al. 2016):

1. *Defining the property space*

    In the initial step of QCA, it is important to consider all possible configurations of factors of illicit wildlife detectability in prior studies. Accordingly, the entirety of combinations of the binary states in the presence or absence of the four factors (governance, transportation, product, and stakeholder recognizability) hypothesized to

influence detectability comprise the property space for a total of 16 (i.e., 2^4) combinations per row. These possible values are then arranged into a truth table (Rihoux & Ragin 2008), which presents all of the theoretically possible combinations of conditions, to be refined later.

2. *Developing set-membership measures*

In the second step, I acknowledge the non-dichotomous nature of the variables and the necessity of calibrating variables based on set-memberships. To calibrate variables by set membership scores, a degree of membership is assigned to each case in a pre-determined set (Basurto & Speer 2012). To ensure I capture the nuance of each condition and minimize the potential for data loss, I opt to employ fuzzy-set membership (Rihoux & Ragin 2008). Accordingly, I employed the three membership scores (i.e., 1.0 = fully in, 0.5 = crossover point, and 0.0 = fully out) to evaluate the calibrated variables (Ragin 2009). However, for two measures comprised within the product and transportation conditions there was additional nuance to be derived. Therefore, I employed two additional membership scores (i.e., 0.75 = more in than out and 0.25 = more out than in) (Ragin 2009) to assess measures of the extent of processing and mode size more thoroughly.

3. *Evaluating the consistency in set relations*

In the third step, I refine the truth table by determining which configurations of conditions could serve as adequate conditions to yield illicit supply chain detectability. Specifically, the truth table was reduced to notable combinations based on (1) frequency and (2) consistency (Ragin 2009). Foremost, the frequency cut-off denotes the minimum threshold for a number of cases to result in the anticipated outcome when compared to

the total number of cases (Thiem 2022). The frequency cut-off is determined by the size of the sample and in medium-sized samples (e.g., 10-50 cases), such as in this study (i.e., 20 cases), the cut-off is 1 (Ragin 2008).

Next, the consistency, or extent to which the solution is considered sufficient to result in the anticipated outcome, was assessed (Rihoux & Ragin 2008). Thus, I set cases which resulted in high levels of detectability to a value of "1", which aids in visualizing the maximum number of potential combinations which result in the same outcome (Russo et al. 2019). To determine the measure of consistency of membership scores in a causal set, the sum of shared membership scores in a causal set was calculated prior to dividing it by the sum of all membership scores relating to that causal set (Gligor et al. 2020; Russo et al. 2019). This measure, raw consistency, establishes a minimum threshold for which cases in a truth table must achieve to be deemed sufficient to result in the outcome (Schneider & Rolfing 2016). To evaluate raw consistency, the minimum allowable consistency score was set to 0.80, which is the threshold consistent with fsQCA literature exceeds the suggested minimum 0.75 threshold for crisp-set QCA to achieve sufficient consistency of membership scores in a causal set (Fiss 2011; Gligor et al. 2020; Ragin 2008; Woodside 2013). In setting the raw consistency threshold to 0.8, the cases in a solution resulting in the same anticipated outcome must share upwards of 80% of their membership scores across conditions.

4. *Logical Reduction*

To conclude the application of fsQCA, I wanted to ensure adequate coverage. Coverage provides support for how well the causal combinations feasibly yield the intended outcome of detectability (Woodside & Baxter 2013). Specifically, raw coverage

provides the proportion of cases which are covered by a single combination (Rihoux &

Ragin 2008). Alternatively, unique coverage provides the proportion of cases which are

covered by a single combination, but no other combination (Rihoux & Ragin 2008). Prior

to running a necessity analysis, I first conducted a sufficiency analysis, as recommended

(Ragin 2008) and adopted by recent QCA studies (Arellano et al. 2021; Gligor et al.

2020). To establish a condition's sufficiency, the set of cases which comprise the

conditions must be a subset of cases which correspond to the outcome variable (Cooper

& Glasser 2016). However, to establish a condition's necessity, the set of cases which

correspond to the outcome variable exists as a subset of cases which compose the

conditions (Cooper & Glasser 2016). A necessity analysis reveals conditions which are

consistently present when the anticipated outcome is also present, and thus deemed

necessary for the outcome to occur (Ragin 2008). In extant QCA literature, 0.90 is

considered the threshold for necessity, while 0.10 is considered the threshold to establish

sufficiency for both raw and unique coverage (Woodside et al. 2018). The coverage for

the solutions presented in this study can be found in Table 3.

