A MATTER OF MINDS: ENVIRONMENTS, TRUST, AND CIVIL WAR

by

JOSHUA AARON DIX

(Under the Direction of Jeffrey Berejikian)

ABSTRACT

Trust is the universal human force that ties individuals together and interweaves them into groups, communities, and nations. When trust breaks down, these ties unravel, and conflict is likely, as the agency necessary to peacefully solve complex collective action problems is absent. Within the intrastate conflict literature, trust is often left out—that is, it is often assumed that the existence of conflict implies the absence of trust. This assumption may be faulty on multiple levels, because in the first instance what it does not do is consider why there is an absence of trust, and ultimately it conflates two different concepts–one being distrust and the other being a deficit in the ability to trust. The former concept, distrust, may be perfectly logical and based on a rational decision resulting from an adversary's actions. The latter concept, a deficit in the ability to trust is very different, and that is the subject of this dissertation. Research in neuroscience suggests that the biological mechanism that enables trust depends on the neurohormone oxytocin. Building on research in the neuro- and nutrition sciences, this dissertation describes a set of environmental conditions that hinder the production of oxytocin (the trust hormone), and it argues that these conditions lead to biological trust deficits. A variable to measure these deficits has been created, and this variable is tested in the least likely

circumstance for trust to exist: intrastate conflicts (civil wars). This dissertation offers three articles. In the first article, the trust deficit variable is created, the science behind it is explained, and it is tested on existing trust data. In the second article, the trust deficit variable is tested on intrastate conflict onset and duration. In the third article, the variable is tested on intrastate conflict recurrence. The results indicate that countries scoring high on the trust deficit variable are more likely to have longer intrastate conflicts and experience intrastate conflict recurrence. It can be concluded from these results that an improvement in environment and nutrition will result in lower trust deficits and a lower likelihood of intrastate conflict.

INDEX WORDS: Civil wars, trust, nutrition, environments

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JOSHUA AARON DIX

Major Professor:	Jeffrey Berejikian
Committee:	Loch Johnson
	Andrew Owsiak
	Alex Anderson

Electronic Version Approved:

Julie Coffield
Interim Dean of the Graduate School
The University of Georgia
May 2015

DEDICATION

To Mom.

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CHAPTER 1

INTRODUCTION

Trust is not only the glue that holds societies together, but it also a lubricant, guiding societies through the difficulties of overcoming collective action problems. Trust fosters positive social interactions, interweaving individuals into groups and groups into the very fabric of society. Trust can be thinly defined as a willing extension of vulnerability in exchange for some expected benefit—either mutual or otherwise. At its core, however, trust is much more. It is a deeper individual feeling or collective understanding that the parties to a dialog will not ultimately be disadvantaged, even if it is within the immediate interests of one or all of parties involved to defect.

This project is centered on generalized trust, one of the key social science measures of trust. Generalized trust represents an overall sense of trust that extends beyond individuals who are known personally to the participants to those that are unknown—that is, it is a sense of trust for people that people have never met (Robert D Putnam, 1995b). Generalized trusters are more likely to engage, interact, and cooperate with strangers than personalized trusters, who require face-to-face interactions in order to trust other people (Marschall & Stolle, 2004). In general, the research seems to accept that people are inherently one or the other (Lewis & Weigert, 1985; Rotter, 1971). Scholars suggest a number of reasons for this: upbringing, institutional development, political culture, and identity ties (Hardin, 2001; Lewis & Weigert, 1985; Stolle, 2002; Eric M Uslaner, 2008). Still, an overarching problem exists in the literature on generalized trust, and that is if it is an innate individual trait, then the existing explanations are flawed as long

as there are people who are not generalized trusters who grew up in good homes, in countries with strong institutions, and in states with positive, political culture. Furthermore, explaining generalized trust as an innate characteristic, by definition, implies that there is some biological variable contributing to this phenomenon, but while the social science research to date has assumed the validity of this factor it has failed to determine if the biological science supports it.

This project builds upon existing research in neuroscience, nutrition, and the social sciences to explain that generalized trust is, at its foundation, neurohormonally based, and that in conditions in which the very nutrients necessary for the synthesis and uptake of oxytocin (the trust hormone) are low, generalized trust deficits occur. In other words, generalized trust is not an innate trait, but a characteristic contingent on a set of biological components that can be directly influenced by social policy intervention.

This theory is explored in the least likely circumstance for trust to exist, intranational conflict, specifically focusing on the role of trust in these civil wars and their aftermaths. The current research on these wars contends that greed, grievances, conditions for insurgency, opportunity, and the lack of non-violent alternatives cause civil wars, as well as determine their lengths and recidivism rates (Collier, 2000; Doyle & Sambanis, 2000; Fearon & Laitin, 2003a; Gurr, 1970; Horowitz, 1985; Shils, 1957; Yilmaz, 2009). These factors, while substantial, do not completely explain or predict civil war onset, duration, and resurgence.

This dissertation offers an explanation of the effects of biologically induced trust deficits on civil wars. Research in neuroscience demonstrates that trust is an automatic response, occurring as a result of the neurohormone oxytocin interacting with the brain (Kosfeld, Heinrichs, Zak, Fischbacher, & Fehr, 2005; Parker, 2014; P. J. Zak, 2005b). Research in the nutrition sciences finds that vitamin C is required to synthesize oxytocin, and plant-based

estrogens are responsible for oxytocin uptake in the brain (Naidu, 2003; Paul J Zak & Fakhar, 2006). Finally, research in both the social sciences and environmental chemistry demonstrate that pollution hinders oxytocin production (Grimes, 2003; H. Johnson & Vanjonack, 1976; Paul J Zak & Fakhar, 2006). This project tests whether areas of the world with environments less conducive to oxytocin synthesis and uptake are less trusting and therefore more likely to pursue civil wars, more likely to have longer civil wars, and more likely to see increased civil war recidivism after the initial conflict officially ends. Within this context, the existence of conflict does not necessarily demonstrate the absence of the capability to trust. However, in those states that have an environment that hinders neurohormonal development, there is a demonstrable absence of the capability to trust. It is within those states that the greatest trust deficits occur, and, as a result, the corrosive effect of low trust contributes to longer civil wars and civil war recurrence.

This project consists of three major empirical sections (articles that will ultimately exist as stand-alone articles). Chapter 3 asks what biological factors affect generalized trust. It examines the relationship between nutrients (vitamin C and phytoestrogens), pollution (artificial xenoestrogens), and trust. It uses Food Balance sheets from the United Nations Food and Agriculture Organization to determine the per capita intake of the aforementioned nutrients and the World Bank's Development Indicators to determine xenoestrogen levels per country year. Through factor analysis, a new variable indicating trust potential by country year is developed. World Values Survey data are used to determine generalized trust. The environmental factors are then tested against control variables commonly attributed to creating trust. The findings indicated that the environmental factors are statistically significant and positively correlated to trust. A substantial research review is provided before performing the statistical analyses that

demonstrates much of the social science trust literature focuses on group-level behavioral patterns. The gap in the social science research is the human element—the actual biological processes (microfoundations) that determine how people create and interpret trust feelings.

Chapter 4 asks what hidden factors affect civil war onset and duration. It takes the nutrition-trust relationship and tests it on civil war onset and duration. Current research suggests that grievances, greed, opportunity, conditions fostering insurgency, and the nonexistence of non-violent alternatives for change all contribute to civil war onset and longer civil wars. The existing research also focuses on the obvious lack of trust that exists between warring parties or between parties and the government and its effects leading towards disorder and violence (Keele, 2007; Kumlin, 2002; Letki, 2006; Nye, 1997; Nye, Zelikow, & King, 1997; Offe, 1999; B. Rothstein & D. Stolle, 2008; Stojek, 2010; L. R. Weber & Carter, 2003).

While these factors are by no means irrelevant, this article suggests that many states that ultimately see civil wars do so because of the lack of trust potential that inherently exists within them because of malnutrition. When sub-par nutrition levels exist, the factors that current social science research suggests are supposed to foster generalized trust and social capital fail to do so because the individuals comprising the state populations have diminished trusting capacity. Lacking such capacity, trust across factions breaks down. Accordingly, the protections that are (or should be) in place to thwart civil wars fall apart because without a society capable of maintaining those protections, they fall into nonexistence.

Logistic regression analysis is used to determine civil war onset. An Accelerated Failure Time model is used to determine duration. This study finds a negative correlation between trust potential and civil war durations—that is, as trust potential increases, civil war duration decreases. Likewise, when trust potential decreases, civil war duration increases.

Chapter 5 asks what hidden factors lead to civil war recurrence. It builds on the second article and focuses on civil war recidivism. Research in post-civil war outcomes cites a number of causes for post-civil war recurrence. If the war is classified as an identity conflict (relating to ethnic, nationalist, or religious groups), then the research suggests higher rates of civil war recurrence after the initial conflict finishes (Kalyvas, 2003; Toft, 2003). The research also focuses on the winners of the conflicts and suggests that rebel and military victories are less likely to see civil war recurrence than government and non-military wins (Cederman, Wimmer, & Min, 2010; Nilsson, 2008). A lack of civil war recurrence has also been linked to third-party negotiations (David Mason, Gurses, Brandt, & Michael Quinn, 2011; Hartzell, Hoddie, & Rothchild, 2001; Kalyvas, 2000; Licklider, 1995). As seen in the other articles, these explanations for war recurrence are good, and they do explain many events. There are, however, too many outliers to ignore the potential that other unexplored factors are at play.

The theory suggested here is tested against civil war data between 1961 and 2008. Given that this theory suggests higher trust potential scores drive down the likelihood of civil war recurrence, a number of interaction variables are created and run with these regressions. The dependent variables in this study are whether or not the civil war saw no recurrence of war after the 2-year and 10-year marks (Warend2 & Warend10). The findings indicated that while identity type itself does lead to a higher likelihood of civil war recurrence, the interaction variable between trust potential and war identity type is negatively correlated with recurrence. That is, identity civil wars with high trust potentials are far more unlikely to see civil war recurrence than identity wars alone. A similar relationship exists between conflicts that end with third-party negotiations; civil wars in states with higher trust potentials that end in third-party negotiations are far less likely to see civil war recurrence.

This project is presented in four additional Chapters. Following this Introduction, Chapter 2 contains the literature review. Chapter 3 starts the article series. The third chapter provides an introduction to both the social science literature, as well as the neuroscience literature, nutrition literature, and analysis. Chapter 4 contains the second empirical article, which is the first application of the theory to civil wars: onset modeling, duration modeling and analysis. Chapter 5 contains the third article, an analysis of the suggested theory tested on civil war recidivism. Finally, Chapter 6 offers a conclusion, a course for future research, and policy implications and suggestions.

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CHAPTER 2

LITERATURE REVIEW

This dissertation takes an atypical approach to the understanding, explanation, and prediction of intrastate conflict events by pulling together established research on human interaction and trust, not only from the social and cognitive sciences (within which political science typically finds its comfort zone), but also (and less typically) from nutrition science, neuroscience, and biochemistry. It offers a biological understanding of trust in the social sciences. When state populations consume specific nutrients at low levels and ingest specific pollutants at high levels, they enter a space in which the environment affects trust. Within this space, states behave differently because of the biological impacts their environments have on their populations' ability to trust. The dissertation finds that states that occupy this environmentally poor space have predictable behavior patterns because micro-level environmental constraints hinder the development of trusting responses. These states, because of their specific environments, are more prone to conflict and will see longer civil wars than those states without such properties.

Provided here is a substantial literature review on the topics covered in this dissertation from the various disciplines involved. The first section of this literature review discusses the current understandings and previous findings regarding civil wars, civil war onset, civil war duration, and when civil wars are most likely to relapse once they have completed. The second section discusses trust and its microfoundations within the social sciences. The third, and final

section, offers a description of trust and its foundations from a biological perspective in the hard sciences discipline.

Intranational Conflicts: Onset, Duration & Relapse

Research on intranational conflicts focuses on the motivations and social conditions for when and where intrastate conflicts are most likely to occur. Interstate conflicts are generally classified as wars or violent hostilities between regions or factions within a single country. Intrastate conflicts can exist from the levels of minor, violent protests to major civil wars, and they can be caused by grievances on any level of society, from individual groups to government elites (Sambanis, 2004).

One of the major differences between civil wars and interstate wars is violence against civilians: in interstate wars, attacks on civilians are generally off limits; the same cannot be said for civil wars. Another difference is that during civil wars and repeated conflicts, violence is usually perpetrated by neighbors against neighbors; in many of these conflicts, the sides know each other. Civil wars are generally carried out in order to be the winning party; they establish policy by force and without input from other groups. Civil war violence is not random, but directed at achieving a set of particular goals by rebel leaders. They are battles aimed at winning sovereignty. While leaders may or may not have ulterior motives of their own that are not in line with the ideology of their cause, in order to properly offer a challenge to the state, they must be able to mobilize and recruit members to be the costs of the war (Kalyvas et al., 2006). In this regard, in order for civil wars to recur, there must be opportunity, as frustration and anger alone are not enough to mobilize people to fight (Fearon & Laitin, 2003a; Gurr, 1970).

In our modern times, intrastate conflicts occur far more often than wars between states (Collier & Hoeffler, 2004). What determines their onset? As mentioned above, there is much research within the field of international relations and comparative politics that says when ethnic tensions rise or reach some culminating level, strong rhetoric turns into violent protests, and eventually civil war. After the collapse of the Soviet Union, scholars focused on nationalism and ethnic/cultural grievances as the cause of intrastate conflicts (Connor, 1994; Huntington, 1996; Muller & Weede, 1990).

With the newly established states came a swath of political violence, as cultural, ethnic, and national factions clashed with and among each other. After their independence, many of these states had weak governments that could not or would not provide national security. With the state in this weakened position, formerly out-group factions had the opportunity to openly air their grievances in the public square and act on them. Tajikistan saw a civil war beginning in 1992 when ethnic factions from the Gorno-Badakhshan and Garm regions rose up because they were underrepresented within the state apparatus. Georgia saw intergroup grievances and violent intrastate conflicts in the early 1990s, which ultimately led to de facto independence for Abkhazia. In Moldova, Russian nationalists rose up against the state, ultimately carving out the eastern-most region of the state in the War of Transnistria as a separatist entity.

Donald Horowitz's work on ethnic groups and conflict demonstrates that countries with strong ethnic homo- and heterogeneity are less likely to see the more extreme violent conflicts. Ethnically homogenous states are less likely to see violence because minorities often do not have the strength to garner forces against the state and their grievances—if they exist—stagnate. In ethnically heterogeneous societies, there is competition between ethnic groups, and, in many cases, faction populations must cooperate in order for the state to function. Horowitz argues that

where violence is most likely to occur is in those countries with one strong ethnic majority and a sizable ethnic minority. In this case, in order to maintain its position of power within the state apparatus, in-groups may take steps to limit out-group representation in the ruling elite and prohibit out-group members' populations from meaningful individual political participation (1985). Cederman, Wimmer, and Min challenge these claims, arguing that it is really ethnonationalist claims on state power that act as the catalyst for intrastate conflicts in the modern era (2010).

Overall, current international politics theories on these types of conflicts can be reduced to four different causes: greed, grievances, capability for violence, and the lack of nonviolent alternatives for resolution. Scholars note that there are multiple paths to war, and researchers in the field must take all variables that may lead to war into consideration. As such, studies on civil wars usually control for a number of other possible variables: dispersion of populations; density of populations; ethnic, linguistic, and religious diversity; regional effects; types of neighborhoods; internal geography; availability of water and food; literacy rate; development; labor; trade; sanctions; conflict history; years at peace; state age; regime type; and polity. It is important to take all these factors into consideration in order to determine the existence of interaction effects, omitted variables, and bias. Still, even with these four causes and the many controls, the field of conflict studies is far from reaching a consensus on what starts civil wars or determines, for certainty, how long they will last (Dixon, 2009).

Greed has been a driving source for the quest of power since human beings first took up arms against each other. The selfish desire for power and wealth–to share in or take natural resources and wealth by one or more populations or entities—drives intrastate conflicts as well as international wars (Collier, 2000; Collier & Hoeffler, 2004; Mason, 1996). The international

affairs literature shows that not all intrastate conflicts are specifically driven by ethnic or ideological causes. A number of these conflicts can be explained through economics and utility theories. Collier and Hoeffler explain that rebels will often partake in civil wars when they believe that the costs of cooperating are outweighed by the benefits that rebellion brings (1998)—that is, they will pursue violent action when they believe they can get better results than remaining peaceful. They point to other research and note that while ethnic fractionalization and population size are strong determinants of conflict onset and duration, natural resources and income are also extraordinarily telling and significant predictors as well. For example, as drugs and diamonds can be produced and distributed easily, they can be easy targets for insurgent groups or militias, looking to increase their share in power and wealth (Collier, 2003). Factions within a nation may also provoke intrastate conflicts. In these cases, the end goal is often that one group monopolizes the entire wealth of the natural resources within the state (Collier, 2000).

In addition to greed and grievances as root motivations for intrastate conflicts, the literature points to the capability (actual ability or perceived ability) of non-state actors to inflict mass violence upon other demographic groups as causes of these conflicts (Collier, Hoeffler, & Rohner, 2009). Fearon and Laitin challenge current theories of intrastate conflicts, stating that institutional weakness results in intrastate conflicts (2003a). The authors note that while insurgency may be common in cases of ethnic nationalism, a demonstration of guerilla war does not imply ethnic nationalist causes of war—that is, the existence of a certain tactic generally associated with ethnic conflicts does not mean that we can assume that the use of the tactic means the causes of these wars are ethnically based. Instead of looking at religious and ethnic factors as causes of intrastate conflict, Fearon and Laitin suggest that we should look for specific environmental conditions that favor guerilla warfare (2003a).

The authors find that insurgency is most commonly found in militarily weak states because the practice can be used in order to propagate whatever agenda the applicable faction has in mind, regardless of its territorial location or its political or religious perspective. In addition to military weakness on the state level, the authors also find that instability, poverty, and large populations also contribute to the risk for civil war, and these factors provide a far better explanation than do the prevailing ideas that inequality, lack of civil rights and liberties, and minority-faction discrimination. Finally, the authors note that terrain matters. In states with mountainous areas or higher ground, civil wars are more likely to occur, as insurgents have places to hide, away from the eye of state officials. The authors argue that in order to thwart the perpetual cycle of insurgent practices, international organizations (Ios), non-governmental organizations (NGOs), and international governmental aid programs aim their efforts at helping countries stabilize and bring their populations out of poverty (Fearon & Laitin, 2003a).

In addition to Fearon and Laitin's model, the Collier-Hoeffler Model of Civil War Onset (CH model) looks at a number of variables known to be in association with these types of conflicts, controlling for a number of other variables: GDP per capita (with growth), diaspora of ethnic group, male level of education, the existence of a previous war, duration of peace if it existed, percentage of mountainous terrain, ethnic and religious fractionalization and polarization, ethnic dominance, income and land inequality, and democracy. Collier & Hoeffler find that conditions that favor rebellion are most likely to lead to conflicts. As in the Fearon and Laitin model, when minority groups are able to finance rebellions and make them feasible, the CH model tells us that conflicts are more likely to occur. Also, as male secondary education decreases, conflicts are more likely to occur. Finally and counter to the age-old adage that "time

heals," the CH model demonstrates that intrastate conflicts involving states with large diasporas tends to slow down the healing process (Collier, 2005).

The literature points to intrastate war as a means of last resort. Research illustrates that conflict onset is most likely to occur as ethnic group representatives' exclusion from political office increases, when the ability to mobilize increases, and with previous conflict experience. Underrepresentation, exclusion from state government services, and the inability to utilize the governmental apparatus for solving collective action problems thus leads to challenges of the regime through violent means as a last resort (Cederman et al., 2010). Where state institutions are weak, insurgencies are often most effective, as they [the state governments] cannot garner successful counterinsurgencies because of their own internal disorganization. As such, insurgencies are often pursued because poor state counter-insurgencies often result in the deaths of countless innocent civilians, leading the insurgents to believe they can quickly win over nonparticipants and thus overthrow the incumbent regime (Fearon & Laitin, 2003a).

What determines how long intrastate conflicts will last and when they will end? Arguably, the primary condition for the continuation of civil wars is the obliteration of trust between population groups and/or the state. As mentioned previously, duration may be affected by the capability for violence of the individual groups within states (Fearon & Laitin, 2003a). Collier, Hoeffler, and Söderbom suggest that both systemic conditions existing prior to and during conflicts determine how long they go on (2004). Shorter conflicts are those in which military intervention comes from other states or non-state actors (NSAs), on behalf of those taking part in the rebellion.[1] The authors note that high inequality, low income, and medium ethnic fractionalization are associated with longer conflicts; these same variables are associated

[1] Outside help from other states or non-state actors may change the classification of the conflict.

with low levels of social trust (Kawachi, Kennedy, Lochner, & Prothrow-Stith, 1997; Leigh, 2006).

Generally, there is not a conclusive date or time that conflicts end; rather, they are muddy (Kreutz, 2010). Through the UCDP Conflict Termination dataset project, Kreutz demonstrates that conflicts are more likely to end when governments win or with the deployments of peacemakers. Kreutz notes, however, that a previous conflict that had been fought with rebels who sought government control or combatants who were ethnically mobilized led to higher risks of recurrences of violence (2010).

While there are many ways to classify different intranational conflicts, many scholars divide intranational conflict by identity or non-identity wars (Fearon & Laitin, 2003a; Sambanis, 2001). Identity wars are those in which the warring sides are divided by demographic-based grievance: ethnicity, religion, or nationality issue. Non-identity wars are those driven by reasons such as economics, income inequality, or resource redistribution. Where the first conflict included fighting over identity issues, future war is more likely (Toft, 2003).

In the scholarship concerning civil war onset, fractionalization—the likelihood that any two random people chosen in a population will come from different demographic groups—is the key variable. It is used to explain the first instance of war within a state (Collier & Sambanis, 2005; Sambanis, 2001). In the civil war recurrence scholarship, a different measure is used: demographic dominance (sometimes called "multiethnicity" or "polarization"). This variable is different from fractionalization because it takes into consideration the size of the largest identity group within a specific demographic (ethnic, religious, etc), the number of large ethnicity groups, and the population size of the second largest identity demographic (Ellingsen, 2000). Where demographic groups dominate minority factions, recurrence is greater, as rebellion is

more common for minorities when they feel subjugated. In other words, the more heterogeneous a society is after a civil war takes place, the more likely relapse is because aggrieved rebels are better able to form a cohesive group than in more fractionalized populations (Collier & Sambanis, 2005).

