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Liver Fluke Infection and Fish Consumption in Khon Kaen, Thailand: A Case Study on Negotiating the Middle Ground between Western Science and Eastern Culture

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Liver Fluke Infection and Fish Consumption in Khon Kaen, Thailand: A Case Study on Negotiating the Middle Ground between Western Science and Eastern Culture

By

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of the

University of California, Berkeley

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Abstract

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This research investigates why typical strategies for promoting health, prolonging life, and preventing disease do not work in many communities. I use the liver fluke infection endemic in Khon Kaen, Thailand to explore the middle ground between Western science and Eastern culture. Prior work on the *O.viverrini* infection in Khon Kaen, Thailand has focused almost exclusively on developing effective medical treatment for the liver fluke infection. This dissertation employs a case study designed to explore the conditions that created and perpetuate the problem in the first place. In concrete terms, I analyze how the worldviews of local villagers shape their attitudes toward life (and death), which in turn determine if they engage in the high-risk behavior – eating undercooked fish – that makes them vulnerable to the infection. My research focuses on these people in-situ over a three-month period, and includes data from participant-observation, interviews, and video-recordings. This work seeks to illuminate how people's thinking and reasoning skills, and personal/cultural identities affect their abilities to learn and act on new health concepts. This potentially provides a window into future educational strategies in a complex world.

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DEDICATION

I dedicate my dissertation to

Ballerina, Vagabond, Nerdy Brahmin,

Superwoman, Sweetheart, Peace,

Scooby-Doo, Grandma,

and those who lost their battles to cancer around the world (e.g., Professor Randi A. Engle and Smokey).

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CHAPTER ONE: INTRODUCTION

Rationale

Public health efforts to change human behavior and make the world a better place often fall short of their goals. For example, although smoking is addictive and can lead to lung cancer and circulatory problems, people still start and continue smoking. To contend with such issues, standards and regulations can help establish new norms. Regulations including high taxation, advertising, and smoke-free workplaces have discouraged the habit. Yet, neither penalties nor incentives achieve what we are really after: a system and a culture that effectively discourages smoking. Similarly, this dissertation explores the conditions that created and perpetuate the liver fluke infections endemic in the first place.

This research focuses on the problems at the core of health intervention by examining the worldviews of local villagers who continue to consume undercooked fish. The term *worldview* represents people's "holistic and intricate picture of life, including its meaning and significance" (Tilburt, 2010). What are their definitions of health and well-being? What is a "good life?" What causes illnesses? These questions need to be answered before we seek solutions so that solving one problem does not cause another—the original problem may decrease, but its causal factors remain.

Understanding people's experiences and their worldviews on life may help researchers better approach the problem by looking at the assumptions underlying typical health interventions, instead of further researching the benefits and risks of new developments or enacting new control legislation. If the liver-fluke infected population defines health as having a meaningful and enjoyable life, the public health goal of promoting health by simply prolonging life in a way that lowers the quality of life could imply a fundamental mismatch between concerns of local people and those of researchers.

Finding root causes for intervention failures in public health education requires that researchers use s*ystems thinking* or *design thinking,* which has been used frequently in engineering education and which views problems as parts of mutually interacting systems (Dym, Agogino, Eris, Frey, & Leifer, 2005) with a human-centered perspective. Since problems may be inter-related, one needs to figure out how far to go in identifying the crucial actions needed to address the immediate problem of interest. My research, thus, seeks to study the high-risk behavior of eating undercooked fish, not by itself, but as a part of larger factors governing social processes perpetuating the behavior. As a result, in addition to traditional public health intervention aimed at changing people's behavior, we need to consider how people's definition of health, and their personal reasoning skills, can be incorporated into the educational intervention.

We need to consider the implications of the inconsistent meaning of *health literacy* (Lindström & Eriksson, 2011), and *science literacy*, which has been debated for their ambiguous, multi-layered meaning (Hodson, 2003) and their implementation into practice in curriculum development and teacher development policies. The inconsistent meaning of *health literacy* and *science literacy* perhaps can be elucidated through people's definition of health, and their personal reasoning skills, respectively. Thus, it is time to look beyond the definitional

meanings of these two terms, and the particular behavior of eating undercooked fish. We should instead examine how the worldviews and individual reasoning (deeply ingrained in the term science literacy) of local villagers shape their attitudes about health. This can thus affect how we can better address health education projects.

In other words, science education aimed at promoting reasoning should consider people's *own* way of reasoning. What are their definitions of what it means to be reasonable? What counts as "scientific knowledge"? What are considered bad decisions? Understanding personal reasoning processes may help researchers understand that we humans live multidimensional lives, and that "our individual ways of living and making meaning are different." Because we have a "limited view of the larger systems we inhabit," science educators should not be led to believe that theirs "is the only way of seeing or doing, or at least that it is the best way" (Lemke, 2001). Perhaps, we should be skeptical and critical about the typical causal reasoning: consuming undercooked fish can lead to liver fluke infection and in turn, deadly cancer. There are vast number of variables (e.g., genes, environment, immune system, host-parasite fitness (known as *optimal virulence*)) that cause liver fluke infection and the cancer and that the causation might not be linear (i.e., *systemic causation*). Only when we take into account people's personal reasoning will it be possible to move towards a complete understanding of the problem, and begin to develop an educational approach that brings together science and society, namely *knowledge co-creation*.

That is to say, the Western perspective is not the proper lens for viewing the underlying structures that sustain cultural beliefs influencing the acquisition and spread of the liver fluke infection. We need to understand how the behavior of eating undercooked fish fits into their culture—the standardized values of their community. In Mary Douglas's seminal work *Purity and Danger* (1966), she was struggling with these ideas. "The arguments of the book…are far from logically consistent and at points are mutually contradictory." "The text has moved from an erroneous account of difference" between us (moderns) and them (primitives), "through an account of sameness, to a new and more detailed account of difference" (Fardon, 2001). This was a highly creative approach to the study of human behavior and was a major contribution to Len's and my thinking to negotiate the middle ground between Western science and Eastern culture.

Statement of the Problem

The parasitic flatworm *Opisthorchis viverrini* is a freshwater liver fluke that infects many people globally, not only people in Thailand. The liver fluke infection is recognized globally as one of the "emerging, neglected, and under-estimated problems of world health today" (Grundy-Warr et al., 2012). Between six and eight million people (Grundy-Warr et al., 2012; Jongsuksuntigul & Imsomboon, 2003; Sithithaworn & Haswell-Elkins, 2003) in Thailand are infected with *O. viverrini*. While many infected individuals are asymptomatic or exhibit only mild symptoms, some eventually develop cholangiocarcinoma, a cancer that initially involves the gallbladder and bile ducts and that spreads to the liver and beyond (Sripa et al., 2011). The prognosis for individuals diagnosed with cholangiocarcinoma is extremely poor—approximately 5,000 cases of CCA diagnosed yearly in Thailand closely matches the number of people who die each year (Parkin et al., 1992).

The infection rates are higher among residents who reside at the Lawa Lake, Khon Kaen than among those residing elsewhere in Thailand (Upatham & Viyanant, 2003), and the intensity of the infection is greater among rural dwellers than their urban counterparts (Kurathong, Lerdverasirikul, Wongpaitoon, Pramoolsinsap, & Upatham, 1987; Upatham & Viyanant, 2003). The fact that the liver fluke affects mostly low-income populations calls for national and global attention, because according to WHO, health is one of the fundamental rights of every human being regardless of their socio-economic condition, beliefs, and religion.

Thailand has not been able to reduce the level of *O.viverrini* infection, and alarmingly high levels of CCA incidence remain (Sithithaworn et al., 2012). The country has sponsored community health education on liver fluke infections intermittently since 1967, and has provided low cost cooking pots and proper fish cooking methods (Upatham & Viyanant, 2003). Despite these efforts, and an effective parasite-control drug, people continue to eat undercooked fish. Re-infection after medication actually increases the risk of the cancer (Pinlaor et al., 2004). At the Khon Kaen[1] University hospital alone, an average of 1,000 people per year were diagnosed with fluke-caused cancer from 1990 to 2010.[2] Clearly, the existing literature is not helpful and current methods are not adequate to the challenge.

It is extremely important that we researchers understand different dimensions of the problem at a fast pace, because the situation could get worse very quickly as a result of ongoing dam construction along the lower Mekong River. Dams "would fundamentally change the river flow regime," reducing the natural fish habitat, sediment, and nutrients (Ziegler et al., 2013). This could result in "a loss of fish diversity and abundance" and "disruption of fish migration patterns" as seen in many past hydropower projects (e.g. Aswan Dam (Egypt) and the Danling and Huangshi Dams (China)) (Ziegler et al., 2013). In Lao PDR, the dam construction to improve flood reduction and road infrastructure accelerated the full life cycle of *O. viverrini*. The manmade habitats (i.e., dams) allow the parasite to emulate its natural full life cycle in a shorter time because, in such confined environments, small aquaculture increases in number, resulting in a higher number of free-swimming cercariae, thus increasing the chance of them getting into fish and infecting it (Ziegler et al., 2013). Even though this is a conjecture—unproven claims with uncertainties, the long-term possibility is so high that we cannot simply ignore it.

Research Goals

The purpose of this study is to investigate how the worldviews of local villagers shape their attitudes towards life (and death). Local villagers may think that humans live on borrowed time and they therefore do not put much thought into the details of life that Westerners take very seriously. Seeing death every day, some villagers may become disengaged from life; while others may decide to live their life to the fullest – in their own way. Specifically, the differing viewpoints are elucidated and related to their fish eating behaviors and must be taken into account if we are to thoroughly understand context of their behavior.

[1] Khon Kaen estimated total population is 150,000.

[2] The information is obtained from Sripa's article, *EcoHealth Approach: Lawa Model, Opisthorchiasis control program*, in Thai.

However, without knowing the local villagers' method of reasoning or how they employ reasoning to come to conclusions, my analysis of their worldviews would be merely my own reasoning (based on my own worldviews) of why they say certain things, especially when things are not stated directly in a manner logical to me. People – myself included – are "complicated and interesting," to borrow Daniel Kahneman's expression (2012) and often make errors of judgment (Greenberg & Lowrie, 2012). "Reasoning does exactly what can be expected of an argumentative device: Look for arguments that support a given conclusion"(Mercier & Sperber, 2011). Things others say may thus be logical in their own views, but, as pointed out by Immanuel Kant, their logic has nothing to do with reality as perceived by an individual researcher. So to be as objective as possible and come closer to the people's own interpretations, I make an effort to analyze what they say in relation to their way of reasoning.

In addition to seeking to understand the local villagers' thinking and reasoning skills, I intend to document their emotions displayed through facial expressions, body language, and actions. Emotions are central to human thinking and in fact "reasoning comes later and is often guided by the emotions that preceded it" (Brooks, 2009). It is not sufficient for humans to live by logic alone: human minds need an emotional element that determines their fundamental view of life (Markus & Kitayama, 1991). Thus, people's emotions indicate what they value in life, which is an important part of their personal/cultural identities. Most importantly, emotions possess a strong social component which makes people bond with their communities. Because *emotion* is difficult to quantify, whether it be its definition or its measurement (Mauss & Robinson, 2009), and because "there is no single gold-standard method for its measurement" (Scherer, 2005), I choose to investigate villagers' emotions on a more subjective, surface level through my own observations—remembering that most Thai people are passive, have a strong sense of acceptance and respect, and like to say things that others want to hear.

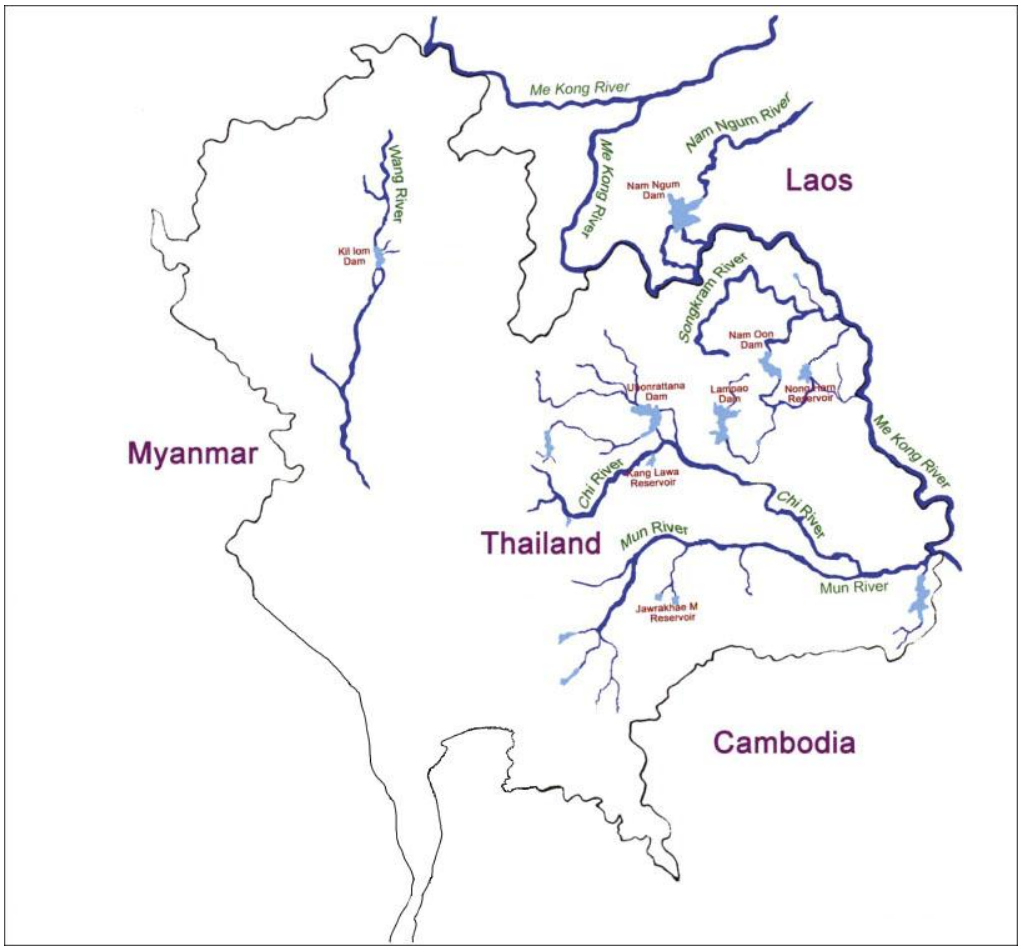
In sum, I choose to investigate the liver fluke infection endemics on a philosophical level: by studying people's thoughts, feelings, and actions. Studying these people also affords the opportunity to explore the relationship of Western science and Eastern culture: Western science, more or less, puts great emphasis on reasoning whereas Eastern culture is more feeling-based. My ultimate goal is not to simply choose between one or the other, but to try to relate the mind of the researcher to the mind of the people studied to form a coherent circle of understanding. It is my hope that this dissertation "is sophisticated and significant enough to merit citation far beyond the borders of science education;" fulfilling Lemke's expectation of how the field should do research (Lemke, 2001).

Liver Fluke Infection: *Opisthorchis Viverrini*

In Thailand, the *O. viverrini* was first discovered in the post-mortem examination of two prisoners in Chiang Mai, the largest city in the northern part of Thailand (Leiper, 1911). Later examination of male prisoners in Chiang Mai discovered that 17% of 230 prisoners were infected with *Opisthorchis felineus* (Kerr, 1916). This same type of parasite was found a decade later during an autopsy of a 17-year-old Thai male in Roi-et, northeast Thailand, in 1927 (Prommas, 1927), but a few years later, Laotian people were found to be infected with *O. viverrini* (Bedier & Chesneau, 1929). Sadun (1955) confirmed that the *O. viverrini* is indeed the prevalent type in Thailand, and not the *O. felineus* (Sadun, 1955; Upatham & Viyanant, 2003).

Northeastern Thailand's rainfall drains into two main rivers, the Mun and Chi. The upper Chi river in Khon Kaen, Thailand, has three lakes—Gudkao Lake, Kongkaew Lake, and Lawa Lake—which together are called the Lawa Lake complex. Downstream, the Chi flows into the Mun shortly before the latter empties into the Mekong, the major river that flows from the Tibetan plateau through China, Lao People's Democratic Republic (PDR), Cambodia, and Vietnam. The Mekong forms the eastern border of Thailand with Laos. *O. viverrini* is endemic throughout countries along the lower Mekong River, (Sithithaworn & Haswell-Elkins, 2003).

Figure 1: Lower Mekong River that runs through Lao PDR, Thailand, Cambodia, and Vietnam, respectively.

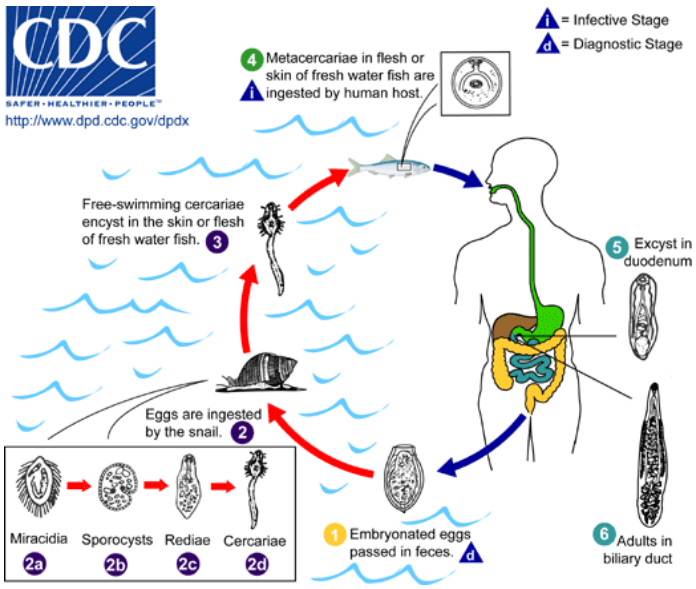


Adapted from (Andrews, Sithithaworn, & Petney, 2008)

The *O.viverrini* transmission cycle starts with infected freshwater fish. Humans can get infected through eating the undercooked fish. Once infected, humans can spread the disease through feces. If the feces get into water sources where snails reside, snails can ingest parasite eggs. After several developmental stages, the swimming larval forms of the parasites come out of the snails to find the next intermediate host—fish, and bury in its "tissues, muscles, fins, scales, or visceral organs" (Grundy-Warr et al., 2012). Human infections result from consuming raw or inadequately processed fish that contains metacercariae—the encysted maturing stage of parasites. One developmental cycle of the parasites takes at least four months to complete (Sithithaworn & Haswell-Elkins, 2003), depending on host fitness and others. The life cycle of

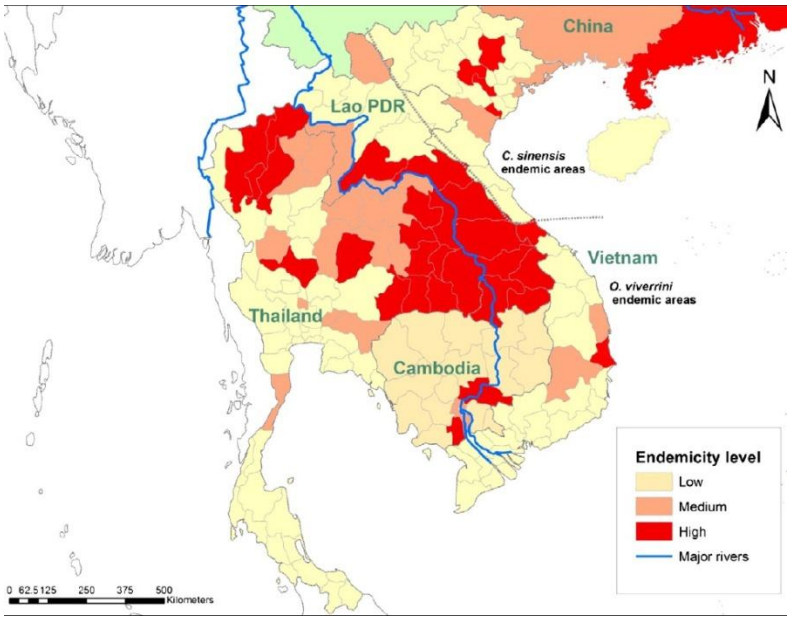
O.viverrini is formally represented by United States Centers of Disease Control and Prevention (CDC) as in the Figure 2 below.

Figure 2: Life Cycles of *O. viverrini*



The prevalence of *O. viverrini* infection is not only high in humans (Suwannahitatorn et al., 2013), but also in the canine and feline world as well. According to the nationwide survey in 2009, the prevalence in humans was ranked in decreasing order by regions as follows: the northeast (16.6%), the north (10%), the central (1.3%) and the south (0.01%) (Figure 3) (Sithithaworn et al., 2012). However, geographies of the liver fluke infection are largely undetermined. For instance, variations in prevalence vary from 2% to 71% across northeast Thailand (Andrews et al., 2008). In the three villages along the Chi River in Khon Kaen, the prevalence were 3.8% and 36.4% (of 78 dogs and 22 cats), respectively (Enes, Wages, Malone, & Tesana, 2010). These animals, thus, maintain the *O. viverrini* eggs in the environment, proliferate, and perpetuate the life cycle of *O. viverrini* in the same way as the humans do.

Figure 3: The prevalence of *O. viverrini* and *C. sinesis* in South East Asia. The prevalence of the infections is represented by color (red --greater than 15%, tan --5.1-15%, and apricot --0-5%),



(Sithithaworn et al., 2012)

Symptoms of the liver fluke infection and mechanisms of how the infection leads to cancer are unclear. Yet, once the infection turns to cancer, the chance of survival is almost zero. Most infected people show no symptoms after the infection. Only approximately 7% of those infected show "non-specific symptoms such as right upper quadrant abdominal pain, flatulence, and fatigue" (Sripa et al., 2007). Three possible mechanisms of *Opisthorchis*-Derived Cholangiocarcinoma (CCA) Initiation have been proposed: 1) through mechanical damage, 2) as molecular products, and 3) through immunopathology. All of the mechanisms lead to DNA damage, which results in the inhibition of a normal DNA damage response or DNA repair. Consequently, cells are killed while malignant transformation is promoted – called "cancer inductive state" (Sripa et al., 2007). That is, infected people are not likely to recognize their infection, but once cancer has developed 30-40 years after, they are expected to live only 3-6 months after diagnosis (Sripa et al., 2007), and five years at best after chemotherapy treatment (Chamberlain & Blumgart, 2000).