3.4 FINDINGS

The results of the necessity and sufficiency analyses appear in Table 3, where at a value

of 0.812 for raw consistency and 0.840 for solution consistency, both exceed the 0.80 threshold

to respectively achieve sufficiency and necessity for fsQCA (Fiss 2011; Gligor et al. 2020; Ragin

2008; Woodside 2013). As recommended by Ragin and Fiss (2008) and employed in the extant

operations and supply chain literature employing QCA (Arellano et al. 2021; Gligor et al. 2020;

Russo et al. 2019), I indicated the presence of a condition with black circles (●) and the absence

of a condition with crossed circles (⊗) (Table 3). As shown in Table 3, there are two

combinations of governance, transportation, product, and stakeholder recognizability which yield

an outcome of high illicit wildlife supply chain detectability and are represented by five total

cases.

	Combinations	
Conditions	Solution 1: *Cases 4 & 15*	Solution 2: *Cases 11, 12 & 14*
Governance	⊗	⊗
Transportation	⊗	●
Product	●	●
Stakeholder Recognizability	●	●
Consistency	0.812	0.823
Raw Coverage	0.421	0.469
Unique Coverage	0.421	0.048
Solution Coverage	0.421	0.557
Solution Consistency	0.840	0.814

Note(s): ● core causal condition present, ⊗ core causal condition absent

Table 3. Configurations for yielding high illicit wildlife supply chain detectability

The first solution reveals that when high levels of product and stakeholder recognizability

exist with simultaneously low levels of governance and transportation, detectability of an illicit

wildlife supply chain is comparatively high. The second solution that yields elevated rates of

detectability occurs when high levels of product and stakeholder recognizability related factors

are combined with high levels of transportation related measures and low levels of governance.

With two combinations of conditions resulting in high detectability, the existence of equifinality

of conditions in attaining high detectability is implied, thus providing support for Proposition 1.

Additionally, acknowledging that both Solution 1 requires high levels of the product and

stakeholder recognizability conditions, while Solution 2 requires high levels of product,

stakeholder recognizability, as well as transportation conditions to result in high detectability,

there is corresponding support for Proposition 2. Collectively, an overall consistency of 0.812

and 0.823 for Solution 1 and 2, respectively, the overall consistency exceeds the minimum

threshold of 0.80 for fsQCA, thus demonstrating sufficient consistency of membership scores in the causal set (Ragin 2008).

3.5 DISCUSSION

Reflecting on the findings of this research, there are two configurations of governance, transportation, product, and stakeholder recognizability which appear to yield elevated detectability of an illicit wildlife supply chain (Table 3). The first solution demonstrating high detectability includes the presence of high product and stakeholder recognizability related measures. Specifically, the cases included in the first solution (i.e., Cases 4 and 15) exhibit elevated values for the *extent of processing* and *quantity* measures.

In both cases, the wildlife being illicitly traded are alive, and thus sold whole. As anticipated, live wildlife are both larger and easier to notice than processed wildlife products of the same species (Rosen & Smith 2010) Additionally, they may emit noise or move while in transit, making them more detectable (Knowles et al. 2014). Accordingly, the product related measure exhibited by live trade, *Extent of Processing* is rated 1.0 or "Whole (alive)" (Table 1) for all five cases, which is reflective of full membership in the group. In addition to the extent of processing, the quantity of wildlife being traded contributes to the detectability of an illicit wildlife supply chain. This finding echoes findings from literature on other forms of illicit trade (i.e., drugs and arms), which assert that greater quantities are more easily detected (Giommoni et al. 2022). In alignment with this notion, the product related measure, *Quantity* is rated 1.0 or "Mass quantities" (Table 1) for each of the five cases, thus displaying full membership in the group.

In addition to product related measures, the first solution also uncovers a connection between detectability and higher rates of stakeholder recognizability, both from a consumer and