Interestingly, it is not the size of the minority that portends civil war, but the size of the majority that seems to matter more: groups with less than 80% of the entire population are more likely to see violence from civil war than those state majorities with more than 80% of the total population (Ellingsen, 2000). Risks of recurrence increase with larger population sizes, as groups that are more likely to fight may live in the country—that is, a higher population means a higher probability of violent actors within the population (Collier & Hoeffler, 1998; Gleditsch, 2007). The research points to the relationship being proportional.

The time that the civil war took place matters as well. Civil wars that took place during the Cold War are less likely to have established durable peace, while civil wars that finished after the Cold War ended, have generally seen less civil war recurrence over time (Hartzell et al., 2001). The length of the initial civil war matters as well; shorter wars are more likely to relapse, while longer wars are not (Hartzell et al., 2001). In addition, the farther in time after a civil war completes, the less likely it will relapse into another conflict. The reasoning for this is that as time passes, the opportunity costs to return to conflict are expensive, and old hatreds are more likely not to be major issues any longer (Collier & Sambanis, 2005).

Civil wars result in mass casualties, but ethnic or identity civil wars are especially violent and often lead to genocide (C. Kaufmann, 1996). We can use theory from international relations to explain how the security dilemma affects ethnic civil wars (Sambanis, 2000). The security dilemma occurs when two or more groups find themselves in conflict, and one (or both) groups

believe itself (themselves) to be less secure relative to the other (others) (Jervis, 1978). While the two groups may not desire or intend to go to war with each other or favor a deterioration of relations, any buildup of arms or attempts to be more diplomatically or militarily secure is interpreted by the others as threatening.

Each misunderstanding of the security buildups is seen by the other groups as a provocation, and they pursue military buildup as well. With each step of the process comes more conflict escalation, eventually resulting in violence between groups. In the wake of civil wars due to ethnic reasons, states emerging from the war in weakened capacities that have difficulties providing adequate support for all identity groups may see civil war relapse. We can see the security dilemma at play here. Ethnic groups face other ethnic groups that they cannot trust, and their actions towards securing themselves are perceived as threats by the other ethnic groups (C. Kaufmann, 1996; Posen, 1993). When the war does eventually begin again, members of all ethnic groups must join the war effort because they can be easily identified as enemies, if they are from different ethnic groups.

Charles Tilly coined the term "multiple sovereignty," which is a set of structural conditions that enabled civil wars to occur (Tilly, 1978). Peace fails after conflicts because unsatisfied factions are able to mobilize armed challenges to the regime in power after the conflict. These groups can be new rebels, old but dormant rebels who may have hidden within the general population to escape capture, or some combination of the two. Mason, Gurses, Brandt, & Quinn demonstrate that the outcome of the initial civil war determines the degree to which multiple sovereignty is maintained—that is, civil war recurrence depends on the ability of rebel groups to challenge the status quo, which itself is dependent upon whether the initial conflict's conclusion was brought about by a rebel or government win or via a third-party-

negotiated settlement (2011). The authors note that victories by military groups (be they state or rebel) destroys and depletes the losing group's infrastructure and mobilization capabilities. This makes reorganizing post-conflict extraordinarily difficult because groups will lack material resources and have a difficult time recruiting others to the cause (Licklider, 1995; Wagner, 1993).

Post-conflict conditions for war are more likely to exist and civil wars are more likely to reoccur if rebel groups win the wars but are unable to maintain their power. In other words, if rebel groups won the civil war and are able to maintain the regime and have the capacity to provide governmental services for the population, repeat civil war is unlikely (David Mason et al., 2011). The logic here is that when rebels win, they topple governments and sideline its leadership. If they can survive long enough to gain legitimacy then peace can be durable. While it may take time for rebel groups to reconstitute government and its institutions, they do have the ability to redistribute themselves to provide goods and services in lieu of the bureaucracy.

If the government wins the initial civil war, peace may not be as durable. The argument here is that when rebels believe they are going to lose, they can simply disappear into the general population and wait until they deem it safe to begin attacks again. To find rebel groups and prevent a future war, governments may follow a few paths: intimidation and repression of rebel-supporters and policy reforms aimed at winning the hearts and minds of former rebels and their supporters. Mason and Krane argue that the latter option is not often pursued because the, state's inability to control the distribution of its power, the lack of effective institutions, or the lack of political will to implement policy reforms to assuage out-group grievances was most likely a major contributor to the cause of the civil war in the first place (Mason & Krane, 1989). To put it differently, post-war regimes—if they are members of a differing group that existed in power

before the wars—are largely constrained by the same forces that the pre-war regime faced (Skocpol, 1976). Assuming the government does pursue a policy to root out and punish the rebel groups and their supporters, recurrent civil war is likely.

Similarly to rebel wins, civil wars concluded through negotiated settlements are also more likely to maintain the peace over time if they survive peacefully for a few years after agreements are signed (David Mason et al., 2011). Immediately following peace accords, credibility is a major issue, as both sides, because of reasons the wars were fought, may not trust each other to follow the agreed upon terms. If one or both sides do not trust each other enough not to defect or, worse, believes that the other side may defect without impunity, then the condition for civil war recurrence exists and is more likely. A caveat to this is that in most cases, where negotiated peace accords work to prevent future conflicts, the initial conflicts are generally identity based (Licklider, 1995).

Taking these studies together, it may appear that clear military victories are the best possible outcome to ensure a durable peace. While it does seem that military wins are less likely to lead to the chaos that brings more wars, Licklider demonstrates that military victories in identity wars are likely to be followed by genocide (1995). In these cases, third-parties face a dilemma: whether it is better to stop identity wars and prevent the deaths of many at the risk of future war or to allow the fighting at the risk of many deaths to prevent future wars. Licklider's research does show that in negotiated settlements, genocides do not occur.

In order to ensure durable peace, Hartzell, Hoddie, and Rothchild suggest a combination of solutions: peacekeeping forces, institutions that support power sharing, and the demobilization and disarmament of rebel militarized groups (2001). Peacekeeping hinders the civil war recurrence by acting as a trust apparatus so that sides cooperate and fear defection at lower rates.

Strong autocracies and democracies are less likely to see war recurrence, as they usually embody the capacity to carry out state policy (Hartzell et al., 2001). Weak regimes—those that have overall feebler governments or are in the process of transitioning to a new system of government—are more prone to conflict (Hegre, 2001). Additionally, weaker non-democratic regimes often see far more battle deaths than democratic regimes during civil wars (Lacina, 2006).

Institutions play a major role in preventing civil war recurrence. As such, states with weak or dysfunctional institutions unable to provide benefits within the country for the people are more likely to see relapses of civil war (Walter, 2011). In such states, governments do not have the capacity to ensure peace or win against rebel factions. When institutions function correctly and the root of state law comes from a constitution, civil war is far less likely to repeat. Research shows that most strong democracies have more effective institutions than weaker democracies (Anderson & Guillory, 1997; Przeworski, 2000). Furthermore, democratic states are more likely to pursue negotiated settlements after and pursue negotiated settlements to settle differences. We also know that democracies tend to be more trusting than non-democracies (Newton, 2001; Eric M Uslaner, 2003).

The conclusion of a civil war does not mean that there is no more violence or that the peace that exists is positive. While populations are no longer at risk of genocide and the broader civil war, they do face new threats: cohabitation with people from factions they may have been fighting against during the war, former militants, vigilantes, riots, and other violent criminals (Call & Stanley, 2001). The authors point to El Salvador and South Africa as examples of states where numbers of civilian casualties were worse after the civil wars concluded. In previous

sections, we have seen that negotiated settlements often prevent the recurrence of civil wars, but this idea is often challenged in the literature.

Given the sheer number of repeat international conflicts in the world, should the United States and other powerful countries continue to pursue peaceful solutions after multiple failures? If so, are there factors that aid in preventing the reigniting of civil wars that are overlooked, ignored, or undiscovered by the field of international affairs? If there are, how do they compare to currently employ political, economic, and social solutions to the prevention of civil war recurrence? From a normative perspective, the Kantians among us would argue that doing no harm and convincing others to do no harm is the primary goal for all humanity, even if they have not been yet been successful in achieving that aim. Others, however, demonstrate that civil wars that end in clear victories are more likely to maintain a durable peace (Luttwak, 1999; Wagner, 1993).

Steenkamp argues that the assumption that violence stops after war is a myth and that the uncomfortable truth is that periods of civil war creates a "culture of violence." Within this culture, violence is often maintained as an accepted norm (2005). In addition to a violent culture, states suffer from the effects of the war itself in health care expenditures, rebuilding educational and economic systems, as well as reconstituting civic institutions.

If the quality of life after civil wars is low enough, frustration, anger, and old grievances come to life once again. When this occurs in combination with conditions of multiple sovereignty, civil war recurrence is possible. In addition, new grievances due to quality of life provide a resource for rebel recruiters (Walter, 2004). To increase the quality of life and prevent civil war recurrence, scholars suggest building better functioning institutions (Call & Stanley,

2001; Collier & Sambanis, 2005; Walter, 2004). Through democracy, states can increase quality of life for their citizens (Kosack, 2003; Robert D Putnam, 1995a).

As mentioned previously, negotiated settlements present a dilemma for some scholars and policy makers, as 3rd party interaction stops the killing but risks future civil war relapse; whereas, allowing the fighting to continue without intervention subjects the state to a possible genocide. This section looks at settlements at two levels: the broad and the specific.

Ensuring inclusion of rebel groups in settlement negotiations increases the probability of peace durability; barring rebel groups from negotiations increases the probability that they continue military action (Nilsson, 2008). Interestingly, Nilsson finds that in situations where there are more than two warring factions in an intranational conflict, if a peace accord is signed, the groups that sign are more likely to stick to their agreement with each other, regardless if other groups that have not signed the agreement continue to fight. As such, while there may be a return to fighting, the violence may not be considered a full-blown relapse to civil war.

When considering the elements of civil war negotiated peace accords, Mattes and Savun say that to foster peace, cost-increasing and fear-reducing provisions should be put into place (Mattes & Savun, 2009). Cost-increasing provisions are those that increase the cost of returning to fighting, such as separating the military forces. An example of a fear-reducing provision would be a third-party enforcement of power sharing. Rebels are likely to continue to fight if they do not trust government forces to stick to their side of the deal. After all, once the rebels put down their weapons, the government once again has the monopoly on violence, and the rebels lose their bargaining power. In this case, rebels must trust the government not to annihilate them. As a result of this distrust, the best solution for distrusting rebels is to go into hiding, or to disappear into the general population. Mattes & Savun's study demonstrates that when states do

not include power-sharing and fear-reducing measures in negotiated settlements, rates of civil war recidivism increase (2009).

Partitions have been a controversial solution to ending civil wars for many years. Horrowitz stated that if it is too taxing to create peace in the short term, then perhaps the best answer to thwart civil war is permanent separation of warring factions (1985). Ten years later, Mearshiemer and Van Evera criticized the United States for signing the Dayton Agreement, suggesting that a tri-partite partition plan for Bosnia had a better chance of being successful (1995). In 1996, Chaim Kaufmann authored a landmark article on partitions as the only solution to the most violent of identity civil wars. Kaufmann's argument was that some ethnic wars were based on hatreds that ran too deep and could not settled in any way other than complete separation. Settlements in which populations were allowed to live among each other risked genocide. Kaufmann's study certainly has its critics in the field of conflict studies.

Sambanis challenges Kaufmann, arguing that his theory on partitions lacks evidence. In fact, Sambanis demonstrates through his own study that partitions lead to civil war recurrence (2000). One of the problems partition theory has had over the years is a lack of description for when partitions should be applied—that is, what the cases they are best suited for actually look like. As mentioned in previous passages, the security dilemma is a key component of civil wars, especially in partition theory, as once ethnic factions determine to mobilize, they do so on such a deep level that disentanglement and halting war violence becomes increasingly difficult. Sambanis tells us that while partition theory looks good on paper, in reality, there are few cases which demonstrate its validity. Furthermore, the cases where it does seem to work suffer from selection bias.

While partitions do separate enemy factions, they do not solve the hatreds problem, and endorsing them may lead to civil war recurrence (Schaeffer, 1990; Walter, 2011). Also, there is an assumption that partitions will guarantee homogenous societies, but this is not the case in reality, as it is extraordinarily difficult to remove an entire demographic of people out of a country. In order to ensure that states do not relapse to war, effective leadership reform may be required so that factions will not mobilize against each other, both across borders and against any minority members still living within the partition walls (Horowitz, 1985). Sambanis contends that partitions do not provide a solution to the security dilemma because ethnic leaders often have predatory intentions in addition to security concerns (2000).

Tying back to negotiated settlements, while they may be a better solution to partitions, they may not be believable, as warring ethnic groups may not trust third-party groups to adequately enforce policy goals (Walter, 1997). Sambanis demonstrates that for identity civil wars, partitions are often implemented. Additionally, partitions are more likely to occur after ethnic civil wars than following ideological or economic civil war, after peace agreements are signed, or in homogenous countries. Even though partitions are more likely to be set up after identity wars, Sambanis does not find that they decrease ethnic hatreds or prevent higher rates of civil war recidivism (Sambanis, 2000).

Current scholarship on environmental factors affecting intrastate conflicts and their recurrence after the fact overwhelmingly focuses on food and water security (Gleick, 1993; D. H. Johnson, 2003; Miguel, Satyanath, & Sergenti, 2004; Toole & Waldman, 1993).

These ideas are seen in the political arenas as well. For example, during his acceptance speech for the Nobel Peace Prize, President Obama stated:

> There is little scientific dispute that if we do nothing, we will face more drought, more famine, more mass displacement – all of which will fuel more conflict for decades. For this reason, it is not merely scientists and environmental activists who call for swift and forceful action – it's military leaders in my own country and others who understand our common security hangs in the balance (Obama, 2009).

The logic here is that the world's poorest states rely on agriculture that is rain-dependent for both food and income security. Because of humanity's impact on the planet's systems, precipitation and extreme-weather-event patterns are changing. While these changes affect environments around the world, people in the world's poorest countries suffer the most.

Change in environments as a result of alternations of seasonal patterns have been suggested to be especially dangerous in regions with histories of civil wars with lasting effects, as such situations often do not affect all groups equally. Marginalized groups in a society still dealing with the repercussions of civil wars may not have access to necessary government resources, and states weakened by civil wars may not be able to provide relief for their people (C. S. Hendrix & Glaser, 2007; Lee, 2009). As a result, states may see a resurgent mix of old and new grievances—perhaps, leading to a flare up of violence or recurrence of war. As environmental conditions worsen over time, food, water, and income insecurity develop into armed conflicts over the competition of these resources (Burke, Miguel, Satyanath, Dykema, & Lobell, 2009). In the future—if everything remains the same—these studies suggest that states should expect increases in resource conflicts, as global climate change continues and summers and winters become longer, while autumns and springs become shorter.

Trust, The Foundations Of Trust, & Conflict

Trust can be thinly defined as a willing extension of vulnerability in exchange for some expected benefit—either mutual or otherwise. At its core, however, trust is much more. It is a deeper individual feeling or collective understanding that participants will not be taken advantage of, even if it is within the best interests of the party/parties involved to defect. Trust is not only the glue that holds societies together, but it also a lubricant, guiding societies through the difficulties of overcoming collective action problems. Trust fosters positive social interactions, interweaving together both individuals and groups into the very fabric of society.

Research in intranational conflict studies largely ignore trust as a cause of war because the mere existence of war, to most researchers, seems to imply a lack of trust. Even so, this assumes that low trust is a prerequisite for civil war. In these instances, trust no longer functions as a binder of individuals and groups, nor does it act any longer as a lubricant that enables societies to solve complex collective action problems.

"Generalized trust," as defined in the social sciences, is a "confidence or expectation" that one person or group will take another person or group's "interests into account in exchanges" (Lin, 2001). Generalized trust expresses confidence of reciprocity between individuals or groups who may be strangers to one another. Generalized trust also exists as a deeper mutual understanding that participants will not take advantage of each other, even if doing so is in their best interests (Marschall & Stolle, 2004). Within the social sciences, there are two main camps regarding the formation of trust. In the first, trust is created from the ground up, between individuals, and ultimately extends upwards to the state (R.J. Lewicki, McAllister, & Bies, 1998; Simpson, 2007; E.M. Uslaner, 2002). In the second, trust is created as a result of the actions of government institutions (be it from the institutional framework of governments or

their specific policies), which provide a plane of existence for trust (Kumlin, 2002; Kumlin & Rothstein, 2005; B. Rothstein & Stolle, 2001; B. Rothstein & D. Stolle, 2008).

When we trust strangers, we are in effect inviting them into our "moral community" (E.M. Uslaner, 2002). Bridging trust to others may be especially difficult if they are different from us. Early social science literature tells us this extension of trust is difficult because of primordialism. The primordialist argument is that individuals are defined by their in-group (Eller & Coughlan, 1993; Geertz, 1963; Shils, 1957).

In the social sciences, generalized trust is often cited as a trait among humans, rather than a state between individuals. In this light, we can divide people into two separate groups of trusters: primordial trusters, who trust and are concerned about other people within their in-groups, and universal trusters, who trust and have concern for people, regardless of their group (Crepaz, 2008). The social science trust literature suggests that this is true as well for countries. Generally speaking, societies with active citizens who participate in community activities trust each other and their governments more than those societies without an active citizenry (Robert D. Putnam, 2007; Paul J. Zak & Knack, 2001). The reverse is valid as well: the populations of poor countries experience low levels of trust. The mechanism behind this finding differs. Robert Putnam tells us that joining and participation in civil societal organizations leads to the development of trust between peoples, and Eric Uslaner tells us that it is the opposite, that once people trust each other, they join organizations (Robert D. Putnam, 2007; E.M. Uslaner, 2002).

Through these organizations, people have the ability to create change in their lives, known as the self-efficacy argument. Civil society (third sector) groups allow individuals to interact with their environments and political institutions on both the local and national levels. Furthermore, as people's faith in their ability to act within the political and public arenas

increase, the more willing they will be to join a variety of other organizations (Hooghe, 2001).

While civil participation can lead to positive social capital, it can also lead to the formation of negative social groups like the Ku Klux Klan (R.D. Putnam, 2001). Putnam's trust building process occurs through two unique dimensions: bonding brings some people together at the expense of excluding others and bridging connects people of different groups together. We have seen a number of ethnic conflicts in developing countries, many of which still rage on today, due to bonding and old primordialist attitudes still making their way to the surface (Suny, 2001). Some scholars tell us that distrust is one of the many legacies that the colonial states leave behind after they collapse or give up a territory (Howard, 2003; Mikheyev, 1987; Mishler & Rose, 1997).

Diversity within democratic communities (different ethnic groups, religions, values systems, etc.) is at the heart of most theories on trust and social capital. American psychologist Gordon Allport was one of the first members of his field to study the human personality. Allport's approach dismissed both behaviorism and psychoanalysis, citing the first as too broad of an approach to understanding the human experience and the second as being too narrow. As racism plagued the United States during Allport's lifetime, he focused his studies on its causes and attempted to thwart it.

In 1954, Allport developed his Contact Hypothesis, in which he stated that one of the most effective methods to decrease prejudice among in- and out-groups is through interpersonal contact. Allport's main idea was that meaningful acquaintance decreases prejudice (1954). The hope was that by building diverse, cohesive communities, decreases in prejudice would result in individuals recognizing that their fears and racism towards out-group members were unfounded and irrational and, ultimately, attitudinal change would occur (Emerson, Kimbro, & Yancey

2002). In effect, a healthy community of trust would be created, providing for the development of a better future for all, not just some.

Converse to Contact Theory are conflict theories, which posit that social structures originate, not from positive contact, but conflict among groups with competing resources and interests (Knapp, 1994). Karl Marx suggested that, as a result of capitalism, internal conflict between the working class and elites would ultimately break down the economic system. Émile Durkheim viewed societies as organisms, and the major conflict across populations he found important was crime. Durkheim believed that it was crime itself that helped societies create and shape their legal systems. Modern conflict theorist Charles Wright Mills wrote that the power elite class in the United States developed from the conglomeration of business, military, and executive branch members, whose interests were counter to the people. Gene Sharp's works build on Mills, stating that power within a state is dependent on the people's willingness to support their leaders, not the intrinsic value of the power in question. Taking Mills and Sharp together, in order to maintain their status, the elites need conflict; otherwise, the people will lose interest.

While some scholars claim that governments do not create trust (Nye, 1997; Nye et al., 1997; E.M. Uslaner, 2003) as mentioned above—there is considerable research suggesting that they do. When government institutions perform well or are perceived to perform well, trust generally increases (Coffé & Geys, 2005; Letki, 2006; Miller & Listhaug, 1999; Mishler & Rose, 2001; Mishler, Rose, & Policy, 1998; R.D. Putnam, 2002; Williams, 1985). After all, if the state does not provide an open environment in which civilians can freely form organizations which the self-efficacy school says creates trust, then how can this trust be created?

State institutions within democracies exist to solve collective action problems surrounding issues of public goods. When institutions are fair and inclusive, not only are they successful at providing solutions for the public, but they create social trust and social capital (Fukuyama, 2001; Bo Rothstein & Stolle, 2002). While seemingly simple, social trust is a complicated idea. To trust others, individuals willingly extend vulnerabilities with hope that others will not only follow through with the agreed upon actions or behaviors, but also that they will not take advantage of the trusters (Offe, 1999). Social capital is a result of public engagement in civic life, as well as attitudes of reciprocity and trust that develop as a result of civic activity; higher levels of social trust leads to better overall government, more productive and stronger economies, and successful, long-lasting solutions to collective action problems (Keele, 2007; R. Putnam, 1993; Robert D Putnam, 1995b; Robert D Putnam, Leonardi, & Nanetti, 1994).