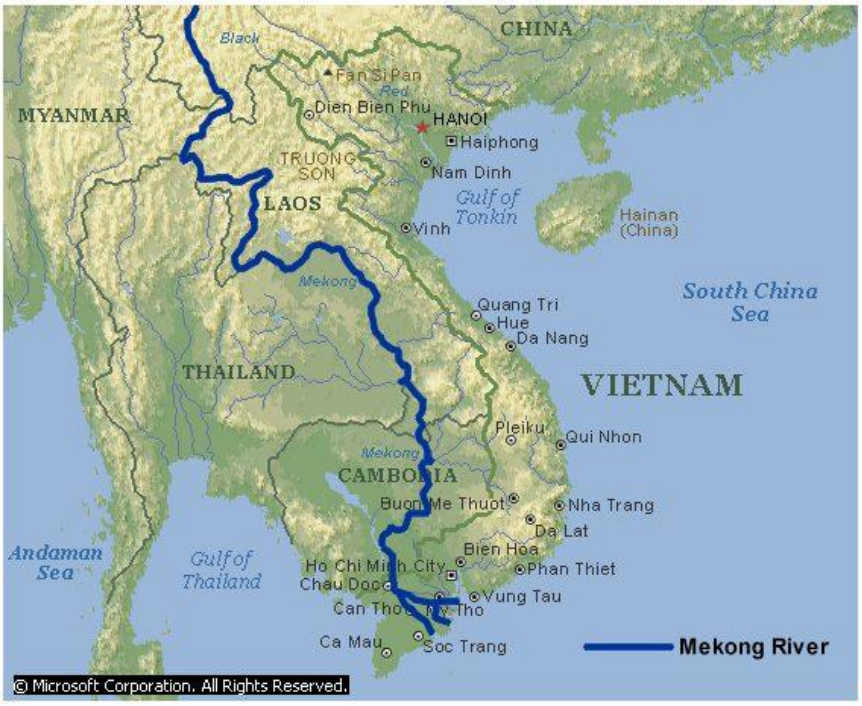
The Geographical Setting of the Study: Thailand

Thailand, known as Siam until 1939, was established "in the mid-14th century" (CIA, 2012). Thailand (literally translated as land of the free) was the only South East Asian country that has never been colonized by European powers. Thailand was on the borderline of French and British colonial competition, and the negotiating skills of Thai Kings (Mongkut, Rama IV (1851-1868), and Chulalongkorn, Rama V, (1868-1910)) made it possible for the French and the English to define the country as a *neutral territory* to avoid going into war with each other. Adopting the "buffer state" role, however, came with a price of loss of suzerainty and political control for more than half of Thailand's territory. As a result, when the Second World War ended in 1945, Thailand was the only South East Asian country whose area was a fraction of what it had been a century earlier (Barton, 1964), leaving Thailand the interesting shape of honed axe

(Figure 2). In spite of this, the country maintained good relations with Western countries, and became a US ally during the Vietnam War against communism.

The country covers a land area of approximately 513 thousand square kilometers, extending approximately 1,500 km from north to south and 800 km from east to west. The size of Thailand is "slightly more than twice the size of Wyoming" (CIA, 2012).Thailand (Figure 4) is bordered by 1) Burma (Myanmar) to the north and northwest; 2) Laos to the north and northeast; 3) Cambodia to the southeast; 4) the Gulf of Thailand to the south and southeast; 4) Malaysia to the south; and 5) Andaman Sea to the south and southwest. Thailand is located close to the equator (a latitude of 0°); thus has a tropical climate with the temperature between 55 and 95 degrees Fahrenheit, depending on the seasons and regions. Geographically, the country is subdivided into six regions, and each region is divided into provinces. The regions include central, northern, northeastern, eastern, western and southern regions. However, in some contexts (e.g. regional dialect), western, central, and eastern regions are considered to be the "central region."

Figure 4: Map of Thailand, showing the Mekong River Basin



("Mekong River," 2000)

As of July 2013 over 67 million people live in Thailand, with approximately equal numbers of male and female individuals (CIA, 2012). The following are the four regions of Thailand in descending order of population: the northeast (about 21.7 million people), the central—excluding the east and the west (about 19.9 million people), the north (about 6 million), and the south (about 9 million) regions (กระทรวงมหาดไทย, 2012). Life expectancy at birth for total population is 74.05 years. Approximately 95% of the people practice Buddhism according to the 2000 census. The second largest religious group in Thailand is Islam (4.6%), and the next largest

is Christianity (0.7%). About 75% of the population is ethnically Thai; 14% are Chinese, and 11% are minority groups such as Khmer (CIA, 2012).

The main language spoken is Thai. The official language is also Thai or more precisely *Central Thai* – the language that most people who live in the central part speak, and the language used in schools (i.e., standard Thai). There are also other three major regional dialects, which are divided up by regions, i.e., north, northeast, and south regional dialects. Thai language is a tonal and analytic language, which is a "language that uses specific grammatical words, or particles, rather than inflection, [(e.g., tense, voice, person, and number)] to express syntactic relations within sentences" ("Analytic Language," 2013). For example, a subject of a sentence is often omitted. Words are selected according to the gender, and tense is conveyed by word choices or tense markers. Thai is mutually intelligible with Lao, which is closely similar to the northeastern dialect (called Isan language) because of their geographic closeness and because of the political history after WWII (Keyes, 1995). The main differences are tone, pronunciation, and speaking styles. Lao also has an influence on the northern dialect, but this dialect has completely different tone than the northeastern dialect. Lastly, the southern dialect has influence from the southern neighbor of Thailand – Malaysia, and from Islam, which is the largest practiced religion in Malaysia. Most Thais from the central part of the country often have problem understanding this dialect because it is a fast spoken language with frequent use of shortened words. English is mandatory in schools; however, the fluent speakers remain only in the elite. According to the recent Education First English Proficiency Index, Thailand ranked 53rd or the world's second-lowest rank in English proficiency, above only Libya ("EF English proficiency index," 2012).

Thai people have a strong sense of acceptance, respect, and caring for each other. People normally avoid public disagreements or disputes and tend to accept things the way they are. Many people would simply accept things they have no total control of (e.g., lack of opportunities and resources), so that they won't get distressed, and blame fate, destiny or bad luck for such misfortune. Plus, people are "we-conscious," look after each other, belong to a group as a whole, and have an indirect style of communication filled with rich yet tacit understanding (De Mooij, 2010). Thais, especially those in the rural areas, very much respect elders and people of high social status. This causes them to be familiar with big differences in status and power between groups of people, and tend not to critically analyze the words and actions that come from society's respected people (i.e., do not challenge authority). Generally, younger generations respect the advice of elders. This can be seen clearly in rural schools where the teachers are regarded as most respected masters who are knowledgeable and possess all wisdom. It would be impolite for students to interrupt and ask questions. Questioning during the class is often viewed as disrespectful to the teacher in many Asian culture like Chinese as well (Ginsberg, 1992).

Democracy in Thailand is certainly a long way from true democracy. The country "has a façade of democracy…[I]ts political system is flawed, dominated by the monopolistic capitalism…" (Pananda, 2012) under a constitutional monarchy. The Prime Minister is the head of government and the King, supposedly being above politics, sometimes is under pressure to intervene in politics to assure the stability and security of the nation. Globalization and foreign investment threaten the domestic economy making poor people feel helpless. This helplessness leads political parties to implement populist programs to get electoral votes. The prospective government would promise a mindless superficial program—specifically for the people who need it most (i.e., poor, uneducated people)—that produces short-term success that is right to

their eyes, but backfires later on. By that time, the government is free to make dramatic changes to a greater national public administration, which secures their power and, in turn, directly and indirectly secures later votes. A dramatic constitutional change happened in 2001 when "a major regime shift from democratic governance to democratic authoritarianism" occurred, which gives "political power and government authority in the hands of a single person: the Prime Minister…" (Bowornwathana, 2005).

This may sound like too simple of a story, but it clearly illustrates the flip side of democracy. As great as democracy can be, it is as fallible as humans are. Let me give a simple but telling example: the 30-baht (about US$1) health care service. Thai Rak Thai (TRT) Party led by Thaksin Shinawatra was known as "a true friend of the poor," supporting "nationalist-communitarian interests" instead of promoting "transnationalism" or globalization (Kitirianglarp & Hewison, 2009). Shinawatra promised NGOs and many social organizations the national health care coverage for every Thai citizen, if elected as Prime Minister. Once he was elected, he launched the 30-baht project to distinguish himself very quickly (Kitirianglarp & Hewison, 2009). Each visit to public hospitals, patients only have to pay 30 baht at maximum. To some extent, the strategy addressed poverty because people, especially the poor, gained access to health services. Yet, this produced positive effects only in the short term because it did not address the social inequalities at its structural basis. The rich who can afford medical bills would go to private hospitals regardless. On the other hand, the financial position of public hospitals was damaged and some had to shut down due to lack of profit as the government failed to compensate the hospitals' losses. The differences in quality of care between existing public and private hospitals have widened because doctors and nurses would rather work in adequate medical resources environment (i.e., private hospitals) and earn more money. Most importantly, general people become less concerned about their personal health and well-being because they could receive health services and treatment with a nominal fee of 30 baht (US$1). Poor people not only care less for their health, but also feel discouraged from seeking health services because of their poor quality (Tangpianpant, 2010): If the poor are sick, they have no other choices but to go to a designated public hospital closest to their home address, and to wait in long lines in poor facilities, only to receive poor treatment. The health inequalities have persisted, and arguably worsened after the 30-baht project. Yet, the people who suffered the most are those who had initiated the idea of universal health care coverage, and those who voted to give the Prime Minister authority to legitimately hurt themselves even more.

Perhaps, the lack of quality education (Mounier & Tangchuang, 2010) contributes to the people's lack of "political and democratic consciousness necessary for liberal democratic policies," (Kitirianglarp & Hewison, 2009) and vice versa. Despite the nation's upgrade status to an upper-middle income economy (with an average income of US$3976 to US$12,275) ("Thailand Now an Upper Middle Income Economy," 2011), Thailand still fails to "deliver quality education." The country has been "more interested in developing conformity and maintaining social stability than in turning out graduates prepared for a modern world." The 1999 Education Act has done very "little more than piecemeal efforts that simply reflect political tussles." "The interference by political and economic interests in the orientation and management of educational institutions; and the commoditization of education – in particular, privatization, internalization and vocationism…invaded the [educational] system" (Mounier & Tangchuang, 2010). Unequal economic success particularly in the north and northeast regions ("Thailand Now an Upper Middle Income Economy," 2011) clearly matches their unequal educational

opportunity. The income inequality has increased, with less quality of life in rural areas (Fang & Sakellariou, 2013). There is "an urgent need of a new and systematic education reform," (Mounier & Tangchuang, 2010) which teases apart the intertwined of economy, political and educational system. Yet, there has been little scholarly debate regarding the educational system in Thailand (Mounier & Tangchuang, 2010).

History of Liver Fluke Infection Control Efforts

As a result of the general educational deficiencies, rising government health care spending, which has enabled numerous control strategies, has not done much to alleviate the problem. In addition to drug development, technological invention, and health education, there have been efforts to improve sanitation and wastewater treatment. Below are summaries of control efforts.

The main strategies for the liver fluke infection control are 1) stool examinations and treatment of infected people with an anti-parasitic drug, 2) health education promoting eating of cooked fish, and 3) improvement of hygienic defecation (Jongsuksuntigul & Imsomboon, 2003).

The official control started in 1950 under the US government support. The small control units aided in diagnosis and treatment of the liver fluke were founded in the five provinces in northeastern and southern part of Thailand. Without the US aid in 1958, the original mission was carried under a rural health development project of Health Development. Stool examination was the main strategy until 1967 when community health education was introduced to Sakol Nakorn province in northeastern Thailand. People were provided with low cost cooking pots and "a cooked fish dish demonstration" (Jongsuksuntigul & Imsomboon, 2003). In 1974, this trial liver fluke control program was discontinued, while health education continued to be the main control strategy. Later, the focus switched back to the medical treatment, perhaps because the educational approach failed to change people's eating. Praziquantel, a parasite-control drug, was first discovered in 1980 to be an effective cure for the infection by researchers at the Tropical Medicine, Mahidol University (Jongsuksuntigul & Imsomboon, 2003).

Since 1980, the treatment of liver fluke infection has been the main control strategy nationwide. Liver fluke control was included on the National Public Health Development Plan (1987-1991), and approximately 5 million people had stool examinations with approximately 1.7 million people tested positive and treated accordingly. An extra half million of people were treated under the support of Federal Republic of Germany government (1989-1992). Liver fluke treatment program was included in every 5-year National Public Health Development Plan from 1987 to 2006 (Jongsuksuntigul & Imsomboon, 2003). Even though Opisthorchiasis was not officially on the 2007-2011 Thailand National Health Strategic Plan (Sripa, 2008) due to the economic crisis (Sripa et al., 2011), providing stool examinations followed by praziquantel treatment is still a common practice nowadays (Suwannahitatorn et al., 2013).

Medical Treatment

Control efforts have focused on understanding the biology of the parasite and its progression toward cancer, methods for early detection, and drug treatment method. Pathobiology of opisthorchiasis and associated cholangiocarcinogenesis (e.g. nitrative and oxidative DNA damage and clinical manifestations of CCA) was proposed, (Sripa, 2003). Additionally, progression from the liver fluke infection to cancer is well discussed in the literature: (Harinasuta, Riganti, & Bunnag, 1983; Thuwajit et al., 2004; Thuwajit et al., 2006)

There are strong correlations among "the intensity of *O. viverrini* infection, parasite-specific antibody response, and abnormalities of the biliary tract…" (Elkins et al., 1990). CCA is estimated to be responsible for about 71% of liver cancers in Khon Kaen, Thailand (Parkin et al., 1992). Also, the most sensitive and reliable method for detection of *O.viverrini* eggs (i.e., the formalinethyl acetate concentration technique) was invented (Rangsin et al., 2009). If applied at the community level, chemotherapy with praziquantel effectively suppresses *O. viverrini* transmission to low levels.

Environmental Control/Infrastructure Change

Because the environment plays a big role in *O.viverrini* transmission, some engineers have considered the environment as part of the system, and looked at how "the interaction among [the] phenomena on different scales," within the environment, affects human health (Levin, 1992). In other words, the researchers looked at the liver fluke infection problem with an ecological model, which regards the relations the disease vectors have with respect to each other and their environments. Spear and colleagues (2012) proposed to investigate spatial and temporal patterns of *O.viverrini* transmission through mathematical modeling techniques. The model would incorporate diverse determinants of transmission dynamics (e.g. sanitation practices, rainfall and flooding events, and intermediate host ecology) to simulate the transmission cycle, which can subsequently be used to assess control strategies. The proposed model was adapted from the *S. japonicum* infection model used in China; the model was proposed to be used to inform the scale of disease control efforts and hence the feasibility of the control options. The project has not been funded and, even if it were, it would probably take a tremendous amount of time, resources, and effort before showing results. [3]

Health Education

Information dissemination through health education has recently been a popular strategy. Health education provides the fundamental information on *O. viverrini*'s life cycle and its transmission to humans. The strategy rests on the assumption that education would change people's behavior of eating undercooked fish and thus, stopping the disease at the moment of infection. Perhaps this approach is popular because health education requires less money compared to the aforementioned strategies, it could be started on a small scale, and it does not require highly specialized people, such as doctors and engineers. And, most importantly, if it is done well, the program can be applied widely within the areas, including in the schools, and perhaps applied to other health-related behavior programs.

Grundy-Warr and colleagues (2012) implied that effective health education is possible only when researchers consider *culture*. However, the authors did not explicitly define the word "culture," but they may refer to it as people's lifestyles, "local belief systems, and collective rituals utilizing [undercooked fish] dishes" (Grundy-Warr et al., 2012). Because most people's primary occupations are fishing, fish is their primary source of proteins. It is easy to find and cheap. Given that the fishing puts the people away from home most of the day, they choose to prepare koi pla (a dish made from raw fish), which is, according to them, delicious and traditional. The authors referred to local belief systems as how the local people accept different kinds of undercooked fish. They are okay with fermented fish, and raw fish with chili and lemon-juice, and do not consider them as *raw* (Grundy-Warr et al., 2012). Many people believe that

[3] NIH grant proposal, 2011

lime-juice "removes parasites" (Grundy-Warr et al., 2012). Lastly, the authors referred to culture as eating koi pla on special occasions (Grundy-Warr et al., 2012). Some people eat koi pla with white whiskey, which could make them less aware of their eating habits. They associated alcohol with masculinity (Fordham, 1995) and an ability to kill parasites (Grundy-Warr et al., 2012).

Even though Grundy-Warr and colleagues (2012) provided examples of what was meant by "culture," they clearly were judgmental in their statements. According to them, people have "*poor* attitudes" and could use some help from "scientific evidence," so that they will have "a *better* local understanding of the most risky fishes and dishes[;]" "allowing local people to make informed choices" (Emphasis added) (Grundy-Warr et al., 2012). We researchers should find ways to "fuse *good* science with local knowledge" (Emphasis added) (Grundy-Warr et al., 2012).The statement implies that researchers' attitudes are adequate, if not superior; science is objective fact, invaluable, and it is what we rely on (or should rely on) when making decisions; and lastly, researchers have quite a good understanding of the risky fish dishes people could learn from. These examples represent the recent trend in the liver fluke literature related to culture.

Currently, health education aimed at changing people's behavior of eating undercooked fish has not worked and perhaps, the fact that the detail and type of health education have not been documented (Sithithaworn & Haswell-Elkins, 2003; Sripa, 2010), contributed to this downward trend in educational interventions. The health education program conducted in 2010 at Lawa village, Khon Kaen resulted in 61.8% of adults and 9.6% of students (of 1,136 total students) infected with *O.viverrini* (Sripa, 2010). Jongsuksuntigul and Imsomboon (2003) summarized the health education effort and stated that community participation and self-reliance was done "through mobilizing of individuals, family and community participation," but with no further details of what they meant by the terms community participation and self-reliance, or what the activities actually look like (Jongsuksuntigul & Imsomboon, 2003). According to Sithithaworn and colleagues (2012), "community-oriented approach" is needed, and not "a top down policy" (Sithithaworn et al., 2012). Despite acknowledgement of empowerment as a potential result of community participation (Keittivuti, Keittivuti, & Srithong, 1986; Sithithaworn & Haswell-Elkins, 2003), researchers never mention barriers facing an effective health education. They simply stated that the opposite might occur: the control campaigns may make people "feel powerless" (Sithithaworn & Haswell-Elkins, 2003).

One possibility of failure might come from how infection by the liver fluke depicted in educational materials. According to the pilot study, figure 2 shown previously (with no added English texts) is commonly used during school health education programs for children. Judging from this figure alone, it is unclear how the disease vector travels inside the human body, and how the fluke (literally translated as *worms* in northeastern dialect) can damage the body. The arrows in the picture could lead children to think that the disease gets into the body through fish and exits the body through feces (human *waste*); thus no big deal. The picture also depicts one disease vector on a one-to-one ratio with other disease vectors. For instance, an egg ingested by a fish eventually generates one worm in the human. Despite its correctness, this could lead children to assume that one snail or one fish can only ingest or harbor one egg. However, in reality, many parasites can be buried under the fish muscle, and are passed through human feces. Lastly, the size of various stages of *O.viverrini* is somewhat misleading. For example, children may be led to believe that free-swimming cercariae can be seen with the naked eyes, when its

adult size is in the order of millimeters and the eggs are only in the order of micrometers (Kaewkes, 2003). Nonetheless, regarding issues of representation, it might not be possible to convey many concepts in one picture, and perhaps it is not wise to do so. That said, the picture may do justice to the travels of the disease vector, between various hosts, but the usage of it certainly requires more transparent and explicit instructions than the one currently used. Perhaps, there is the need for long-term education programs—similar to those suggested for improving the control of schistosomiasis in China (Wang, Carlton, Chen, Liu, & Spear, 2013).

Interdisciplinary Approach (Transdisciplinary Approach)

Perhaps, due to the failure of each and every aforementioned approach, the recent literature supports various sorts of interdisciplinary approaches. Grundy-Warr and colleagues (2012) concluded that we need interdisciplinary research programs that incorporate both "scientific and social methodologies…[within] disease prevention strategies and health education" (Grundy-Warr et al., 2012). Perhaps they meant that we need to utilize qualitative methods often used in social research to really understand what they called "local knowledge" and incorporate that in scientific-based health education. On the other hand, Sithithaworn and colleagues (2012) chose a broader interpretation of the term interdisciplinary. They aim for an "ideal" "Ecosystem health" or "EcoHealth," which brings together doctors, environmentalists, social scientists and others to control the liver fluke infection. This is because the disease problem is complex and involves changes in the environments, reservoir hosts (Sithithaworn et al., 2012), and how government and non-government sectors distribute money and efforts, that affect human health.

Organization of the Dissertation

In the following chapters, I review relevant literature, and discuss my pilot study, dissertation study, and implications for this work. Chapter Two introduces *system thinking*, its associated language, and provides real world examples where the thinking helps us see the problems in a more holistic view. Using the system thinking as a lens, I discuss about Eastern and Western views of health and illness (in the conventional sense of the words) in close association with each other in Chapter Three. The following Chapter Four describes the pilot research I conducted, detailing initial findings that led me to apply greater emphasis on people's definition of health, and their personal reasoning skills, and therefore to select case study methods, detailed in Chapter Five, the dissertation study. By theoretically and practically comparing and contrasting the two views, I am able to integrate the parts (e.g. science and society, scientific rationalism and religion, health and spirituality), bringing us closer to understanding our complex world. These findings are reported in Chapter Three and Five, with the former focusing on the theoretical side of the Western and Eastern views, and the latter focusing on the practical side of them. Chapter Six concludes the thesis, comprising possible leverage points – places to intervene in the system, discussion of my findings, as well as implications and future directions.

CHAPTER TWO: SYSTEMS THINKING

Ever since the Enlightenment, Western society has benefited from classical science, which emphasizes *reductionism* as its defining motif. Macro states in fields from biology to economics to physics have been systematically reduced to simpler explanatory microstates. For instance, classical physicists discovered that studying particle behavior can explain heat phenomena. People approach challenges by breaking them down into manageable pieces. To write this dissertation, I divided it into chapters, outlines, and work schedules.

However, problems arise when the challenges are complex. The slice-and-dice approach provides clear "snapshots" of reality—making it easier to understand, execute, and test using the scientific method. However, this approach does not explain how the component pieces work *together*. Putting each paragraph and chapter together is overwhelming at times. The world does not stand still as I explain it. Unexpected connections emerge among ideas, which in turn render original outlines obsolete. Ideas are like life itself, which is moving and changing. Logical connections within a paragraph and between paragraphs continuously change, making it hard to predict the final product.