enforcement perspective. From a consumer perspective, recognizing both a product's illicit nature and, in the case of wildlife and other natural resources, its vulnerability status can affect consumers' sentiments and future purchase intentions. As seen in other forms of illicit trade (e.g., counterfeits), learning of a product's illicit nature results in a reduction in future purchase intentions (Peinkofer & Jin 2023). Likewise, campaigns which educate the general public on species' vulnerability and encourage citizens to protect their natural resources are associated with a reduction in demand for IWT products (Rosen & Smith 2010). While Case 4 was rated 0.5 ("Familiar with *either* species' vulnerability or legal status") for *Consumer Familiarity*, demonstrating partial membership, Case 15 reflected a lack of membership with 1 ("Familiar with *both* species' vulnerability or legal status"). Accordingly, this research reinforces these notions, emphasizing that greater consumer awareness on both the legality and vulnerability of trading one or more species reduces the incidence of engagement in IWT, and consequently, decreases the amount of IWT and the opportunities to detect illicit wildlife supply chains. From an enforcement recognizability perspective, the findings similarly revealed a link between high levels of familiarity among species legality and vulnerability with increased detectability. As anticipated, enforcement officials who more easily recognize a species and are aware of the legal standing of a species may detect that species in transit at a higher rate as compared to a less aware enforcement official. This is bolstered by the findings of Cases 4 and 15 in Solution 1 retaining values of 1 or "Unfamiliar with species' legal status and unable to identify them," thus exhibiting full membership in the stakeholder recognizability measure of *Enforcement Familiarity* (Table 1).

Solution 2 similarly suggests a relationship between high levels of recognizability measures when paired with high values of product related measures, however it also accounts for

high levels of transportation related measures. When considering the cases included in Solution 2 (i.e., Cases 11, 12, and 14), they all exhibited ratings of 1 for both *Consumer Familiarity* as well as *Enforcement Familiarity*, thus displaying full membership. Hence, we can extend the interpretation of the findings of Solution 1 to Solution 2.

In alignment with Solution 1, the cases in Solution 2 also involved species in these supply chains which are similarly sold alive and in larger quantities. However, these cases also displayed high levels of species fragility. In Solution 2, Cases 11 and 12 demonstrated full membership of 1.0 ("Fragile in most circumstances") in the *Species Fragility* measure, while Case 14 was rated 0.66 ("Durable under specific conditions (temperatures/space constraints)") (Table 1), thus surpassing the crossover point of membership (Ragin 2000; Ragin 2009). Acknowledging that the needs of wildlife vary by species, some retain exhibit elevated mortality rates when transported under certain conditions. For example, birds are prone to stress and don't fare well when transported for long periods of time (Knowles et al. 2014), or reptiles who retain temperature restrictions (Essner et al. 2012). Accordingly, this research provides support for the assumption that enforcement officials could target their searches to supply chains which exhibit these and similar properties, thereby enhancing the potential for detectability.

In considering the measures of the transportation routes and modes used to facilitate IWT, the results suggest that some related measures collectively contribute to the detectability of an illicit wildlife supply chain in Solution 2 but not in Solution 1. The absence of transportation conditions in Solution 1 and presence in Solution 2 highlights the importance of examining not only the conditions, but also the measures within the conditions, as displayed in Table 1. Of these measures, routes which spanned greater distances, and were relatively stable over time corresponded with elevated rates of detectability, as highlighted by the rating of 1.0

("Intercontinental") for *Route Length* across all three cases in Solution 2 (11, 12, and 14). This finding echoes Keskin et al.'s (2013) findings on supply chain visibility. Moreover, the identifiability of ownership and corresponding size of the transport mode were linked with enhanced detectability. Transport modes where the owner could be more easily identified (i.e., private transportation) or heard (i.e., motorized vehicles) were more susceptible to being detected, as emphasized by the 0.33 rating ("Moderately difficult to identify") for *Identifiability of Mode Ownership* across Cases 11, 12, and 14. In considering the size of the transportation mode, the findings reveal that illicit shipments in smaller modes of transportation are more detectable, as similarly demonstrated by the 0.33 rating ("Fits up to 2-5 people") for the measure *Mode Size* in each of the three cases in Solution 2. This finding could be explained by the fact that while a larger mode of transportation such as a shipping container or airplane is more easily seen, the increased size of the mode is also conducive to hiding illicit wildlife products (Schloenhardt 1999).

Curiously, governance did not appear related to detectability in either Solution 1 or Solution 2, each of which the *Legal Definition and Enforcement* were rated 0.33, "There are international protections, but are considered legal to trade under certain cases (e.g., captive-bred) are subject to differences in local/national interpretations" for all five cases. As extant research employing NIT has posed, the presence of formal institutions such as law enforcement has been shown to both proactively and retroactively curb illicit behavior (Ehrlich 1972; Nagin 2013; Paternoster 2019). Thus, we could anticipate the presence of governance systems to improve upon the success of detecting illicit wildlife supply chains by allocating greater efforts through the establishment and enforcement of laws. However, the engagement of governance systems in this context could impose a stronger proactive impact, thereby deterring illicit activity (Nagin

2013; Paternoster 2019). Thus, while institutions or governance systems may impose both retroactive and proactive influence on diminishing illicit activity, the latter influence appears to be stronger in this research setting.