While we know from the research that social trust is important to the development of communities and governments, we also know that, from a social science perspective, it is difficult to increase the levels of social trust. Uslaner believes that social trust in the individual is developed between birth and adolescence (E.M. Uslaner, 2002). After such time, he says that increasing social trust is very unlikely. Putnam's work disagrees and demonstrates that populations with civic attachment through associations and clubs are likely to have stronger civil societies (R.D. Putnam, 2001). Putnam notes that this is not always the case, however; the type of groups people are involved with matters. For example, a local little league is far better at creating social capital than the Ku Klux Klan. The little league bridges together a diverse community of people from different races, religions, cultures, ages, socio-economic groups,

occupations, etc. Hate groups like the Ku Klux Klan, however, only bond trust among selective memberships that seek to prohibit bridging diverse communities together.

Biological Microfoundations Of Trust

In the short time that Homo sapiens has existed on Earth, it has transformed the planet unlike any other creature. Since reaching anatomical modernity 200,000 years ago and behavioral modernity about 60,000 years ago, humans have changed the Earth's atmosphere, disrupted life patterns in the world's rain forests and oceans, discovered nature's technologies and learned how to manipulate chemistry, biology, and mathematics both for the benefit of the entire species and to its detriment (Ehrlich & Ehrlich, 2009). One of the most common themes in academia for the last two millennia has been the human mind: why it does what it does and how it works. While human knowledge of the brain's importance in decision making has existed since ancient Egypt, only in the last 120 years has the study of the brain and the nervous system come into fruition as neuroscience (Mohamed, 2008). Even then, only within the last thirty years have we started to understand ourselves in terms of our relationships with other humans, our emotions, our thoughts, and our decision-making processes. In other words, only now are we starting to understand why we are prone to conflict and why cooperation is difficult to achieve from the perspective of our own biology.

Unlike solitary animals, humans are evolutionarily drawn to social attachments with other humans (Insel, 1997). Interdisciplinary research in the social sciences and neurosciences has demonstrated that there is a direct correlation relationship between trust and a hormone called oxytocin (Baumgartner, Heinrichs, Vonlanthen, Fischbacher, & Fehr, 2008; De Dreu et al., 2010; Kosfeld et al., 2005; Luck & Jungclas, 1987; Sheldrick & Flint, 1989; P. Zak, 2005). In other

words, research in neuroscience suggests that trust itself is a biological function, contingent on the neurohormone oxytocin (Baumgartner et al., 2008; De Dreu et al., 2010; Kosfeld et al., 2005; Luck & Jungclas, 1987; Sheldrick & Flint, 1989; P. Zak, 2005). Higher levels of oxytocin raises the likelihood that individuals will share information with strangers (Mikolajczak, Pinon, Lane, de Timary, & Luminet, 2010).

In order to synthesize oxytocin, vitamin C must be readily available (Hornig, 1975). Increased vitamin C consumption itself increases oxytocin production (Luck & Jungclas, 1987). Plant-based (phyto) estrogens have been demonstrated to take part in the uptake of oxytocin by increasing oxytocin receptors in the brain and aiding in binding (Verbalis, 1999). Studies demonstrate that consumption of organic phytoestrogens increase oxytocin uptake (Albertazzi et al., 1999; Mazur, 1998; Paul J Zak & Fakhar, 2006).Oxytocin is a neurophysical brain hormone and acts mostly as a neuromodulator. The body creates the hormone by synthesizing an oxytocin peptide into an inactive precursor protein by way of the OXT gene. Next, a series of enzymes hydrolyzes the inactive precursor protein into a series of smaller entities. In the last stage of hydrolysis, peptidylglycine alpha-amidating monooxygenase (PAM) catalyzes the active oxytocin nonapeptide (Sheldrick & Flint, 1989).

Oxytocin has two main methods of action: hormonal and in-brain. From a hormonal perspective, oxytocin enables various body reflexes to occur, such as lactation, wound healing, uterine contraction, and sexual expression (Takayanagi et al., 2005). Oxytocin synthesis and release varies in different parts of the brain. The most common method involves synthesis in the hypothalamus, after which the oxytocin is carried by neurons to their axonal terminals in the posterior pituitary, where the hormone is released into the blood directly. Outside of the brain, oxytocin is synthesized in the placenta, retina, Leydig cells (male), corpora lutea (female), and

pancreas (Amico, Finn, & Haldar, 1988; Ang & Jenkins, 1984; Fields, Eldridge, Fuchs, Roberts, & Fields, 1983; Gauquelin et al., 1983; Geenen et al., 1986; Guldenaar & Pickering, 1985; Kukucka & Misra, 1992; Wathes & Swann, 1982; Wathes et al., 1982).

When people or groups of people are determining whether or not they can trust each other, the first step is empathy. The experience of empathy increases levels of oxytocin. Women generally experience higher oxytocin levels than men as a result of shared empathy. Furthermore, the higher the empathy level, the more generous people are towards to strangers (Barraza & Zak, 2009). In their landmark oxytocin study, Baumgartner et al. put oxytocin to the test through a series of trust experiments. The authors found that subjects who received intranasal administrations of oxytocin—as opposed to placebo—continued to trust their partners in exchanges, even after learning of repeated breaches of trust. The same was not true for subjects who did not receive the oxytocin spray. In addition to oxytocin administration or the absence thereof, during the experiments, all subjects underwent functional magnetic resonance imaging (fMRI) exams.

Previous research has illustrated oxytocin's effects on what neuroscientists call "mind reading"—that is, the inference of another individual's internal state. Oxytocin aids in this process by limiting fear responses caused by amygdala activation (Domes, Heinrichs, Michel, Berger, & Herpertz, 2007, p. 731; Kirsch et al., 2005). Specifically, in trust experiments, oxytocin reduces an individual's aversion to being betrayed (Heinrichs, Baumgartner, Kirschbaum, & Ehlert, 2003). The hormone, while having many functions, directly acts to increase the total number and time individuals spend focusing on the ocular region of others.

Additionally, oxytocin is involved with brain function involving the maintenance and development of attachment and interaction behaviors in humans. Oxytocin-exposed individuals

see outsiders as both more trustworthy and more attractive, solely by looking at their faces (Theodoridou, Rowe, Penton-Voak, & Rogers, 2009). Van Ijendoorn, Bakermans-Kranenburg, and Theodoridou demonstrate that oxytocin inhalation leads to increased in-group trust (2012). Bartz et al. exhibit that oxytocin greatly improves the ability to empathize with other people (2010). Oxytocin nasal sprays have also been used in studies to illustrate the hormone's effects on arguments. Ditzen et al. find that people in arguments that have been exposed to oxytocin communicate more and fight less than those not exposed (2009).

We know whether or not others are angry or afraid simply from looking at and around their eyes, and neuroscience research confirms this phenomenon (Smith, Cottrell, Gosselin, & Schyns, 2005). The amygdalae (typically referred to singularly as the amygdala) are walnut-shaped nuclei, found inside the medial temporal lobes of the human brain. The amygdala has a multitude of functions itself but is largely responsible for fear responses, aggressive behavior, and responses to disagreeable stimuli (Kirsch et al., 2005). An increase of oxytocin in the brain activates the right posterior amygdala, purported to be the basal nuclei—in which past research shows activation in individuals before reflective eye movements in the direction of widened eyes in fearful situations—which, in turn, leads to activation of the superior colliculli, which is responsible for physically redirecting covert and overt shifts of attention (Gamer & Büchel, 2009; Ignashchenkova, Dicke, Haarmeier, & Thier, 2003). Essentially, in trust situations, oxytocin allows part of the amygdala to activate so that the individual can focus on the necessary features of others, while numbing the parts of the amygdala that respond to unpleasantness (Gamer, Zurowski, & Büchel, 2010).

The functional Magnetic Resonance Imaging (fMRI) findings in the Baumgartner et al. study are consistent with Domes et al and Kirsch et al: without fear activation as a result of

betrayal, subjects continue to trust their partners. In another study, researchers tested oxytocin levels within subjects' blood during trust experiments and found that cooperating partners demonstrate high levels of oxytocin, as opposed to defecting partners (Paul J Zak, Kurzban, & Matzner, 2004).

Oxytocin also increases average generosity by 80% (Paul J Zak, Stanton, & Ahmadi, 2007). It's important to note that the hormone does not increase an individual's likelihood to take greater and more frequent risks; it does, however, encourage people to trust, even when they should not. For example, Mikolajczak et al. show that higher levels of oxytocin raises the likelihood that individuals will share confidential material with strangers (2010). Again, this demonstrates the hormone's effects on the fear signals. Without increased oxytocin levels, the amygdala would sound the alarms. Instead, because it has been attenuated, it does not (Donaldson & Young, 2008).

Additionally, a simple touch from Subject A to Subject B, followed by an action of trust (from Subject A to B) increases Subject B's likelihood to trust subject A by 243% percent, as opposed to subjects who were not touched. As is expected, oxytocin levels increase with touching followed by trusting (Morhenn, Park, Piper, & Zak, 2008). Heinrichs et al take this study further by testing women's responses to stress exposure. In their study, two groups of women were exposed to a stressor. The first group received a touch from their partners before being exposed to stress, and the second group only received verbal good wishes. The trials demonstrated that women who were touched had lower cortisol (a stress hormone) responses and lower heart rates, as opposed to the second group (Heinrichs, von Dawans, & Domes, 2009).

The PAM system is a vital step in the synthesis of oxytocin. In order for the system to function, ascorbate (Vitamin C) must be readily available, as it is a required compound in the

biochemical process. Vitamin C acts as a cofactor, as opposed to an antioxidant, in the PAM system, and this is extraordinarily important for this article because only this vitamin fits this particular cofactor duty (Hornig, 1975). Luck & Junglas demonstrate that an increased Vitamin C consumption itself leads to increased oxytocin production (1987). In addition to Vitamin C, copper is also necessary for the PAM system, as it is the only metal known that supports peptide amidation of neuropeptides for neurohormones (Bousquet-Moore, Mains, & Eipper, 2010).

Piecing the neuroscience and nutritional research together, we see that because vitamin C is required to synthesize oxytocin, transitively, it is one of the most basic foundations for trust. Not only is there a positive parallel relationship between levels of vitamin C consumption and oxytocin release, but greater vitamin C consumption decreases an individual's reactivity to environmental stressors (Brody, 2002; Luck & Jungclas, 1987). Knowing how the vitamin C-trust relationship works given normal and greater-than-normal levels of vitamin C and/or oxytocin, we must ask what happens in individuals with depleting or depleted levels of vitamin C.

Scurvy, a malnourishment disease most commonly associated with sailors and pirates of the open seas, results from the lack of malnourishment of Vitamin C. The disease was first documented by Hippocrates, and the cure—citrus fruit consumption—was finally discovered by James Lind of the Royal Navy in 1753 (Hippocrates; Lind, 1772). Scurvy is not a disease commonly found in the majority of animals because, unlike humans, they have the ability to produce vitamin C on their own. Because simians (gibbons, capuchins, spider monkeys, and apes), guinea pigs, bats, and humans do not have the enzyme L-gulonolactone oxidase which is required to synthesize the vitamin C, they must consume it within their diets.

Scurvy physically presents itself with lethargy and malaise, progressing to spongy gums, the loss of teeth, mucous membrane bleeding, immobilizing spots on the legs and thigh, and eventually neuropathy and death. For our purposes, however, Scurvy has psychological symptoms as well, which present before the physical symptoms. These include irritability, social introversion, depression, delusions, apathy, hysteria, and a number of other psychological problems. The psychological symptoms of Scurvy occur before the physical symptoms and persist indefinitely at low levels of vitamin C intake without progressing into the more grotesque physical ailments (Schlueter & Johnston, 2011).

The United States government standard for vitamin C intake is ranges between 90-100mg/day (Sciences). The vitamin decomposes chemically under various conditions. High storage temperatures will decrease vitamin C levels, as will normal cooking temperatures; studies show that cooking leads to a net loss of 60% vitamin C in produce (Allen & Burgess, 1950; Roig, Rivera, & Kennedy, 1995). Vitamin C loss from foods can also occur through leeching, a process in which the vitamin, which is water-soluble, dissolves into the water in which the food is being cooked in, and is later poured away, as occurs with the cooking of corn (Combs Jr, 1991).

There are cases of native populations which habituate in extremely cold temperatures, rarely consume produce, and still reach acceptable vitamin C levels. While meat is generally the only food in the diet, these populations eat their meat at near-raw temperatures. As such, they save the nutrients from decomposition (Kuhnlein, Receveur, Soueida, & Egeland, 2004).

Vitamin C is found in most fruits and vegetables, even at trace amounts. Simply consuming food items known to have vitamin C does not guarantee proper intake, as there are a variety of factors that affect nutrient absorption. For example, tobacco smoking generally

decreases vitamin C levels. Studies show that to maintain healthy levels, smokers (regardless of demographic data and cigarette consumption) must consume an extra 60mg/day (P. Weber, Bendich, & Schalch, 1996). Achieving such a nutritional requirement can be difficult or downright impossible to achieve, given the geography and time of year for the individuals affected.

While vitamin C is required for oxytocin synthesis, estrogens have been demonstrated to take part in the uptake of oxytocin by increasing oxytocin receptors in the brain and aiding in binding (Verbalis, 1999). With this knowledge, Zak and Fakhar extrapolate that the consumption of organic estrogens found in foods are likely to increase oxytocin uptake (2006). The authors find that countries in which people consume foods high in phytoestrogens exhibited high levels of trust(2006). Phytoestrogens are naturally occurring, plant-derived compounds, that when consumed mimic the hormonal actions of estrogen. A number of studies in recent decades have demonstrated that phytoestrogens bind to estrogen receptors, resulting in trusting behaviors (Albertazzi et al., 1999; Mazur, 1998; Paul J Zak & Fakhar, 2006).

In addition to their broadly known, negative environmental impacts, many artificial xenoestrogens (i.e. pollutants like DDT, Dioxin, PCBs, etc.) act as estrogen antagonists and block or decrease oxytocin uptake by the brain. In their research, Zak and Fakhar show that people living in countries with environments rich in pollutants high in xenoestrogens are far less trusting than countries that have banned or limited the usage of these harmful (P. J. Zak, 2005a; Paul J Zak & Fakhar, 2006). Research in endocrinology demonstrates that these artificial estrogens harm some oxytocin producing organs in the body and that proper vitamin C levels ameliorates the effects (Murugesan, Muthusamy, Balasubramanian, & Arunakaran, 2005; Pryor).

In addition to specific pollutants, there is also research that correlates total quality of environment to higher interpersonal trust (Yamagishi, 2003).

In this light, trust is, at its foundation, neurohormonally based. There are few studies within the social sciences that ask what the consequences of trust rooted in biology are. Thus, there are holes in the literature. Current research cannot state whether or not states with environments that do not provide adequate vitamin C and phytoestrogens (which presumably hinders oxytocin production) see more or less conflict. The literature is silent on the effects of biologically induced trust deficits, whether they affect societies' abilities in working through and solving collective action problems. These holes are important because a trust deficit induced by biology would presumably leave little room (if any) for active choice and agency. Trust affects every aspect of civil life: from governing institutions to civil society and interpersonal relationships, and currently, the literature is silent on whether or not these biological deficits result in more or less conflict. This dissertation attempts to answer these questions and it integrates biological research with studies in intranational conflict.

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CHAPTER 3

A MATTER OF TRUST: GENERALIZED TRUST & NEUROHORMONES[2]

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Abstract

What causes state populations to be low trusting? This article attempts to capture a general picture of specific environments that negatively affect trust potential, creating trust deficits. Research in the biological sciences has demonstrated that oxytocin, a neurohormone, mediates trusting behaviors. Within the last few decades, some in the social sciences have applied this research to the political sciences. This study adds to the existing research by demonstrating that diet affects collective behavior. Using results from studies from both fields and testing them over a sample of countries that do not meet their per capita intake of recommended nutrients over time, this chapter finds three biochemical factors to be related to trust: two nutritional and one regarding pollutants. Literature in international affairs demonstrates that low trusting states are often plagued with corruption. The study tests the factors on corruption and finds evidence of the factors' effects on the issue.

Introduction

A common theme in academia over the last few millennia has been the human mind, how it works and why it does what it does. Within the last few hundred years, humans have learned more about their physical selves through the advances of technology, the fields of medicine and biology in general. Within the last fifty years, much focus has been dedicated to understanding the human brain and the nervous system (Mohamed, 2008). Through neuroscience, human relationships, thoughts, and decision-making processes have helped human kind come to terms with why it is conflict prone and why cooperation is often difficult to achieve.

At the crux of human relationships is a concept called trust. To thinly describe trust, it is the extension of vulnerability in return for reciprocity. A thicker description of the concept

would be that collective understanding that other individuals or groups do not have bad intentions towards others and will not take advantage of their counterparts who extend vulnerabilities, regardless of whether or not it is in the their best interest to defect. Trust, then, acts as the lubricant that enables individuals, groups, communities, up through societies to solve complex collective action problems within their nation states. In this light, trust also acts as the fabric that holds societies together. As Robert Putnam famously wrote, with higher levels of trust come more developed and functioning civil societies, as well as increases in levels of political participation (Robert D Putnam, 1995a). At the end of the day, trust is one of the main societal factors that develops positive social interactions and integrates both groups and individuals into the framework that is society.

This article is centered on generalized trust, a key social science measure of trust. Generalized trust can be defined as the overall outlook on the trustworthiness of strangers (Robert D Putnam, 1995b). That is, when individuals think of people they do not know, they fall into two unique categories: 1) people can generally be trusted and 2) individuals should be careful of other people. People falling into the first category, generalized trusters, are more likely to go out of their way to meet with and work with strangers (Marschall & Stolle, 2004). Much of the research on generalized trust seems to argue that it is an innate sense they were born with, either humans trust strangers or they do not (Crepaz, 2008; Lewis & Weigert, 1985; Rotter, 1971).

In the social sciences, the nurture argument seems to win out in determining people's generalized trust status: positive upbringing, strong institutions, identity ties (Hardin, 2001; Lewis & Weigert, 1985; Stolle, 2002; Eric M Uslaner, 2008). If generalized trust is an innate

trait, stemming from upbringing, then existing explanations may be flawed, given that not all individuals with the same upbringing trust in the same manner as others in their communities.

This article builds on research in nutrition, neuroscience, and the social sciences to explain the microfoundations of generalized trust. The article argues that generalized trust is neurohormone-based and that the people who live in environments that foster the synthesis of the neurohormone associated with trust are likely to be generalized trusters, whereas, people who live in environments that hinder the production of this neurohormone are more likely to not be generalized trusters.

Theoretical Justification For Different Notion Of Trust

In general, it feels good to trust others and to be trusted by others. This physical feeling of reciprocity is difficult to explain, and the social science literature often ignores it. If the feeling of trusting other people leads to a positive biological response, then that would suggest that the trusting process itself is biological—it would have to be, as we are biological creatures. The question then becomes is there a biological nature to trust that we are overlooking? To answer that question, neuroscience is needed. Integrating research from neuro- and nutrition sciences into social science studies, this article suggests that some states experience trust deficits simply because their environments hinder the production of the hormone responsible for trust. As a result, the people of these states have a difficult time trusting one another, which can have catastrophic, corrosive effects on state institutions and socioeconomics.

Presented here is a theory of the development trust deficits. When the required building blocks for oxytocin are in short order and the production of the hormone itself is hindered by a high concentration of carbon-based pollutants, people are physically affected. On the individual

level, because of low levels of synthesis and uptake compounds and high levels of hindering compounds, an increased distrust of strangers occurs. On the aggregate level, this collective malnutrition leads to trust deficits within the population. People are unable to extend a general trust to both strangers and people that are different from them because they lack the ability to perform a specific neurohormonal pattern.

Over time, this distrust reinforces negative attitudes about outsiders. When in-groups and out-groups that have a diminished capacity to trust interact, , when conflict does arise, the old, negative attitudes are once again reinforced. When these deficits exist, populations suffer higher levels of difficulty in solving collective action problems. Interethnic, socioeconomic, and other faction-based problems become ingrained on a cellular level within the population. With trust deficits, coercive measures become the de facto solution for problem-solving. In addition to disruptions among demographics, these trust deficits also lead to problems within government. Without trust, government cannot function properly and corruption becomes a way of life (Husted & Estudios, 1999) It is at this point that we see the intersection of biology and social culture: when biologically created distrust solidifies itself into cultural values.

To test this theory of low trust, this study offers two hypotheses. In the first, the relationship between the various chemical factors and trust are examined. In the second, the relationship between the factors are tested in conjunction with controls on corruption:

- H1 – Distrust is rampant in states with high levels of pollution and low levels of certain nutrients (vitamin C and phytoestrogens) – referred to for convenience in the remainder of this work as “low levels of nutrition”.
- H2 – Corruption is high in states with high levels of pollutants and low levels of nutrition (vitamin C and phytoestrogens).

Data & Methods

Because global data on individual nutrient intake and hormone levels are not available, research herein is conducted via secondary analysis research design. A dataset is developed that includes factors correlated to oxytocin levels: per capita daily intake of Vitamin C and phytoestrogens, as well as copper. To extract these variables, data from the United Nations Food and Agriculture Organization's food balance sheets is used. Food balance sheets yield a picture of a country's food supply and the pattern of usage in a given year (FAO, 2011). The food balance sheets show how much of any given food item was produced and consumed for people, animals, and agricultural utility.

Food production data accounts for food losses during production, storage, and transportation. Data are presented in terms of food item mass quantity produced for human consumption existing in the country for any given year (kilograms). The FAO provides food production data from 1961-2013 in 200 countries. Some food type examples are: apples, cereals, tea, and sweet potatoes. Primary crops are those food items that come solely from the earth and have not been altered, save for cleaning.

Within the FAO food balance sheets, there are over 25 fruits, vegetables, and other plants that are available that contain measureable amounts of vitamin C and phytoestrogens. Vitamin C is commonly found in dark leafy greens, papayas, peas, and berries. Phytoestrogens are most common in a variety of foods like coffee, tea, apples, yams, and rice. The United States Department of Agriculture's (USDA) National Nutrient Database for Standard Reference (NNDSR) is used to determine the amount of Vitamin C in milligrams and of phytoestrogens in micrograms (Gebhardt et al., 2008). The Nutrient Data itself includes reports for average nutrition values per 100 grams of food. For example, for cantaloupe, the dataset tells users the

grams per 100 grams of sugar, fiber, fat, calories, vitamins and minerals for the flesh, excluding the seeds and skin (inedible portions of the fruit).