By contrast, systems thinkers see the world around us in terms of wholes, comprising a continuously evolving web of interdependence. The approach suggests we step back and "view from 10,000 meters," rather than "divide and conquer" (Richmond & Peterson, 2001). Interrelationships among component pieces in a system are more important than separate details. The following details are often perceived as having specific and static relations with each other: 1) Low-income populations consume undercooked fish; 2) the communities' efforts to control the infection have failed; and 3) Thailand has alarmingly high rates of liver fluke infection, and high levels of fluke-caused cancer. *These high rates of O.viverrini infection (the statement 3) indicate the failure of community health effort (the statement 2)—the failure of changing the people's behavior of consuming undercooked fish (the statement 1).* However, according to the pilot data, not everyone who eats the infected undercooked fish was infected by the flukes. Thus, perhaps the community health intervention failures should not be equated to the existence of undercooked-fish eaters, the high rates of the infection, or the high cancer rate. The interventions may accomplish something, or even create the conditions that perpetuate the liver fluke infections endemic. Yet, looking at the pieces of the problem separately does not allow us to understand the information in a meaningful way.

However, this is not to say that "the systems way of seeing is better than the reductionist way of thinking. I think it's complementary, and therefore revealing" (Meadows, 2008). A rudimentary understanding of the parts is necessary to understand the system, but the connections between the parts also need to be understood. We need to see both the forest and the trees, to ensure understanding of both breadth and depth of the problems. But because the world in which we live in is increasingly complex, and reductionism is so ingrained in our minds—as it is the basis of most scientific fields, I introduce here systems thinking. Using the systems lens, I negotiate the middle ground between Western science and Eastern culture.

Introduction

What is a system? A system is a set of connected entities working together as a whole (system, 2013). The interconnected set of elements, constituting a system, is "coherently organized in a way that achieves something," and produces its "own pattern of behavior over

time" (Meadows, 2008). In sum, a system consists of 1) elements, 2) interconnections, and 3) a function (used for a nonhuman system) or purpose, and produces its own *system behaviors*. We are living in a world of systems. There are biological systems (e.g., human heart and liver), mechanical systems (e.g., a thermostat), human/mechanical systems (e.g., playing a musical instrument), ecological systems (e.g., predator/prey), and social systems (e.g., groups) (McNamara, 2011). Systems can be intangibles (e.g., "following a recipe," "raising a child" (Glouberman & Zimmerman, 2002), and capitalism (Wallerstein, 1991). Systems need not involve humans (e.g., a wheel, and a car key). And systems can be classified in multiple ways (e.g., isolated v. closed v. open systems).

Systems thinking is an approach to analysis that looks at a problem as the result of the *pattern of behavior* of a system. The approach looks for the underlying relationships and connections between the parts of a system, so-called *system structure* (Martin & Forrester, 2001) that produces the behavior. The system structure is the source of system behavior, generally known as the source of the problem (Meadows, 2008). The structure generates the patterns of behavior that are called *system dynamics*. *System behaviors* are referred to as "the way in which the [parts]…composing a system vary over time" (Martin & Forrester, 2001).

World problems, such as poverty, can be understood from a system point of view, and not from linear causal thinking. What causes poverty? People may be poor because their families are born poor, and that is because they are unemployed. And, they are unemployed because their job options are limited due to their lack of education. Their lack of education is caused by drug addiction, and so on. One can always find yet another cause that caused the one that one thought was the cause (Kirkwood, 1998). However, let's consider the following society-level subsystems and the links between them:

- "Desperate people who want quick relief from psychological pain"
- Farmers, dealers, and companies who want to earn money
- Public schools that accept only the best, talented students—determining directly or indirectly by scores, awards or honors from varied fields
- Governments that raise the minimum wage and use law enforcement to assure the effect
- Wealthy people who love to "feather their own nests," and live in close proximity to poor people
- Poor people who find hope through having many children
- Average people who really just want to save enough money for their families

Adapted from (Meadows, 2008)

The interconnections each one has with each other tighten the state of poverty. To illustrate this point, consider how one subsystem relates to the next. In the midst of drug addiction, desperate people may steal their employers' money. Employers could ignore their employees in order to come up with money-making ideas. Public schools could poorly serve indigent students. Governments could shut down many small businesses. Wealthy people could set bad examples for poor people, while the poor could set bad examples for their children. Average citizens could miss opportunities to aid others. Imagine the number of people in a society, and in the world. There are, thus, millions of cycles like this, entangled with each other with no beginning and end.

My Personal Philosophy (My Paradigm)

Instead of introducing technical systems language, here I embed its general terms in my personal experiences. In my opinion, these experiences make systems thinking intuitive, and not vice versa. Many of us are already unknowingly familiar with systems principles, and are natural systems thinkers. Thus, it is crucial to recollect our intuition, i.e., knowledge from within. I will lay out my perception of the world, and welcome you to join me. However, I encourage you to consult your own experiences and trust your own instinct along the way. My experiences can only serve as a starting point. In the end, I am a learner who makes mistakes and changes my mind all the time.

Being a responsible citizen of the world requires the need to balance my goal with society's goals. I choose to do my dissertation research on negotiating the middle ground between Western science and Eastern culture, because I want to understand the systems embedded in and supported by science in the context of culture and society (or the dynamics of science and society). The research satisfies my intellectual curiosity. Yet, I focus on the research, at the same time as experiencing life—making sense of human beings and our nature so as to contribute to the making of safe and peaceful communities. Society's goals, in this case, also include making a contribution to people's standard of living—in a *small* way. Becoming too fixated on my goal of completing this dissertation can nullify the goal of my dissertation research in the first place, and I could miss an opportunity to contribute to the betterment of the communities.

Systems thinkers call this a *feedback loop*. It is like A affects B and B affects A. Discovering reasons for ineffective public health would contribute to the improvement of human well-being. Simultaneously, the betterment of society would give me courage to persevere to my goal. In other words, one's goals and society's goals often influence each other, directly or indirectly. Thus, it follows that I should not focus solely on one or the other. Optimization is a balance between the two. More specifically, this example is called a *reinforcing loop*. The *more* I achieve my goal, the greater my satisfaction, and the *more* improvement of human well-being. And the greater good of a society encourages me to contribute *more* to society. But because nothing grows forever, there's another kind of feedback loop limiting the growth, called the *balancing loop* that limits the growth. Occasionally, I get anxious, procrastinate, and lose focus. When this balancing loop gets significantly strong, I have to weaken it so the reinforcing loop can dominate.

Aside from trying to stay focused on one thing at a time, I often feel that I am straddling two worlds. For instance, I am sensitive and logical; Buddhist and Catholic; and Southeast Asian with Western-based knowledge. I never understand my twin sister's logic and explanations, but am always quick to catch her feelings. She chose to major in culinary arts because she did not like other majors. She is unwilling to read academic books and prefers to retake exams. Yet, all these seem logical to me, seeing her unhappiness visibly etched on her fragile features while reading, and her joyfulness being a C student who "runs the world." Because of her, I am convinced that sometimes, as Bill Maher said, "feelings are more important than facts. Sensitivity is more important than truth." When I was growing up, my Catholic mom reiterated that even if I know everything, nothing would work if I did not trust in God, while my Buddhist (atheist) dad believed things will work out only if I tried my best. I am where the two views come together: if I try *my best*, nothing works. I become too focused on that particular

thing, ignore a broader conversation, and forget about others' feelings. Finally, I am a chemist who does not quite understand what love is. My love of science can't help me understand love.

Systems thinkers encourage *continuum thinking* where the clear-cut boundary between two opposing views is eliminated. "[F]rom a continuum standpoint, "us versus them" disappears" (Richmond, 1993). From the systems thinking perspective, debates are often useless because "the real debate is not black and white." Richmond gave an example of abortion. The most extreme pro-choice people never claim it is "all right to abort a fetus ten minutes before full-term delivery." On the other hand, the most ardent pro-life folks do not think that "the flushing of a live egg due to menstruation really is murder.…Pro-life people really are pro-choice people under certain circumstances," and vice versa (Richmond, 1993). The most crucial issue here is to find the common ground! There are no real angels or villains; no losers or winners. We need not take sides. We only need to pay more attention to "things that are working" underneath obvious controversies (Meadows, 1991).

In my opinion, effective progress cannot be made in a polarized world. For example, Western science should not be viewed as more beneficial than Eastern culture, or vice versa. As Gordon notes,

> The moral dilemmas regularly encountered in contemporary medicine…[are] understood in the context of the denial of shared values and the reframing of values in terms of rationality and the individual instead of culture and society (Gordon, 1988).

The shared values or the concepts of culture are often considered as a type of "belief" that is mistaken or irrational. However, "within the bounds of what a person in that part of the system can see and know, the behavior is reasonable" (Meadows, 2008). If I am a poor fisherman in Northeastern Thailand, working 10 hours a day, with a high debt, a family to support, and *perfect* knowledge (in both experiential and scientific knowledge) of the state of the liver fluke infection, I will probably eat undercooked fish. Perhaps, there is no need to reassert science v. culture, knowledge v. belief, and science v. society. Rationality is culture bound.

There are so many things that I do not understand that I cannot reason with myself. For illustrative purposes, I portray myself as Hamlet—the main character in Shakespeare's play. Do you understand why Hamlet gets involved in the tragedy that leads to death of so many people, including himself? Why did he delay in taking revenge for his father? Why didn't he immediately kill Claudius when he learned that Claudius murdered his father? I often wonder if the events are inevitable or merely accidental. What makes things happen in the first place? What causes accidents? Is it possible to determine cause(s) of the events when I cannot understand the world of other people involved in the events? How do I determine the cause(s) after the fact? Shakespeare tackled fundamental problem of the Renaissance's humanism or humanitas (Latin noun for human nature)—that there's a flaw in human reasoning: We humans are not always capable of cultivating reasons that benefit society as a whole (McLean, 1985).

Systems thinking makes us aware that "the world is greater than our knowledge of it" (Berry, 2011), and that "[e]verything we think we know about the world is a model" (Meadows, 2008). Hamlet revealed the difficulty of living in the world of appearances where what he saw was not "reality." He could never understand or reason through the situation with his limited knowledge. It was impossible to know if Claudius really murdered his father, if his father's ghost was real, what Claudius' motivations and feelings were, or what his own state of (in)sanity was.

Shakespeare stressed Michel de Montaigne (a French Renaissance writer)'s ideas about the limits of human understanding of the world (SparkNotes Editors, 2007). "All decisions are made on the basis of mental models. No one's head contains a family, city…or business" (Forrester, 1996). Our head stores tremendous amount of information that has "a strong congruence with the world." Regardless, "our models fall far short of representing the world fully" (Meadows, 2008). Our knowledge only embraces separate parts of real systems. Consequently, we cannot know what "the… information means in terms of [(complex)] behavior" (Forrester, 1996).

Because no one can be right about everything, we would be better off to incorporate and cooperate, rather than to compete for our stance. Systems "evolve from the lowest level up" (Meadows, 2008). Parts form a whole, and the whole serves the parts. Individuals form a society, and the better society is possible only if each part (i.e., each individual) realizes that he or she is only one part. You have probably heard of the famous Indian legend of a group of blind men eager to touch and learn what an elephant is like. As they did not know what to expect (e.g., its size, shape, and form), each one ends up touching only some part of the elephant. And each argues for the real facts about the elephant. In fact, each is right about one part. However, without listening and collaborating, they are not capable of "seeing" the full elephant. We are not blind, of course. Yet, we often "see" what we want to see—or what the mind is prepared to comprehend.

Perhaps, social class is not so much like "the elephant in the room" (or an obvious problem that no one wants to discuss) that fades into the background. But, with our mind so fixed to the certain features of social class (e.g., income), the notice of *the elephant* always involves, or is, the revelation of ignorance (Meadows, 2008). Worst off, we tend to think that we know everything there is to know about the elephant. For instance, perhaps it is not useful to focus on the fact that among British civil servants, people at the very top of the society (with the highest pay) have the lowest rate of many diseases, and that there's a gradient across the hierarchy, from top to bottom (Marmot et al., 1991). From a systems perspective, it may be useful to look at the interactions of people across different levels of the society. If control-over-destiny factor, as Syme suggested (Syme, 1989), is a key factor here, the reward for yielding to higher authority may come from the individual having authority over someone of lower rank. Thus, it may be useful to understand this sort of dynamic in perpetuating class structures.

For systems thinker, "[e]verything is…connected to everything else, and not neatly" (Meadows, 2008). We humans live in this world together. Thus, we either win together, or lose together, and like any team member who could cause a sports team to lose, an individual could make the world a worse place. People often have the question of "why bad things happen to good people?" To me, the answer is not so much about the reasons of why things happen as it is about realizing *ourselves* and our responsibility as a citizen of the world. In our win-lose cultures, helping people is about being nice and good to others. In a win-win culture, helping others is like helping ourselves. It comes with "the understanding that losers, …if they have no hope of winning, could get frustrated enough to destroy the playing field" (Meadows, 2008) that we are all in it.

Tuning in to System Thinking Paradigm

Now that we have gathered our intuition, let's be more specific and look at definitional problems around the various types of systems, as well as our typical thinking model that is likely to impede the systems way of thinking.

From Simple to Complex System

Systems can be classified as *simple*, *complicated*, or *complex*. This classification is based on *system dynamics*. A system's dynamics can be organized (simple or complicated) or self-organizing (complex). [Note: An unorganized "system" is not a system; it is called *chaos*.] Simple systems can be reduced to their parts; whereas, complicated and complex systems cannot. Complicated systems constitute of multiple parts that contribute to a larger effort. Complex systems, on top of that, are adaptive: multiple parts learn and coevolve as they "interact with one another and respond to changes in their environment" (Hargreaves, 2010).

Here are some real life examples: Following a recipe book is a *simple system* (Glouberman & Zimmerman, 2002). A food dish is a mix of a list of ingredients. The orders of putting each ingredient sometimes matter, but more or less, we can break the dish down into its ingredients. On the other hand, an orchestra is a *complicated system* (Hargreaves, 2010). It is comprised of musicians who play various instruments together, with each contributing to the orchestral music. Every small note, nuance in volume, dynamics, and expression is very crucial to the whole, and slightly missed musical phrases can ruin the whole piece. However, each part is systematically and properly placed. Each musician reads his or her part on the written score, and the piece is usually not open for interpretation by the individual players! Raising a child, on the other hand, is a *complex system* (Glouberman & Zimmerman, 2002). The child and his/her caretaker grow and learn in the process, and have ability to adapt to various situations. There is always some uncertainty associated to it. Raising one child well does not guarantee success in another child (Glouberman & Zimmerman, 2002); whereas, playing an instrument well in an orchestra almost certainly translates to playing well in other bands.

The subtle distinction between a *complicated system* and a *complex system* is very crucial here. Even though, by definition, both systems cannot be reduced to their constituent parts, the complicated system can be thought of as being reducible. Because *each* constituent part of complicated systems contribute to a larger effort, a musician plays his/her part well contributes to pleasant piece of orchestral music. Thus, in reality, and for all practical purposes, the music director would break down the whole musical piece and assign each part to each musician to practice on his/her own time. On the contrary, being compassionate for a child may not contribute to success in raising the child. Other things, such as knowledge of child development, may be needed. Each factor cannot stand alone as contributing factor to the whole. Sometimes, being compassionate leads to bad results. This kind of system gives us troubles. Many public health problems and educational problems are like this; they are complex.

Responding to complex problems as if they are complicated ones can yield negative results (Glouberman & Zimmerman, 2002). For instance, health care systems are complex. Canada's effective public health care system cannot happen through looking at its individual structures—affordability for an aging population, advanced technology support, and individual health care cost, *separately*, i.e., without considering interrelations among the factors (Glouberman & Zimmerman, 2002). Doing so implies that the health care system can be reduced

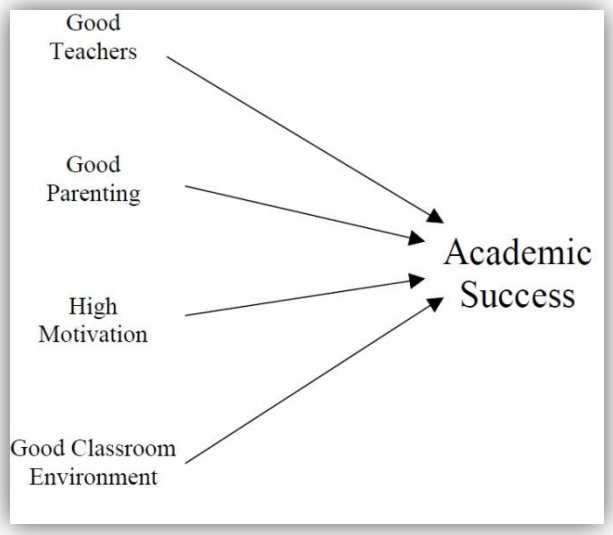
to its parts that contribute to a larger goal, i.e., a characteristic of a complicated system. Often, a musician can individually practice his/her part in order to play well in an orchestra with other musicians. However, optimizing each factor that contributes to the health care reform does not assure its effectiveness for the whole health care system. Increasing care of the aged likely decreases families' responsibilities for taking care of their elderly relatives, which in turn increases the demand for nursing home care and public support of the elderly. These costs likely decrease funding for technology support, which indirectly increases individual health care cost. In sum, complex problems are not linear; there is no "clear linear flow from one step to the next" (Glouberman & Zimmerman, 2002). Each factor affects other factors, and not neatly—not always in the direction that adds up to the larger goal. Effective health care reform in one country may not work well in another country.

Confronting Our Thinking Paradigm

Now, let's take a moment and try answering the following question: "What causes students to succeed academically?" (Richmond & Peterson, 2001)

Perhaps, you come up with a list of reasons that look similar to the Figure 5 below.

Figure 5: Laundry List Thinking Mental Model



(Richmond & Peterson, 2001)

Richmond called this type of thinking, "Laundry List Thinking." Western cultures implicitly agree that "reality works via a structure of serial cause-and-effect relationships" (Richmond & Peterson, 2001). However, not all cultures agree to this view. Some eastern cultures believe in synchronicity view of causality, i.e., reality works by chance or "balance of probabilities," or "God's hand." Academic success is not merely a function of a list of factors (e.g., teacher effectiveness, and levels of student motivation). It does not take the form of a multiple regression equation (Richmond, 1993):

$$y = a_0 + a_1X_1 + a_2X_2 + \cdots + a_nX_n$$

Where y = academic success (dependent variable)

X_i = each factor, e.g., teacher effectiveness and levels of student motivation (independent variables)

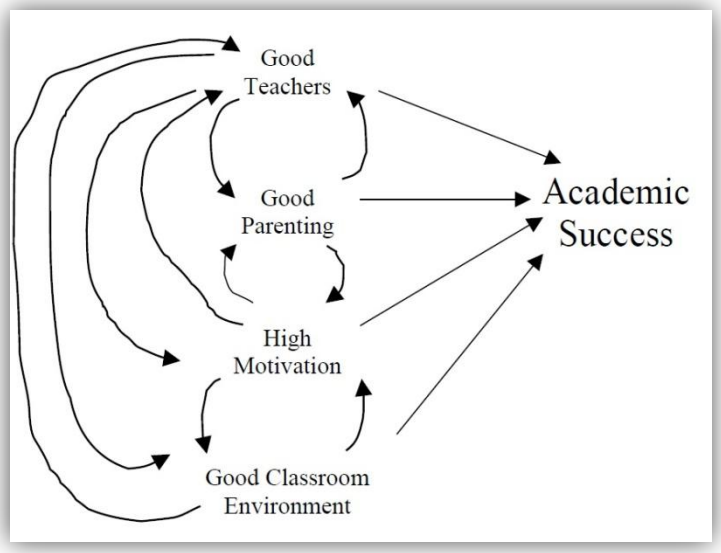
a_i = coefficients (weighting factors) for each factor

Instead, the success depends on the combination of all the factors working together, meaning that:

1) Causality does not run one way. Some factors can serve as both causes and effects.
2) Each factor does not act independently. Some factors depend on other factors.
3) The weighting factor of each factor is not necessarily fixed. It changes depend on the situation (Richmond, 1993).

The reasons why students succeed academically should look much more like the figure 6 below.

Figure 6: Interdependent Relationships Thinking Mental Model

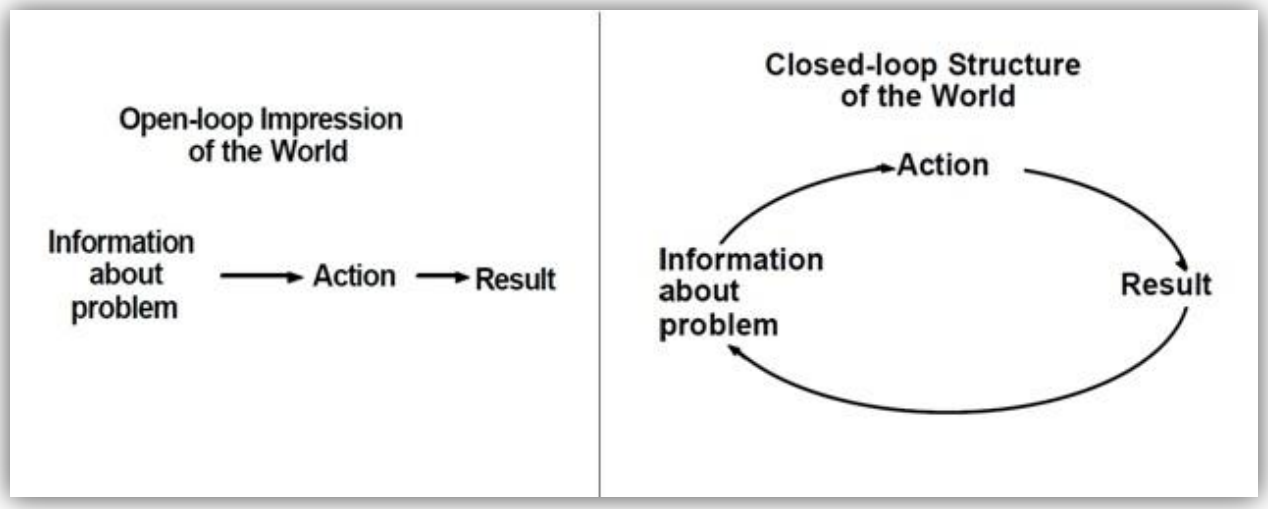


(Richmond & Peterson, 2001)

Closed-loop thinking (non-linear thinking)

We tend to look for the cause of success (or a problem) nearby, "decide on an action, expect a result, and believe that is the end of the issue" (Figure 7, left). However, most of the time, the problem lies, not in the information about the problem, but in the information-feedback control process (Figure 7, right) (Forrester, 1996). Using the previous academic success example, good parents decide that their children's school is not a good school for them to succeed academically, so they change schools in hope that it will be a better environment (e.g., better teachers), and in turn will increase their children's motivation, solving the problem. However, academic success stimulates (or de-stimulates) students' motivation and teachers' effectiveness, as much as they drive it. Even in a new, better school, students' bad grades can lower their motivation, and discourage teachers. In the long run, this can easily turn a good school to a bad one (Richmond & Peterson, 2001). Simply discovering a big factor contributing to the problem and removing it does not necessarily solve the problem (Meadows, 1991).