3.6 CONTRIBUTIONS

Theoretical and Methodological Contributions

This research contributes both theoretically and methodologically to the body of knowledge centered on illicit supply chains and extends the use of QCA in a novel supply chain setting. Specifically, this research provides theoretical contributions in two overarching manners, as outlined by Makadok et al. (2018): by applying theory to a different phenomenon than extant research has previously explored as well as introducing novel constructs as key constructions or conditions resulting in the outcome variable of interest. Specifically, this research (1) bridges the gap between studies employing NIT by applying NIT to the nexus of IWT and supply chain, and (2) expands the external, situational factors considered within environmental and conservation criminology within the context of IWT by introducing additional constructs: governance, transportation, and stakeholder recognizability related characteristics.

Regarding the first contribution, this research contributes by applying NIT to the nexus of IWT and supply chain management. Although NIT (Meyer & Rowan 1977; Tolbert & Zucker 1999) is largely embedded in the notion of governance as a type of formal institution, the extant research within the context of IWT is burgeoning (Han et al. 2017; Runhovde 2022; 't Sas-Rolfes et al 2019). In its current state, IWT research leveraging NIT has drawn largely from the criminology literature to acknowledge the detrimental impact of decoupling (Han & Nelen 2017; Runhovde 2022) and areas for improvement ('t Sas-Rolfes et al. 2019) to bolster protections against IWT. Specifically, 't Sas-Rolfes et al. (2019) highlighted the importance of information

sharing as a fundamental component of improved policymaking, and thus bolstering of institutions. Other studies have examined the inefficacy of institutions in their efforts against IWT, attributing it to taking a symbolic rather than an instrumental approach (Han & Nelen 2017) or due to lack of resources coupled with conflicting demands (Runhovde 2022). Furthermore, NIT has been applied to supply chain management research, including transportation management (Dadzie 1998; Darkow et al. 2015) in addition to a nascent body of literature regarding illicit activity in an organizational context (DiMaggio & Powell 1983). This research builds upon extant research by applying NIT to the nexus of illicit trade (i.e., IWT) and supply chain management, to consider the ultimate impact on detectability of the illicit supply chain. In this setting, however, this research conflicts with prior notions that institutions proactively and retroactively influence illicit actor behaviors. The findings of the research do not demonstrate a significant relationship between governance and the detectability of an illicit wildlife supply chain. However, by applying NIT to this novel context, this research does pose an interesting query as to whether the proactive forces by institutions exert a greater impact on deterring illicit activity in IWT than retroactive forces, thereby reducing the opportunity for detection.

The second contribution offered is the introduction of new constructs of interest related to detectability of illicit wildlife supply chains: transportation, product, and stakeholder recognizability. Although the findings of this research do not demonstrate governance as having a notable effect on the detectability of an illicit wildlife supply chain, there are additional factors which did correspond to elevated rates of detectability. Congruent with NIT, the environmental criminology literature emphasizes the role of situational factors, such as the extent to which a setting is urban, the wealth of the population, the absence of supervision or other social controls,

which provide ultimately an enhance the opportunity to commit a crime (Hitchens & Blakeslee 2020; Sidebottom & Wortley 2015). While environmental criminology has explored situational characteristics such as opportunity (Hitchens & Blakeslee 2020), this research considers the characteristics related to the transportation, product, and recognizability of illicit wildlife by stakeholders.

In examining transportation related characteristics of IWT supply chains, this research contributes by introducing route factors, namely length, in addition to mode factors, including recognizability and size, which correspond to heightened detectability. This research further contributes to theory in the introduction of product related factors: species fragility, concealability, size, and quantity, which collectively contribute to the detectability of illicit wildlife supply chains. Moreover, this research introduces stakeholder recognizability, thereby accounting for the role awareness of legality and identifiability of illegal products by consumers and enforcement officials. Although this research is specific to context of IWT, these transportation, product, and stakeholder recognizability related characteristics can be broadly generalized to other illicit settings. Serving as an initial exploration and establishing a foundation for future research within the environmental criminology literature, this approach could be applied to examine the supply chains of other forms of trafficking (e.g., drug, human), to counterfeits, and even illicit activity within legitimate supply chains, such as cargo theft.