The dataset provides nutrition information for foods that are cooked, raw, and stored. This is especially important for vitamin C. The nutrient degrades under harsh conditions. The NNDSR measures vitamin C as a result of these various processes through the dichloroindophenol titration method. Average phytoestrogen values are measured individually and in total, including isoflavones, coumestrol, biochanin A, and formononetin. Low levels of both vitamin C and phytoestrogens are expected to be positively correlated with trust deficits.

Because pollutants result from the general breakdown of organic chemical products and data to measure values directly are not readily available, they are measured here through a number of other variables. This method is consistent with the literature (Paul J Zak & Fakhar, 2006). First, for pollution data, this article draws on the World Development Indicators (WDI) from the World Bank. For water pollution, measures for emissions of organic water pollutants in kilograms per day per worker are included. This variable is determined by the World Bank through local water tests that determines of the amount of oxygen that bacteria living in bodies of water need to consume in order to break down the organic waste within the water, the final result being an accurate measurement of the pollutants to which people themselves are subjected (2012).

Organic water pollutants can also exist as a result of industrial activities that degrade water quality. They are measured in kilograms of pollutants per worker per country and year. The pollutants covered in this category are in terms of concentration or load of organic matter, minerals, metals, bacteria, toxic materials, and sediments within the water supply. These data are quite reliable because sampling techniques are inexpensive and require less learning curves and

technological capabilities than determining air pollution does. Limitations and inaccuracies, if they do exist, are largely due to errors in the measurement process.

Also included are variables for air pollution caused by construction and manufacturing industries, other societal sectors, combustible waste and renewables, as well as a variable to measuring organic-based water pollution. These pollution data also come from the World Bank's World Development Indices. Carbon dioxide is calculated in terms of thousands of kilotons per year in emissions, accounting for those products associated with global warming, such as greenhouse gasses. In addition, carbon dioxide emissions result from the burning of fossil fuels, waste materials and cement and industrial production. While world output of carbon dioxide is largely exact, one limitation can be the specific determination of country carbon dioxide output if neighboring states are heavy polluters.

Nitrous oxide emissions result from fossil fuel combustion, forest fires, fertilizers, and animal waste. It is measured in terms of kilograms per worker by country and year. Nitrous oxide data is somewhat limited as the only countries that report their values are the ones that belong to the United Nations Parties to the Climate Change Convention (UNFCCC). These data are collected from the WDI dataset as well.

Combustible waste is pollution due to the burning of waste materials. It is measured in kilograms per person per country and year. In interest of full disclosure, while these data are found in the WDI dataset, they are compiled by International Energy Agency (IEA) and contributed to the World Bank's data collectors. Examples of combustible waste products are animal products, solid biomass, by products of biomass, as well as city and industrial waste. These data come largely from country estimates. Utility, oil, national energy, and electric companies and corporations are all consulted in compiling the aggregate estimates. It is

expected that all the pollutants listed within this section will be positively correlated to trust deficits.

Trust data is taken from the World Values Survey. The study uses the "generalized trust" or "interpersonal trust" question (depending on the survey year) to determine the proportion of the population in each country by year that believes that people can be trusted or that people must be wary of each other. Within the survey itself, individuals are asked, "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?" At its core, this question helps social scientists determine "generalized trust" (also known as "interpersonal trust" in other studies, as mentioned previously), which is the belief or understanding that strangers or people in general can be trusted by the individual answering the question.

Corruption, or fraudulent activity from agents of political power, threatens the state's economic system, as well as financial markets. Because of corruption, government efficiency decreases, private business (if it exists) grows unevenly, as the environment succumbs to patronage. As a result, regime, market, and economic stability all suffer. In this study, Transparency International's Corruption Perception Index (CPI) is used to measure corruption. The index covers countries for the years 1993 to 2014. Within the index, lower scores indicate more corruption, and high scores indicate states that lead the world in near corruption-free nations. The Nordic states and the continental European states routinely rank the highest, and failed totalitarian states rank the lowest. The CPI focuses on states' public sectors and determines the extent to which they are corrupt; it is one of the top indices used to measure corruption (Transparency International 2014).

Because the measure of corruption itself demonstrates the extent to which states' public sectors are involved in activities which are illegal, empirical data is difficult to obtain. As such, the CPI focuses on perceptions of corruption. The CPI, therefore, relies on measures that test the effectiveness of the courts and the freedom of state media in situations revolving around corruption itself. CPI data for any given year comes from a conglomerate of independent institutions that collect data for two years, prior to the score year in question. Countries receive a score (0-100) and a rank among the cleanest to most corrupt nations of the world (Transparency International 2014).

To test whether the relationship between vitamin C, phytoestrogens, and trust did exist and to collapse vitamin C and phytoestrogen intake information into useful data, a set of variables were created. The variable operationalization process for this study required a number of steps. The first was to sum the total vitamin C and phytoestrogen values separately by food consumed per capita, as provided by the USDA's NNDSR. To achieve this, the following formulas were used:

$$\text{Vitamin C per person per day} = \sum(\text{Crop equivelent food item per person in grams} * \text{mgVitamin C per gram of specific food item})$$

$$\text{Phytoestrogens per person per day} = \sum(\text{Crop equivelent food item per person in grams} * \text{ugPhytoestrogens per gram of specific food item})$$

Because of the number of biological variables responsible for neurohormone levels, the nutrients necessary to synthesize those neurohormones and the organic compounds that both aid and hinder neurohormonal uptake within the brain, a variety of statistical methods are necessary to accurately formulate a proper answer to the question of how environments affect trust. Testing all these variables together through ordinary-least squares (OLS) statistical methods would prove to be quite onerous—if not, a nightmare, given the difficulties of demonstrating predictive power with so many similar competing variables.

A better method is principal component analysis, which reduces the variables into a series of related factors. In essence, principal component analysis boils out "factors" or common variance among a set of variables. The factors themselves capture a three-dimensional view of the data by acting as a set of linear combinations loading on to the variables. To illustrate, when we look at a coffee mug, we easily recognize it because of its shape and the angle that from which we see it. If, however, we see the coffee mug from an odd angle, where we cannot see the handle, the mouth, or the bottom, we may mistake the coffee mug for another object, perhaps a large paper weight.

What principal component analysis does is rotate the data space to a point where the new view is one that demonstrates the directions where variance is the highest. These axes, ordered specifically by variance, are the principal components. The first axis contains the most variance, axes afterwards contain remaining variance orthogonal (at a right angle to) the first principal component. In our coffee mug example, principal component analysis would rotate the coffee mug along three axes, ultimately providing us with a complete picture. Given the new information of the object, we would be able to determine what the object was. Principal component analysis ultimately gives us a factor score (or sets of factor scores), which allows us

to identify classes of factors among our various independent variables that affect the dependent variable.

Factor analysis is employed in this study, as it is believed that there are a set of hidden variables causing fluctuations in social trust. As it is not possible to test these variables directly, factor analysis is a good tool to bring them to the light. Before the factor analysis was run, it was expected that as a result of the analysis, two or three factors would come to the forefront. If there would be two factors, it was thought that one would emphasize pollution and the other nutrition. If there were three factors, it was thought that one would emphasize pollution, another oxytocin uptake, and the last, oxytocin synthesis.

In the case that there were three factors, with the synthesis and uptake compounds split into different factors, the uptake factor would therefore reflect the extent to which the state's population had met the recommended nutrition standards for uptake of oxytocin. It was thought that the second (or third) factor that comes forth from the analysis would cluster on pollution, reflecting the extent to which a state's environment has the potential to hinder the environment and ultimately, negatively affect oxytocin production in later tests within this chapter.

These factors are important, as they provide a mechanism to test whether their existence at specific levels affect state trust deficit levels. To illustrate how factors can be used to explain trust deficits, states that have low nutrition-related factor levels should be more likely to have higher levels of distrust, as the nutrition necessary for the synthesis and utilization of oxytocin is in short supply. It is important to note that high scores on the pollution factor do not necessarily guarantee the existence of trust deficits. Bridging from the literature from the nutrition sciences, high nutrition scores may counteract the high pollution scores. That is, states scoring low on the pollution factor and high on the nutrition factors should be more likely to be less trusting, as

without enough nutrition itself, trust could remain low because oxytocin (presumably) is low as well. Finally, if states score high on the pollution factor and are less trusting, it could be argued that nourishment alone cannot counteract the effects of pollution, as the pollutants interfere with brain chemistry directly.

For the principal component analysis, in order to obtain the orthogonal values, the Varimax rotation method is used. After the factors were determined, they were tested against World Values Survey data for distrust (1-%Trusting/Country/Year) through OLS against the aforementioned control variables. This study uses whole data. As such, the number of cases available for study are limited. The factor loadings cover the years 1995 to 2008, as they contain the highest number of cases among each of the various datasets utilized within this study. Moving forward, there simply is not enough pollution data available to create the factors within this study for future articles in this work.

As such, another measure is created in this study. This study also employed OLS to create a model to determine trust deficit levels using just the nutrient components (vitamin C, copper, and phytoestrogens). To create this variable, the total per capita per day vitamin C, copper, and phytoestrogen values were determined (as described earlier in this chapter) and formed into three variables. A dataset was put together using total vitamin C, copper, and phytoestrogens consumed per capita per country per year for the World Values Survey countries between 1980 and 2008.

A variable for poor nutrition was added, where country years received a “1” if they do not meet at least 100mg vitamin C and at least 500ug phytoestrogens per day and “0” if they met those requirements. Once this was done, a basic ordinary-least squares (OLS) regression where the “generalized trust” question (“most people can be trusted” v “you have to be more careful”)

was the dependent variable and vitamin C and phytoestrogen consumption were the independent variable was run to determine if there were correlations between the nutrients and trust as the biological science studies suggested. The regression was sorted on the poor nutrition variable.

Detailed Analysis Of Results And Discussion

Three factors were realized after the analysis, as expected: one centering on oxytocin synthesis, another on uptake, and another clustering on pollution. The factor loadings can be found in Table 1. Principal component and factor analysis can be trying, as variables can sit on multiple factors, sometimes all factors. This can make it incredibly difficult to determine a variable's particular effect in the overall experiment. For this study, variables with high explanation of variance are emphasized in the naming of the individual factor.

To illustrate, the pollution factor contains information for all variables (including nutrition data) within the analysis, but because pollutants' loadings are largest by far, they are recognized as such. Figure 1 is a scatterplot of the pollution factor to distrust. The correlation between the pollution factor and distrust is 0.17. In Figure 1, it is seen that there is a positive correlation between higher levels of pollution and an absence of generalized trust (being more careful than trusting of strangers). To be more specific, each unit increase on the pollution factor yields a 0.17 unit increase in distrust. This finding shows support for H1.

The implications of this are that pollution is correlated to trust deficits. To draw from studies in comparative politics and the social science literature in general, the Nordic states are cited as consistently being the most trusting countries (Bo Rothstein & Uslaner, 2005). Coming in at fairly low levels of pollution, Sweden, Norway, and Finland all exhibit low levels of carefulness of others; the findings here are consistent with the literature (Inglehart, Puranen,

Pettersson, Nicolas, & Esmer, 2005). This is important because other studies utilize independent variables vastly different from those traditionally employed in social science studies, and yet this study demonstrates similar results.

The synthesis factor, includes a number of loadings, but most values were low and did not make a high enough contribution to the factor. It explains 45% of the variance between all the variables. The synthesis factor is negatively correlated to distrust, as is expected. Figure 2 is a scatterplot of the correlation. To be more specific, a unit increase in on the synthesis factor yields a -0.09 decrease in distrust—or, it increases trust. This result again shows support for H1. More intake of the synthesis factor results in increased trust and decreased distrust. More so than the other two factors, the synthesis factor provides a strong downward trend. This suggests that it plays a greater role in creating trust deficits when it is absent.

Looking to the literature again, Moldova is often cited as one of the least trusting countries (Sapsford & Abbott, 2006). The results of the scatterplot are consistent with the literature. Moldova's population attains very low levels of the synthesis factor and are, at the same time, very careful of one another. On the opposite side of the line, Sweden, Norway, and Finland have high levels of the synthesis factor, and demonstrate very high levels of generalized trust (low levels of carefulness). These results are consistent with the social science findings within the social science literature and the World Values Survey (Inglehart et al., 2005).

Figure 3 concerns the uptake factor, which explains 20.8% of the variance between the variables and overall carefulness of others. With regards to distrust, it is negatively correlated, as is expected as well. The magnitude of the effect of the uptake factor on trust deficits is surprising, given the emphasis placed on it by the literature from the Zak group. Still, a lack of

uptake nutrition is still positively correlated with trust deficits at a statistically significant level. This finding supports H1.

With regards to the combined nutrient variable tests, results were as expected. First, two sets of variables were obtained (one set in which states have poor nutrition and another in which states did not have poor nutrition). The resulting number, which was highly correlated to generalized trust with both vitamin C and phytoestrogen levels statistically significant, was labeled Biologically Induced Trust Deficit (BITD). The variable was standardized to a 100-point scale, where lower numbers represent trust deficits. Finally, the formula obtained in the determination of the BITD variable to country years within the 1980-2008 time frame was applied to country years that did not have data on "generalized trust" (from the World Values Survey), as well as to country years before 1980.

The resulting dataset included BITD country years ranging from 1961-2008.[3] For the purposes of this study, however, the data years between 1995 and 2008 are the only considered years. For perspective, each unit increase of the BITD score leads to a decrease of 0.53% in distrust—or, a half a percent increase in trust. The negative correlation between higher levels of nutritional compounds and lower levels of trust are consistent with the H1. As in the nutrition model that includes pollution, Sweden and Norway have higher BITD scores (indicating more trust) and negatively correlate with distrust.

In Table 2, the results from the OLS regression with the factors from the factor analysis are displayed. The pollution and synthesis factors are both significant in the model. These findings show support for H1: higher levels of environmental factors that hinder the production of oxytocin decrease trust and lower levels of environmental factors that aid in the production of

[3] This variable will be used in later chapters as the main independent variable.

oxytocin also decrease trust. Counter to the first hypothesis, however, when including vitamin C in the mix with pollutants and phytoestrogens, the study finds that the uptake factor is not significant. The implication of this finding is that the absence of the oxytocin synthesizing molecules and the existence of oxytocin hindering molecules create low-trust environments. This finding does not nullify previous findings that phytoestrogens create trust. It may be that the process that creates and increases trust may be different from the process that creates and increases distrust.

The environmental variables achieved through factor analysis were also tested against measures of corruption, in an attempt to see if there is a correlation between poor environments and states with corrupt public sectors. A test was run using OLS regression with the three factors as main independent variables and GDP as a control variable, as higher GDP is an indicator for less corruption. The results are in shown in Table 2, Model 1. In Table 3, the results of the tests are shown. Model 2 represents the relationships between just the three factors and Transparency International's Corruption Perception Index. Model 3 represents those relationships along with two control variables: GDP per capita Purchasing Parity Power and press freedom. The GDP measure comes from the World Bank's World Development Indicators. The GDP per capita PPP variable is measured in 2011 constant US dollars. The study uses constant GDP per capita PPP data to account for real changes over time. It was expected that higher GDPs would be correlated with lower levels of corruption (Husted & Estudios, 1999; Mauro, 1995).

The press freedom variable comes from Freedom House. The measure is based on a 100-point scale, where higher numbers represent more corrupt presses and lower numbers represent freer presses. The literature demonstrates that free presses are more likely to report on corruption in government, keeping governments in check (Brunetti & Weder, 2003). It was

expected that more freedom within the press would be correlated with lower corruption levels. The results of the table concur with these expectations.

Existing models in social science research are important to understanding trust and human relationships. With advanced biology and technological methods, fields outside of the social sciences have determined that trust may be something far more visceral with biological roots. This idea is extremely important for the social sciences because it allows us to advance our models, to include new information that improves our current research. If trust has biological foundations and limits, then factoring this knowledge into our current studies, we may be able to say that without certain biological prerequisites, our current solutions to improving trust among nations and their demographics will be ineffective. In such cases where the requirements are not met, policy makers should alter their tactics so they can provide the correct resources to improve trust. In other words, our existing models can be improved, and they should be in order to incorporate new findings and to prevent the employment of solutions that cannot be effective.

Three factors, each representing the extent to which a society is positively or negatively affected by the environment, add to an increased understanding of trust. The results of this project find, similar to past studies that the existence of artificial xenoestrogens in an environment results in decreases in trust. The study finds that natural phytoestrogens aid in increasing trust. This study adds another variable, vitamin C, which appears to be a vital microfoundation, whose absence from an environment increases distrust. Controlling for income, the pollution and synthesis factors are significant.

As is the nature in the field of political science, the research offered in this study is not conclusive evidence that the existence or absence of environmental factors cause trust or distrust.

It does, however, suggest that we are on the right track by considering human biology in our quest to understand generalized trust in human society. Institutionalists argue that institutions are responsible for trust development in society—the idea being that working institutions foster greater trust and broken institutions foster distrust.

The synthesis factor has a much higher effect within states where recommended nutrition is not met on a per capita daily basis. A positive synthesis factor leads to less corruption. An explanation for this may be that in states where overall vitamin C consumption is low, it follows that phytoestrogen consumption may not have an effect on trusting behaviors as low vitamin C may mean less overall oxytocin available for uptake. In other words, in order for phytoestrogens to have a positive impact on trust to negate distrust, diet matters.

The fact that healthy biological microfoundations in trust are seen to contribute to lower levels of corruption will be surprising to current scholars in international affairs, as few studies have attempted to demonstrate links between the biological sciences and social trust. This relationship is logical, however. In order for institutions to be functional, they must have capacity. Where the synthesis factor is high, we can infer that people are more trusting, that they approve of their governments and participate in the political realm and hold their countries accountable through their presses.

Research in the social sciences have, within the last few decades, just begun to explore the biological mechanisms of human social and political behaviors. As we've seen in this work, generalized trust is much more than meets the eye. It is more than institutions, more than cultural mannerisms, and more than economics. This is not to say that biology is the silver bullet on our journey to understand distrusting behaviors—rather, it is to point out that it does have a

place within our studies and that it can work in conjunction with our current models. In other words, biology may help us understand human behavior better.

For example, Paul Zak's interdisciplinary research on oxytocin and trust can work alongside Robert Putnam's research. Putnam describes bridging trust as extending trust across in-groups and out-groups respectively. It may very well be that societies that are unable to bridge or bridge poorly where they exist within oxytocin-factor-poor states. It may be that societies existing in these environments are more likely to see political violence, intrastate conflicts, and/or brutal civil wars. Furthermore, these states may, because of their environments, see recurring violence after wars quell, and never develop positive peace within their countries. More research is needed in these regards.

By understanding the microfoundations of human behavior, we can build better models that encapsulate advances in knowledge. This study expands on the existing research on neuroactive hormones and trust, bringing in another piece to the puzzle (vitamin C) and suggesting that we can use environmental factors as proxy variables for trust. For, trust is not only the glue that holds societies together, but the lubricant that aids transactions between people, groups, businesses, cultures, and government entities, leading to stronger countries, societies, and economies.

This study suggests that generalized trust is not some inherent trait that exists randomly, but a characteristic dependent on the existence of certain environmental conditions. Knowing that some states are deficient in trust because of their agricultural production and pollution is the first step in a much longer process of development. By encouraging more healthy environments, states may see higher level of trust, lower levels of distrust, fewer instances of corruption, and

stronger institutions. Policy makers, domestic- and foreign-aid workers, and society in general may be able to increase trust in their respective areas.