Figure 7: Human Open-loop Impression of The World (left), and Closed-loop Structure of the World (right)



(Forrester, 1996)

Additionally, the causal impacts are not always linear. In terms of the academic success equation, for example, someone might learn that for a particular classroom, bringing in good computer equipment (i.e., creating a good classroom environment) increases students' grades. Say, if I put 10 computers in a rural classroom of 50 students, on average, students' grades will go up by 20%. However, it is possible that if I put 20 computers, their grades will not go up at all. And if I put 50 computers so that each student has his/her own computer, their grades will go down. This shows a disproportional effect of a cause. "Small push produces a small response" (Meadows, 2008). Yet, more of a push does not necessarily produce more response, just as it progresses in a linear fashion.

We need to consider a *limiting factor* (Meadows, 2008). In a chemical reaction this is called a *limiting reagent*. A limiting reagent limits the extent of a chemical reaction. Other reagents added in excess will have nothing to react with to form product. In the case of computers in classrooms, technology may not be the most limiting factor. Excess technology can be a distraction, damaging students with "too much of a good thing" (Meadows, 2008). However, the situation may be completely different for a different classroom because the classroom itself is a *complex adaptive system*.

In sum, the feedback loop thinking is a shift "from viewing the world as a set of static, stimulus-response relations to viewing it as an ongoing interdependent, self-sustaining, dynamic process." The loop itself is responsible for generating the systems behavior (i.e., the problem). "This is in contrast to holding some set of external forces responsible:" the external force can bring the behavior into view, or act as a "precipitator," but not as a cause (Richmond, 1993).

Thinking generically

Systems thinking diverts attention from specifics (e.g., specific person), or from the immediate faults (or merits) of certain people, to the underlying structure that makes events almost inevitable (Meadows, 1991). We tend to be captivated by events, and think in terms of specifics (Richmond, 1993). We've seen "event-event analysis" (Meadows, 2008) everywhere in

the news. Nelson Mandela's death influences investment in South Africa. Adolf Hitler's policies created the Holocaust. John Wayne, wearing a safety helmet while fighting fires in a movie scene, created health and safety awareness among workers. But, were they "determined changes in history, or tides in history that swept these figures along on their crests?" (Richmond, 1993)

The thinking suggests us to look beyond the surface of things. Robert Pirsig, the author of *Zen and the Art of Motorcycle Maintenance*, once said that

> [I]f a factory is torn down but the rationality which produced it is left standing, then that rationality will simply produce another factory. If a revolution destroys a systematic government, but the **systematic patterns of thought** that produced that government are left intact, then those patterns will repeat themselves in the succeeding government (emphasis added) (Pirsig, 2009).

The structure (the system) demands that workers work in a factory from eight to five. "There's no villain, no "mean guy" who wants them to live meaningless lives." It is just that no one is willing to change the structure just because it is meaningless. The factory, the government, and a motorcycle are all systems—the true, real system constructs out of the systematic thought (i.e., *thinking paradigm*). The motorcycle, for instance, is "primarily a mental phenomenon." The motorcycle is made out of steel that only has shape out of someone's mind—as a philosopher Phaedrus put it; while in fact, the "steel" has "no shape at all." And even the steel itself "is out of someone's mind. Anyone from the Bronze Age could have told you that" (Pirsig, 2009). Certainly, government can do much to intensify (or ease) the economies, in the same way Hitler intensified the Second World War. However, the cycles of interconnections of parties within the economies, and that of the ecologies of war do not come from the government or Hitler alone. Thinking generically moves away from praising John Wayne in one situation and casting blame on his character in another situation (e.g., his name was used as a "nickname for the guard who was the meanest and toughest of them all" in the Stanford Prison Experiment in 1971) (Zimbardo, Maslach, & Haney, 2000). Instead, we should look for an internalized set of values instilled in every one of us.

For instance, the value of money is a mental construct. We often think in terms of cost and price. Many quality goods come at a high price. Some brand names even increase price of their goods to create "good quality" impression in our minds. Consequently, we internalize the meaning of money as a store of human worth. Money becomes our *habitus*—the embodiment of culture, politics, and other objective social structures. According to Bourdieu (1998), the habitus "is a socialized body. A structured body, a body which has incorporated the immanent structures of a world …and which structures the perception of that world as well as action in that world" (Bourdieu, 1998). We tend to select jobs based on the highest possible pay, rather than following our bliss. To many of us, jobs equal money. We inevitably affirm a shared paradigm about the value of money every time we buy or sell something. Consequently, we unconsciously perceive people who are paid less [as] literally worthless (Meadows, 1991, 2008). This creates "the idea that some lives matter less [which] is the root of all that is wrong with the world," said Paul Farmer. We make something out of nothing. We give real meaning to money. And this is analogous to "how banks create money out of thin air," and we are really mad about it. Having said this, "some more fundamental change in the system is required" (Richmond, 1993).

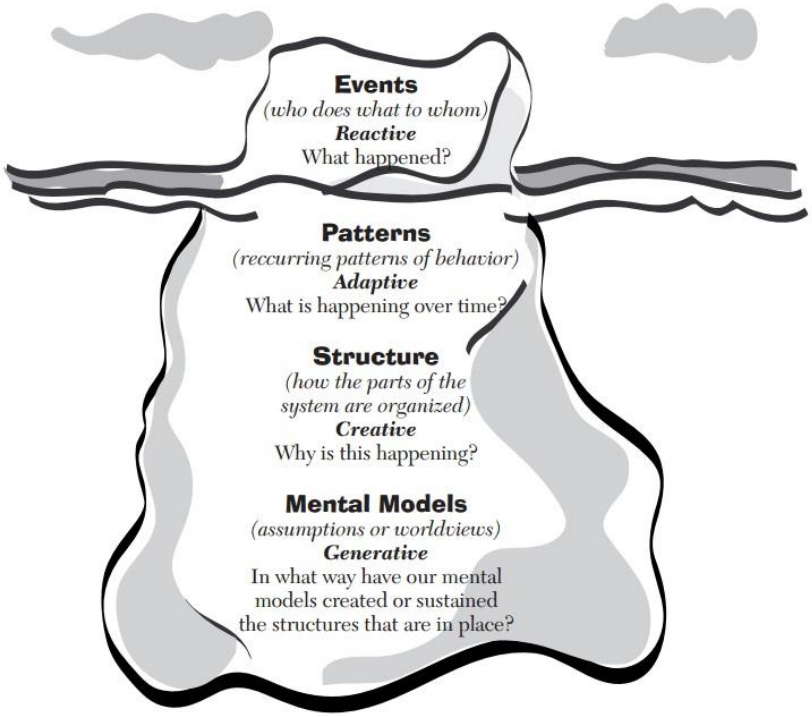
Change is possible at the level of paradigm. For systems thinkers, paradigms are the mind-sets out of which systems arise, and are "the sources of systems" (Meadows, 2008). Paradigms dictate rules of the game, our logic, our meanings, values, and societal norms. This is

exactly the place where we should attack for change (Kuhn, 1996), because for change to occur, there must be a change in meaning. According to Kuhn, *paradigm shift* is not easy because "there is a social determination not to see them" (Meadows, 1991) and sometimes, we need to change the entire dynamical worldview in which it exists. However, it can be done! In a top-down approach, "[w]e don't have to change anyone's values, we just have to get the system to operate around real values" (Meadows, 2008).

This is the reason I examine the worldviews of local villagers who continue to consume undercooked fish. Perhaps, health has completely different meanings to them. To change their eating behavior so as to meet our definition of health may need a complete redesign of their thinking systems. It may require a radical change in their meaning of life, or it may require just a click in their mind. However, changes need to come from both the villagers and researchers. The way researchers approach the public health problems need to change to ensure sustainability.

Regardless, systems thinking encourages us to look underneath the tip of an iceberg (i.e., events) (Figure 8), and be aware of our worldviews that significantly contribute to the mass of the iceberg below the surface of the water. The events "are the most visible aspect of a larger complex—but not always the most important." And "[t]o act only when a problem becomes obvious is to miss an important opportunity to solve the problem" (Meadows, 2008). This is because we tend to act on the obvious and to ignore what lies underneath. Thinking generically helps us get to the bottom of the iceberg—to our worldviews that generate systems structures (Figure 8) that cause events.

Figure 8: *Events* are served as merely the tip of an iceberg.



(Sweeney, 2011)

A Different Look at Time

Moving away from specifics, to thinking about problems in the broadest sense allow us to look at systems behavior over a longer time frame. Systems thinkers look at both immediate effects and long-term effects, in both past and future directions. Present events are the consequences of actions long ago set in motion, and the impacts of those events will unfold over time. That is, an event exists over a longer time frame than here and now. Consequently, the cause of a symptom cannot "be found nearby and immediately before the observed consequence." In complex systems, "the cause of a symptom is usually far back in time and arises from an entirely different part of the system" (Forrester, 1996). Note: we are talking about complex systems, not simple systems in which cause and effect are closely related in time (e.g., we feel hot when we touch a hot stove).

This is analogous to Einstein's "spooky action at a distance." Simply put, a "quantum entangled" particle can be affected instantaneously by what one does to a related particle at a great distance, in seeming contradiction of the theory of relativity, which would appear to limit communication channels between the particles to the speed of light. This appears to invoke some kind of magic. So, let me give real-life examples. Let us get back to the poverty example in the introduction (page 2). This time, rather than one subsystem relating to the next and tightening the state of poverty, a random act of giving to the desperate breaks up the initial interrelationship between subsystems and interrupts the whole chain. The desperate become hopeful, and no longer need quick relief from drugs. Thus, they do not steal their employers' money. The employers now pay more attention to loyal, hard-working employees, and thus earn increased profit through excellent customer service. This profit, in turn, is enough to cover the employers' children's expenses (e.g., tuition), and so on. At this point, it is legitimate to say that that act of giving to the desperate brightens children's futures. One small act could make a big difference to the people far away, i.e., the action at a distance! Because the world is complex with millions of interrelationships among people, we humans cannot tell how our indirect consequences of actions—good and bad—stretch out over time.

Thus, a solution to a problem always involves the tradeoff between short-term gains and long-term successes. "Actions that yield immediate rewards almost always exact punishment in the long run, and vice versa" (Forrester, 1994). A student who works overnight to finish a final project pays by being inefficient for final exams the next day. The desperate can take their mind off of depressing issues now by taking drugs. Yet, this comes at the expense of future deteriorating health. Improved long-term public health often involves an unsustainable population explosion. That said, we should consider both humanitarian (short-term goals) and ethical (long-term goals) aspects. For instance, "[f]ood aid to starving populations seems humanitarian in the short run," but is not ethical solution in the long run as it "may well encourage population growth and greater starvation of more people in the future" (Forrester, 1994). Often, one generation of people does not live to see the long-term consequences of their actions.

On the other hand, time just is, and has a cyclical nature with no beginning or end. Yet, we intuitively perceive or believe it to be linear. We draw a linear timeline from the past through the present into the future, horizontally or vertically. We perceive time as linear because we are born, live a life, grow old, get hurt and die. In addition to limited time we have in this world, linear time is enforced by the fact that our memories add up. When we perceive time as linear,

living in the moment and thinking ahead are different because they are different points on a line. Thinking ahead often means not enjoying the moment. However, if we perceive time as cyclical, remembering the past, and thinking ahead are simply different forms of living in the moment. The past is nothing but present memories. The future is nothing but our present memories forming a prediction or expectation. These repeat over and over again—like the moving point along the circle. The time does not begin or stop, and simply continues.

Systems thinking encourages us to be aware of our perception of time (and alternatives), and realize that *no* one way is "true." We can choose whatever view that helps us achieves our goals, and do not have to devalue the others. Judging from English language alone, perhaps English speakers think more of a long term, and past events. As a non-native English speaker, I am forced to pay attention to time structure of events. This is because English has different verb forms for past, present, and future. However, I am not so conscious of time speaking my native Thai language. Thai only has one verb form—the present tense. Things in the past and future are indicated by tense markers or word choices instead (e.g., yesterday). And the markers can often be omitted because past or future events can be implied through meaning. English language tends to take me further away from the present moment. Yet, it is very useful in planning for the future. In the end, concept of time serves different purposes in different environments, and exists only in our mind. And I am learning not to get attached to any particular view.

Example Systems Application

Although I have confronted our typical thinking model that is likely to impede the systems way of thinking, I still need to apply systems thinking to real-world situations. This section provides examples of public health-related problems, and explores how might the systems thinking helps turn the problems around.

Public Health

Public health is the science of promoting health, prolonging life, and preventing disease—through the use of intervention. It is a growing field that incorporates interdisciplinary approach from various fields, including cultural anthropology, sociology, and psychology. Different professions see health problems from different angles. Consequently, public health research reflects practical understanding of a number of theories—ranging from micro-level health behavior psychological theories to macro-level socio-cultural theories. Researchers from various fields use different field-specific languages sometimes to convey essentially the same concept. Regardless, in the end, public health researchers propose interventions in order to address the chosen health problems, and attempt to assess outcomes for change and further improvement.

Public Health Interventions

A number of challenges plague today's state-of-the-art science of the aforementioned public health objectives. For instance, improvement of health through medical services is only available for specific diseases. Not everyone wants to live a long life—with poor quality. And, preventative healthcare often points to personal behavior choices, which are sensitive topics to talk about and are extremely hard to alter.

I believe the core of these interwoven problems lies within researchers' idea of creating interventions as the end product. The idea structures perceptions and actions of the people involved: Firstly, interventions create a rigid boundary between target population and

researchers; where the former receives aid from the latter. Secondly, an existence of intervention programs authorizes the position and knowledge of researchers (e.g., doctors, public health official, and health educators). Thirdly, the interventions are often mistaken for the solutions of the problems. And lastly, the intervention process often entails people's dependency on researchers.

An intervention persistently builds a wall between researchers and a target population. Typical public health model: after understanding a chosen public health problem, the researchers then devise an intervention to address it. For researchers, this intervention often serves as an entry ticket to the community. The intervention is the vehicle by which the researchers could try to solve the people's problems. Sometimes, communities are involved in developing an intervention. This is called community organizing—or "a process through which communities are helped to identify common problems or goals, mobilize resources,…develop and implement strategies for reaching the goals they collectively have set" (Minkler, 2012). However, the interventions are initiated by the researchers who often do not belong to the communities they try to help. The researchers more or less act as givers of the intervention programs in a one-way relationship. If there are things to be learned on the researchers' side, they have never been put as programs or artifacts, and this separates the researchers from the target population.

Consequently, the intervention programs authorize the position and knowledge of the researchers. I believe language plays a significant role in giving researchers this power. Fred Kofman wrote:

> [Language] can serve as a medium through which we create…realities as we begin to talk about them.…The language…fundamentally structure the perceptions and actions of its members…[, and] is more primordial than strategy, structure, or…culture" (Kofman, 1992).

According to the normal dictionary, an intervention is an "act…of interfering with the outcome or course… of a condition"(intervention, 2013). Even though a *public health intervention* refers to an activity undertaken to prevent, maintain, or improve medical conditions for a positive change, the word arguably implies an act of intervening. The common use of the word *intervention* in public health research makes the interruption legitimate. Unconscious and regular use of the word public health intervention also suggests that the researchers have enough knowledge to intervene for positive change. And I doubt if that's always the case.

This is how the community-based interventions are introduced. However, the community organizing part of the interventions is a very weak balancing loop that tries to counter the strong reinforcing one that has long dominated researchers' thinking. It may be much more effective to weaken this reinforcing loop (i.e., weakening the language, and in turn, the action of creating an intervention). Thus, this dissertation hopes to set an example by not focusing on developing an intervention per se, but rather focusing on understanding a system and a culture that create and perpetuate the liver fluke infections. Perhaps, the intervention itself is part of the problem. Of course, interventions could provide people knowledge, and knowledge is no doubt power. However, real power is power over the knowledge—the right to provide knowledge through the interventions.

The interventions are often mistaken for the solutions of the problems. Public health researchers establish routines and procedures to come up with interventions. First, we do a background literature review and develop a theoretical model to understand a chosen public health problem. Then, we collect data through quantitative or qualitative methods to better understand the problem. Finally, researchers propose an intervention that we think would address it. These are typical steps required for many academic journals and some ethics committees. After this well-thought-out systematic investigation, the researchers tend to be in the think-they-know-it-all stage—at least before health assessment occurs. I believe we forget that the world is complex. Our public health system and many health problems are also complex, and our research culture may not comprehend their complexity. As a result, our predetermined, closed-ended interventions do not match the level of complexity of the problems. In other words, the solutions are no match for the problems.

Our closed-ended intervention solutions barely manage to get around the real issue. Depending on target populations, the focus of tobacco control intervention programs range from smoke-free environment, tobacco use prevention, to behavior modification, and smoking cessation. None of these programs tackle the problem at its roots. None of them supports "a system and a culture where …[no-smoking] is what people do, day in and day out, even when no one is watching" (Gawande, 2013). None of the programs encourage people to think for themselves, so as to understand themselves and our world of temptation.

I say this with a disbelief in intervention programs in general—but not the ideas behind them! Perhaps, some data collection methods (e.g., PhotoVoice, participant observation) can serve as *interventions* by themselves. These methods are more open-ended (i.e., unpredictable and flexible), and allow dialogue to go both ways; thus, limiting the risk of ethnocentrism on both researchers and target population. The methods target not only individuals and their rationality, but also culture and society.

Researchers and smokers tend to pay much attention on the medically addictive properties of nicotine, but not much on the dependent nature of smokers on drug. Many people neglect that the drug provides smokers pleasure—a positive effect! Smokers often start smoking as a way to avoid solving actual problems. The drug provides them pleasure and serves as a quick solution to the *symptom* of the problem, i.e., to relieve their stress. However, when the effect of stress-killer drug is over, the problem resurfaces and smokers face with the actual problems. The addiction occurs when *the solution* or the drug "undermines the original capacity of the system to maintain itself" (Meadows, 2008). More specifically, the addiction occurs when the drugs weaken their thinking and problem-solving ability. Not capable of solving the real problems, smokers then apply more of the *solution*. They turn to smoking every time they face problems. It is true that nicotine in tobacco stimulates the act of smoking. However, it is also true that the addiction happen when smokers allow the drug to carry *all* their load—not being aware of the real problems. Smokers could allow the drug to carry *some* of the load and do not become addicts, i.e., getting pleasure from smoking while thinking and solving problems. Hypothesizing about this feedback process as a non-smoker, I am aware that different smokers experience different stories. My intention here is to bring to notice the dialectical relationship between smokers and drugs. Perhaps, drugs are as much addictive as people rely on them for *solutions*.

Analogously, the intervention process often entails people's dependency on researchers. System thinkers call this type of system trap, "shifting the burden to the intervener" (Meadows,

2008). The term intervention carries quite a load of dependency with it, due to the fact that the intervention programs are initiated by the researcher, and also provide authority to them. The interventions, thus, discourage the great majority of people to create interventions for themselves. Consequently, people often feel helpless and are tied to the helper for success. With the best of intentions, the researchers utilize interventions as tools to solve problems. It functions as a drug that doctors prescribe to ease patients' *symptoms*. However, researcher aid that attempts to solve people's personal problems fosters more dependency on aid in the future, because the interventions have shifted the responsibility for health away from individual citizen and onto health programs. According to Redfield, a Médecins Sans Frontières (MSF) doctor, "humanitarianism, it seems, always leaves one wanting more" (Redfield, 2013).

The typical public health interventions fail to sustain their goals because public health researchers tend not to work within the community capacity limit (the systems limit). Educators call this limit the "Zone of Proximal Development (ZPD).[4]" Teachers should work within the students' ZPD—providing them with enough assistance and tools so that they can work independently in the near future. The interventions should intervene "in such a way as *to strengthen the ability of the system to shoulder its own burdens*" (Meadows, 2008). However, the researchers often put more help than necessary. And more help is not always better. If the help takes the load off people's shoulders *entirely*, the people's capability to repair themselves will be reduced, and they will not learn how to help themselves in the near future. At this stage, the system breaks down and cannot function by itself. The interventions function exactly like drugs that people turn to every time they face difficulties. The interventions would rather hurt than help people. Raising a child with too much love can be a bad thing.

Community organizers may not agree with this point because they help people through building "community capacity." The community organizers help communities identify causes of the problems, build a network, and implement appropriate strategies. Sometimes, asset-based community development (ABCD) is used whereby researchers help people find the strengths within the communities. Let me clarify this tricky and subtle point: "Building community capacity" or involving people in the research process needs to happen *before* or *during* the intervention process, and not after. Because, once the addiction trap is formed, any help for building community capacity (e.g., developing a leadership role) is simply self-defeating. The intervention programs already reduce people's capability to help themselves, so "more of the intervention is needed to achieve the desired effect" (Meadows, 2008). For the building community capacity to be effective at this stage (i.e., for intervention programs to work), the community needs to go through withdrawal process to break out of the addiction first.

Public Health Assessments

It is hard to tell if interventions are successful without distinguishing between short and long-term goals. If researchers can lower the rates of liver fluke infection with parasite-control drugs, the drug control treatment is so-called successful. However, the high rates of *O.viverrini*

[4] Lev Vygotsky introduced the theory in 1933, late in his life. He was trying to find a true diagnostic instrument that wasn't as narrow as IQ tests. He claimed that what a child could do with someone else (interpsychologically) could predict what the child could do independently (intrapsychologically). "The zone of proximal development of the child is the distance between his actual development, determined with the help of independently solved tasks, and the level of the potential development of child, determined with the help of tasks solved by the child under the guidance of adults" (Valsiner & Van der Veer, 2000).

infection persists because more fish continue being infected with the fluke and people continue to eat undercooked fish. In the long run, interventions are successful if they can change the way people think about health and well-being, and if they cause people to critically analyze their own reasoning processes that lead them to eat undercooked fish. Granted, the drug control treatment is only successful in the short term. If the interventions are successful in the long term, then we often get confused about what to assess in the here and now. We wonder if small-scale change would make a big difference in the future, especially if the change is on a philosophical level (i.e., a change in thinking). But because there are always tradeoff between short term gains and long term successes in the system (Forrester, 1994), the change now would be modest if the long term success is to be expected.

Perhaps, public health assessments should gear toward assessing resilience, rather than productivity or stability. Resilience is "the ability of a system to recover from perturbation; the ability to restore or repair or bounce back after a change due to an outside force" (Meadows, 2008). It is one thing to measure the change. It is another thing to measure the adaptability to change. For instance, reduced rates of the liver fluke infection and level of fluke-caused cancer serve as a productivity measurement of liver fluke infection control efforts. However, this says nothing about how communities/individuals adapt to their environment, and manage their everyday lives. How do they adapt to anti-parasitic drugs or cooked-fish eating behavior? Resilience takes into account the dynamic nature of the system. The adaptability may present itself as short-term oscillation behavior or long succession rates of the liver fluke infection. This flexibility is extremely important because if changes occur faster than people can adapt, "breakdown of resilience" of the system will happen (Meadows, 2008). At this point, the change passes beyond their "healthy identity" (e.g., having "meaningful social contacts" with others (Cassel, 1974)), and they are vulnerable to many diseases (Berkman & Kawachi, 2000), and not just the liver fluke infection and the liver and bile duct cancer of immediate concern.