In addition to the stated theoretical implications, the application of QCA to explore the detectability of IWT from a supply chain perspective has three overarching methodological implications: (1) an expansion of the nascent utilization of QCA within the supply chain management and operations literature, (2) utilization of QCA to examine IWT from a supply chain perspective, and (3) application of QCA to an interdisciplinary study rooted in supply

chain, conservation, and criminology foundations. Although QCA has been widely applied to research originating across natural and social sciences disciplines (Basurto 2013; Clarke 2020; Masue et al. 2013), the supply chain management work employing QCA is still emerging (Arellano et al. 2021; Gligor et al. 2020; Russo et al. 2016). However, there have been multiple calls to apply the QCA methodology to supply chain contexts (Ketchen et al. 2022; Russo et al. 2019). In its current form, QCA research from the supply chain and operations disciplines have primarily relied on survey (Arellano et al. 2021; Gligor et al. 2020; Gligor et al. 2022; Russo et al. 2016) or secondary data sources (Wang et al. 2022; Yin & Ran 2022). Although relying on these sources of data can provide a larger sample size to draw from certain topics, such as IWT, benefit from interview data given its ability to provide a richer depiction with more nuanced detail (Jacob 1987). Accordingly, this study provides a first methodological contribution in the extension of QCA research conducted by supply chain and operations disciplines by applying the QCA methodology to interview data.

The second methodological implication of this research is rooted in the extension of QCA's boundary conditions to more unique contexts. Although studies employing QCA in supply chain management have emerged in recent years, the topical areas have been fixed in more traditional contexts, such as performance (Arellano et al. 2021; Gligor et al. 2020), innovation (Gligor et al. 2022), resilience (Yin & Ran 2022), and sustainability (Wang et al. 2022). However, the pervasive nature of illicit supply chains on a global scale (ICE 2024; OECD 2024) in conjunction with the nascent literature on illicit trade as a supply chain risk (Duensing et al. 2023) makes a robust case for additional exploration in this realm. Accordingly, this research broadens the application of the QCA methodology, yielding novel insights to extending the study of illicit supply chains (Duensing et al. 2023; Griffin et al. 2024; Keskin et al. 2023).

The third manner in which this study contributes empirically is in the application of QCA to an interdisciplinary research environment. Specifically, this research integrates perspectives from conservation, criminology, and supply chain literature sources. Moreover, when addressing particularly complex or pervasive problems, such as illicit supply chains, there is an opportunity to tackle them by conducting interdisciplinary research (Pohl et al. 2017). Accordingly, interdisciplinary collaboration promotes resource sharing and consequently fosters enhanced efficiency and innovation in the research (Xue et al. 2022). In referencing extant research, few QCA studies leverage an interdisciplinary approach and have thus far been limited to social sciences (Verweij & Trell 2019). However, research leveraging the QCA methodology has not yet simultaneously drawn upon conservation, criminology, and supply chain disciplines to develop a holistic comprehension. Therefore, this research serves as a foundational example of blending perspectives to address complex problems and promotes prospective interdisciplinary research utilizing QCA.

Practical Contributions

This research provides meaningful implications for firms, as well as governmental and non-governmental organizations in laying the foundation for all parties to improve upon their strategies to detect and ultimately protect against IWT. Collectively, this research illuminates that measures of interest should be considered differently based on the species use and location of operation, which influence the detectability of an illicit wildlife supply chain based on varying levels of conditions: (1) transportation, (2) product, and (3) stakeholder awareness.

In consideration of transportation related factors, organizations that rely upon certain transportation modes to conduct their business or whose business is primarily centered on logistics should understand the risk which IWT poses to their operations. Firms could do this by

first considering the native species and methods of transport which are routinely traded in their location of operations. For instance, in more temperate or tropical climates, primates, birds, and reptiles are routinely transported live to be sold as pets (Interviewee 19, personal communication, July 27, 2023; Interviewees 21 and 22, personal communication, August 3, 2023). Acknowledging that live transport of wildlife requires certain speed and temperature constraints (Lambooy 1988), firms who similarly require expedited shipping times and temperature-controlled environments (e.g., pharmaceuticals) could heed caution in coordinating their shipments to avoid the potential for supply chain infiltration in these contexts. Governments and NGOs which are engaged in IWT interdiction efforts should similarly take into consideration transportation related factors. For instance, law enforcement officials could modify their searches to target packages which are routinely shipped short durations along the same route, or which are shipped at suspicious times of day, such as reptiles which are regularly shipped at night to capitalize on the cooler temperatures and lesser staffed air and seaports (Interviewee 4, personal communication, June 7, 2023).