Article I Tables

Table 1: Country Year Rotated Factor Loadings of Pollutants and Nutrients: 1995-2008

	LOADINGS		
	Factor 1: Pollution	Factor 2: Synthesis	Factor 3: Uptake
CO2 from manufacturing	0.953	0.075	0.093
CO2 other sectors	0.955	0.068	-0.054
Combustible waste and renewables	0.927	0.141	0.004
Vitamin C	-0.260	0.804	-0.189
Phytoestrogens	-0.217	0.0127	0.956
Water pollution by worker	-0.022	-0.680	-0.282

Table 2: Country Year OLS Regression of Factors from Analysis on Trust: 1995-2008

TERM	MODEL 1
Intercept	0.76*
	(0.04)
Pollution Factor	0.14*
	(0.07)
Synthesis Factor	-0.09*
	(0.03)
Uptake Factor	0.01
	(0.03)
R^2	0.29
N	39

*$p < 0.05$

Table 3: Corruption, Factors, and Controls

TERM	MODEL 2	MODEL 3
Intercept	5.663*	5.108*
	(0.226)	(0.448)
Pollution	-0.374	-0.180
	(0.451)	(0.256)
Synthesis	1.326*	0.838*
	(0.265)	(0.154)
Uptake	0.345*	0.147
	(0.181)	(0.103)
Free Press		-0.083*
		(0.013)
GDP (PPP)		0.000*
		(0.000)
R^2	0.146	0.743
N	188	185

*$p < 0.05$

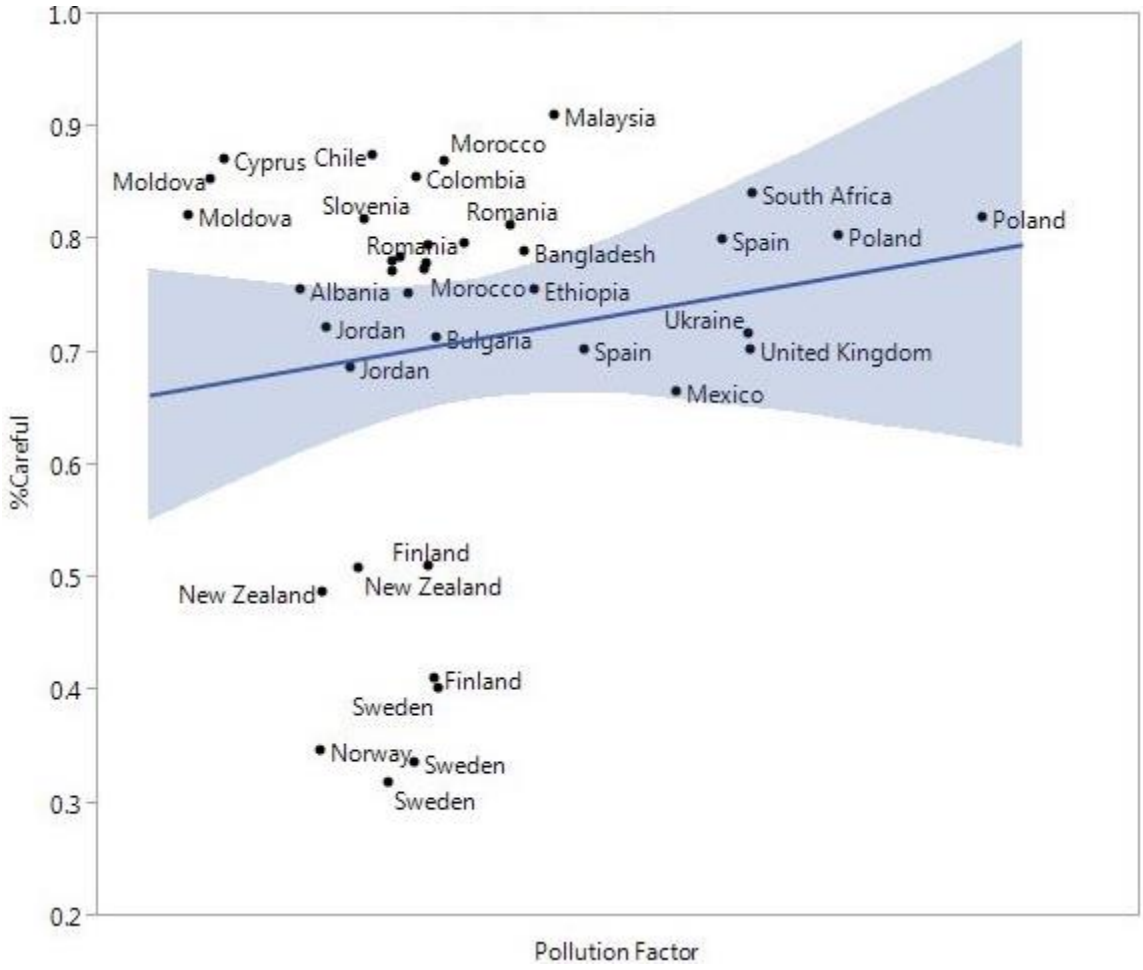

Figure 1: Scatterplot of Lack of Trust (being careful of others) and the Pollution Factor

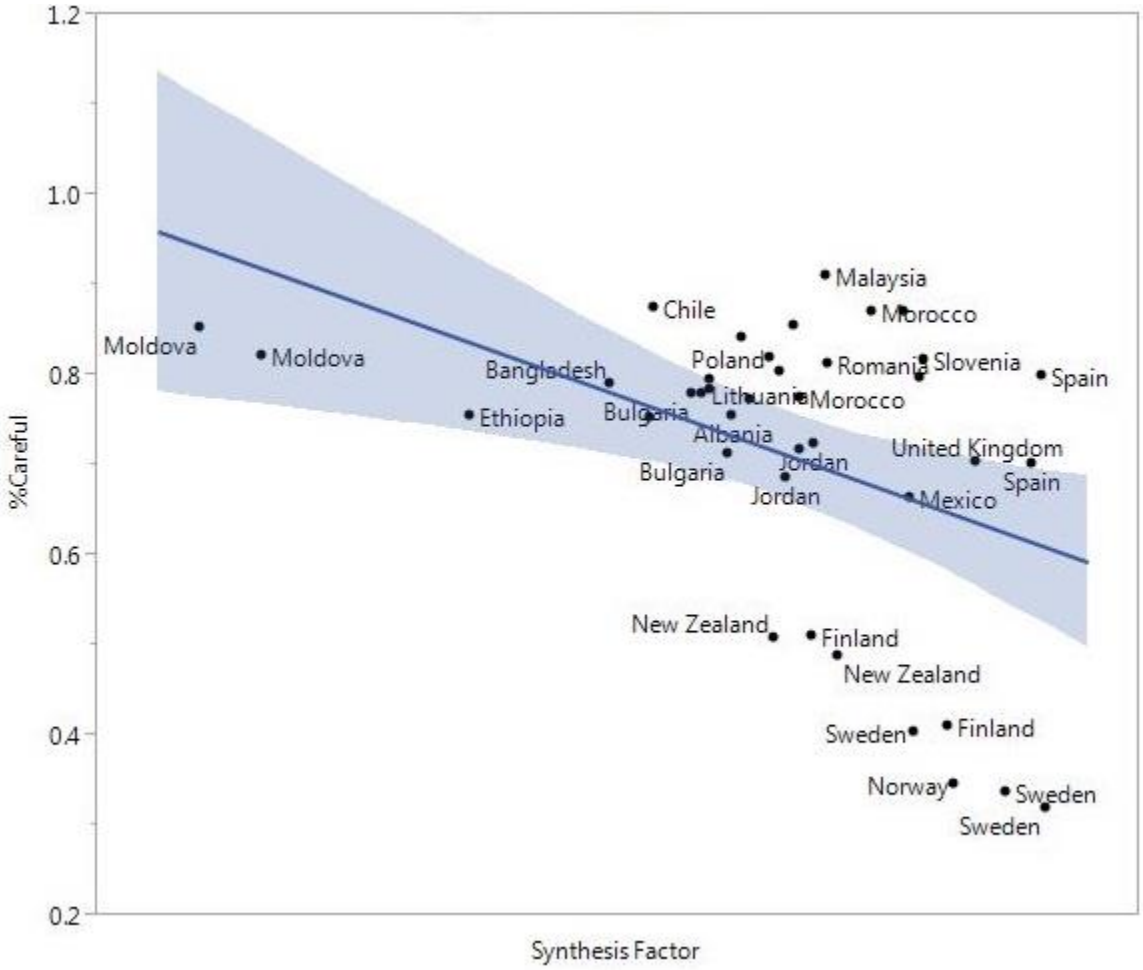

Figure 2: Scatterplot of Lack of Trust (being careful of others) and the Synthesis Factor

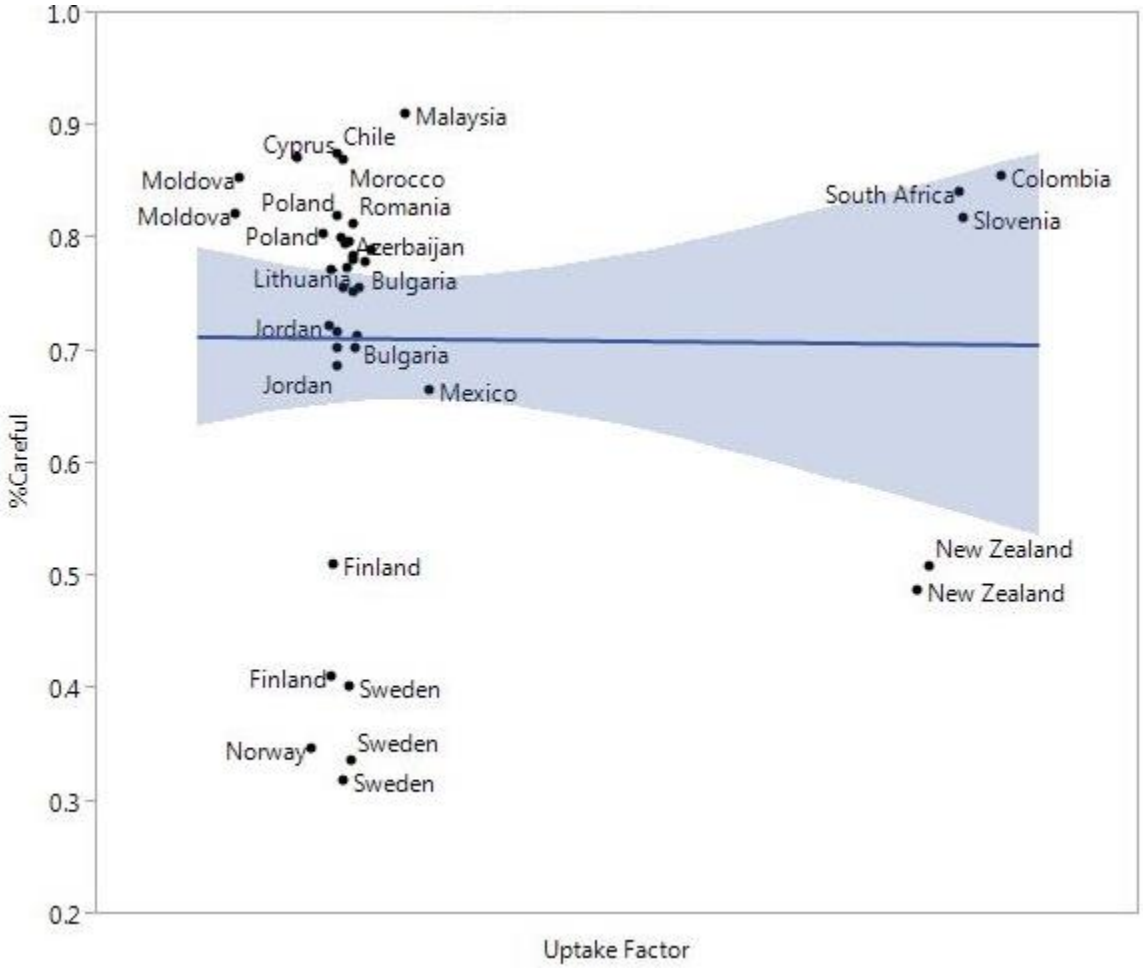

Figure 3: Scatterplot of Lack of Trust (being careful of others) and the Uptake Factor

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CHAPTER 4

FOOD FOR THOUGHT: TRUST DEFICITS & INTRASTATE CONFLICT[4]

[4] Dix, Joshua. To be submitted to *Economics and Human Biology*.

Abstract

Research in intranational conflict studies largely ignore the lack of trust as a causal factor for war, as the mere existence of war, to most researchers, seems to imply an obvious absence of trust. Building on research in the neurosciences and nutrition sciences, this study demonstrates that trust is a function of biology. It offers a set of environmental conditions that hinder the production of neurochemical compounds, which ultimately yields biologically induced trust deficits. It offers a variable to measure these deficits, and tests this variable in the least likely place for trust to exist: civil wars. Specifically, this study focuses on civil war onset and duration. The findings are that states with trust deficits rooted in biology are more likely to have more civil wars and longer civil wars.

Introduction

This work takes an atypical approach to the understanding, explanation, and prediction of intrastate conflict events by pulling together established research on human interaction and trust, not only from the social and cognitive sciences (within which political science typically finds its comfort zone), but also (and less typically) from nutrition science, neuroscience, and biochemistry. It offers a biological understanding of distrust that can be of significant value to the social sciences. When state populations consume specific nutrients at low levels, they enter a space in which the environment affects the ability to trust others. Within this space, states behave differently because of the biological impacts their environments have on their population's ability to trust others. In this study, an argument is made that states that exist in these environmentally poor areas have predictable behavior patterns because micro-level environmental constraints hinder the development of trusting responses. This process makes

them more prone to conflict in general. When those conflicts do occur, they are of longer duration than in those states that experience civil wars without these environmental properties.

As mentioned in Chapter 2, research in intranational affairs focuses on the motivations and social conditions that lead to intranational conflicts (wars or violent hostilities between regions or factions within a single country). In general, research on civil wars argues that grievances, greed, and the lack of alternative methods for problem solving are the most common reasons for these conflicts (Sambanis, 2004). The research detailed in this Chapter posits that another, controllable, factor is a significant contributor to intranational conflicts.

Theoretical Justifications For Trust Deficits As A Cause Of War

Research in intranational conflict studies largely ignores generalized trust as a cause of war because the mere existence of war, to most researchers, seems to imply a lack of trust. However, there is literature that directly links low trust to the advent of intranational conflict (Rohner, Thoenig, & Zilibotti, 2013). Low trust in general is a prerequisite for civil war. During these events, trust no longer functions in holding societies together and helping societies solve complex collective action problems. In this article, it is argued that trust is more than just a social relationship that is absent or present within states before they commit to internal war.

This dissertation posits that generalized trust on the individual level can be affected by one's environment. When individual consumption of vitamin C, copper, and phytoestrogens are low, basal levels of oxytocin are in short supply. Vitamin C is important because it is a required cofactor for the PAM enzyme to synthesize oxytocin. Copper is significant as well because it is the only metal that has the capability to support peptide amidation of neuropeptides, making it the key component not just for oxytocin synthesis but other neurohormones as well (Bousquet-

Moore, Mains, & Eipper, 2010). Phytoestrogens increase the uptake of oxytocin within the brain. In addition, organic pollutants play a role in decreasing overall oxytocin levels. When these organic pollutants are introduced within the body, they act as estrogen antagonists, which lower overall oxytocin uptake by the brain. Within states, when the masses are affected by the environment by the aforementioned factors, overall trust capability within the state drops, creating a trust deficit.

Essentially, the environment itself creates a cap on trust, leading these countries' populations to behave differently than state populations unaffected in this manner. With the existence of collective individual trust deficiencies, grievances create a shock to the system. Because of decreased capacity for trust within society, tensions increase, and the desire for cooperation decreases. As such, pathways to negotiation become less appealing than pathways to violent conflict in order to solve the collective action problem faced. Civil wars then rage on.

With regards to this project, realists may argue that trust is not a factor—that only interests and outcomes matter in the realm of civil wars. While it is true that interests and outcomes do matter, they are only part of the story. The research provided within this dissertation suggests that there are subsection of states with environmentally induced trust deficits, and when these deficits exist, generalized trust is in short supply. As a result, interests are affected. With little ability for generalized trust, interests are belligerent and non-trusting sides have little guarantee that their opponents will cooperate.

Ultimately, this leads to a path in which violent conflict becomes more appealing. The data collected herein demonstrate that biologically trust deficient states are more likely to see more civil wars, longer civil wars, and increased rates of civil war recidivism. These states

simply behave differently with regards to their interests, and they are that way because the environmental ills within their states cap their people's ability to be able to trust.

While this dissertation is a quantitative study on trust deficits and civil wars, it does provide a design for in-depth case studies. The test of the theory is two-fold. First, a selection of cases should be made in which states have similar factors. That is, states should be of similar Gross Domestic Product per capita Purchasing Parity Power, cultural attitudes, ethnic fractionalization, religious polarization, educational systems, regime types, civil liberties, and civil rights. The only difference between states should be the environments.

Three countries could be selected: one environmentally poor, one environmentally mediocre, and one environmentally healthy. Alternatively, for a two-case study, only the poor and healthy countries could be selected. Once the countries are selected, in-depth studies of the environments should be conducted in order to determine whether the population is actually attaining its necessary intake of vitamin C, phytoestrogens, and copper. It would also be important to determine the amount of pollution the society is subjected too, in general.

Once the states are chosen and the environments are thoroughly investigated, the case studies should focus on how grievances are processed within the state. That is, are they solved peacefully or through violent conflict. In order to achieve this, case studies should look at negotiations and their outcomes, whether to peace or to war.

Aside from the obvious potential for violence and destabilization, grievances within states bring a number of obstacles: informational inaccuracies and uncertainty (Underdal, 1983). Trust provides a mechanism to overcome these obstacles. Trusting parties which are open and honest with one another can minimize mistruths about each other's intentions and decrease uncertainty by providing information about needs, wants, and concessions.

That said, in order for grievances to be resolved peacefully, a number of steps must occur. First, and foremost, there must be an outcome in which both parties win; otherwise, talks are likely to collapse (Paik & Tung, 1999). Second, within trust deficient states, it is expected that the steps to procure peace falter and fail given the magnitude of the trust deficit. For example, it is expected that in the most trust deficient states formal negotiations do not take place at all because parties lack the ability to trust within the negotiation apparatus. If, however, parties do go to negotiations, perhaps the most important requirement is the starting point. A willingness to listen and understand other groups is an important step in resolving grievances (Malhotra, 2004).

Therefore, parties should lay out their grievances and be willing to at least understand the problems and desired solutions to societal problems which would avert civil war. Because they lack the capacity to trust others, parties from biologically induced trust deficit (BITD) states are expected to go into negotiations without the ability to understand other parties in the negotiations. Furthermore, they are likely to see others, not as partners, but as enemies. As a result, negotiations (unless they last) are expected to fall apart, and war is expected to be a more appealing strategy for a winning outcome.

In the event that the war ends and grievances—whether they are new or old—bubble to the surface again, because of the failure of previous attempts at negotiation, it is expected that populations from trust deficient states forgo talks and opt for fighting at first chance. In the future, these states are less likely to solve their internal issues by including third-parties because of the initial failure of the first talks.

Also of importance with regards to resolving grievances is reputation (Zacharia & Maes, 2000). Parties with histories of bad reputations often find themselves in conflict and

disagreement. Another important factor of negotiations is dependence. Trusting parties will structure agreements in which the outcome is dependent on all members participating according to the agreed upon terms. Within these agreements, when all parties cooperate, all parties end up with positive outcomes. When one party cooperates and another party defects, the party that defected encounters an outcome that is far better than the outcome of the party that cooperates. When both parties defect, both parties end up with mediocre outcomes, often leading to situations in which they are worse off than they were before they entered into agreements with one another. Trust deficit countries are expected to have a defect-only strategy.

Furthermore, negotiations with enemies or adversaries are usually calculative and include careful measures regarding concessions made to opposing sides. These agreements usually include substantial penalties for breaking contracts, enforcing participation through sticks, as opposed to carrots. It is expected that negotiations in trust deficit countries end up in contracts which are longer, more drawn out, and include a number of punishment provisions for varying degrees of infractions.

The importance of accurate and truthful communication cannot be stated strongly enough. In addition to honest communications, parties must trust each other enough to signal their needs as needs and their concessions as concessions (Malhotra, 2004). In their landmark work on labor negotiations, Walton & McKersie argue that when major concessions are not labeled as such, negotiations can fall apart (1991). The authors give an example of a corporation which was fed up with the process and wanted an end to the conflict. The corporation made a last-ditch effort, conceding many of its demands. The other party, however, expected a drawn-out battle, and held out for a better deal. As a result of this action, the corporation's leadership determined the other party to be greedy, and they walked away from the table. The lesson

learned here is open communication on all sides greatly decreases uncertainty and inaccurate assumptions. Parties within trust deficient states are likely to express similar behaviors when seeking to resolve grievances. Because of their decreased inability to trust, they are expected to lower incidences of accurate signaling of concessions and higher incidences of expectations for longer discussions, where each condition within formal documents are gravely contested.

One of the reasons that negotiations fail is because sides use less than honest tactics to achieve their goals (Roy J Lewicki & Polin, 2013). Because of the population's inability to trust, these tactics are expected to be pursued in order to maximize the gain of in-groups and maximize the losses of out-groups. Negotiators are expected to practice competitive bargaining—or, opening with exaggerated offers. They are also expected to attempt to manipulate the other side's emotions by way of faked disappointment, anger, and elation. The sides are also expected to misrepresent their positions and employ bribery and spying to learn about the intentions and ultimate goals of their opponents.

As such, within trust deficient intrastate conflict negotiations, positive tactics for peace that are expected to be employed are trust building exercises within before formal negotiations themselves (Kelman, 2005). Also, negotiators are expected to induce reciprocal concessions. In this case, after the initial demand is made and rejected, a lesser demand is asked for, and the opponent takes it, conceding, and feels obligated to return the favor—thus, starting the conversation and moving towards a possible agreement (Cialdini et al., 1975).

The use of such tactics are expected to have consequences, both in the short and long terms (Roy J Lewicki & Polin, 2013). In the short-term, as long as deceptions remain hidden from other groups, gains are expected. However, it is expected that population groups which

have been deceived in the past will exact retribution in future relations. When grievances arise in the future, groups may opt for war as a solution because of consistent past defections.

Should groups choose negotiations, parties are expected to start off with extreme positions with hard demands and very little room for movement and little room for movement. These positions and lack of leeway for discussions implicate a likelihood for collapse, sooner or later. Furthermore, if intrastate populations are willing to pursue violence in order to achieve their goals, tensions are expected to increase and negotiations are expected to collapse, leading to civil war or civil war recidivism.

In this article, the state histories of civil war are examined. It is believed that states will see higher onset and duration of civil wars where intake levels of vitamin C and phytoestrogen are low. Two hypotheses are offered:

Hypothesis 1 (Onset):
All things being equal, civil wars are more likely to occur in years where states have profound nutritionally induced trust deficits.

Hypothesis 2 (Duration):
All things being equal, longer civil wars are more likely to occur in years where states have more profound nutritionally induced trust deficits.

Methodology[5]

For the full operationalization of the main independent variable, BITD, please see the second part of chapter 2. In short, the variable was created using the UNFAO's food balance sheets, which show the human-consumed food within a country in a given year. Each food item within each country and each year is then collapsed, and the nutrition information is pulled out for both vitamin C, copper, and phytoestrogens. Those variables are then put through a model (demonstrated in the second part of Chapter 2) to form one variable, representing the strength of the trust deficit within the country. Low levels of the Biologically Induced Trust Deficit (BITD) variable equate to low levels of trust (strong trust deficits).

An additional step is applied to the BITD variable in this chapter. Given that the model fits trust for the years 1980-2008, and there is food data going back to 1961, the process included putting the entire time frame into the model. As a result, trust deficit data now exists on all countries included in the UNFAO food datasheets between 1961 and 2008, including those states with missing data during the 1980-2008 time period included in the World Values Survey.

Main Independent Variables Used in the Study

This article uses two main independent variables. The first is a dummy variable that indicates a Biologically Induced Trust Deficit State (BITDS), and the second is a value (continuous) variable (BITDV) that is formulated by two environmental conditions (as explained

[5]With regards to the methodology of this project, there is an issue with data availability. The original goal involved applying the dataset created in the first article to test for civil war onset in this article. As it stands, the data for water and some air pollutants are unavailable or, they are available in abundance for some states but not others. As such, I have created a different dataset using just phytoestrogen, copper, and vitamin C consumption. In essence, this still uses the most important parts of the trust deficit variable. This change is noted now in the third chapter. The construction of the variable can be found in Chapter 3 as well.

in the previous section). For the first variable, the total per capita consumption of Vitamin C is under 100mg per day per year. In the second environmental condition, total per capita phytoestrogen consumption is below 500µg per day. Cases that satisfy all these requirements are valued at "1" and other states at "0." This variable is lagged. The second variable, the BITDV, is based solely on total phytoestrogen and vitamin C consumption. BITDVs range from 0-100 on a continuous scale, where lower numbers represent higher trust deficit values. The average BITDV is 41. This variable is lagged.