What Trouble Epidemiologists

Epidemiology faces with the three problems: 1) unidentified risk factors that are potentially at the root cause of many health problems, 2) people behaving irrationally despite learning health and science facts, and 3) a resulting increase in people becoming at-risk—fewer people leave the group than enter it (Syme & Ritterman, 2009). All of these lie in the fact that we have not discovered fundamental causes of disease, i.e., things that would influence many specific mechanisms of disease and thus many disease outcomes. While social conditions (Link & Phelan, 1995), environmental, and community forces have been proposed to be fundamental causes of disease, it is not feasible to change these broad social determinants of health (e.g., income level, level of social support, "the air we breathe," and "the groups to which we belong"). "[I]t is not as easy to specify what precisely it is about these forces that can be intervened upon to make a difference for health" (Syme & Ritterman, 2009).

However, because environment and individuals are inseparably intertwined, researchers turn to study individuals instead. Darlene Francis's research implied that environment can influence how the genes are expressed (Mudd, 2005). Krieger (2005) argued for studying the human body as it is the literal or metaphorical incorporation of social, political, and environmental influences (Krieger, 2005). Upon Marmot and colleagues' (1991) discovered the influence of social-class on health (Marmot et al., 1991), Syme (1989) hypothesized that the problem occurred at the psychological level, involving "the concepts of participation and

control" (Syme, 1989; Syme & Ritterman, 2009). These psychological causes were also proved to be biological causes as well: Having less control over one's destiny affects biological processes that make a person susceptible to a wide variety of diseases (Bosma et al., 1997; Stansfeld, Fuhrer, Shipley, & Marmot, 1999). Thus, environment and individuals are not so distinct after all. They help us relate the mind of the social epidemiologist to the minds of the neurobiologist and the physician. "It is a remarkable circle of understanding" (Morowitz, 2004). In the end, our thought becomes our destiny—Mahatma Gandhi. To control one's destiny is to control one's thought.

So, what's the problem? Ironically, I believe the problem lies in the culture of linear thinking and *control*. Obesity causes high blood pressure (HBP). HBP causes damage to your heart, which can cause irregular heartbeat, and so on. "Linear causal thinking is reductionistic by design, seeking to explain complicated phenomena on the basis of simpler elements" (Suchman, 2002). Epidemiologists are reductionistic, idealistic practitioners hoping to save the world with the goals of predictability and control. Once obesity and HBP are determined as risk factors for heart diseases, the researchers devise interventions to modify those factors in the hope of preventing the conditions from developing.

This very act "blinds us to patterns of complex interdependence and other phenomena" (Suchman, 2002). "[R]isk factors, diseases, and health resources are in a continuous state of interaction and flux….[And there are often] long delays between causes and effects," (Homer & Hirsch, 2006) and multiple causes interacting with each other. Below is a fictitious, hypothetical story that is given in an introductory class in the Graduate School of Public Health at Berkeley. In response to the story, the "first-rate health promotion and disease prevention programs," and "the account of the fundamental forces that caused the problem" (Syme & Ritterman, 2009) were proposed. However, they arguably illustrate overlooked assumptions leading to the three aforementioned problems.

Interlude—Falling a Cliff Example

[There is] a curvy road in the mountains where, at one point, cars fall off a cliff at a high rate crashing at the bottom of the mountain [and] caus[ing] severe physical injuries. The head and spinal-cord injuries [incurred] are serious and require skilled medical attention. Unfortunately, the medical care at the bottom of the mountain is rudimentary and [inadequate.] Thus, [victims] must be transported long distances by helicopter or ambulance to get help.

First-rate health promotion and disease prevention programs:

- A hazard assessment and barrier program: certain groups [(e.g., elderly, people with visual impairment) will be barred] from driving on this road.
- A behavioral intervention: a safe-driving course.
- An environmental intervention: car manufacturers will be required to reinforce and strengthen cars before they can use the road.
- Medical facility will be built at the bottom of the cliff.
    - Economic barriers for care will be removed—everyone has universal access.
    - Culturally appropriate medical treatment with language translation [will be provided].

Fundamental [action that eliminates] the problem:

- Fixing the road

(Syme & Ritterman, 2009)

If cars falling off a cliff causing an injury are treated as a typical public health disease whose major risk factors are unknown, perhaps, it is worth to further understand the situation by talking to the injured people before proposing any types of intervention programs. What are their states of mind when driving on a curvy road? Would it be different from driving a curvy road in the mountains? How well and how often do these people drive? What's the weather like that day? Have the injured patients been in similar situation before? How well did they think they do in that kind of stressful situation? Did their attitudes about life change after the fact? Are there any corruptions in road projects? Perhaps no first-rate injury prevention programs are necessary. With limited funds, a small-scale education intervention may be sufficient—the education that causes the mind to think.

Maybe, the fundamental cause of the problem actually resides "in here," rather than "out there." No matter how broad systems thinkers look at the problem, they believe that the cause of a problem resides in us—at the level of the paradigm (Meadows, 2008). Thanks to a friend, whom I call Bozo, the ideas started to sink in after our usual weekend hiking. While he was paying attention to trails, I kept thinking of a short-cut—both on the way up and down—and babbled on my brilliant ideas. Of course, he did not believe me, and I survived to torture him

with my writing (he helps me proofreading this entire dissertation and pointing out incomprehensible sentences) and I feel very thankful for his patience. I knew right then that there are a trillion ways for people to fall off (or not fall off) a cliff. In my right state of mind (as I believed) and alongside experienced hikers, I truly believed it was worth a try. In the end, I had experienced nature from a bird's-eye view, reinvigorating my mind, aching feet and tired legs. What else do I need in life? He diverted my attention saying that I could try off-trail shortcuts once I have real hiking shoes. And Bozo probably repeated the art of walking down hills hundreds of times, so it kept replaying in my head, "When gravity is your friend, you have to try to keep the center of your weight before your feet, and not behind." Maybe, the problem is to comprehend "how what goes on inside one's head interacts with what goes on in one's environment"—Zimmerman's definition of *psychological empowerment* (Zimmerman, 1990).

I use hiking in place of driving because I don't drive. This way, the event allows me to "walk a mile in the other person's moccasins." Did Bozo mean that the more technology, the more risks I could take? Say my shoes function as a car in the falling cliff example above, I doubt if the environmental intervention would help much. If having meaningful social contacts is the key here, the intervention may just involve converting all lanes in that curvy road to be carpool lanes. If attacking the root cause of the problem would have the modest impact on various diseases/injuries, then fixing that road is not the appropriate metaphor for taking into account "the context of environmental, community, and social forces" (Syme & Ritterman, 2009). Fixing the road does not reduce the chance of people getting injured in other situations.

Systems thinkers would focus more on process and relation, rather than outcome and control. Since human behaviors are complex, a safe driving course out of context may not prove useful. It may be useful to know the nature of the drivers' thought and actions. Were their thought and action connected? How are they interacting? What patterns seem to be emerging? This is different than "giving up all intentionality." We simply have to "hold our intentions more lightly. As we let go of rigid control, we don't have to live in such a tight existential space" (Suchman, 2002). "And in the end, it seems that mastery has less to do with pushing leverage points than it does with strategically, profoundly, madly, letting go and dancing with the system" (Meadows, 2008). We may have to go back in time before the scientific revolution period to close the loop of understanding. "It is to let go into not-knowing, into what the Buddhists call enlightenment" (Meadows, 2008).

The above so-called problems may only need to be rephrased differently, so that it is the people's problem and not the researchers'. Perhaps, we should assume that drivers have "a strong motivation to solve the problem, but might need a little reminding" (Gause & Weinberg, 1990). All the drivers needed maybe was a simple sign at the most dangerous part of the road that said: "Are ***your*** lights on?" (Gause & Weinberg, 1990)

Systems Thinking in Education in 22nd Century

The systems thinking has well-developed by Jay W. Forrester and woven into many academic disciplines (e.g., environmental management, public health, and education) for almost five decades; however the idea does not get the attention it deserves. Perhaps this is because the systems thinking pinpoints the necessity of breaking down the boundaries between academic disciplines (Forrester, 1996) that are so ingrained in the way we think. In his student's words, "[t]he right boundary for thinking about a problem rarely coincides with the boundary of an

academic discipline" (Meadows, 2008). Think about the world's pressing problems today, such as terrorism. Many people do not realize that they unconsciously and artificially create *national boundaries* as a way to see the problem, without questioning their appropriateness. Researchers from various disciplines then rush in to contributing their expertise, and further "*see things* and *think about things*" (Meadows, 2008), in the same old way that arguably creates the problem in the first place. For instance, International Relations people discussed about "the political economy of transnational terrorism" (Rosendorff & Sandler, 2005). An economist jointly wrote the paper about the "economic consequences of terrorism in developed and developing countries" (Sandler & Enders, 2005). On the other hand, the terrorism was phrased as informal means of social control by the sociologist. Black (2004) eliminated the person from the analysis and purely talked about "social space"—yet within national laws or national boundaries (Black, 2004). No amount of contributions from each discipline will help us solve the problem if we are incapable of seeing "the system" and blurring the unnecessary, but intuitive boundaries. We need to drop the boundary that our minds happen to be accustomed to and look for underlying "common elements in diverse settings rather than focusing on differences" (Forrester, 1994).

Here, education could play a significant role in bringing researchers from various fields together. We need to keep pace with complex problems we face in the world today by making change in our K-12 education systems to promote systems thinking. The thinking supports critical thinking skills, transfer of learning, and self-reflective skill (metacognition), all of which educators have been fighting for. Systems thinking helps learners tighten the links "between the various physical and social subsystems that make up our reality" –interdependence (Richmond, 1993), which is a basis for critical thinking skills. In systems term, critical thinking skill is the ability to "see and deduce behavior patterns rather than focusing on, and seeking to predict, events" (Richmond, 1993). This deep understanding allows learners to transfer what they learn in one context to a different context, and know about what they know (and do not know), i.e., metacognition. Seeing connections among various fields at an early age, students would learn to look at real-world problems from different angles. And this can really change the world! I believe that "man's ability to participate intelligently in the evolution of his own system is dependent on his ability to perceive the whole" (Wallerstein, 2011), and systems thinking in education can really change a prevailing ideology of hopelessness.

In the next chapter, I illustrate my system of thinking, and review relevant literature in the light of that. I present literature related to health and science education, theories of health and social behavior, behavioral decision making, and religion/spirituality. I then situate my theoretical framework within the Western and Eastern views.

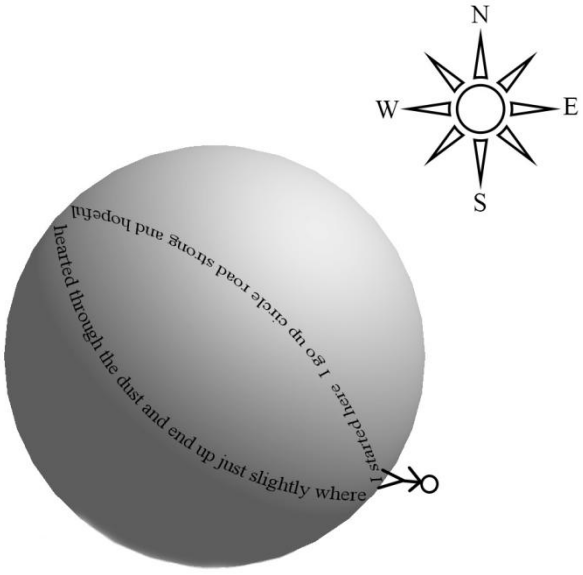
CHAPTER THREE: WESTERN AND EASTERN VIEWS

My System: Western and Eastern Views

> In the sky, there is no distinction of east and west; people create distinctions out of their own minds and then believe them to be true….[Yet,][u]nity can only be manifested by the Binary. Unity itself and the idea of Unity are already two.—Buddha

I build "a model of the system, which takes us outside the system and forces us to see it whole" (Meadows, 2008). West or East is simply an illusion. Knowledge is always changing. For so long, we believed that Earth was the center of the universe and that the Sun revolved around the Earth. The reason for the belief was, probably, common sense based on everyday observations of the Sun rising from the east and setting on the west every day. This had changed when we looked at the Earth from the outside in—looking down on earth—that we realized the possibility of being otherwise. In the same vein, standing on flat ground allows us to believe that there is clear distinction between West and East. However, a compass does not work in outer space in the same way as it does on earth. For our purpose here, it is safe to say that a compass does not work in outer space! Adding a third dimension makes changes the two-dimensional plane into a sphere with no particular directions. Now, the boundary is unclear. West can become East and vice versa with a mere rotation (Figure 9).

Figure 9: Trapping in Circle



Adapted from (Silverstein, 2011).

That is, Western science and Eastern culture should not be viewed as universal and specific, respectively. "[W]e make a greater and greater investment in our system of labels. So a conservative bias is built in" (Douglas, 1966). Western medicine, for instance, has been viewed as a system that arrives at conclusions by averaging large pools of individual data (Hoare, Buetow, Mills, & Francis, 2012). According to Douglas, the increasing differentiation between "them" (primitives) and "us" (moderns) is driven by technological factors—the idea built from Durkheim's idea of an increasing division of labor in the world of capitalism (Fardon, 2001). Human behavior should thus be attributed to society at large, and our goal, according to

Durkheim, is to discover *social facts* (Durkheim, 1982), followed by the Kantian principle, "thought can only advance by becoming aware of the conditions of its own subjectivity," i.e., *reflexivity* (Fardon, 2001). Growing up in Thailand, living in the United States for almost a decade, and travelling back and forth from time to time, I could not step out of my background. I could neither provide an *emic* (a term from cultural anthropology relating to local inhabitants' thought processes) perspective of the local villagers' behavior of eating undercooked fish, nor that of researchers' behavior of devising an intervention. Instead, I naturally adopted what I perceived as an *etic* (i.e., science-oriented) perspective, viewing Western science and Eastern culture with the equal weight. In sociological term Len's introduced me, I am a *marginal person* who is comfortable moving back and forth between the two seemingly contradictory ideas. In systems term, I am a natural systems thinker, trying to discover *system structure* that produces the behavior of eating undercooked fish. Consequently, "social systems [that] are built on contradiction…[and] at war with themselves" (Douglas, 1966) seem less intractable to me.

My model of the system has originated from my background. I believe that western and eastern views "are not intrinsically in conflict, and to assume that we must choose between them is to adopt an artificial or false dichotomy" (Christensen, 1987). However, I draw a boundary between Western and Eastern views for simplicity and for clarity (Meadows, 2008). This system allows me to explain Western and Eastern views of health and illness in relation to each other.

In this chapter, I explore the relationship of Western science and Eastern culture by comparing and contrasting the two views. More specifically, I discuss cultural aspects of science—or rather ambiguity in scientific concepts and in beliefs/cultural systems. First, I discuss health education and science education as they relate to the high-risk behavior of eating undercooked fish. The discussion includes their goals and the similarities in their goals' multi-layered-meaning. Next, I consider how health and science educators can bring culture back in to resolve the ambiguities. Western-based theories of health, social behavior, economic decision-making, and cultural theory of risk are also discussed. This is to consider today's educational views of learning and understanding, as well as the behavioral aspects of acting on the understanding. Then, I discuss religion/spirituality and how they might help us better understand our world. Within the topic, I talk about multiple pairs of concepts that have roots in Western and Eastern world: unity v. binary, suffering v. health, and *kamma* v. *God*. Finally, I end the chapter with the theoretical framework that integrates distinct constructs from various theories, which may help us see the complementarities among the theories, and help us address the widespread liver fluke infection in Khon Kaen, Thailand.

Health Education v. Science Education

Health education is the field concerned with ways to teach health-related knowledge—the complexities of human diseases, their causes, their physical processes, how to biomedically suppress disease symptoms, and how to maintain good health. It is concerned with individual-level, preventative health care, and often focuses on particular diseases: Health education provides individuals "skills for rational choices" and helps them "clarify their values" (Whitehead, 2003). It is about both behavioral change and understanding health and disease contexts.

On the other hand, science education is concerned with how people learn science and with pedagogy. This field promotes various perspectives on learning, from learning in terms of

observable patterns (the behaviorist/empiricist perspective), learning with understanding (cognitive/rationalist perspective), and learning in context (situative/ pragmatist-sociohistoric perspective) (Greeno, Collins, & Resnick, 1996). These perspectives are often combined to create learning environments, develop curricula, and design assessments. Science education is about teaching scientific concepts and developing students' abilities to apply those concepts to real problems.

Both fields have similar goals centered around disease/injury prevention. Health education focuses more on behavior change and puts emphasis on understanding health information. Science education focuses more on the learning than its application to real life. Yet, both fields aim at developing personal learning and thinking skills toward the capacity to make changes based on them. For health education, changes happen on the individual level, i.e., behavior change. For science education, changes can also happen on the cognitive level, namely *conceptual change*. In respect to the liver fluke infection, the health education outcome would be reduced number of undercooked fish eaters; whereas the science education outcome would be perfect scores on a test that asks learners to interpret the liver fluke infection information, or their capability to apply what is learned about the liver fluke infection to other water-borne parasites.

One goal often cited in the literature on health education is *health literacy*. According to WHO, health literacy refers to "the personal, cognitive and social skills which determine the ability of individuals to gain access to, understand, and use information to promote and maintain good health" (Nutbeam, 2000). Measures of health literacy include measuring health-related knowledge, attitudes, motivation, and self-efficacy (i.e., having control over own life). However, one can measure success only in the short term. Depending on the content and method of health education, health literacy is defined and measured differently—ranging from individuals having low autonomy to empowerment (or self-efficacy). Despite being directed at changing behavior, health literacy evolves and covers "both personal and social benefits." It has "profound implications for education and communication methods." Health education is also used "as a tool for social change, and for political action" (Nutbeam, 2000).

Although the term *science literacy* (*scientific literacy*) has been used frequently in the literature, it has rarely been defined by educators. According to National Science Education Standards (1996), science literacy "is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (National Research Council, 1996). Due to the broad definition of the term, educators discuss the concept in terms of specific abilities. Given that science is part of our everyday lives, science literacy has less to do with science concepts and specific domains, and more to do with the abilities to appreciate and be curious about everyday experiences, and be able to arrive at logical conclusions using scientific thinking process (National Research Council, 1996).

However, both health literacy and science literacy have roots in the term *literacy*. The term lies not only in the ability to read and write, but rather in individuals' capacity to expand and deepen their skills over a lifetime (Freebody & Luke, 1990). Paulo Freire, a Brazilian educator and theorist, captured the essence of the term with his *critical consciousness* concept, or what he called *praxis*. To Freire, literacy is reading both the word and the world (Shor & Freire, 1987). According to him, teaching is more or less a social act. To effectively teach poor peasants how to read the word hunger, teachers need to make them aware of "the reasons behind their

experience of hunger." The word comes from the world, and once they can read the word, they understand the world and take action to improve their quality of life (Freire & Macedo, 1995). Consciousness represents "inward knowledge," and is "never a mere reflection of but a reflection upon material reality[/world]" (Freire, 1985). The word and the world are interrelated and interdependent. That said, the word literacy itself has deep meaning that implies learning processes and how reading and writing skills can improve health and well-being.

Health Literacy

Definitions of health literacy have been used inconsistently in the literature and sometimes the definition was left implicit or entirely assumed (Friedman & Hoffman-Goetz, 2008). According to the Healthy People 2010 report, health literacy "is not just the ability to read health text; rather, it is a set of skills that involves recognizing, processing, integrating, and acting on information from a variety of platforms" (Borzekowski, 2009). Other definitions are similar yet different. I think the difficulty lies in the broad meaning of *health* and *literacy*. According to WHO's definition of health, health "is a multi-dimensional concept" (Chatterji et al., 2002), comprising physical, social, mental, and spiritual aspects (Lindström & Eriksson, 2011). Similarly, literacy encompasses a complex set of abilities, which can be categorized into function literacy, interactive literacy, and critical literacy (Nutbeam, 2000). Plus, there are behavioral aspects of health and the educational aspect of learning.

Researchers have attempted resolutions to the definitional problem of health literacy. Lindström and Eriksson (2011) proposed the term *healthy learning* in place of *health literacy*. The word *healthy* follows Aaron Antonovsky's concept of salutogenesis that supports general quality of life and wellbeing (i.e., health-disease continuum), and not merely prevention of particular diseases. Using the salutogenic framework, they believed the word *learning* better represents a lifelong learning process and illustrates learners' experiences in a more reflective way (i.e., empowerment) than the word *literacy*. Together, healthy learning is

> a lifelong process where people and systems increase the control over, and improve health, wellbeing, and quality of life through the creation of learning environments characterized by clear structures and meaningful empowering conditions where one becomes an active participating subject in reciprocal interaction with others (Lindström & Eriksson, 2011).

Other researchers avoid the use of the term health literacy altogether and instead discussed its practical contributions. They talked about health education geared toward social skills, actions, and organizational practices; and health education that helps reduce health disparities (Wallerstein & Bernstein, 1988). The focus is on how to help individuals understand problems and improve their situations.

Community organizing for health to the rescue?

Community organizing has been increasingly utilized as a tool to reduce health disparities, with agreeable key concepts. Community organizers first selectively identify targets of change with the community members, making sure that the smallest voice is heard. The members collaboratively participate in dialogues while developing critical consciousness, which then empowers people to transcend their "oppressed" status. Through understanding root causes of the identified problems, community members put concerted efforts to network and counter the imbalance of power that exacerbates the problems with people's power (i.e., building community capacity) (Minkler, 2012).

Community organizing efforts, to some extent, take into account ambiguous meaning of health literacy, because the process is concerned with people's cultural identity that translates to their understanding of health problems, and consequently their abilities to act on their understanding. Community organizers are concerned with *cultural humility*, the process of being open to others' culture (Minkler, 2012). This concept is broader than *cultural competence* that emphasizes understanding others' culture. Cultural humility does not necessarily assume that people have innate abilities in recognizing, interpreting, and correctly reacting to people of different cultures, but rather assumes that people can accept mistakes, learn, and apply new understandings (Tervalon & Murray-Garcia, 1998). Regardless, researchers have a strong subconscious conviction of what constitutes a good health decision. Surely, undercooked fish dishes are easy to prepare and affordable, and eating undercooked fish is a socio-cultural activity. But why don't the eaters change their habits, knowing that eating undercooked fish can lead to deadly cancer?