In addition to considering the mode and route factors of transportation, it is similarly pertinent to examine product related factors, such as the ways in which wildlife are concealed in IWT. Although affected industries and products vary broadly, firms should independently consider whether IWT has the potential to pose a substantial risk to their operations and affect the product which they manufacture or distribute. Specifically, heavily processed products, such as powdered items are subject to a higher risk of supply chain infiltration by IWT. For instance, pangolin scales and rhino horns often undergo extensive processing by being dried and crushed into a powdered form before being concealed in baby formula/powder bottle packaging (Interviewee 4, personal communication, June 7, 2023). Alternatively, wildlife products which

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are shipped whole can be concealed in larger products, such as hiding elephant tusks in lumber (Interviewee 12, personal communication, July 14, 2023). In these scenarios, firms operating in higher risk industries or products (e.g., powdered products, supplements, lumber) should consider paying greater attention to more thoroughly testing products throughout the supply chain to minimize the potential safety risk to consumers as well as conducting auditing or bolstering supervision efforts to identify the location at which their supply chain was infiltrated.

In addition to physical concealment strategies, traffickers can employ false documentation as a means of concealment, particularly in the pet trade industries where illegal wildlife are often transported alongside legal wildlife (Shepherd et al. 2007). Thus, this research highlights this connection and emphasizes the need for firms operating in pet industries to be more diligent in establishing high supply chain visibility to ensure illicitly acquired wildlife do not infiltrate their supply chains. However, these product related contributions are not only applicable to firms, as governments and enforcement officials could similarly target these and other products or industries which have been previously identified as higher risk or historically leveraged as a type of concealment strategy to improve the success of their interdiction efforts.

Aligning with identified concealment strategies, this research highlights the need for stakeholder awareness along supply chain networks via communication and collaboration across firms, NGOs, and governments on a global scale. As concealment methods are typically used for the same species along the supply chain, (e.g. using lumber to hide elephant tusks) it is pertinent for governmental officials that seize IWT products to communicate to officials up and downstream in the supply chain. Officials can thus be aware of products used as part of a concealment strategy and better direct their search efforts. NGOs and firms, who use different technologies and tactics to identify IWT, should similarly communicate with governments to

efficiently provide insights for governments to refine their detection tactics and more effectively interdict IWT as a whole. In addition to identifying advancements and innovative techniques for concealing wildlife, the employment of false documentation highlights the necessity for enforcement officials to enhance their abilities to decipher between illegal and legal species. In scenarios where species are listed as Appendix II by CITES, or are otherwise permitted to be captive bred, this warrants further examination to ensure the legality of the species. In addition to enforcement awareness, consumer awareness of species legality and endangerment is particularly vital. This research emphasizes the need to employ awareness campaigns, which have been proven to be historically successful in reducing demand (ICE 2024; Rosen & Smith 2010). Moreover, enhancing consumer awareness can also aid firms in their endeavors to uphold consumer safety. If firms are able to provide an additional avenue for IWT education in which they inform consumers of potentially suspicious symptoms of IWT in their products, they could consequently prevent consumers from being exposed to IWT. Moreover, firms could request to receive detailed feedback from consumers, which could aid their efforts in identifying nodes in their supply chain which are currently or have an elevated potential to experience infiltration by IWT.

3.7 LIMITATIONS AND FUTURE RESEARCH

Although this research employs a novel methodology to yield theoretical and practical contributions to the supply chain discipline, the limitations should also be considered. Foremost, the context of this study was limited to examining the detectability of IWT. However, there are underlying similarities across different forms of illicit trade, such as the motivations of actors and strategies to conceal the activities or products. Accordingly, there is an opportunity to extend this research to the illicit trade of counterfeits or the trafficking of drugs, humans, or arms in

effort to extract similarities or differences and establish a comprehensive understanding of illicit supply chains. Recognizing the variance in perceived importance and intensity of regulation of IWT on a global scale, future research could apply this to the context of drug trafficking, where there is a permissiveness over certain types of uses of drugs (e.g., medical and recreational marijuana). Alternatively, researchers could consider the contexts of counterfeits and varying tolerance of intellectual property rights infringement to explore the conditions which contribute to the detectability of counterfeit products and/or supply chains.