Dependent Variables

The civil war onset and duration data are compiled from a number of sources: including Sambanis 2000, Collier & Hoeffler 2004, Licklider 1995, Freedom House, and the CIA Factbook. Civil war onset is coded as a dummy variable. If a civil war, which involved the deaths of over 1,000 people begins in a particular year, that year is coded as "1;" all others are coded "0." The data include civil wars that occurred between 1961 and 1999. While the combined intrastate conflict data go back to 1945, the environmental data exists from 1961 onward. For the years between 1961-1999, there were 64 major civil wars out of a total of 5,467 total country years. The dependent variable in Hypothesis II is civil war duration, a continuous variable, measured in years.

Independent Variables for Controls and Alternate Hypotheses

GDP Per Capita This variable comes from the Penn World Table as well as the World Bank's World Development Indicators (Heston, Summers, & Aten, 2002). Altogether, there are 6,610 country years of per capita income data. Data are measured in standardized 1985 1000s of

US Dollars. They are logged, as well as lagged by a year. Research in intranational conflict suggests that lower per capita income is associated with civil war onset and longer civil wars. Similar findings are expected in this article.

As mentioned in the literature review, research in civil war studies also notes that population size is a factor, as larger populations increase the possibility for grievances against governments. In this article, state populations are controlled for in the models. State population between 1961 and 1991 is based on estimates from the Correlates of War dataset, while population from 1992 to 2008 is based on estimates from the World Development Indicators. Population is measured in 1000s. Data are logged, as well as lagged by a year. Larger populations are expected to be associated with both civil war onset and longer civil wars.

Research in conflict studies notes that rough terrain is associated with civil war and longer civil wars. The reasoning is that such terrain is often difficult to control and offers a hiding place for insurgents (Fearon & Laitin 2003). For example, mountains and forest areas are wild and difficult to navigate with military vehicles. This variable is compiled using the CIA World Fact Book. The data are logged. These data are expect to be positively associated with both civil wars and longer civil wars.

Fearon & Laitin also argue that states that are separated from the capital city's region by at least 100km of water see higher incidences of civil war and longer civil wars (2003). As with the mountains argument, the authors suggest that these states have geography that is very difficult to control. I use their variable, which is coded as a dummy.

The greed research argues that natural resources are a cause for civil wars. To control for this explanation, World Development Indicators are used to determine the percentage of fuel as exports within each state. States with oil exports of greater than 33% of total are classified as oil

exporters and receive a "1" value; all other states are valued at "0." Being an oil producer is expected to be positively correlated with civil war and civil war duration.

A variable is also included as an indicator for drug financing. This variable goes towards the greed argument in which civil wars are caused by factional desires for more wealth and power. Given that illegal drugs bring in large sums of capital which can be used to purchase luxury goods, as well as weaponry, revolutionaries and insurgents often use drugs for currency in situations where hard currency is unavailable (Berdal & Malone, 2000; Collier, 2003; Ross, 2004). Civil wars in which insurgents have used drugs (contraband) as a major means of financing their campaigns are included in this variable and receive a "1" value; all other states are valued at "0."

The civil wars literature also argues that government type contributes to civil war (Walter, 2004). To account for this explanation in my models, the study uses the polity variable from the Polity IV regime index. This measure scores states from -10 to 10 on a continuous scale, where "-10" represents full autocracies and "10" represents full democracies. As the current research finds, autocracies are expected to be more associated with civil war than democracies. Within the models presented in this study, the Polity IV measure is lagged by one year.

Political instability is associated with civil wars as well. States with unstable governments and unruly populations are breeding grounds for revolt (Hegre, 2001; Weingast, 1998). Grievances are often high, and governments are unable to control their borders. As a result, factions within the state are able to galvanize support and take arms up against the state. This study uses the Polity IV regime index to determine political instability. This variable is coded as a dummy variable, where "1" indicates that the country had greater than a 3% change in

polity three years before the country year tested. This variable is lagged by a year. This study also includes a measure for new states. This variable is compiled using the CIA Fact Book. States are considered "new" if they achieved independence within the two years prior to the civil war. New states are likely to see civil wars if they do not have sound institutions after independence (Collier, 2003; Walter, 1997).

Ethnic polarization and fragmentation are also associated with higher incidences of civil wars, as with extensive divides between ethnic populations comes grievances against the government and different populations within society (Chakravarty, 2015; I. A. Elbadawi & Soto, 2015; Garcia-Montalvo & Reynal-Querol, 2004; Hegre & Sambanis, 2006; E. Kaufmann, 2015). To control for this explanation, this study uses Fearon & Laitin's 2003 measure of ethnic fractionalization. The authors compute this variable by factoring the proportion of the group with the highest population as well as the log of the total languages spoken by more than one percent of the population.

In addition to ethnic polarization, research suggests that religious polarization is a factor for civil war (Dowd, 2015; Koos & Pierskalla, 2015; Murshed, 2015; Traunmüller, Born, & Freitag, 2015). Similarly to ethnic fractionalization, religious polarization involves strong bonds between groups. The literature demonstrates that religious polarization leads to conflicts that involve incredibly violent deaths and torture. The CIA Factbook is used to code this variable, and it is coded as a continuous variable for the percentage of religious groups in each state by country year.

Results And Discussion

Overall results suggest that trust deficit levels do impact the onset of civil war—that is, civil war onset is more likely to occur when states have more profound trust deficits (very low BITDV levels). Likewise, civil wars are less likely to occur in years when states do not have strong trust deficits (higher BITDV levels). This holds for the logistic regression results (Table 4). It is important to note that the dummy variable indicating that a state is a BITD country is significant, but negatively correlated with the onset of civil war. This finding was not expected. However, the BITD dummy variable by nature encapsulates a variety of state environments, ranging from the worst-case-scenario type of state to states that miss their required intakes by one milligram of vitamin C and one microgram of total phytoestrogens.

The results from the model with the BITDV variable are good, as they illustrate positive results for the first hypothesis: states are more likely to experience civil wars when their environments hinder oxytocin production. When the vast majority of a population is consuming inadequate levels of vitamin C and phytoestrogens, a societal trust deficit is created. These trust deficits contribute to the willingness to fight against the state and other factions within the state in order to achieve their collective goal. In other words, states with severely low levels of collective consumption of nutrients are choosing to fight, instead of choosing to cooperate. Therefore, as seen from this model's results, it can be said that the low levels of nutrition facilitate conflict.

Detailed Discussion of Results: Civil War Onset Model

The results of this model (Table 4) illustrate that there is, in fact, a slight connection between the microfoundations of trust and conflict. Results of the whole model test demonstrate

that lower levels of the trust deficit variable translate into a higher likelihood of civil war onset. In other words, each unit increase in BITD leads to a 1% decrease in the odds that a civil war occurs. This finding adds to both the trust and the conflict literatures, as it demonstrates that the two are entwined on the cellular level. This shows some support for the overall argument that environments that hinder the production of oxytocin produce trust deficits within the states.

The model finds other variables to be statistically significant as well. As expected, a negative correlation exists between GDP and civil war onset. Research on civil wars demonstrates that low GDP is commonly associated with civil war onset (Collier & Hoeffler, 2002; I. Elbadawi & Sambanis, 2002; Hegre & Sambanis, 2006; Joshi & Quinn, 2015; Bo Rothstein & Dietlind Stolle, 2008). This makes sense because GDP is a strong predictor of state institutional effectiveness. The model shows that a unit increase in lagged logged GDP leads to a 43% decrease in the odds of civil war.

Also, population size was found to be significant and positive with a one unit increase in lagged logged population leading to a 24% increase in the odds of civil war onset. Additionally, as seen in the literature, the existence and extent of mountainous terrain were both found to be positive and significant, meaning that civil wars were more likely to occur with increased population sizes and rougher terrain. Here, an increase of logged percent mountainous terrain leads to a 30% increase in the odds of civil war onset.

The model demonstrates that oil producing states are 2.29 times as likely to experience civil war onset as non-oil producing states. New states and states with stability problems were also positively correlated to civil war onset. New sates were 7.95 times more likely to see civil war onset than older states. Finally, a unit increase in political instability nets a 110% increase in the odds that a civil war occurs in a given country year. Taken together, trust deficits, combined

with lower GDP, higher population sizes, and rough terrain, are all recipes for catastrophic, internal wars.

In Table 5, a predicted probability table of the effect of trust deficits on civil war onset can be found. This table consists of only the significant variables in the first model (lagged and logged GDP, lagged and logged population, lagged percentage mountainous terrain, oil producing states, new state status, and the BITD variable). The predicted probability table holds all variables except for the BITD variable at their means or medians, depending on the variable type (continuous or binomial). A "0" score (high trust deficit) yields a 22% chance of civil war in the given year. At a "25" on the BITD variable, civil war onset probability drops to 18%. At "75" for the BITD variable score, civil war onset probability is 15%. At a "75" level, onset is 12%. Finally, at "100," civil war onset is 10% probable.

In Figure 4, a predicted probability chart is presented, demonstrating the effect of the BITD variable, given a worst-case scenario state profile. Lagged logged GDP is held at 4.89 (lowest possible), lagged logged population is held at its mean, percentage mountainous terrain is held at its mean, oil production state is held at 1, instability is held at 75%, new state is held at 1, and BITD is set to be variable. From the figure, it can be seen that there is a sharp negative slope. Thus, it can be said that holding other significant variables at their worst levels, a bottom BITD score of "0" has an almost 80% probability of civil war onset, while a "100" BITD value (high trust) has a 55% probability of civil war onset. Again, this finding supports the first hypothesis. Despite other effects, lower levels of appropriate individual nutrition lead to a civic trust deficit, a societal problem. Increased appropriate nutrition appears to bring down the probability for war.

Detailed Discussion of Results: Civil War Duration Model

Because duration times are not distributed normally, it is necessary to use the Weibull distribution. Herein, parametric survival analysis is used, specifically an accelerated failure time (AFT) model. This model assumes that the covariate's effect decelerates or accelerates the survival of some item by a constant. While proportional hazard (PH) models are more often applied to survival data, the AFT model provides similar results—based not on the hazard function as seen in PH models, but on the survival curve. The AFT model is used here because it is both conceptually intuitive and easier to interpret.

The results of the duration model (Table 6) demonstrate a clear correlation between the biological foundations of trust and conflict length. Specifically, a one unit increase in the BITD variable decreases the survival time of the war by 3%. This finding, similar to the models within the first hypothesis, supports the overall argument that poor environments hinder trust development which have profound effects on civil wars. In Table 6 and Table 7, these results can be found.

The model shows that other variables are statistically significant in addition to my main independent variable. A one unit increase in lagged logged population increases the civil war by 26%. This fits with the existing literature. Increasing the lagged and logged polity score by one unit decreases the length of the war by 4%. In other words, as polity scores move from authoritarian to democratic, civil war length decreases. The model demonstrates that oil producing states' wars are 32.5% shorter than non-oil producing states. While it was expected that oil producing states would have longer civil wars, the reason why they are more likely to have shorter wars may be that oil producing states are more likely to have strong militaries (Art,

1980; Coker, 1983). These strong militaries may be more effective at quashing civil clashes. More research should be done to determine the reason.

As expected, states where drug running is used to fund illicit activities have longer civil wars. These states' civil wars are 47.3% longer than civil wars in states where drugs are not an issue. Religious fragmentation has a very powerful effect on the length of civil wars. Increasing religious fragmentation greatly reduces the probability that the civil war ends at all. This runs counter to the literature, as studies frequently find that once controlled for, counterintuitively religious polarization does not contribute to civil war onset or duration (Collier & Hoeffler, 2004; Fearon & Laitin, 2003b; Hegre & Sambanis, 2006).

What is interesting is that the model demonstrates that GDP is not a significant variable in the model. Its sign is also in the wrong direction. Increased GDP should negatively affect civil wars' durations. Also not significant is being a noncontiguous state, the percentage of mountains, ethnic fragmentation, instability, and majority Muslim states. This runs counter to the position that states with difficult terrain and instability are likely to experience longer, more drawn out wars. Running the model without the BITD variable, percentage mountains, ethnic fragmentation, instability, and majority Muslim states all become significant at the $p=0.1$ level on one-tailed tests.

It is interesting that including the BITD variable pushes other variables out of the range of significance. This does fit within the hypothesis posited in this study, however. What the models show is that by adding a variable that measures these trust deficits, the model is able to account for more of the story. According to Dziak et al, the AIC estimates the "constant plus the relative distance between the unknown true likelihood function of the data and the fitted likelihood of the function of the model [which means that] a lower AIC means a mode is

considered to be closer to the truth" (2012). The BITD model has an AIC estimate of 491.31, and the non-BITD model has an AIC of 495.00, so it must be accepted as the better, more accurate model. Hypothesis 2 should be accepted.

In this article, two hypotheses were put forth. In the first, it was argued that civil wars were more likely to occur in states with environments that hinder oxytocin production. In the second, it was argued that states with environments that hinder oxytocin would have longer civil wars. For both civil war onset and duration, the lack of nutrition appears to be a key aspect in creating trust deficits.

While the current studies in nutrition and conflict do focus on the effect of certain nutrient deficiencies on population behavior, these pertain mostly to the availability of food to prevent hunger (Blattman & Miguel, 2010; Buhaug & Lujala, 2005; Toole & Waldman, 1993). A plethora of studies do test the effects of micro- and macronutrient deficiencies on individuals and populations; these, however, are often related to the disorders caused by malnutrition, be it from a lack of carbohydrates, proteins, fats, or organ-related vitamins (Costa, 2012; Ke, 2014; Loewenstein & Phillips, 1973; Marchione, 2013; Trienekens, 2013)

While the research presented in this article may appear to be different, it is actually quite similar. This article may be thought of as one of the first epidemiological explorations of the effects of intracranial micronutrient deficiencies on intranational conflict. While each intranational conflict has its own individual story, we use scientific methodology to provide insight to collective causes, effects, and solutions for prevention. The research presented in this article does just that. For example, let us look at a few conflicts where this research could be applied: Guatemala in 1968, Cambodia in 1975, Nicaragua in 1978, and Senegal in 1989 can all be classified as states with low GDPs per capita, high ethnic fragmentation, and low polity

scores. Adding the extra variable of trust capacity, the model outperforms the currently excepted explanations. For example, this model holds that the conflict in Guatemala had a 98% failure probability by the 29th year, when it ended. Guatemala's 1968 trust potential level is 4. Nicaragua's trust potential level was 41 in 1977 (predicting for 1978), and the trust capacity model is twice as effective in predicting the length of the conflict of two years. Finally, Senegal's conflict in 1989 lasted 12 years, and the model again, predicted a higher failure probability after 12 years than current explanations. As seen in this duration model, controlling for a number of variables currently established in the literature as causes for civil war duration, when trust potential is added to the equation factors that were once considered important no longer proved significant. While this variable alone should not be seen as a silver bullet that allows us to ignore other factors, it does offer new insight into factors that contribute to longer or shorter conflicts.

The conclusion of this article is two-fold. Civil wars are more likely to occur in regions of the world where vitamin C and phytoestrogens are in short supply, and civil wars that do occur in these regions are more likely to last longer. These nutrients are paramount to the proper development of the neurohormone oxytocin (the trust hormone). At lower agricultural consumption levels, trust deficits occur, corroding the very fabric of society. Without trust to hold societies together and aid in the collective action solving process, societies fall apart. By allowing for incremental environmental change, a positive relationship between per capita decreases in the nutrients required for synthesizing the hormone responsible for interpersonal trust and civil war onset is seen.

Malnourishment comes in many forms. It can be due to a lack of calories, fats, minerals, protein, and vitamins. The research in the biological sciences focus on individual effects of

malnutrition on people because of health concerns. This article focused on the effects of malnourishment on the brain because of social science concerns. When the average citizen has not consumed an adequate intake of vitamin C and phytoestrogens, it has a major effect on trust within society, the state of the nation, and ultimately, it can exacerbate the likelihood or continuation of civil wars. Policy makers, aid providers, and scholars alike should advocate for healthier environments as a risk-reducing mechanism for violence.

Table 4: Country Year Logistic Regression of Civil War Onset 1961-2008

TERMS	Mode 1
Intercept	1.962
	(1.889)
Log GDP (1985 USD 1000s)	-0.888*
	(0.207)
Log Population	0.250*
	(0.101)
Log %Mountains	0.300*
	(0.113)
Oil Producer [1, 0]	0.263
	(0.213)
Ethnic Fractionalization	0.259
	(0.569)
Religious Fractionalization	-0.533
	(0.774)
New state [1, 0]	1.129*
	(0.304)
Polity	0.026
	(0.022)
Instability	0.471*
	(0.142)
Nutritionally Poor State [1, 0]	-0.558*
	(0.277)
BITD	-0.039*
	(0.020)
R^2 (U)	0.149
N	5329

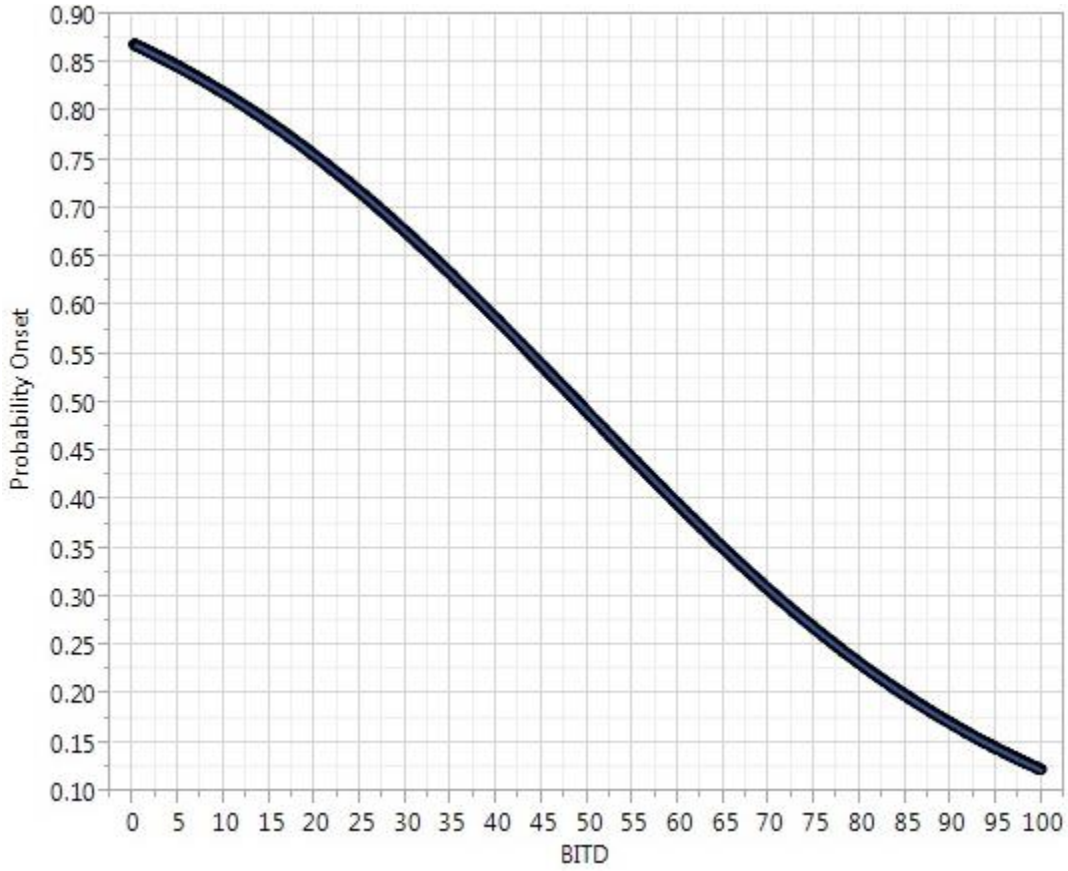

Figure 4: Worst Case Probability of War

Table 5: Onset Probability

BITD	ONSET PROBABILITY
0	22%
25	18%
50	15%
75	12%
100	10%

Table 6: Country Year Duration Model

TERM	MODEL 1
Intercept	-0.341
	(0.932)
Oil Producer[1, 0]	-0.272
	(0.161)
Ethnic Fractionalization	-0.202
	(0.389)
Religious fractionalization*	2.674
	(0.649)
New State [1, 0]	0.003
	(0.191)
Polity*	-0.067
	(0.018)
Instability [1, 0]	0.071
	(0.114)
Lagged GDP	0.000
	(0.000)
Lagged Population*	0.219
	(0.086)
Log Mountain Percentage*	0.178
	(0.073)
Drug Financing [1, 0]*	0.272
	(0.119)
Noncontiguous State [1, 0]*	0.496
	(0.133)
Nutritionally Poor [1, 0]*	0.47
	(0.131)
BITD*	-0.022
	(0.011)
Δ	0.626
	(0.064)
AIC	429.144
N	63

Table 7: Time Ratios for Table 6

TERM	TIME RATIO	B=1/Δ
Intercept	0.711	1.598
Oil Producer[1, 0]	0.762	
Ethnic Fractionalization	0.817	
Religious fractionalization	14.491*	
New State [1, 0]	1.002	
Polity	0.935*	
Instability [1, 0]	1.073	
Lagged GDP	1.000	
Lagged Population	1.244*	
Log Mountain Percentage	1.195*	
Drug Financing [1, 0]	1.312*	
Noncontiguous State [1, 0]	1.642*	
Nutritionally Poor [1, 0]	1.599*	
BITD	0.978*	

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CHAPTER 5

POST-CIVIL WAR RESURGENCE AND THE ENVIRONMENT[7]

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Abstract

Trust is largely ignored in intranational conflict studies as a cause of repeated civil war, as to most researchers, the existence of war implies the absence of trust. Research in neuroscience suggests that trust itself is a hormonal function. In this article, it is argued that sub-par agricultural conditions that hinder the production of oxytocin (the neurohormone responsible for trust) result in trust deficits. After explaining this relationship and noting the specific conditions, the variable used in the last chapter is used to demonstrate that extreme biological trust deficits result in increased rates of civil war recidivism. The variable is modeled, and the results indeed show that civil war recidivism is more likely in states with very strong trust deficits. Furthermore, states with biologically induced trust deficits are more likely to see civil war resurgence in both the short and the long term.