To overcome broad and vague definitions of culture and health literacy, I analyze how the worldviews of local villagers shape their attitudes towards life (and death). At this philosophical level, I avoid using "culture" as a dismissive term, juxtaposed against "reason." This way, culture is not used to perpetuate a sense of "otherness" or distinction between groups of people (Good, 1994). Let me make the point a little close to home: people start and continue smoking every day, despite the fact that it can lead to lung cancer and circulatory problems. Good (1994) argued that disease itself is a cultural domain, and we might benefit from abandoning beliefs as products of culture and explanatory factors for irrational behavior (Good, 1994). The local villagers' definitions of health and well-being, and their causes of illnesses may lead us to reconsider our definition of what a "good life" is. After all, individuals' knowledge, and theory cannot be detached from society (culture), belief, and practice no matter how hard we try to separate them to identify health status predictors.

Science Literacy

Science literacy (scientific literacy), "literacy in science," and science learning are often used interchangeably in science education. Researchers define the term and provide frameworks for practicing it differently (Daviss & Thier, 2002; Michaels, Shouse, & Schweingruber, 2007). The 2007 National Research Council (NRC) report *Taking Science to School* defined four strands of competencies in science learning: 1) understanding scientific explanations, 2) generating scientific evidence, 3) reflecting on scientific knowledge, and 4) participating productively in science. The 2009 NRC report *Learning Science in Informal Environments and Surrounded by Science* added two new strands for learning in informal environments: 5) sparking and developing interest and excitement, and 6) identifying with the scientific enterprise. These strands are intertwined: "progress along one strand promotes progress in the others." The strands "provide a framework for thinking about the elements of scientific knowledge and practice" and for educators to define, plan, and assess appropriate outcome measures, so as to understand whether, how, or when learning occurs (Michaels et al., 2007).

This dissertation examines the first strand—understanding scientific explanations, because it is rather intuitive to think about the behavior of eating undercooked fish as a result of misunderstanding the scientific explanations related to the liver fluke infection. According to the *National Science Education Standards*, "Understanding science requires that an individual integrate a complex structure of many types of knowledge, including the ideas of science,

relationship between ideas, reasons for these relationships, ways to use the ideas to explain and predict other natural phenomena, and ways to apply them to many events" (Michaels et al., 2007). This research examines whether and how scientific knowledge of liver fluke infection and treatment may influence the local villagers' fish eating behavior.

However, scientific knowledge or scientific explanations are still a broad and ambiguous term. What are differences between description and explanation? What counts as a scientific explanation? Keil (2006) argued that scientific explanations have distinct kinds of causality (e.g., *common cause/effect*, and *causal homeostasis*) (Keil, 2006). McNeill and Krajcik (2008) argued that scientific explanations need to contain claims, evidence, and reasoning (McNeill & Krajcik, 2008). Then, there comes a debate between the distinction between argumentation and explanation (Berland & McNeill, 2012; Osborne & Patterson, 2012; Osborne & Patterson, 2011). Wellman (2011) defined explanations as answers to why or how questions (Wellman, 2011), and chose to identify children's scientific explanations with keywords such as "because," " so," and "therefore" (Hickling & Wellman, 2001). Some researchers looked instead at forms of explanation, such as probabilistic, functional, teleological, or formal explanations. Others focused on underlying cognitive structures (e.g., conceptual change), and placed an emphasis on prior knowledge and types of causality (Perkins & Grotzer, 2005).

Socio-cultural perspective on science education to the rescue?

The socio-cultural perspective views knowledge as situated *between* people and dispersed throughout the environment. Learning, thus, strongly relates to participation in and interaction with groups of other individuals (Greeno et al., 1996). From this perspective, learning is a dialectical process. It is a socially constructed activity in the setting in conjunction with one another—not merely a cognitive process residing in the brain (Lave, 1988). Cognition is situation-specific. This perspective views science learning as a human social activity (Lemke, 2001), and supports ethnographic study (participant-observation) (Greeno et al., 1996), whereby researchers participate in the life of the target populations. The research method helps researchers understand the people's "cultures," including their behaviors, sense-making, and belief systems (Malinowski, 1978).

Regardless of how science educators bring *culture* to develop a holistic understanding of learning, culture itself is surprisingly a problematic concept. Belief systems are complex (Good, 1994); culture is a semiotic and interpretive concept that requires further explanation. (Geertz, 1977). We humans have interpretive limitations when it comes to culture, and "without critically assessing and challenging [the concept of culture], we become more deeply complicit in reproducing inequality" (Briggs, 2004). We are simply interpreting the culture's interpretation of events.

This dissertation reverts the ambiguity back to individuals by consider the people's *own* way of understanding science. In particular, I focus on their critical reasoning because according to the 2012 NRC report, critical reasoning is crucial to understanding science. It allows learners to master scientific content, which lays the knowledge foundation that in turn reinforces reasoning skills. The report, *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*, emphasizes critical reasoning as a cognitive skill enabling learners to learn how, why, and when to apply knowledge to real-life problems. Also, "a central purpose of education is to improve students' [critical] reasoning abilities" (Lawson, 2006). Broadly speaking, "reasoning is generally seen as a means to improve knowledge and make better

decisions (Mercier & Sperber, 2011)," thus improving our quality of life (North, 2012). Based on these assumptions, I consider the people's definitions of what it means to be reasonable, what counts as scientific explanations, and their personal reasoning processes.

Below is the summary of relevant health and social behavioral theories, and concepts in behavioral economics. The concepts are based on Western science of how people reason and behave the way they do.

Theories of Health and Social Behavior

The Theory of Reasoned Action (TRA)

The Theory of Reasoned Action assumes "behavior is the output of rational, linear decision-making processes" at a specific point in time (Edberg, 2007), and primarily concerns *behavioral intention* as the most important determinant of health. Behavioral intention is a function of 1) a person's attitude and 2) a subjective norm. The former involves a personal evaluation of behavior and behavioral outcomes. The latter involves normative beliefs—ideas about whether key people approve or disapprove of the behavior—and motivation to behave in a way that gains approval.

Psychosocial mechanism

Eating undercooked fish may be perpetuated in the community through psychosocial mechanisms, which start at the psychological perceptions of what is socially acceptable (Christakis & Fowler, 2007; Marmot et al., 1991; Szreter, 2003). Christakis and Fowler (2007) discovered that "the spread of obesity may rely less on behavioral imitation than on a change in an ego's general perception of the social norms regarding the acceptability of obesity" (Christakis & Fowler, 2007). People familiar with seeing others eat undercooked fish may unknowingly form abstract references to the normality of the practice.

Political Economy & Paulo Freire's critical reflection

Political economy represents "the fundamental political issues which arise from the [production], accumulation and distribution of the surplus product in capitalism," borrowing Peter Burnham's explanation (McLean, 2003). Here *political economy* expands on Neo-Marxism—which incorporates development and underdevelopment concepts postulated by André Gunder Frank and Immanuel Wallerstein—and Max Weber's broader concept of social inequality. I will focus on the interactions between the national economic system and local cultures. More specifically, I will examine how the political economy exerts its force in people's decision-making. This is because health status depends on "the economic and social systems rather than solely on the actions of self-directed individuals. [People]... are limited by their location in the social and economic system" (Minkler, Wallace, & McDonald, 1994). For example, given that many local villagers work as fishers and/or farmers, who have high debts and are away from their houses most of the day with no cooking ability, eating raw fish may be a matter of survival—an affordable and traditional way of life, which allows them to preserve and affirm their own identity and culture.

It is of utmost importance to attempt to fine tune my research to people's perceptions of external circumstances because according to Freire, only people in the community can best help themselves and others within the same community through collective action (Minkler et al., 1994). Attempts to help *others* with their community problems will likely result in failure as long

as perception of *problems* does not spring from community members (Steiner, 1999). Freire stressed that each individual is a part of the problem as well as the solution. He encouraged people to look critically at their world in order to transform it, "learning to perceive social, political, and economic contradictions, and to take action against the oppressive elements of reality" (Freire, 1970). People's awareness of external circumstances in my case ranges from liver fluke infections and poor community sanitation infrastructure, to personal perceptions of individual influence on the community. For instance, do they accept that people who eat undercooked fish could be bad role models for young children (Bandura, 1986)? Do they agree that with poor sanitation systems, infected people are likely to pollute water sources (by passing liver fluke eggs through feces, and consequently perpetuate and proliferate the life cycles of *O.viverrini*)?

Structural vulnerability & Social conditions that affect health

Structural vulnerability is a useful social-level concept for understanding the widespread liver fluke infection because structural vulnerability is "a product of class-based economic exploitation and cultural, gender/sexual, and racialized discrimination, as well as complementary processes of depreciated subjectivity formation" (Quesada, 2011). The term includes personal attributes such as appearance, cultural values, occupation, for example that determine the position of individuals and their access to power/control, affecting their exposure to risk.

Relatedly, social conditions involve factors that include person's involvement with others, including job positions, race, socioeconomic status (SES), gender, stressful life events, and social support (Adler, Boyce, Chesney, Folkman, & Syme, 1993; Link & Phelan, 1995). Poor social conditions are "fundamental causes of disease" (Link & Phelan, 1995) worthy of attention because they generate and perpetuate hierarchy and health inequalities.

Behavioral Decision Making

Current research in the field of behavioral economics frames behavior and decision-making as due to the combination of "person" and the "situation." The idea originated from the field of epigenetics, which studies how environmental conditions regulate gene expression, i.e., the relationship between individual differences and situational factors (Appelt, Milch, Handgraaf, & Weber, 2011).

However, individuals are still the focus. *Individual differences* vary "from decision style to cognitive ability to personality" (Appelt et al., 2011). In social psychology, *attribution theory* is used to explain the way in which people make sense of the behavior of others, and how they form causal judgment. Sometimes, people make causal judgment when there is no cause and effect relation for the events (Heider, 1982). People are "complicated and interesting," to borrow Daniel Kahneman's expression (2012). "People are more concerned about losing what they already have than gaining what they do not yet have" (Greenberg & Lowrie, 2012). Reasoning often favors easily justifiable decisions that are not necessarily better. It "does exactly what can be expected of an argumentative device: Look for arguments that support a given conclusion" (Mercier & Sperber, 2011). "We [humans] do not know why we act as we do; we only know a few local reasons on a certain time scale and within a limited range of contexts" (Lemke, 2001).

Risk Assessment

People often make errors of judgment and bad choices by processing probabilistic risk information from a personal reference level (Greenberg & Lowrie, 2012). Human brains have

strengths and limitations. According to Kahneman (2012), there are two types of thinking, called System 1 and System 2—fast and slow thinking, respectively. "System 1 [(or intuitive inference)] operates automatically and quickly, with little or no effort and no sense of voluntary control." "System 2[(or explicit reasoning)] allocates attention to the effortful mental activities that demand it, including complex computations" (Kahneman, 2011). Even though System 1 is fast and accurate in many tasks, it is prone to predictable errors. And human behavior is "primarily the application of system 1 thinking" (North, 2012). From *prospect theory (loss-aversion theory),* people base personal decisions on perceived gains rather than perceived losses. Here comes how *framing* can be used to aid people in making good decisions. Health information is better phrased as "gain," instead of "lose." It is better said "the chance of survival with cancer is 2/3" than "the chance of dying with cancer is 1/3." We also have a tendency to favor information that conforms to our beliefs, i.e., having *confirmation bias*. And we tend to overestimate the risk probability in the vivid occurrences that immediately come to mind, i.e., *availability bias*. For example, a person continues to smoke because her/his grandmother smoked and lived to be a 90. Lastly, *risk aversion* is the concept that humans prefer lower payoff but certain bargain over higher payoff but with uncertainty. However, many, if not all, psychological research has been done in the laboratory, and some researchers (e.g., (Mercier & Sperber, 2011)) argued for studying reasoning in interaction. This is because human mind is a social mind. Regardless, we humans are systematically illogical. Reasoning (rationality) involves exercising control over our natural mind that pulls in a different direction.

Risk Perception

Because humans are social animals, perceptions are socially constructed by "ways of life," cultural values and institutions (Douglas, 1966). Absorbing the ideas of Durkheim, Douglas believed in *social facts* that exist independently of the will of an individual—how individuals are bonded by feelings of belonging or solidarity, which makes behaviors (e.g., smoking and eating undercooked fish) less individual choices, and more the result of *collective consciousness*. According to Durkheim, collective consciousness is "the totality of beliefs and sentiments common to the average members of a society [that] forms a determinate system with a life of its own" (Durkheim, 2010a). For instance, each individual has a relative sense of dirt (and cleanliness). We do not clean or "chase dirt" only to "escape disease" and control disorder, but we does it so as to "make unity of experience," "making it conform to *an* idea" sprung from our "ways of life" (emphasis added) (Douglas, 1966). That is to say, the act of eating cooked fish cannot be simply an act of avoiding the liver fluke infection or cholangiocarcinoma.

Local villagers must have their own schemas, or individual thoughts embedded in cultural life. According to Kant, a *schema* is "a lens that both shaped and was shaped by experience" (McVee, Dunsmore, & Gavelek, 2005). Douglas argued that we make this schema or "pattern-making tendency" in relation to our social structures. The difficulty in allocating definitely what causes liver fluke infection or cholangiocarcinoma may validate the behavior. This way, ambiguity may be dealt in a deeper level of existence, i.e., their thought systems. The behavior may be supported by certain moral values, and conformed to group behavior. For instance, the villagers' belief in uncertainty in life or their concept of impermanence may confine their behaviors. But the behavior "symbolizes both danger and power" (Douglas, 1966). Schema involve adaptations between people and environments (McVee et al., 2005), and can be molded

into more sophisticated forms. This is similar to how *habitus* reproduces social structures, and at the same time has the possibility of change over time (Bourdieu, 1977).[5]

This is why Durkheim saw religion as "the most fundamental social institution" that gave rise to other social forms (Allan, 2005). Durkheim was concerned about effects of modernity:

> increasing importance of the state and restitutive law, decreasing important of religion and moral solidarity, increasing structural complexity and interdependency, increasing generalization of culture and media of exchange, and increasing levels of individualization (Allan, 2005).

He was concerned about culture in modernity—culture as a whole that creates social cohesion. Toward the end of Durkheim's work, *The Elementary Forms of the Religious Life* (1912, 1976), he left the thought that "there is something eternal in religion that is destined to outlive the succession of particular symbols in which religious thought has clothed itself." He believed that "religion gave birth to all that is essential in the society" (Allan, 2005), including science. We are perhaps in a period of transition, what he called "a phase of moral mediocrity."

Religion/Spirituality

Religion/spirituality is known to be a social phenomenon and a positive psychological concept that affect people's health (Miller & Thoresen, 2003). For example, people use it as a way to cope with chronic (Pargament, Poloma, & Tarakeshwar, 2001) and mental (Coin et al., 2010) illnesses. According to a Nobel laureate in physics, Charles Townes, the goal of religion is similar to the goal of science, which is to understand the order in the universe. Religion gives us a sense of "purpose and meaning of our universe and how we [humans] fit into it" (Townes, 1966). Einstein believed that "the path to genuine religiosity…[lies] through striving after rational knowledge" (Einstein, 1940). Rational knowledge in so-called science inevitably relies on faith—things that we cannot directly experience through senses (e.g., relativity theory). Scientific discoveries are based on selective observation and rely on conjecture that involves faith (Townes, 1966). Our mission then is to find how the knowledge resonates with our human experiences, generating its *meaning*. Many aforementioned health and social behavioral theories, and psychological concepts in behavioral economics are empirical and largely quantitative. Yet, we assume they are qualitative ones, which give us values we hold dear, or the values consistent to our worldviews. The concept of health is intertwined with the concept of religion/spirituality for health means different things to different people, i.e., context-dependent.

Regardless of challenges of defining religion and spirituality and the criticisms/concerns about the field (Miller & Thoresen, 2003; Zinnbauer & Pargament, 2005), I consider religion and spirituality to be our desires/needs to lead a meaningful life. I believe all religions are grounded in a sense of connection and purpose, trying to provide answers to the fundamental nature of existence of human and human's relationship to existence. We all want to lead a meaningful life. Thus, we can talk about the meaningful life in the light of any religions or no religions—just as how Dalai Lama argues for religion-free compassion (Lama, 2012). Religions serve as paths to a meaningful life. We can follow different paths, or create our own paths to follow, as long as we are on our ways. This is why some people prefer using the word spirituality instead of religion. Nevertheless, spirituality also lacks a definitive definition. Some believe it is an emotion and

[5] I am indebted to Seth M. Holmes for his help in explaining Bourdieu's idea, as well as invaluable knowledge I learned through his "Theories of Health and Social Behavior" class.

feeling of something greater than ourselves. Others understand spirituality as the way we relate to the ultimate conditions of existence (Zinnbauer & Pargament, 2005). Broadly speaking, spirituality concerns with things that cannot be experienced by physical senses and cannot be seen or explained (Miller & Thoresen, 2003).

Just as *culture* influences health (e.g., (Hunt, Schneider, & Comer, 2004)), religion/spirituality also influences health. According to Geertz, religion serves as a cultural system (Geertz, 1977) that influences people's conception of health. My concept of religion/spirituality is similar to Geertz's concept of culture. To him, culture refers to webs of significance humans themselves have spun. Consequently, the analysis of the culture is "not an experimental science in search of law but an interpretative one in search of meaning." To me, the concept of religion/spirituality springs from the existence of man who is a social animal that interacts with others to become "a particular kind of man"—who is not just to breath, talk, and eat (Geertz, 1977), but whose actions create systems of *meaning*. Perhaps, eating undercooked fish in a delicate social situation is the product of interplay between "what is innately controlled and what is culturally [and metaphysically] controlled." So to understand what the certain eating behavior really means, we need to look past the "misleading tags" of the "cultures" and of the metaphysical types (i.e., religions), to grasp firmly the essential character of man (Geertz, 1977). That is to understand the people's paradigm—their world views.

Granted, I take Christianity and Buddhism to represent the two seemingly distinct traditions in the Western and Eastern world, respectively. I then illustrate how the two views intersect regarding health and wellness issues, as well as disease/illness causation. I choose these two religions not only because I grew up and identify myself with them, but also because I want to touch local Thai villagers and Western researchers where they can easily be touched. Since the carcinogenic liver fluke, *O. viverrini*, has infected millions people around the world for more than 40 years, even with tremendous research effort to reduce the level of the infection, a new way of thinking might be needed. This new way of thinking about the problem may change people's hearts and minds and lead to *transformative learning*—the process of changes in understanding the self, belief systems, and lifestyle (Clark & Wilson, 1991).

Unity v. Binary

Many religions often discuss about the body (e.g., the mystery of the self, and the multi-centered self), which relates to the issue of health:

Buddhists believe in the unity of the self manifested by the binary. According to Zen Master Dogen, to study the self is to forget the self, and to forget the self is to be enlightened by *everything* in the world. That is, "there *is* no self, and the *self* realizes the fact" (Aitken & Steindl-Rast, 1996). "All that we are is [merely] the result of what we have thought"—Buddha. What really remains in our experiences is nothing, but our quest, i.e., emptiness. Self experiences the emptiness, which in turn helps us appreciate the substance. Experiences are practices, which themselves are not a vacuum, yet nothing we perceive through senses can stand alone. We are part of everything—"being one with the altogether other" (Aitken & Steindl-Rast, 1996). In the Dalai Lama's words, emptiness is "the true nature of things and events" which comes into being by conflict of opposites (e.g., individuals and environment, oneself and others). No-self and self, existence and non-existence are complementary. This is to say that monism (holism) in the Eastern traditions is too limited a term to be understood as the oneness or the vast emptiness (Aitken & Steindl-Rast, 1996). The Unity can also refer to oneself and the Buddha, and the

Buddha can be found in oneself. With this awareness, taking care of one's health means taking care of the Buddha, taking care of others', or taking care of all selves. Looking this way, the widespread practice of eating undercooked fish may symbolize the reduced sense of community of the Thai populace at large. In a globalized world, people often become too focused on themselves and care less of others' health.

Similarly, I believe Western religious traditions, such as Christianity, are not dualistic fundamentally or inherently, and that God does not really separate from us. In Bible, Saint Paul claimed, "I live, yet not I. Christ lives in me." [Gal. 2:20] Christ here may represent the spirit of man. During my usual prayer before bed, I came to a realization of what my mom probably meant when she told me to speak to God. Sitting still with eyes closed, I live, but *Christ* remains. The reality remains. "Christ" here is a title, just as "Buddha." When I let go the notion of cosmic Christ, the reality indicated by the term is still there. Before I know it, God will disappear, and I still sit there. In other words, I disappear (when I let go, I don't know anything remains.) and God remains (knowing is after the fact). Approaching this from another angle, resurrection represents the fact that Jesus died and yet he lives—non-being and being. Both are correct at the same time. And because nothing is part of everything, we are talking about what Buddhists call emptiness (Aitken & Steindl-Rast, 1996). Having said this, God is in us. Taking care of one's own body is important because it is his temple:

> "What? know ye not that your body is the temple of the Holy Ghost which is in you, which ye have of God, and ye are not your own? For ye are bought with a price: therefore glorify God in your body, and in your spirit, which are God's" [1 Corinthians 6:19-20].

Perhaps, every one of us intrinsically cares for our own health and well-being, but some do not realize the matter, and wait around for helpers. The power (i.e., "God," "Buddha") is in us. On the contrary, we use the word "God" to cover our ignorance. Researchers have to discover a way to raise the people consciousness, so they realize their own potential of controlling anything, including their health behavior.

Suffering v. Health

Addressing suffering may indirectly address the failure to promote population health because suffering and health are an indivisible whole—two sides of the same coin. One may find the improvement of health through the least suffering, and thereby gain a better understanding of effective health interventions. And because suffering plays a significant role in a number of religions, it is very important to understand health through the lens of religion. Suffering and health are very context-dependent as it depends on one's definition of living a meaningful life. For instance, I suffer from writing this dissertation, having to produce written content everyday; while my thesis adviser, Len is more likely to think it is worthwhile suffering. Because public health lies in the fact that nobody wants to suffer (at least physically), it is important to look at suffering within the people's and researchers' frames of reference, more specifically through the lens of Buddhism and Christianity. If the frame of reference changes, then the problems must be solved in a different way. If the liver-fluke infected population defines health as having a meaningful and enjoyable life, pinpointing health as having healthy liver and bile duct may not prove useful. Researchers may need to tweak their mindsets so as to match the people's while simultaneously fulfilling the researchers' own goal.

Buddhism regards suffering as a result of individuals' desires to cling to what is impermanent in the world. In contrast, Buddhism regards health as the state of being free from desires. Using the WHO's definition of health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 1989), health in Buddhist terms is the state of being free from physical, mental and social *desires*. That is to say health is not the gaining of anything, but it is the absence of the disease called desire or craving. Living a healthy and meaningful life means stop doing what causes suffering and be enlightened—the state of maintaining a balance of the mind, body, soul, and spirit, i.e., the *Middle Way*. At the time of the Buddha's great realization experience, he said that all humans are enlightened. "Only their delusions and preoccupations keep them from realizing that fact." Everyone has the potential to be fulfilled in life if we can see through the delusions and attachments. We can be fulfilled when we are not directly trying to achieve it, i.e., when we are not striving for the causes of the fulfillment, but instead enjoy the present on the ground of existence, i.e., *impermanence*.