Related to geographic distinctions, my study was limited to the origin point and nodes further upstream in the supply chain due to my participants' expertise and the setting of in-person interviews. Acknowledging that the entirety of in-person interviews were conducted across Africa (i.e., South Africa, Zambia, Botswana, Kenya, Uganda, and Rwanda), which is where highly poached species inhabit, the participants were more knowledgeable about these species. However, given the global nature of illicit supply chains along with the notion that more shipments are searched upon import rather than export (World Customs Organization 2013), it is pertinent to broaden this research to other geographic regions which would yield insights downstream in the supply chain. As many illicit wildlife supply chains originating in Africa ultimately cease in Asia (TRAFFIC 2024), it would be worthwhile to connect with wildlife trade experts located in these geographic areas.

Moreover, while I endeavored to include a diverse set of participants across academia, government, and non-profit organizations, there is a dearth of involvement from industry professionals. However, in all instances, practitioners reported a lack of insights or monitoring of IWT infiltration or declined to participate. In either case, IWT can inflict substantial damage to businesses across industries and sectors (Duensing et al. 2023; Hilend et al. 2023). Hence,

extending this study to for-profit organizations could yield meaningful insights which could

transverse industries.

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APPENDIX

A. Interview Guide

Hello, my name is Rowan Hilend, and I am a logistics PhD student at Michigan State University. I interested in learning more about the flow of wildlife throughout the entire supply chain (i.e., from the species' native habitat to the end customer). Today, we would like to talk with you about your understanding of illegal wildlife trade and how your role relates to the practice.

Your participation in the study will help my research team and I to better understand illegal wildlife trade and how wildlife are transported globally. There are no right or wrong answers to these questions.

Results from this study will be summarized in a journal article. To make sure we report correct details, we request to audio record this interview. However, we want to be clear that your answers will remain completely confidential and under your control throughout the entire process. Your interview recording will be assigned and titled an identifying number. Additionally, transcription, notes, and any other related materials will be assigned a matching identification number and all other identifying information will be removed.

However, you may choose not to participate in the interview at any time. You may also choose not to answer a particular question of the interview. You may also choose to pause or stop the recording. If you do not understand the questions, please ask and I will be happy to explain the question in greater detail. The entire interview should take about 60-90 minutes. Do you have any questions before we get started?

If you have any other questions after our interview, please feel free to contact me at hilendro@msu.edu or Whatsapp/mobile at +1-925-949-9632.

*Note: Interviews take place via audio interview. The sampling method is snowball or convenience sampling. If discussions are recorded, it is for transcription purposes only. Various roles are expected: hunter, trafficker, NGO, enforcement. Not all questions apply to each role.

INTERVIEW QUESTIONS

The following questions focus on learning more about your current employment as it relates to illegal wildlife trade. By illegal wildlife trade, I mean the illegal trade in wild plants and animals which includes an illicit supply chain over source, transit, and destination geographies.

Role-related Questions

1) How did you originally get involved in [role]? What originally interested you about [role]?

2) What does your average day look like as a [role]?

3) What training did you undergo for [role]? Did you need to receive any certifications or licensure for [role]?

4) As a [role], what types of technologies do you typically use? Are there any specific apps or software that you use? For what purposes do you use [technology]?

5) What challenges do you currently face in your work related to (intercepting) the illegal trade of [species]? How do these challenges compare to challenges you have faced in the past?

6) In your role, are you focused on one or more specific species of wildlife? If so, what is the most important species of wildlife or collection of wildlife?

[SKIP IF NOT SPECIES EXPERTS]

Let's talk a bit more about your work with [species]. The following questions focus on learning more about how [species] is obtained, transported, and sold. As supply chain researchers/logisticians, we are especially interested in the acquiring, processing, and movement of [species]. By processing, we mean the changing of [species], whether it is cared for, if live, or how it is cooked, smoked, dried, powdered, or otherwise preserved, if dead.

Let's first begin with questions related to where [species] is found.

Species Related Questions
7) In what kind of environments do [species] live? Is this environment specific to a limited geographic area?

8) Are there known areas where poaching of [species] is concentrated? If so, where are these areas?

9) How are [species] *found* in their natural environment? Are specific strategies or technologies used to find [species]?

10) How are [species] *obtained or captured* in their natural environment? Are specific strategies or technologies used to capture or obtain [species]?

11) How large are [species]? How does the size of [species] impact the difficulty of finding and capturing [species]? How does the size of [species] impact the difficult of transporting and concealing [species]?

12) What challenges do you currently face in your work related to the *discovery* of [species]? By *discovery*, I mean finding [species] in their natural habitat. What challenges have you faced in the past?

Now, let's discuss how [species] is transported.