Introduction

Given the sheer number of repeat international conflicts in the world, should the United States and other powerful countries continue to pursue peaceful solutions after multiple failures? If so, are there factors that aid in preventing the reigniting of civil wars that are overlooked, ignored, or undiscovered by the field of international affairs? If there are, how do they compare to currently employed political, economic, and social solutions to the prevention of civil war recurrence? From a normative perspective, the Kantians among us would argue that doing no harm and convincing others to do no harm is the primary goal for all humanity, even if they have not been yet been successful in achieving that aim. Others, however, demonstrate that civil wars that end in clear victories are more likely to maintain a durable peace (Luttwak, 1999; Wagner, 1993). Falling into the former camp, an agricultural solution is offered to aid in the prevention

civil war recurrence that can be implemented by state, international, and non-profit organizations: improve the overall quality of international food aid and stress the production of micro-nutrient rich foods.

After the fighting stops in civil wars, social trust levels between groups are quite low, if they exist at all (Collier, 1999). The potential to trust, however, is not completely destroyed. Generalized trust--that basic propensity to extend trust and good will towards strangers—is an extraordinarily important component of a society's collective ideology (Putman, 2000). While this conclusion is generally viewed through a social lens in international affairs, evidence in neurochemistry suggests that trust is biologically facilitated by the neurohormone oxytocin (Brody, 2002; Englard & Seifter, 1986; Keller, 2005; Kosfeld et al., 2005; P. J. Zak, 2005b).

In order to synthesize oxytocin, vitamin C is required, while plant-based estrogens aid in the uptake of the hormone in the brain (Padh, 1990; Parker, 2014; Patisaul, 2005). Copper is also required to synthesis oxytocin (Bousquet-Moore, Mains, & Eipper, 2010). In this study, a variable is utilized that measures biologically induced trust deficits (BITD) by country and year between 1961 and 2004. The variable is based on the relationship between three micronutrients (vitamin C, copper, and phytoestrogens) and trust, as measured in the World Values Survey (WVS).

The research questions in this work have been what causes low trust and how does low trust affect civil wars when other factors are controlled for? Specifically for this chapter, the question is: do these deficits affect civil war recurrence outcomes? The overall results of the study show that civil war recurrence is more likely when states have very strong trust deficits. The theory in this article is that low intakes of copper, phytoestrogens, and vitamin C cause trust low levels of trust within individuals, as there are lower levels of oxytocin saturated within

individuals' brains. When this phenomenon occurs at the societal level, affecting the population to the extent to which the average individual suffers from nutrient-specific malnutrition, disagreements, tensions, and general senses of unwillingness to cooperate saturate the state. This unwillingness to cooperate increases the propensity for violence as a means to remedy grievances. In other words, low rates of nutrient intake acts as a root cause for civil war recidivism.

At very low levels of these nutrients, the probability of civil war recidivism is very high, but as nutrition increases, the probability of war decreases substantially. This Chapter will first provide a brief recap of the BITD development. Second, the BITD will be tested against controls on civil war recurrence rates. Following a report of the findings is a detailed discussion including a section on policy implications for future wars, as well as academic studies.

The goal of this research review is to present existing explanations for the recurrence of civil war in both the short- and the long-term periods of time. One of the major differences between civil wars and interstate wars is violence against civilians: in interstate wars, attacks on civilians are generally off limits; the same cannot be said for civil wars. Another difference is that during civil wars and repeated conflicts, violence is usually perpetrated by neighbors against neighbors; in many of these conflicts, the sides know each other.

Civil wars are generally carried out in order to be the winning party; they establish policy by force and without input from other groups. Civil war violence is not random, but rather is directed at achieving a set of particular goals by rebel leaders. They are battles aimed at winning sovereignty. While leaders may or may not have ulterior motives of their own that are not in line with the ideology of their cause, in order to properly offer a challenge to the state, they must be able to mobilize and recruit members to be the costs of the war (Kalyvas et al., 2006). In this

regard, in order for civil wars to recur, there must be opportunity, as frustration and anger alone are not enough to mobilize people to fight (Fearon & Laitin, 2003a; Gurr, 1970).

Trust Deficits as a Cause of Civil War Recurrence

Trust can be thinly defined as a willing extension of vulnerability in exchange for some expected benefit—either mutual or otherwise. At its core, however, trust is much more. It is a deeper individual feeling or collective understanding that participants will not be taken advantage of, even if it is within the best interests of the party/parties involved to defect. Trust is not only the glue that holds societies together, but it also a lubricant, guiding societies through the difficulties of overcoming collective action problems. Trust fosters positive social interactions, interweaving together both individuals and groups into the very fabric of society.

There is a hole in the intranational conflict research, as it largely ignores the importance of trust as a factor of civil war recurrence. Perhaps, researchers view the existence of conflict as an implication of the absence of trust. In the events leading up to civil wars and during those wars themselves, trust no longer acts as the glue that holds states together or enables societies to successfully solve complex collective action problems This article argues that trust is more than an existing or absent relationship between members of a state.

What humans eat greatly affects their behaviors, how able they are at completing simple and complex tasks, as well as the decisions they make, and the policies they pursue (Lozoff, 1989; Lozoff, Jimenez, Hagen, Mollen, & Wolf, 2000; Pollitt & Leibel, 1976). Neuroscience research suggests that trust is actually a biological function, dependent on the neurohormone oxytocin (Baumgartner et al., 2008; De Dreu et al., 2010; Kosfeld et al., 2005; Luck & Jungclas, 1987; Sheldrick & Flint, 1989; P. Zak, 2005). As oxytocin levels increase, so does the likelihood

that people will interact with strangers and trust them inherently (Mikolajczak et al., 2010). To produce oxytocin, the body needs vitamin C (Hornig, 1975).

Increased vitamin C consumption itself has been demonstrated to increase oxytocin levels and production (Luck & Jungclas, 1987). Phytoestrogens (plant-based estrogens) are vital in the uptake of oxytocin within the brain (Verbalis, 1999). Furthermore, studies demonstrate that consumption of organic phytoestrogens increase the uptake of oxytocin (Albertazzi et al., 1999; Mazur, 1998; Paul J Zak & Fakhar, 2006). These neuroscience studies demonstrate that trust is, at its most basic level, neurohormonally based.

Herein, it is argued that states with agricultures that do not provide adequate vitamin C and phytoestrogens levels hinder oxytocin production, resulting in biologically induced trust deficits. Because of these deficits, the glue that binds society together corrodes, and collective action problems become far more difficult to solve peacefully because the ability to extend trust to strangers does not exist. These deficits affect every aspect of civil life: from governing institutions to civil society and interpersonal relationships. Where these types of deficits exist, civil war recurrence may be inevitable.

In this article, the effect of biologically induced trust deficits on civil war recurrence is examined. In post-civil war, strong BITD states, populations are at a severely diminished capacity for trust because and malnutrition and the effects of war. These states are not only disjointed and separated by faction, but their populations also lack the fundamental, biological elements to trust strangers. As such, our existing social science explanations for fostering generalized trust and building social capital to prevent civil war recurrence fail, as populations are missing the precursors for trust development. Putting this new understanding of trust

together with current social methods to foster lasting peace after civil wars, I offer the following hypotheses:

H1: All things being equal, civil war recurrence is likely to occur in countries with strong trust deficits.

Research in the social sciences suggest that identity wars (those where the basis of fighting is determined over race, ethnicity, religion, or some other identity-based issue) are more likely to relapse into war (Quinn, Mason, & Gurses, 2007; Sambanis, 2002). That said:

H2: All things being equal, civil war recidivism rates in countries which have had identity civil wars will increase with increased trust deficits.

Methodology

The main independent variable in this article is BITD (see Chapter 2 for the operationalization of the variable). Adding to the dataset created in the second article, this article employs one nominal dependent variable. The variable spans the years between 1961 and 2004. Cases are excluded that have civil wars that continue to rage on today. A few cases were also excluded because nutrition information is not available. All in all, 16 country cases had to be removed because they lacked either nutrition data or they had ongoing civil wars. Countries excluded because of lack of available nutrition data and/or continued civil war were Afghanistan, Bosnia and Herzegovina, Burundi, Central African Republic, Congo, Democratic Republic of the Congo, Dominican Republic, Ethiopia, Iraq, Moldova, Mozambique, Sudan, and Uganda.

The dependent variable itself has three levels, and ordinal regression modeling is performed. Given any country year in which a civil war ends, states received a "0" if their wars do not relapse at all into future fighting. Second, states received a "1" if their civil wars relapsed within the first five years (years 1 to 4 after fighting stops after the first iteration of the war). Third, states received a "2" if their wars had relapsed after the five-year mark. The study is set up this way in order to keep the end results fluid and to allow for one overall logistic regression. This technique of asking whether or not civil war occurs in the short- and long-terms can be found within the literature (i.e. Sambanis's 2002 study on partitions). The data on civil war recurrence come from the Correlates of War's Intra-State War dataset V4.1.

Alternate Explanations (Control Variables)

To determine Per Capita Income, data is used from both the Penn World Table, as well as the World Bank's World Development Indicators (Heston et al., 2002). Data are measured in standardized 1985 1000s of US Dollars. They are logged and lagged. Values are used in the year in which the civil war ended. Research suggests that lower per capita income is associated with higher incidences of civil war recurrence (Walter, 2004). Similar results were expected for this study.

Research in civil war studies also notes that population size is a factor, as larger populations increase the chance for post-civil war factional disagreements (Quinn et al., 2007). In this article, population is controlled for in the model. While population from 1992 onwards is based on estimates from the World Development Indicators, state population between 1950 and 1991 is based on estimates from the Correlates of War dataset. Population is measured in 1000s.

Data are logged, as well as lagged by a year to prevent a priori effects. It is expected that states with larger populations see increased civil war recidivism.

This study controls for geographic explanations for civil war recidivism with regards to terrain, the percentage of mountains within a state and states with capitals surrounded by water. Research in conflict studies notes that rough terrain is associated with insurgencies. The reasoning is that harsh terrain is often difficult for states to control and offers hiding places for insurgents (Fearon & Laitin 2003). For example, mountains and forest areas are wild and difficult to navigate with military vehicles.

The variable is compiled using the CIA World Fact Book. The data are logged to demonstrate minute differences. It was expected that this variable would be positively associated with civil war recurrence in both the long and short term. In addition to rough terrain, the authors also argue that states with areas greatly separated from the capital city's region by water are more likely to see higher incidences of insurgency, as these regions are also difficult to control. Their variable is employed and coded as a dummy. A "1" represents a noncontiguous state (state with its capital separated to the rest of its body by a great deal of water) and "0" represents a contiguous state. It was also expected that this variable have a positive correlation with civil war recurrence.

The civil wars literature argues that government type contributes to civil war. To account for this explanation in my models, the polity variable from the Polity IV regime index is utilized. This measure scores states from -10 to 10 on a continuous scale, where "-10" represents full autocracies and "10" represents full democracies. Results were suspected to be similar to the literature. It was expected that strong autocracies be highly correlated to civil war. This is expected because grievances are rife within the autocracy literature. Autocracies are generally

less stable, more likely to suffer from institutional woes, and have groups within society that are bullied or prevented from using the state apparatus to solve collective action problems (Bodea & Elbadawi, 2007; C. Hendrix, Haggard, & Magaloni, 2009; Sambanis, 2002). In the models, the polity value within the Polity IV data set is used.

As mentioned in the literature review, ethnic and religious grievances are major issues of civil war (Esteban & Ray, 1999). To test for the effects of these groups in civil war recurrence, a measure called polarization is used. The measure accounts for individual ethnic shares within countries. To control for this explanation, the Fearon & Laitin measure of ethnic polarization is used. In addition to polarization based on ethnicity, research suggests that religious polarization is a factor for civil war (Garcia-Montalvo & Reynal-Querol, 2004).

The CIA factbook is used to measure this variable, and it is coded as a continuous variable for the percentage of religious groups in each state by country year. Given some of the rhetoric within the news media in the past decade that wars are mostly found in states where Islam is most prevalent, a variable is included that measures the percentage of Muslim population. This measure comes from the CIA World Factbook.

As mentioned in the literature review chapter, civil war relapse is less likely for democracies because of the nature of democracy and democratic institutions alike (Anderson & Guillory, 1997). To control for the third-party settlement explanation—that settlements are less likely to result in civil war recurrence, Doyle & Sambanis data is used and expanded upon. To build the variable, cases were carefully studied and the data was entered into cells where blanks existed, as to whether they were decided by third parties or not. The authors' civil war outcome variable which indicates whether the original civil war outcome ended with a rebel victory, a government victory, a truce, or a third-party settlement is used. The variable was recoded as a

dummy variable. A "1" indicates a third-party settlement, and a "0" indicates the lack of a third party settlement to conclude the fighting.

This study also controls for inequality via the GINI index, a measure of income distribution and inequality. Civil war studies demonstrate that states with high levels of inequality are more likely to see conflict. Inequality causes grievances, which translate into war (Ascher & Mirovitskaya, 2013; Morelli & Rohner, 2014; Murshed, 2015). The measure for the GINI index comes from the World Bank's WDI dataset. Finally, a measure is included for the number of people killed during a state's initial conflict. This measure of combat-related battle deaths comes directly from the Correlates of War's Intra-State War Data (v4.1).

Detailed Discussion of the Results

As a reminder from earlier in this chapter, the dependent variable in this study is civil war recidivism. The dependent variable had three levels. The first, a "0," indicates that after the initial civil war ends, no civil war recidivism is experienced. The second, a "1," indicates civil war recidivism occurring within 1-4 years, and the third, a "2," indicates that civil war recidivism occurred after the 5-year mark. The model results can be seen in Table 7 at the end of this article. The model demonstrates some interesting results. First and foremost, the BITD variable is both significant and negative, as expected. A one unit increase in the BITD variable decreases the probability of being in being in one of the higher sets of categories by 10.15%. This illustrates support for the hypothesis that states with stronger environmentally induced trust deficits are more likely to see conflicts.

In Figures 5 & 6, the predicted probabilities of the model (recidivism) are shown. Figure 5 specifically shows the probability of not having any civil war recidivism. In Figure 6, the

predicted probabilities of having civil war recidivism in the short and long terms are shown. The predicted probabilities have been separated in such a way for ease of reading. The predicted probabilities charts hold other model variables constant, and demonstrates the effects of the BITD variable. As can be seen, at low scores on the BITD, the probability of civil war increases in the long term. A score of 30 on the BITD variable in the year that the initial conflict ended results in a 70% probability that that country will experience civil conflict in five years or more. Perhaps an explanation for this phenomenon may be that in such staunch trust deficits, recovery is extraordinarily difficult and the environment acts as a catalyst for future disagreements (or old revisited ones) to reignite at some point down the road.

Interestingly, that same score of 30 on the trust variable has a 15% probability for both a relapse in the short term or not to see any relapse at all. Moving up the score, at 60, the probability for civil war recurrence in the long term and in the short term both drop to about 10%. The probability of not seeing civil war recurrence at all at that level is about 70%. What is seen here is a clear correlation between strong trust deficits and civil war recidivism. It should be noted that there is a small uptick in civil war recidivism in the short-term between the 30 and 45 levels. This may occur because of the volume of cases were removed from the model, as mentioned in earlier sections. Hypothesis 1 should be accepted.

Looking at other variables, it is seen that both GDP per Capita and the GINI coefficient are not significant. The geographical variables (mountainous terrain and noncontiguous states) are not significant either. Polity, war type, and civil war outcome (in page numbers) was not significant either. It is believed that this occurs because trust deficits have a stronger relationship with the dependent variables, rendering other variables insignificant within the model.

With regards to the other variables, ethnic polarization is negatively correlated to civil war recidivism, and this is expected. At low to middle levels of ethnic polarization, societies are fragmented. At higher levels of ethnic polarization, ethnic homogeneity nearly exists. Ethnically homogenous states rarely see internal conflict as there are fewer transaction costs and a higher likelihood of cooperation between in-groups (Raleigh & Hegre, 2009).

Counter to the rhetoric coming from many in the news today, this study demonstrates that civil war recidivism rates negatively correlate with Muslims. These results can be seen from Model 3. That is, with each percentage increase in the Muslim population within a state, the probability that that state encounters relapse of a previous or a recently finished civil war decreased by 4%. In addition to the BITD variable, ethnic polarization, and Muslim populations, instability was also significant. Looking at the coefficient and taking the inverse, we see that stable countries have almost an 88% lower probability of being on a level ("1" or "2") in which they experience civil war recidivism than instable states.

With regards to identity wars, counter to Hypothesis 2, the model shows that states that have had these wars have lower probabilities of experiencing civil war relapse rates in the future. Model 2 demonstrate this pattern. In Figures 7, 8, and 9, the predicted probabilities for civil war recidivism by war type can be seen. To illustrate, the probability of no civil war relapse is higher for those states that had identity wars. The probability of civil war relapse within the first four years in identity-war countries for the most part is very low. Only at extremely low BITD levels are civil war recidivism rates higher. As for the long term, recidivism is almost 10 percent more probable in nonidentity-war countries than identity-war countries.

Looking at the results, we see that the BITD variable performs as hypothesized. In both the short and long terms, the variable produces significant results. This model shows that as

BITD levels increase (representing weaker trust deficits), the likelihood that states face a civil war recurrence decreases. Therefore, we accept both H1 and H2.

The purpose of this article was to test a new variable on intrastate conflict recidivism. The argument that is clear here is that when social scientists consider their studies, they should not only consider social factors, which drive individuals and groups to take up arms, but nutrition as well, which affects our behaviors. What is seen in this study is that low levels of vitamin C and phytoestrogens contribute to low trust. Low trust should be a common nutritional issue. The results in this article are interesting because they give us a new way to not only look at trust, but a new way to test it.

More importantly, these findings suggest that human diets affect human conflict. By taking the biological roots of trust into consideration, we can test how trust itself affects our variables (i.e. identity wars and negotiated settlements). Regarding the relapse into civil war after the initial conflict, it appears as though nutrients are key factors. Low consumption of Vitamin C and phytoestrogens are directly correlated with higher incidence of relapses into civil war. This research differs from many studies that look at nutrition strictly as a property of hunger. In those studies, hunger is a cause because individuals band together to form groups that attempt to alleviate hunger by taking up arms. In this study, nutrition—or the lack of it—is seen as part of the process that affects behavior; it either exists in us at proper levels, enabling us to function normally, or we lack it and operate at diminished capacities.

It is important to recognize that nutrition is not a silver bullet in civil war recidivism prevention, but just a piece of the overall puzzle, especially for malnourished states. In the data presented here, it should be noted that because of the small number of cases in civil war recidivism over the long term (10 years after the initial war), we cannot jump to conclusions.

This study does, however, prepare the way for future studies on the nutritional effects of violent behavior and civil wars. Whether or not a civil war reignites seems to be somewhat dependent on the existence of certain bioenvironmental conditions (per capita consumption of phytoestrogens, copper, and vitamin C).

By blending quantitative methods with research in the neurosciences, this project demonstrates that biology can greatly impact sociology. On the flip side, by understanding this key point, sociology can greatly affect biology—that is, knowing that malnutrition can lead to trust deficits and ultimately endless cycles of conflict, good social nutrition policy may be able to decrease the probability of civil war recidivism. Policymakers, scholars, and aid advocates alike should promote nutritional programs in post-civil war societies, not only for full stomachs and strong bones, but also for healthy brains. The nutrients focused on in this study are not expensive to attain or difficult to distribute. By providing such nutrients for individuals in war-torn states, the international community may have an important tool in its tool box to help in the prevention of civil war recidivism.