Impermanence is the notion that nothing lasts forever: every existing thing and every sensation arises, exists, and disappears. Everything is in a constant state of flux. And this is the true nature of reality, i.e., *emptiness*. Good *and* bad things never last. "If things are going well, enjoy it because it won't last forever. And if things are going badly, don't worry because it won't last forever either." More importantly, "there is nothing either good or bad, but thinking makes it so" (Shakespeare, 2003). Imagine a train of thought approaching the station we are standing at. The train will approach us and will soon past the station. All we have to do is to not getting on the train and letting it go, i.e., *non-attachment*. The *control* in this case is not about closing off the station and not letting the train in; or trying to find who sends the train to our station and stops that person; or discovering the purpose of the train and purposefully deciding if we want to get into the train, but about being a careful observer; letting all the trains into the station and then letting them go—both positive and negative thought. The issue here is not so much about trying to find causes of the desire or pleasure (or concentrating on "why"), as it is about realizing the causes of the suffering or the distraction from suffering (or the "what"), which is the thought itself.

With respect to health, Buddhists believe non-attachment to fleeting desires leads to positive health. When we are aware of, observe, experience, and understand this fact ourselves, we truly accept uncertainty in life and act accordingly. For instance, we become conscious of our bodies, minds, and social needs, and try to negate those desires when they arise. However, if suffering does not disappear at the level of thinking, then we need to actually do something about it (e.g., seeing a doctor). The Buddha offered the *Noble Eightfold Path*—the way to end of suffering, which includes for example, cultivating the right thought, right understanding, right speech, and right action. The right thought is the basis for the others: with the right awareness, we know where discomfort lies in our bodies and then get a proper treatment. Even if, say, the liver fluke infection is detected at the late cancer stage, we would accept the decay of the human organs, remain appreciative of life, and maintain our health as much as we can. In the end, everyone can't escape sickness, old age, and death, but we can control our thinking about them, act wisely, and *live* in the present. Having said this, the Buddha emphasizes that "to keep the body in good health is a duty," if we have not ceased to be, because good health goes hand in hand with strong mind—the fuel for a meaningful life.

On the other hand, rather than removing the cause of suffering and having a healthy life, Christianity encourages us to look at the positive side of suffering. This comes with the assumption that suffering—without dying—is temporary. In the Bible, suffering is often associated with "an experience of an impasse and, at the same time, a breakthrough," like an American expression of "no pain, no gain" (Aitken & Steindl-Rast, 1996). According to the Bible: In the name of God, Jesus Christ suffered greatly on the cross. However, he was liberated and ascended to heaven. Christ here represents human beings. In Scripture [Job 1:9-11], Job lost his possessions and his family. Yet, the tragedy brought out his character, strength, and perseverance [Rom. 5:3]. In other words, suffering can bring out the best in people [I Pet. 5:10]. "People without shortcomings have fewer advantages"—Abraham Lincoln.

Suffering is the broad term that can be applied to the context of health behavior. From a Christian perspective, poverty can be viewed as suffering that might bring out the best in the poor. Being put in the situation where cooking fish is an added effort out of regular hard work, local villagers may occasionally give in to the legitimate temptation of eating raw fish. Needless to say, their eating of cooked fish is worthy of our praise. That is to say, the behavior of eating undercooked fish may be altered with a proper acknowledgement of the *effects* of poverty. Researchers may need to put more weight on positive sides (e.g., their endurance) of the people's current suffering, in order to prevent the people from future suffering (e.g., the liver fluke infection and its associated deadly cancer). For the liver fluke infected population, the emphasis may be put on how lucky they are that the liver fluke infection diagnosis comes early on, while they can get treated and survive. Having said this, perhaps, the liver fluke infection should be publicized as an early stage of cholangiocarcinoma. Acknowledging the people's positive behaviors, such as having stool test, may further increase those behaviors, similar to how teachers support young children's positive behaviors (Sugai et al., 2000).

The problem in our society is that it is set up so the successful have more means to acquire success—a better chance to fulfill themselves. However, it is also possible and likely more fulfilling for people with limited resources and options to find hope and comfort in their suffering. They can gradually liberate themselves, one step at a time! Even though, some advantages of wealth are typically more attractive, I believe that some disadvantages of poverty, if used wisely, shine brighter than any advantages.

Every one of us suffers. Christianity regards suffering as common to all and simply a part of life. This is because we all want to belong and be loved. If it were otherwise, we would suffer. This shows dialectic of human life. We are capable of love, and, by the same token, we are susceptible to suffering. Jesus suffers because he loves his Father and human beings. On the flip side, the sadness provides us a better view of joy; suffering makes us realize love. "God so loved the world that he gave his one and only Son..."[John 3:16] Jesus so loved humans that he sacrificed his life. Paradoxically, "if you love until it hurts, there can be no more hurt, only more love"—Mother Teresa. This is to say that "only people who are capable of loving strongly can also suffer great sorrow, but this same necessity of loving serves to counteract their grief and heals them"—Leo Tolstoy.

Perhaps, in Christian views, love is the key to positive health. "Love your neighbor as yourself." [Mark 12:31] Much scientific research has been done about the chemistry of attachment and the psychology of affection, for example. But the point here is that feelings and emotions can play important roles in how we think and behave. In the end, love is essentially an

emotion. This is the reason why I attempt to interpret local villagers' emotions in everyday life, especially when they talk about health. Emotions would not only indicate what they value in life, but may also represent their whole health—whole person. Making a lasting change in the people's behavior may involve coping with their own emotions.

Regarding love, the Buddha elaborated on various types of love and stressed on the types that bring happiness to *another* (called maitri, Thai name: ไมตรี), and remove *another*'s suffering (called karuna, Thai name: กรุณา), called loving kindness and compassion in English, respectively. In the Buddha conversation with King Pasendadi, He explained:

> [Loving kindness and compassion are not] based on lust, passion, attachment, discrimination, and prejudice.... [Loving kindness and compassion] do not demand anything in return…They extend to all people and all beings. In [loving kindness and compassion] there is no discrimination no 'mine' or 'not mine.' And because there is no discrimination, there is no attachment. [Loving kindness and compassion] bring happiness and ease suffering. They do not cause suffering and despair…The prosperity and security of one nation should not depend on poverty and insecurity of other nations….[L]astings peace and prosperity are only possible when nations join together in a common commitment to seek the welfare of all….If you only want your loved ones to follow your own ideas and you remain ignorant of their needs, it is not truly love. It is only a desire to possess another and attempt to fulfill your own needs, which cannot be fulfilled in that way (Hanh, 1991).

After all, Buddhism and Christianity have similar underlying coexistence of love and suffering. Loving beyond our own circle of love (e.g., our family members, and our countrymen) is very much needed in this world as it heals suffering. It is rather said that Jesus Christ practiced loving kindness and compassion, which is not a usual type of love we generally practice or refer to in everyday life. Metaphorically, He sincerely took our sins as His own. If we can love *God* without knowing exactly who He is, perhaps we would be capable of loving others outside our circle of love, i.e., practicing compassion. This is similar to how Mahatama Gandhi served the poorest of the poor from within, realizing that the suffering of others was indeed his own suffering (Aitken & Steindl-Rast, 1996). In the end, compassion literally means "suffering with others." And only when we love others, we do to others what we want them to do to us. [Matthew 7:12] If others suffer, then we would share the load.

Cultivating love and compassion, researchers and local villagers may change the spread of liver fluke infection in Khon Kaen, Thailand. Researchers may benefit from showing Thai local villagers their passions for public health, their willingness to exchange what they learn in schools to real settings, and their aspiration to make a difference in the world. I believe it is important to show the villagers how much we care. The villagers may easily connect this way and start to feel for others. They may feel obligated to spread as much the liver fluke infection knowledge as they can. This includes correcting each other's misunderstanding of the topic. The Thai villagers may then feel for those who suffers from liver and bile duct cancer and thus be vigilant in reminding others about eating undercooked fish, or using human feces as free, nutrients-filled fertilizer (as parasite eggs can get into water sources and fish this way). To me, love is the answer to living a meaningful life because love has the capacity to connect and unite us. The lack of love is the fundamental cause of diseases and illnesses in this world.

God v. Kamma (Karma)

I consider here how Christianity and Buddhism explain the cause of disease (health). The cause of disease/illness is not usually obvious if we are not conscious of our own previous

actions that may have caused the disease/illness. And even if we do, it is not easy to pinpoint exactly what causes it because the disease/illness could be caused by multiple actions. If physical damage can be detected, we could try to think of a possible cause of that damage. Doctors could help us make a reasonable link to our past behavior or our genetics by looking through our medical history. Stress, or people's vulnerability to disease (e.g., *optimal virulence*—host-parasite fitness theory) often become parts of the explanation. Nonetheless, if not because of epidemic, no one knows what causes disease/illness. Why one person survives the deadly disease when Western medicine offers no hope? Or why one apparently dies with a simple, successful surgery?

Buddhists call this mystery *kammic* factors. *Kamma*, in Pali, literally means action or doing. The term is specifically defined as action based on intention: "Bhikkhus! Intention, I say, is *kamma*. Having willed, we create *kamma*, through body, speech and mind" (Payutto, 1993). Every action (*kamma*), even one little thought, has its consequences (*vipaka*). *Kamma* and *vipaka* are generally known as "cause and effect," or "action and reaction" (Ratanakul, 2008). The relationship between cause and effect is not one-to-one: "one action brings multiple results and one result is caused by multiple actions" (Paonil & Sringernyuang, 2002). "[A]ccording to Buddhism, life is not limited to a single, individual existence." All life evolves in a successive cycle of birth, sickness, old age, death and rebirth. The present life is a part of this cycle, and "[e]xistence is thus at the same time an effect in one respect and a cause in another" (Ratanakul, 2008). Analogously, health (or disease) is a result of previous collective good actions (or bad actions) from preceding minutes, days, and life! And our present actions also serve as causes of future health (or disease). That is to say, present events are the index of the past and that of the future. But because most of us do not have past-life memories and cannot know all of the past causes of an event, the working of *kamma* in our views is thus complex. Without the belief in "the round of existence…that stretches out across space and time" (Ratanakul, 2008), the theory of *kamma* appears to invoke some kind of "fatalism or determinism or predestination" (Sayadaw, 1996).

Perhaps, local villagers trip up on the view of predetermined fate associated to *kamma*, and ignore that present actions can alter the course of the future as well. For some people, the liver fluke infection might be mainly caused by *kamma* in past lives. However for others, the infection might be mainly caused by their own action of eating undercooked fish in these lives. In both cases, Buddhism advises people to always physically get treated because we cannot certainly know if the infection is caused by *kamma*. Even though the infection caused by *kamma* cannot be cured until the *kammic* effect is exhausted (Ratanakul, 2008), taking care of our bodies serves as a good action that will bring good results in the future.

I believe Christianity would call the medical mystery/miracle the *God* effect. The term *God* here represents the ultimate source of power, or the uncontrollable external factors in human life. To some extent, *kamma* is exactly like the ultimate power because one's *past kamma* cannot be altered—one is born with it. In our everyday usage, Thai people are likely to denote unexplainable events, especially misfortunes, to *kamma*. This is not exactly blaming fate and destiny, but instead used to encourage acceptance, when things do not work out as planned. Similarly, Westerners often denote unimaginable events to *God*. This encourages faith and trust in the higher power that things will be okay; thus inducing acceptance as well. The working of *kamma* is essentially complex and beyond our discussion here. The working of *kamma* is hard to

grasp, and so as the working of *God*. The phrase "God works in mysterious ways" is not directly found in the Bible; however, there are phrases that seem to give the similar meaning, such as, "Verily thou art a God that hidest thyself, O God of Israel, the Saviour." [Isaiah 45:15] Until we can conceive life's complexity, *God* is a simple, easy to understand, and succinct term to hold on to. "God has a plan," or "God will help those who help themselves" are always up-to-date encouraging mottos, so long as each individual knows what he/she means by *God*.

Perhaps, researchers need to understand the high level of *O.viverrini* infection in Thailand as a unique health problem. This is because the people there have specific views on health and disease that are similar, yet different from Western-trained researchers. We researchers may need to analyze the data with no preconceived notions of medical factors that cause diseases. Non-medical factors, such as, ethics or morality may be considered for gaining a better understanding of the problem and devising an effective health intervention. Aside from nature and nurture factors, individual and environmental causes of diseases, there exists the working of *God* and *kamma*.

Science has explained health from various levels of analysis, from micro to macro, individual to global. However, science cannot explain health on the fundamental level, that is, on the level of our existence. What it *means* to live a healthy life? I believe this philosophical level is the ground of other levels of analysis. It is arguably the most important level of analysis, not only because it exists in other levels, but also because it touches on our deepest moral concern for life, i.e., value we put on life. That is to say, our current list of determinants of health (e.g., social class, culture, education, and environment) would be a little bit more complete when considering "our desires/needs to lead a meaningful life"—my definition of religion and spirituality.

Theoretical Framework

Based on my literature review and preliminary data analysis, I have put the behavior of eating undercooked fish within a theoretical framework. My model focuses on the individual level of analysis, and derives from two social and behavioral science theories: 1) the Theory of Reasoned Action (TRA), and 2) the Leventhal framework. The eastern view is embedded within these western-based theory and framework. Additionally, the model applies the worldview theory in science education to fit the concept of health and well-being (Figure 10).

The Theory of Reasoned Action

The Theory of Reasoned Action states that behavior is determined by *behavioral intention* (See details in the "Theories of Health and Social Behavior" section.). In my model, I use the term attitude, represented in a dark blue rectangle (Figure 10), to denote any individual beliefs that lead to eating or not eating undercooked fish. This concept of attitude is broader than the TRA's concept and incorporates normative beliefs, which are a component of subjective norm, as well. The other component of subjective norm (behavioral motivation) is not covered in this framework.

I cover the two important health-related beliefs separately: 1) beliefs about the nature of health and well-being, and 2) beliefs about causes of illnesses. I intend to examine the four intertwining dimensional aspects of health—physical, social, mental, and spiritual (Lindström & Eriksson, 2011)—through a person's worldview, and in turn observe how each aspect contributes to personal definitions of health and well-being. I ask people about their overall

conceptualization of health, which is not confined to absence of disease (i.e., liver fluke infection). This is similar to Cobern (1996), who asked people about their worldviews to evaluate if these worldviews were scientifically compatible, i.e., if science is an authentic part of their everyday thinking (Cobern, 1996). Perhaps, if a person perceives his/her health and well-being as having a purposeful and meaningful life, he/she may not care much about harm to certain bodily organs. In sum, these beliefs would illustrate people's personal/cultural identities.

Providing people information on causes of illnesses has long been used as a health prevention strategy and used to promote behavioral change. Health education assumes that information would lead people to avoid those causes (i.e., changing behavior leading to the causes). However, this is not always the case. There exist other non-biomedical explanations about the causes that people perceived as beyond their control. To name a few, there are the interpersonal causal ontology, which regards illness as caused by "black magic" or envy, and the moral causal ontology, which regards illness as caused by individual's own past actions (the theory of *kamma*) (Shweder, Much, Mahapatra, & Park, 1997). Worse, telling people what they should do may provoke their inner sense of rebellion (Kirmayer, 1990). Thus, asking people about their beliefs about causes of illnesses would help identify what ontologies they have.

Leventhal Framework

Because health education suggests that teaching people health-related knowledge would help them maintain good health, I also ask about their scientific knowledge of liver fluke infection and treatment, as well as their experiential/anecdotal knowledge about liver fluke, which may not necessarily be *scientific* but very much intertwined with beliefs about health, well-being, and causes of illness. According to the *Leventhal framework*, illness representation contains five key domains: identity, cause, timeline, consequences, and control/cure (Leventhal, 2001). These attributes can give rise to risk perceptions and worry, which can then influence behavior. In my model, scientific knowledge about liver fluke infections covers the first four domains in the Leventhal framework. The last domain is covered in scientific knowledge about treatment specific to liver fluke infection. Experiential/anecdotal knowledge covers the folk knowledge explanation. This knowledge then contributes to attitude (Leventhal's risk perceptions and worry), and in turn to eating behavior (Figure 10). Note that these three classifications of knowledge, represented by blue vertically aligned rectangles, are by no means exhaustive or mutually exclusive. However, the knowledge is contingent on publicly available scientific knowledge about liver fluke, represented by the bright blue rectangle, located on a different plane than the other kinds of knowledge. This publicly available scientific knowledge is dynamic and conditional, which is also emphasized in the Leventhal's illness representation (Leventhal, 2001).

My framework can be simplified and grouped into scientific knowledge (represented by the green circle on middle, left of the Figure 10) and cultural beliefs (represented by the blue circle on right). Both individuals' scientific knowledge and cultural beliefs interact to form attitudes that lead to the behavior of eating fish (Figure 11 on left). The two circles roughly indicate the two seemingly contradictory views (e.g., science and society, scientific rationalism and religion, health and spirituality) that I try to integrate. The boxes and circles represent concepts *conceptually*, while in reality, they are all intertwined (Figure 11 on right). They simply serve as concepts to be explored in the actual dissertation study. They are, in no way, predetermined themes to be reaffirmed in the fieldwork data. The themes found in the pilot study

(Chapter Four) informed this framework. Simultaneously, these themes are, to some extent, consistent to those found in the dissertation study where they are explored in more detail.

Figure 10: Framing Science, Culture, Attitude, and Health

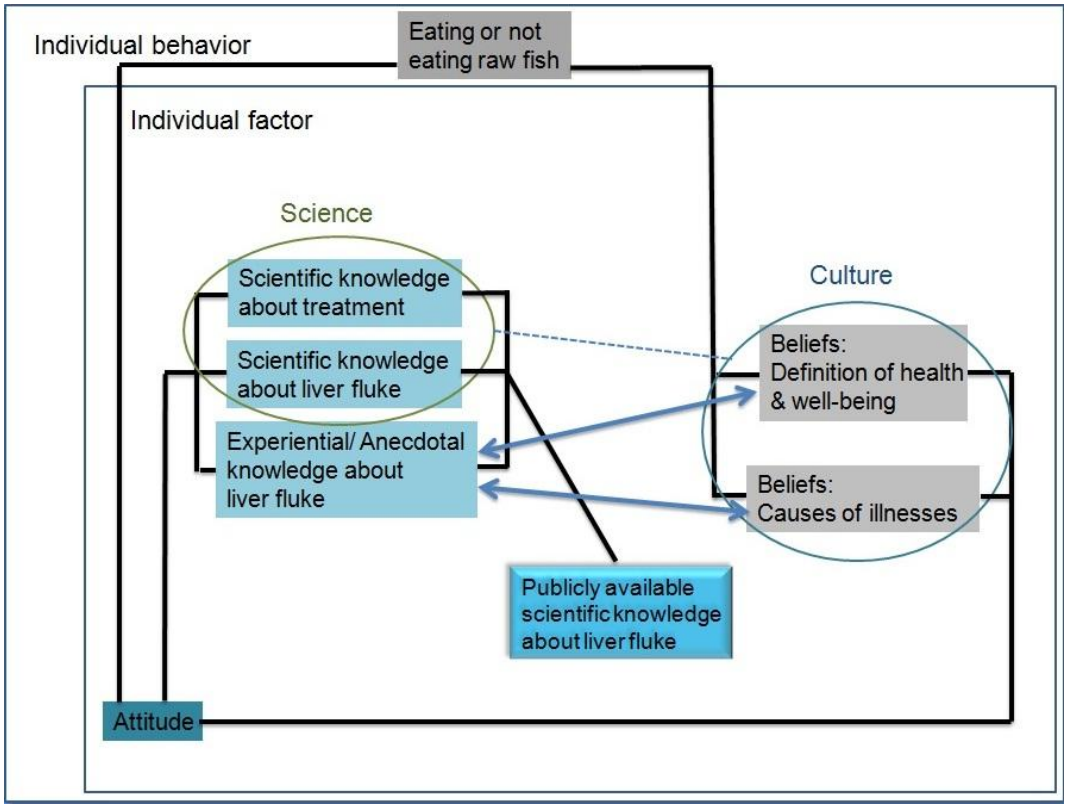
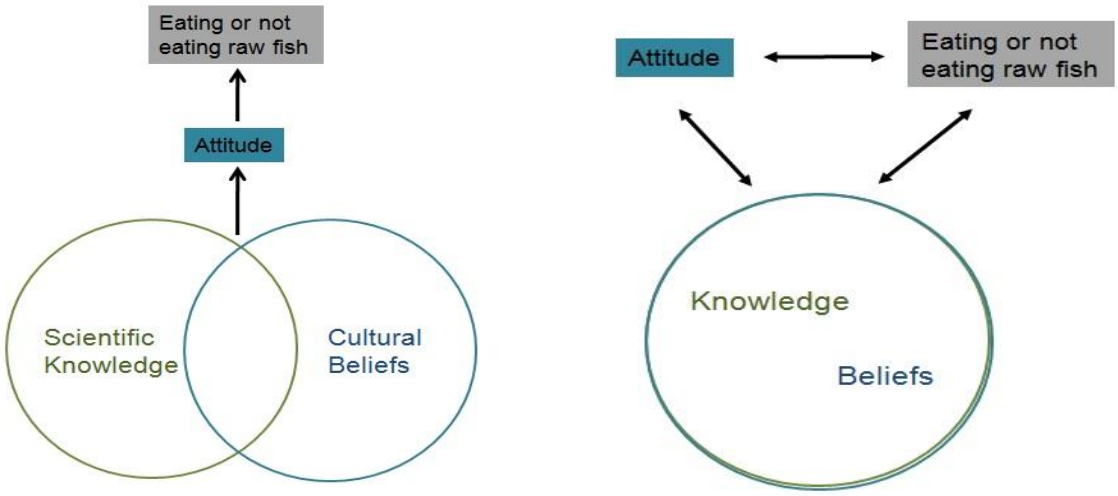


Figure 11: Simplified Framework. (Left) Scientific knowledge and cultural beliefs interact to form attitudes that lead to the behavior of eating fish. (Right) The entanglement of scientific knowledge, cultural beliefs, attitudes, and the behavior of eating fish.



My hypothesis is that, there are cultural conflicts between our scientific knowledge of liver fluke infection/treatment and people's experiential/anecdotal knowledge, resulting in people's continuing to eat undercooked fish. Thus, high-risk behaviors such as eating undercooked fish may simply signal that more fundamental, larger problems are in charge of the real social processes that perpetuate the behavior, and that, there is an urgent need to negotiate the middle ground between Western science and Eastern culture. That is to say, the framework shown here is only for simplicity's sake. The complete framework should be a multi-scale model of the dialectical relationship between individual actions and social practices.