Transport Related Questions
13) What mode(s) of transportation are used to transport [species] after they are captured? By modes of transportation, I mean by parcel/shipment, boat, airplane, motorbike, bicycle, donkeys, or other pack animals, or perhaps another method.

14) Why is this mode of transportation used? Does this mode of transportation help to hide wildlife? If so, how is wildlife hidden in this mode of transportation?

15) Has the mode of transportation changed from the past to now? If so, how?

16) What route(s) are used to transport [species]? What is the starting point of this route? What is the ending point of this route? How far is [species] typically transported?

17) When transporting [species], what stops or checkpoints are made along the way? By stops or checkpoints, we mean any set points on the route which you plan to travel through each time.

18) How do these stops or checkpoints make transporting [species] more or less difficult? Does it make it more or less likely to be detected by authorities?

19) Is [species] typically transported with other products?

[SKIP TO PROCESSING QUESTIONS IF "NO."]

20) Why is [species] transported with these products?

21) Are these products used to hide [species]? If so, how is [species] hidden by these products?

22) At what point is [species] combined with these products? When I ask about the "point," I'm wondering if this might be at a certain point along the route.

23) How does concealing [species] with [products] change the difficulty of detecting [species]?

24) Is [species] ever transported with different forms of products? *Repeat prior 3 questions if yes*
    Finally, let's talk more about how [species] is sold and used by buyers.

Processing Related Questions
25) Where is [species] purchased (by middle men)? Where is [species] sold (to end consumer)?

26) Are there middlemen in the value chain? For example, this could include people who process or store [species]. How many middlemen are there?

27) What form is [species] sold in? By "form," I mean is [species] usually sold when it's alive or dead?

28) If alive, how long can [species] remain in captivity? How does this impact the difficulty to transport [species]?

29) What type of processing does [species] undergo before being sold? Again, by "processing," I mean the caring for [species], if alive, or how it is cooked, smoked, dried, powdered, or otherwise preserved, if dead.

30) How does the [species] form change its ability to be transported? Does this make it easier, more difficult, or not impact the ability to conceal [species]?

31) How do buyers use or consume [species]? Are there additional processing steps that the buyer needs to do before using [species]?

The following questions will be more specific to buyers and related demand for [species].

Buyer Related Questions
32) Who are the typical buyers of [species]? Where are these buyers in the value chain? For what purpose(s) do these buyers use [species] for?

33) What other purposes can [species] be used for?

34) How familiar do you feel the average buyer is with the *legal* status of [species]?

35) How familiar do you feel the average buyer is with the *endangerment* status of [species]? How familiar do you feel the average buyer is familiar with the product they're consuming?

36) How do these most important buyers come to learn about [species]? How do these buyers go about purchasing [species]?

37) If these buyers cannot purchase [species], what alternative products are available? Which alternatives are considered the most popular?

38) How does demand for [species] compare to alternative products? How does demand for [species] compare to other species?

39) How has *demand* from buyers changed over the years? Has demand increased, decreased, or remained about the same? Is it from one geographic area or multiple? How has demand for alternatives changed?

Governance Related Questions
40) How would you rate the strictness of the laws on wildlife trafficking in your region? How do these compare to neighboring countries or cities?

41) Are these laws stricter for certain species? If so, for which species in particular? How are the laws different for [species]?

42) How would you rate the effectiveness of the laws on wildlife trafficking in your region? How do these compare to neighboring countries or cities?

43) Are [species] which are trafficked in [region with stricter/less strict] more often prosecuted by law enforcement?

Detection Related Questions

44) How detectable is the supply chain for [species]? Are [species] which are trafficked in [region with stricter/less strict] more often detected by law enforcement?

45) Are most of the people in the supply chain for [species] caught? Are certain supply chain actors caught more often than others?

46) How many poachers/traffickers are there in this supply chain? How many do you think are caught?

[SKIP IF NOT CONVICTED TRAFFICKER]
Now, if you feel comfortable, I would like to learn a bit more about the events related to your encounter with law enforcement. As a reminder, as supply chain researchers, we are interested in this component of the experience and anything you share with us will remain confidential/anonymous.

[RESUME HERE]
Now that we're getting close to the end of our interview, I'd like to learn more about what you'd like to share with others.

Public Perceptions/Next Steps

47) What do you wish were different about public perceptions regarding the trade of [species]?

48) What do you wish were different about public perceptions regarding the trade of wildlife products as a whole?

To finish up, I just have a few quick questions about yourself.

49) What is your country of origin?

50) What year were you born?