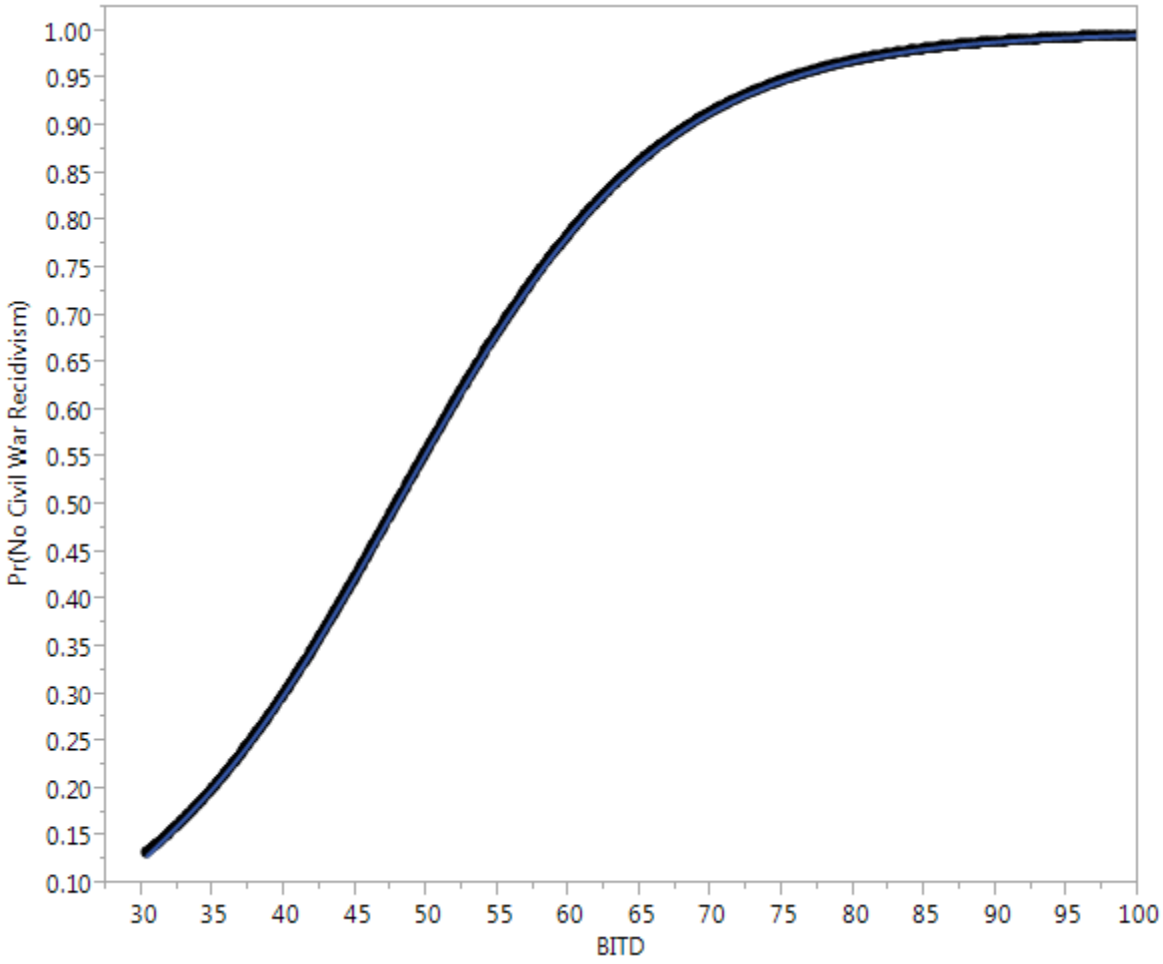

Figure 5: Predicted Probability No Civil War Recidivism

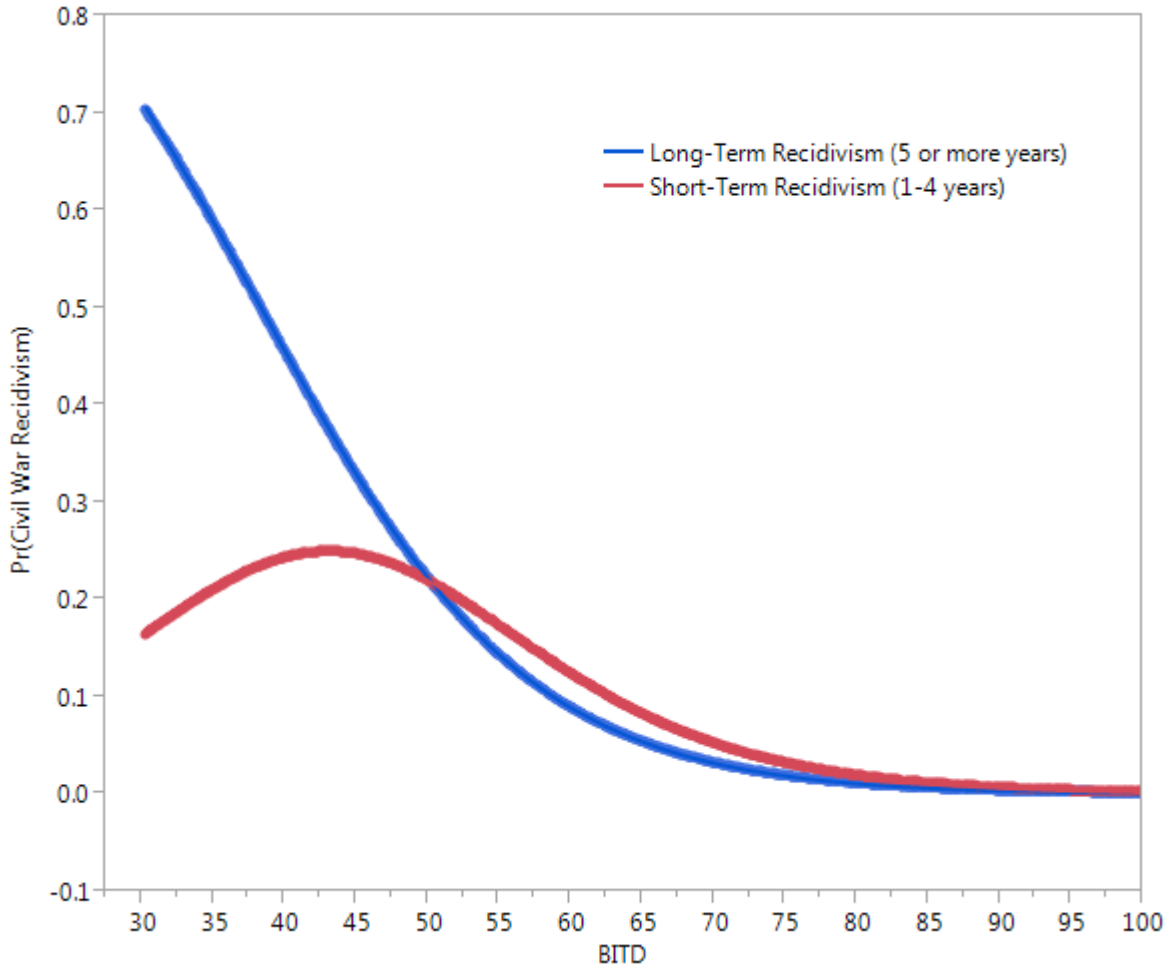

Figure 6: Predicted Probability War Returns in Short and Long Terms

Table 8: Recidivism Regression

TERM	MODEL 1	MODEL 2	MODEL 3
Intercept [2]	19.195**	4.757**	4.665**
	(9.203)	(1.927)	(1.815)
Intercept [1]	20.215**	5.426**	5.3167**
	(9.257)	(1.959)	(1.849)
BITD	-0.107**	-0.050**	-0.0485**
	(0.047)	(0.021)	(0.019)
log GDP (End Year)	0.282		
	(0.630)		
Log Gini (End Year)	-0.025		
	(0.053)		
Log (Mountains)	-0.616		
	(0.412)		
Ethnic Polarization	-11.467*	-3.634**	-3.214**
	(4.275)	(1.467)	(1.363)
War Deaths	0.000		
	(0.000)		
Stable State	-1.976**		
	(0.790)		
Muslim Population	-0.040**		-0.012*
	(0.017)		(0.007)
Polity (End Year)	-0.012		
	(0.070)		
Log Population (End Year)	-0.264		
	(0.331)		
Noncontiguous State	0.457		
	(0.538)		
3rd Party Settlement	-0.176		
	(0.497)		
Identity War	-0.678	-0.618*	
	(0.507)	(0.314)	
N	43	55	55
Psuedo R^2	0.310	0.119	0.106
AIC	105.654	104.137	105.450

**p < 0.05
*p < 0.10

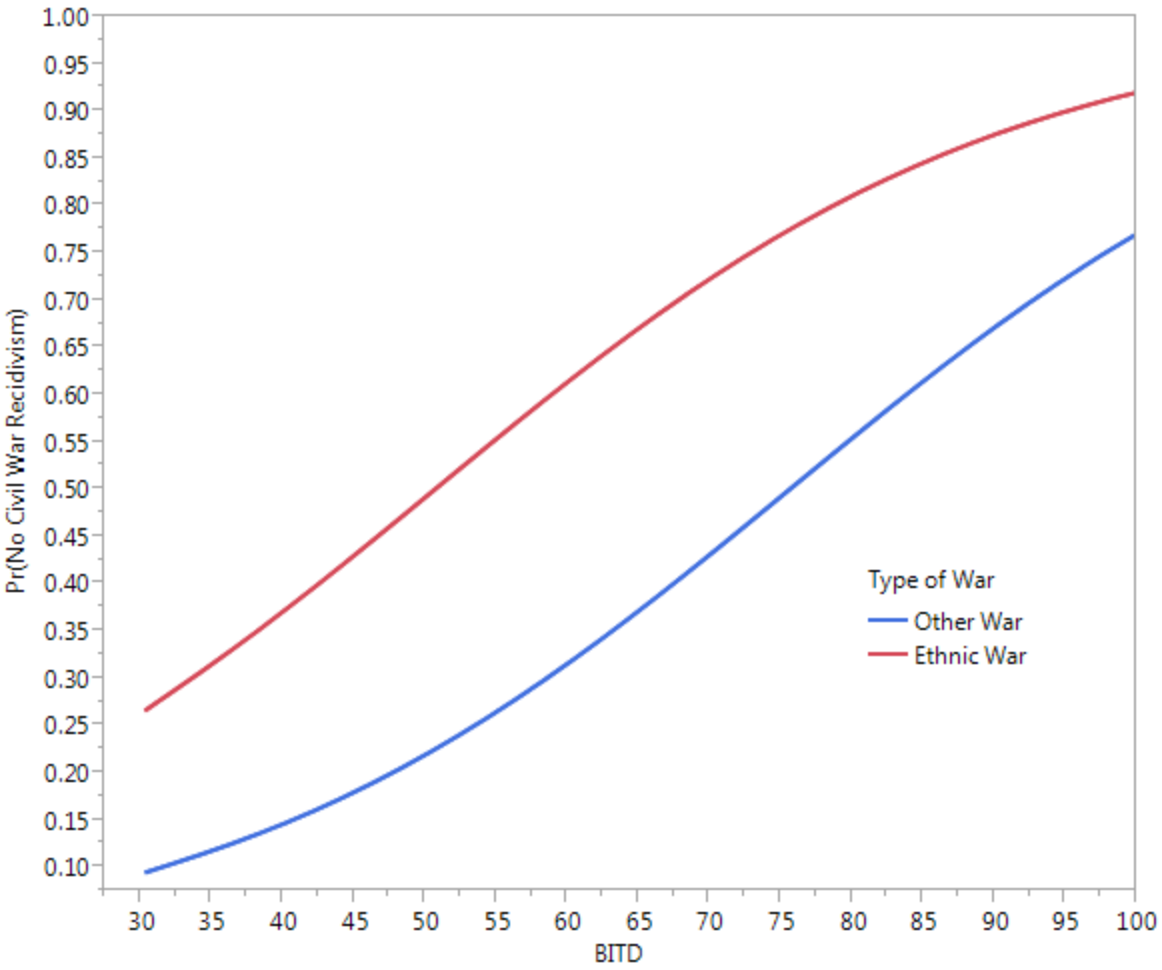

Figure 7: Predicted Probability of No Civil War Recidivism by War Type

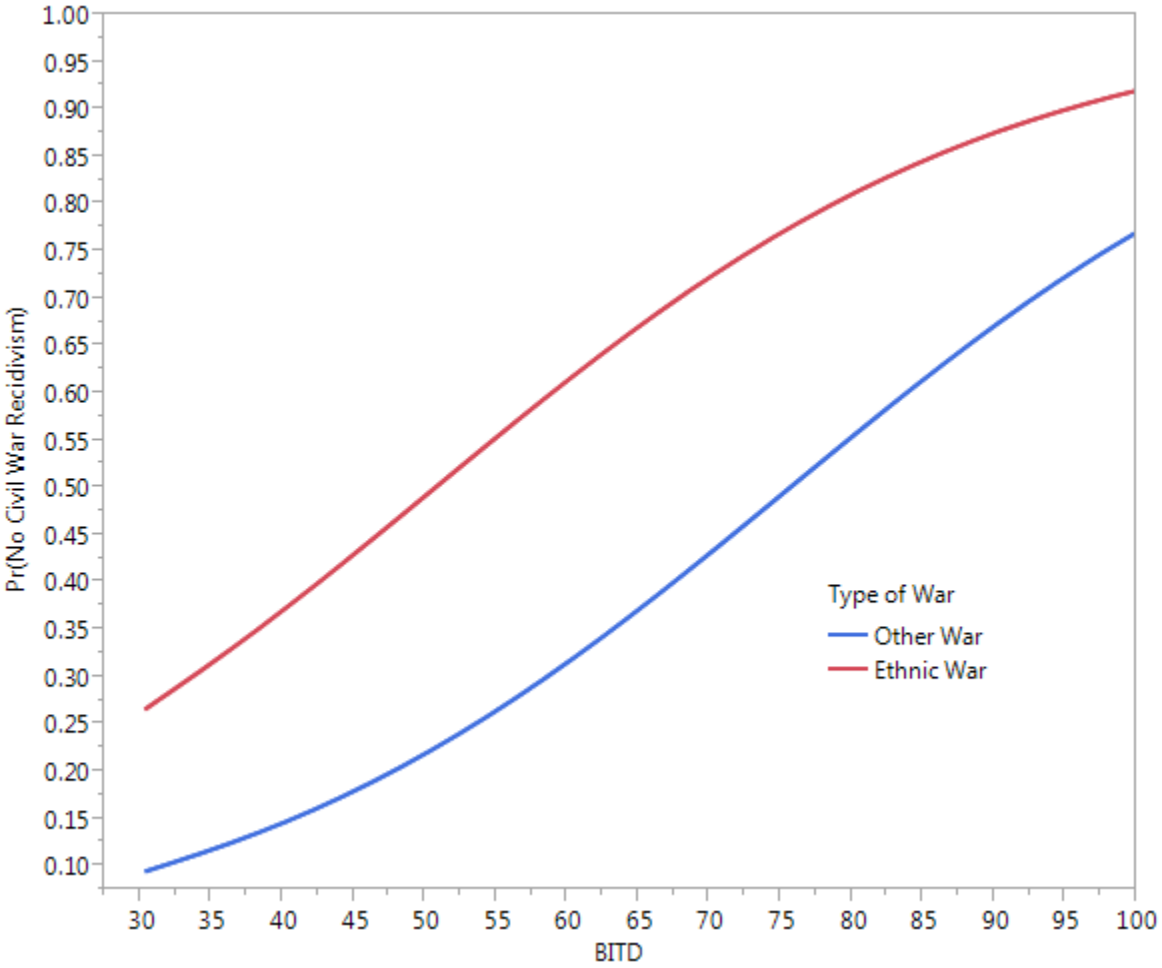

Figure 8: Predicted Probability of Short-Term Civil War Recidivism by War Type

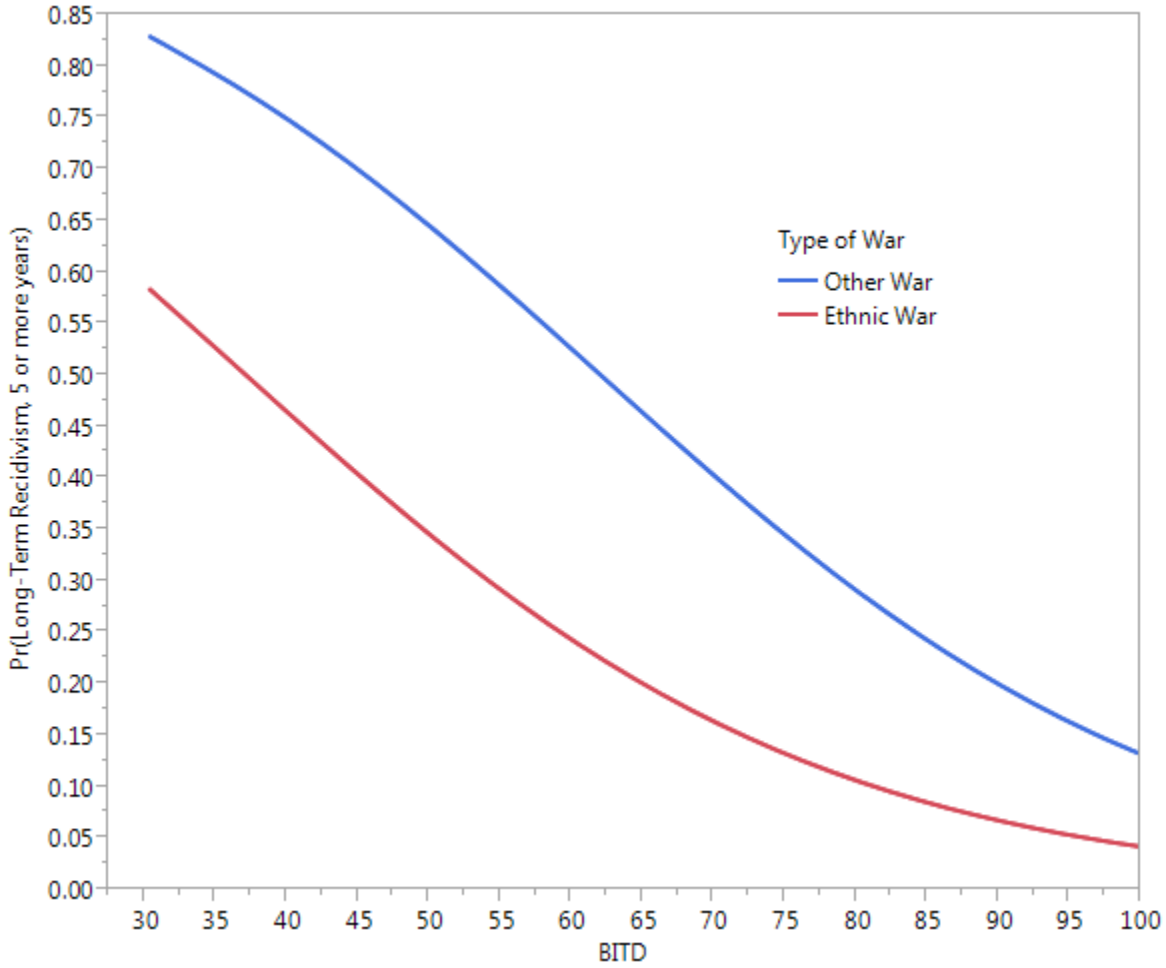

Figure 9: Predicted Probability of Long-Term Civil War Recidivism by War Type

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CHAPTER 6

CONCLUSION

Focusing on the biological microfoundations of trust gains insight into how human beings work. To simplify the theory herein, compare the human being to a computer—albeit a fleshy, organic computer that creates and replicates itself. Social science theories tend to focus on the effects of attitudes, historical events, governmental institutions, etc. This pattern of research was referred to earlier as outputs. In the computer analogy, these explorations can be compared to software programs. This research is different and important because it essentially analyzes the effects of hardware inputs on trust and then to conflict. More to the point in the computer comparison, if the potential to trust is essentially a hardware issue; a software solution will not fix the problems.

This dissertation suggests that trust is facilitated by something much more basic and static than relationships, that it is created and developed as a result of the foods humans eat. This research suggests, too, that trust potential can be modeled and applied to country years in which generalized trust data is not available. Ultimately, this knowledge allows trust to be affected directly by positively (or negatively) manipulating the availability of nutrition. The research provided in this dissertation not only advances the academic studies of international development, decision making, and nutrition sciences, but also has great potential to affect real-world events. A proper diet, in the short term, may quell conflict and provide a space for cooperation, and, in the long term, aid in the development of healthy and objective minds, thus providing the foundations for positive peace.

Additional information has been provided that adds to current research. As noted previously, this theory is not a silver bullet; it cannot act alone to determine when civil wars will happen, how long they will last, and whether they will recur after the initial war finishes. It does, however, enhance current theories. For example, as seen in the third substantive article, decreasing trust deficits in identity wars leads to lower civil-war recidivism rates. As shown in Article 3, the variables commonly associated with civil war duration time increases are still statistically significant with the inclusion of trust deficits, but trust deficits are significant as well—and the new variable included in the model helps add to the explanation of the variance in the model.

This project does have its limitations. The first article takes pollution (artificial xenoestrogens) into consideration and demonstrates that it negatively affects trust. Because of limited data, the second and third articles do not include this major factor. As pollution data becomes more available, future studies should test their effects on civil war onset, duration, and recurrence. Another important point is that this research is specific to countries that do not meet per-capita, recommended daily intakes for nutrition. As it stands, the pollution factor's effects really do stand as a knowledge gap within this dissertation and expanding to the real world.

All limitations aside, the new information provided in this dissertation has real policy implications. The first is that healthy environments lead to shorter civil wars and less civil war recidivism. To this end, policy makers and aid agencies should strive to ensure that areas susceptible to violent conflicts and civil wars have healthy environments. While such a suggestion may be a pipe-dream at best for many places, given the research presented in Article 3 and Article 4, nutrition provisions may be enough to stave off civil wars or decrease their durations and chances of recurrence.

How can states ensure adequate nutrition consumption? From an international aid perspective, aid agencies and organizations providing food should supply not only food stuffs to stave off hunger, but also to ensure proper nutrition. Given the research provided herein, daily vitamin supplements may be a key factor in the prevention of prolonged conflicts and save millions of lives. Medical education must be provided to include information about the supplements, how to take them, and why continuing to take them every day is important—otherwise, host-country nationals may be wary of these goods.

From an agricultural aid perspective, foods containing higher levels of vitamin C, copper, and phytoestrogens should be consumed. If people live in areas with low-level access to these foods, biofortification may be a solution to providing proper nutrition. Biofortification is an agricultural process that breeds nutrients into plant foods and plant-based foods. It is thought of as the future strategy to combat micronutrient deficiency (Bouis & Welch, 2010; Nestel, Bouis, Meenakshi, & Pfeiffer, 2006; Saltzman et al., 2013; White & Broadley, 2009). Researchers at the University of Georgia have found that beta carotene acts as a nutrient stabilizer and retainer in the gut. Biofortification of beta carotene and other micronutrients into rice, corn, and other rural base foods has the possibility to solve the micronutrient problem for the world's poor.

In recent years, there have been some problems with biofortification. The first problem is that foods that have undergone the process are often orange. Orange (or other food that is not naturally colored) has a negative connotation to many of the world's poor populations. These populations may associate foods with unnatural colors with animal feed. Oddly colored food is also often associated with food aid, and many people around the world will reject food aid, as accepting food aid has a negative effect on prestige and life happiness (Barrett & Maxwell, 2007; Friedmann, 1993; Hancock, 1992). Multiple studies do show, however, that with proper

education, populations will produce and eat augmented crops (De Groote & Kimenju, 2008; De Groote et al., 2010; Mwaniki, 2006).

This project identifies a previously unknown variable and brings it to the forefront. It has been analyzed, tested, and its effects on our current understandings of intranational conflict have been demonstrated. Pictures of the current state of research in civil war onset, duration, and recurrence studies have been provided, and the holes and gaps in research and data have been noted. It finds environments that foster oxytocin production are correlated with trust. It also finds states with these environmental conditions are more likely to see shorter civil wars, as well as less civil war recidivism after the initial conflict officially ends.

To that end, we should strive for healthier environments to maintain our trust potential. Whether we choose to trust or not is for another research project—but by keeping our trust-potential level maintained, we may live to see shorter and fewer civil wars.

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