CHAPTER FOUR: PILOT STUDY

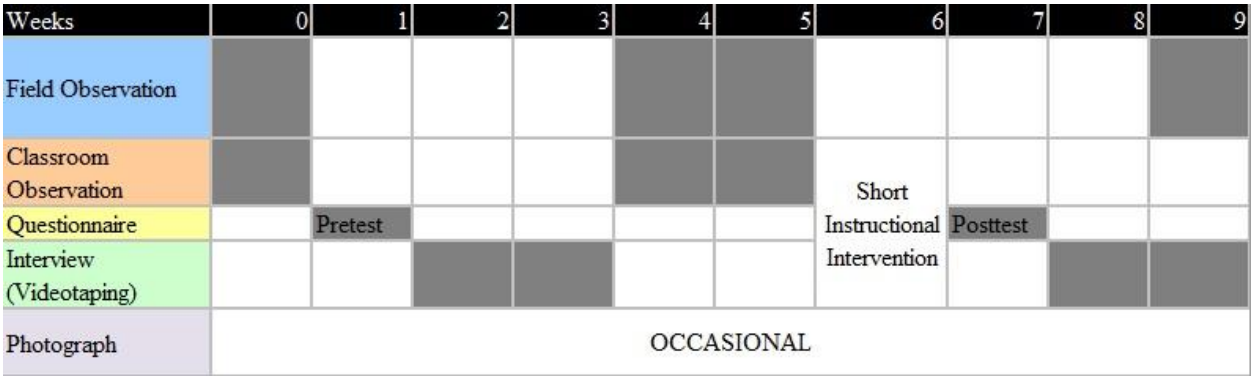
This project began when Banchob Sripa, Associate Professor in the Department of Pathology at Khon Kaen University (KKU) in Thailand invited Robert C. Spear, Professor of Environmental Health Sciences in the School of Public Health at UC Berkeley, to participate in a study of the *O.viverrini* infection control project in Khon Kaen. Angelica Stacy, Professor of Chemistry at UC Berkeley, suggested that I could contribute by examining local villagers' undercooked fish consumption in light of their culture, social context, and scientific knowledge of the liver fluke infection. As the first step, I conducted the exploratory pilot study discussed in this chapter.

Six months later in 2012, after obtaining human subjects approval from both institutions, the two-month field research started.

Study Questions and Overall Design

To help understand the context of the behavior, I observed Sripa and his students provide liver fluke infection information in places such as schools and local health centers. To understand what leads people to eat undercooked fish, I developed a data collection plan as followed:

Figure 12: Data Collection Activities



Field observation and classroom observation allowed me to interact with people and observe researchers working together with local villagers (e.g., students, teachers, and health educators). I later situated myself in the schools known to have relatively high child liver fluke infection rates. Questionnaires were conducted to get an overview of students' knowledge about liver flukes and their familiarity with eating undercooked fish. The subsequent interviews were conducted to get a more in-depth understanding. Photographs and video-recordings of the environment have been kept mainly to document the situations.

Specifically, my ad hoc hypothesis was that local villagers did not understand the basic science behind the infection, much less had the capacity to act on this understanding. I assumed that inadequate public health knowledge was the main reason why they did not change their fish eating behavior. To contextualize, I examined the people's life and work conditions, their lifestyles, their eating customs, and local traditions of eating undercooked fish:

- Whether and how scientific knowledge of liver fluke infection and treatment influences the local villagers' fish eating behavior?

- What factors and/or conditions determine their fish eating behavior?
- What cultural factors (e.g., social relationships) and value systems support the widespread practice of eating undercooked fish?
- Why do some people eat undercooked fish, while others eat cooked fish?
- What are the critical research issues?

Study Participants and Context

Participants of this study were both male and female and ranged from age nine to approximately 70. They included school-aged children, the middle-aged, and retired adults. Some people were not highly literate, but all were fluent in the local Thai dialect. Young children grades 4 to grade 9 students were enrolled in the Bannlawa or Benchamitrawitayakom Schools in the year 2012. Student consent and parental permission was obtained for inclusion in the research study. The remaining participants either lived or worked in Bannlawa, Bann Korksoong, Bann Padang, Bann Nonlamom, or Bann Tard villages.

I targeted middle school students, in hope of achieving lasting behavioral change in young children. According to Fox and colleagues (2010), health and illness concepts begin to develop and change during middle childhood. In addition, children of age 10 already know that their minds can influence how they feel. That is, they believe that both physical aspects and socio-psychological factors affect one's susceptibility to illness—the inseparability of mind and body (Fox, Buchanan-Barrow, & Barrett, 2010). They have quite a good understanding of disease/illness. Children of this age slowly develop the concept of consequences or prevention of illnesses, which is not simply that of mere concrete causes or symptom of illnesses (Paterson, Moss-morris, & Butler, 1999). "Childhood is an important period of the development of health concepts, attitudes, and patterns of health behavior that will impact on future adult health status" (Normandeau, Wins, Jutras, & Hanigan, 1998). Thus, working with middle school students may affect change at the fundamental level—at the least sophisticated stage. Children may illustrate early development of human thinking about health and illnesses, and their nuances, so behavioral change might be easier and more sustained at this stage.

Due to a long latency period time between liver fluke infections symptom development, local villagers may be benefit by learning about the disease at a young age. The fact that liver and bile duct cancer can develop 30-40 years after the first infection should be emphasized among children. Besides, children normally think that illnesses are "contagious, cured by the medical profession, and are relatively *short-lived*" (emphasis added) (Fox et al., 2010). Young children "have more difficulty establishing an association between two events that are greatly separated in time" (Olvera-Ezzell, Power, Cousins, Guerra, & Trujillo, 1994). Thus, perhaps, if they were not informed about the long term effect since little kids, the not-knowing may continue into adulthood—when it is too difficult to digest and to admit the information, and then change their fish eating behavior. This cumulative nature aspect of risk is somewhat analogous to that in smoking. Young smokers frequently deny the short-term risks of smoking (Slovic, 2000). Thus, it is important to educate young children.

The school selection was driven by logistics. Sripa selected those two schools for me because they were only about a 45-minute drive from the KKU, and I could visit the schools every weekday. From his past experiences, he knew the teachers and students there would be active participants in my project. Most importantly, they would already have a basic

understanding of the liver fluke that I could further explore in depth. Sripa's research group had provided these students a 4-hour educational lecture on the parasite. Yet, the liver fluke infection rates remained high among the students and local villagers around the villages where the schools were located. This perplexed him and me.

During the first three weeks of the study, I lived in a student apartment near KKU and commuted to the schools every weekday. Then, I was invited by the science teacher in the Benchamitrawitayakom School to live with her relatives in Bann Tookmon. I moved there so as to avoid traffic congestion—which occasionally interfered with my interviews and/or observations. Bann Tookmon is located midway between the Bannlawa School and the Benchamitrawitayakom School, so it took only about 15-minutes to get to each school. Spending times with villagers 24/7 for close to two months (with occasional home visit over weekends), I obtained a better understanding of the context where the liver fluke infection occurred. I thank my host family, a couple who took me in as their youngest daughter and never asked a dime for my living expenses (e.g., utilities and food)!

Both the Bannlawa and Benchamitrawitayakom Schools are public and called "educational-expanded-opportunity schools" (Thai name: โรงเรียนขยายโอกาส), meaning that the schools had recently extended their grade levels to cover Grades 7 through 9. This resulted from following the 1999 National Education Act extending compulsory education from 6 to 9 years. Before then, rural schools usually had kindergarten to Grades 6. And because many rural students cannot afford the cost of traveling to far-away schools offering Grades 7 to 9, the government extended the grade levels within the existing rural schools. Parents can now abide by the law. However, with the same limited resources (e.g., building size, curriculum materials, and number/training of teachers), education in Grades 7 to 9 in these schools is arguably of poor quality. The letter of the law is met, but not the spirit of it! Most students graduating from these schools either go directly into the work force or continue their education in vocational tracks for few more years to prepare for a more technical job (e.g., as an ironworker). Only a few students go to academic tracks, and almost none of them pursue college/university education due to its high cost.

These two schools are local-village schools. They only accept children who live within the 5 mile radius from where the schools are located. *Bann* literally means house in Thai. *Bannlawa* means house Lawa, or Lawa village. Students who attend the Bannlawa School, live in Lawa village. However, students who attend the Benchamitrawitayakom School, come from five villages around the area: Bann Korksoong, Bann Padang, Bann Nonlamom, Bann Tard, and Bann Pao. Thus, the school is bigger than the Bannlawa School, both in term of size and total number of students. The Bannlawa School is located on the West side of the Kang Lawa Reservior (Figure 1); whereas the Benchamitrawitayakom School is located on the East side.

Economically, students from these schools are poor. Below is the picture of their houses and outdoor kitchens (Figure 13). Most of them live with their grandparents, rather than their parents, who often work in the city and leave children to their grandparents, who farm for a living. The students either walk or ride motorcycles/bicycles to school. Students use the northeastern dialect (Isan language) in their everyday speech, and speak standard Thai only with teachers—and only during school lessons. Teachers sometimes use the Isan language to give a more honest conversation and deeper intimacy. Every teacher understands the Isan language, but not everyone can speak it.

Among students who were willing to participate in my research study, thirty-six of them were selected by their teachers for interviewing. Eighteen students were from each school. Three were from each grade level (Grades 4 to 9). I asked class teachers to qualitatively select three students from their own class such that the students would represent differences in academic ability (a high-achieving student, a middle-achieving student, and a low-achieving student), thinking that a wide variety of academic ability may correspond to a wide range of ideas. The students whose families live within a short walking distance from the schools were my priority, and a few other extra students were picked arbitrarily when the selected ones were absent during the day of the interview. The teachers also helped me ensure that the students represented a wide range of geographic areas—from different parts of the villages or from different villages.

Adult local villagers were mainly parents or relatives of the student interviewees. My initial intention was to have a better understanding of the students' scientific knowledge of the liver fluke infection through their parents. For example, did parents influence their children's understanding of the liver fluke infection? What did parents say about their children? The adult participants were in their homes when I visited, with no prior arrangement. Occasionally, they referred me to have conversations with others nearby. Other adult participants were found conveniently in public spaces, or more private spaces such as an annual district conference meeting on the current status of *O.viverrini* and cholangiocarcinoma.

Figure 13: (Left) Houses and shacks local villagers live in. (Right) Local villagers' outdoor, open kitchen.

Measures Related to Science Learning

Data Collection and Instruments

Field Observation

Field observations were performed first, and continued throughout the study. This was to try to understand community values, and to make sense of the phenomenon of eating undercooked fish in terms of the meanings that people ascribe to them. Places included markets, convenience stores, health centers, community gathering places, community science centers, and temples. Households were observed during parent interviews.

Participant observation occurred during social activities such as fishing.

Classroom Observation

Classroom observations were performed to observe existing practices and teaching methods that fit the students' *learning styles*. If improving the liver fluke infection rates in Khon Kaen involves instructional interventions, I believed that this information might be useful in understanding students' learning process and the challenges they face in classrooms.

Questionnaire

Students were asked to fill out a survey twice during the study:

1) The first survey (pre-test), completed before the interviews, asked for students' basic demographic information, motivation, behavioral skills, and knowledge related to the liver fluke infection. The survey questions were adapted from the Holliday's dissertation that tests people's information, motivation, and belief related to anemia (Holliday, 2011). Knowledge questions were adapted from information learned during the field observation, more specifically, during the annual conference meeting about the liver fluke infection. Teachers and a group of students were asked to look at the survey questions beforehand. This was to ensure that the language was appropriate for the children of the age range being tested. The questions were adjusted accordingly.
2) The second survey questionnaire (post-test) was conducted following the first round of interviews and a mini instructional intervention. This questionnaire was to check whether their knowledge related to the liver fluke infection increased, stayed the same, or if it further confused them. Because many children had poor reading skills, I read the questions aloud, as well as the answer choices for every student, trying to assure their full understanding. Students also had opportunities to ask questions that they might have at this time.

Interview

Each questionnaire was followed by semi-structured interviews. The first round of interviews (See Appendix A for the interview guide) asked students about their routines (e.g., what they normally eat and do), and their opinions on the picture of the liver fluke life cycle proposed by the Centers for Disease Control and Prevention (CDC) (Figure 2). Basic demographic information was asked toward the end of the interviews. This was to avoid *stereotype threat* (Steele & Aronson, 1995). The routine question was meant to get students to feel comfortable that there were no right or wrong answers. This question was open-ended in nature. This was to keep the conversation flowing, and provided the students a chance to tell their stories so that I could refer to in later questions. I attempted to spot the students' verbalization skills per Paterson and colleague's suggestion that verbal intelligence is "a significant predictor of level of conceptualization" (Paterson et al., 1999). The liver fluke life cycle was chosen in this case because a similar representation was used during the health educational lecture by Sripa and his research group. Additionally, I also asked the students whether they have heard of the liver fluke prior to my arrival. This was to see whether previous lectures had any sustained impact on their understanding. Health risks associated with eating undercooked fish, perception of risks, awareness of death from liver cancer, and the associated belief systems were recorded during the interviews.

This data was then roughly analyzed and used to design a short instructional intervention. Specifically, I tried to devise a better representation of the liver fluke life cycle, and showed it to students. The intervention took approximately 30 minutes. It was framed as a short lecture on the

liver fluke infection. The lecture included possible impact of the infection on society, and its damage to human bodies.

The second round of interviews, followed by the post-test questionnaires, probed students' understanding of what they learned in the short instructional intervention, as well as their decision-making skills in various situations (See Appendix A for the interview guide). The liver fluke transmission cycle was shown. The students were also asked if they thought that a liver-fluke-free environment would be possible in the near future. The question was phrased, "will it be possible that nobody in our community eats undercooked fish?"

Interviews were conducted at the schools during regular school hours. Questions were asked in approximately the same order as seen in the interview guides (Appendix A); the order depended on students' responses—some questions aid easier flow than others. However, not every question in the interview guides was asked. Thus, analyses for generalization would be conservative.

Results and Discussion:

Quantitative Research

Firstly, there was no difference in knowledge between regular undercooked-fish eaters and non undercooked-fish eaters. In fact, all students seemed to have a good understanding of the basic liver fluke infection information (Figure 14). Secondly, there were no gender differences in mean knowledge of the liver fluke infection. Thirdly, their knowledge was independent of past liver fluke infections. And lastly, the behavior of eating undercooked fish (calculated from the two bolded questions in the questionnaire; see Appendix A for details) was independent of individual's past liver fluke infection.

Section II: Knowledge related to the liver fluke infection

Figure 14: Percent (%) Distribution of Student Responses (pre-test)

Information	Correct	Incorrect	Not Enough Data	Don't Know
1. Liver fluke infection is caused by food we eat.	**50.68**	5.94	28.77	16.44
2. Food causes liver fluke infection.	**46.58**	9.13	21.92	24.2
3. Liver fluke infection is incurable disease.	11.87	**44.75**	4.11	41.1
4. Some people who are infected by liver fluke have no symptom.	**15.53**	16.44	6.85	62.56
5. In some people, liver fluke infection causes abdominal pain that instigated by undigested	**29.22**	9.59	5.94	57.08
6. In some people, liver fluke infection causes them to poop too often.	**25.11**	10.5	7.76	56.62
7. Eating koi-pla (raw-fish dish) makes you stronger.	2.28	**71.23**	5.02	22.83
8. Lime/lemon can kill liver fluke hidden in food.	16.89	**14.16**	9.59	60.27
9. Liquor can kill liver fluke hidden in food.	9.59	**33.79**	5.48	52.51
10. Raw fish that are fermented more than 2 months contain no liver flukes.	**15.98**	34.25	**6.85**	44.75
11. Antiparasitic drug for liver fluke infection should be taken once a year.	20.09	**16.44**	6.39	58.45
12. We can prevent widespread of liver fluke infection by pooping in the toilet.	**38.81**	**14.16**	6.39	42.47

Even though these descriptive statistics obtained from approximately 300 students provided us an overall understanding of the students' knowledge, the data tells nothing about what they think or why they think that way. Some students copied their friends' answers, and some answered them very quickly. So, I believed it was important to perform more in-depth qualitative studies to gain an insight into this matter.

Qualitative Research

Almost all students experienced seeing adults eat undercooked fish. However, only a small number of students regularly ate undercooked fish, and of these students, their parents, and/or close relatives regularly ate undercooked fish.

Problems of Assessing Scientific Knowledge

I had a difficult time trying to determine if students' explanations were "scientific." I can always think of a possible reason why they said certain things, and that science itself is ambiguous, uncertain, and changeable (Townes, 1966). I could not be certain if they were

referring to out-of-context wisdom of community, or just misapplying the knowledge needed to change their eating behavior. For instance, a student explained to me how alcoholic beverages could be used to kill germs on a skin cut. And by the same token, it should kill parasites in our bodies, too. Also, a local woman claimed that there must be some sort of acid in lime juice as when it is added to undercooked fish, the fish turns from transparent color to white color, implying the acid would also kill the liver fluke. Another 5th grade girl compared the liver fluke cycle with the butterfly and mosquito cycle she learned in a science class. Despite the similar stages that butterflies and mosquitoes have to go through from eggs to lava to adult animals, there are many differences (e.g., time-dependent and multual relationships between hosts and parasites).

Catalogue of Themes

The following themes arise from the data obtained through fieldwork, and from students and other local villagers:

Pragmatic Life—following the flow of life

Most local villagers lived a simple, generous life. In a student's words, we live "a simple, economical life and enjoy what [we] have." She used the word *self-supporting economy*. This term has a special meaning for Thai people. Not only does it carry a positive connotation, but Thai people use it to honor our King Bhumibol (the reigning King of Thailand)'s philosophy. According to the King,

> [a] self-supporting economy means to **have enough to survive**. .. [A] self-sufficient economy does not mean that each family must produce its own food, weave, and sew its own clothes, […but it] mean[s] that each village or each district must have **relative self-sufficiency**. Things that are produced in surplus can be sold […] in the same region, not too far, so that transportation cost is minimized (emphasis added) (King Bhumibol, 1997 during his 70th birthday speech).

A self-supporting economy means that an individual has enough to survive through community trades. Local villagers took the matter further by sharing excess goods—with no money involved. They converted the excess to good deeds (i.e., good kamma). Growing up in the city, I had never thought that giving without expecting something in return, as frequently seen in the Bible (e.g., Luke 6:35), was viable. Each individual would share rice or a plant they grew, or sometimes animals they raised (e.g., rooster and duck) or found locally (e.g., fish and shrimp). They simply acted as one big family. The villagers normally opened their gates and relaxed on their porch when not working in the farms. My host family usually sat in their porch all afternoon, inviting passers-by to have a chat or eat with them. The villagers I met seem to feel very comfortable asking others for things they didn't have, yet needed at the moment. Perhaps, they knew that they would not be turned down unless it just wasn't possible. Indeed, people would give things away without being asked when they have an excess. Their words regularly knocked me dead: one time when I was contributing a small amount of money (~$10) for the water bill, and my host mom said "Is it difficult? Do you have to go through troubles?" I pondered, "How can she say this to a relatively rich student? Had she not accepted the fact?" As much as they do not feel the lack of anything, I felt lacking in so many ways.

I experienced the Buddha's *Four Requisites* in practice with my own eyes. Food, clothing, accommodation, and medical care are the four necessary things we humans need in life. Local villagers grew their own plants and rice, raised animals for food, weaved their own clothes (Figure 15), had a place to stay, and had access to medical care. According to the Buddha, this is

all humans need in order to be happy and fulfilled. Most households that I visited contained only basic accommodation and not much more, such as fans, a radio, and a bathroom with no water heater. Few houses had a computer or internet access. People rarely shopped for groceries because they grew everything they needed. They even made their own detergents and soap. However nowadays, to only have what is necessary requires a bit of work (at least to me). I can't imagine my day without a computer and internet.

Eating undercooked fish was a direct result of living a simple, generous life. According to the 5th grade boy Dang, eating undercooked fish was a traditional way of living that passed from generation to generation. Economy in the researched villages was based mainly on fishing and agriculture (Figure 15). Fishing is the primary source of nutrition that is free and easy to find locally. Approximately five adults I talked to have explored multiple fish recipes with locally available ingredients and found the undercooked fish dish the most irresistible of all kinds of meat. In my view, this fact and the tradition of sharing food alone can sustain the behavior of eating undercooked fish. Local villagers may simply want to share the *goodness*, and become unaware of the consequences of this small, generous action. I always have an urge to eat one particular brand of chocolate that I ate when I was young. Perhaps it is not so much about the taste of that chocolate as it is about the memories associated to it—even knowing that the chocolate carries an entire year's load of sugar. Similarly, eating undercooked fish created a lasting memory on a local villager:

> …During lunch out there in a farm, we would catch fish, chop it, put some salt and spices into it, and sometimes squeeze red ants on the tree—mostly mango trees, as the ants served as lime juice. Then, enjoy it together with other farmers….We didn't know about the liver fluke then, say 10 years ago, but I still had memories doing that[—seeing]… our ancestors ate it….

In my conversation with Spear, he initiated the term *culturally addictive behavior* to explain the phenomena. Eating undercooked fish is undoubtedly a culturally meaningful social activity. This reminds me of the Mary Douglas' (1978) risk perception, which is a "socially or culturally constructed phenomenon" (Oltedal, Moen, Klempe, & Rundmo, 2004). However, my use of the term culture here is more dynamic than her use. This is because her initial study was conducted in a more closed environment in Congo, where people had a vivid tradition and a strong local leader (i.e., before the globalization period); whereas my study was conducted in a more opened environment in rural Thailand, where mass media had a huge influence in the people's perceptions. Consequently, the fish eating behavior is comparable to smoking behavior in general. Thus, if smoking is addictive, then eating undercooked fish is certainly addictive as well. Pleasure obtained, the taste, the social experiences and memories associated to both behaviors could be surprisingly similar.

Figure 15: Various occupations local villagers have: fishermen (Top left), weavers (Top right), farmer (Bottom left), and sellers (Bottom right).

Climate and Culture

Generally, villagers lived a slow-paced life. Everyone in the villages knew each other. They would take time to greet each other, pay close attention, did not feel reluctant to provide suggestions, and encouraged each other during hard times. Despite their tight, caring communities, village schools were of poor quality.

A teacher from the Benchamitrawitayakom School blamed the school's poor quality of education on the "educational-expanded-opportunity" program, "We have middle school students who are not motivated and do not want to come to school, but they are forced to do so as a result of the nine-year compulsory education…These students do not pay attention in classes." However, another kindergarten teacher argued the problem was the school's limited resources: "We do not have enough books, internet access, and computers, for example…Plus, teacher's competencies in teaching upper class students (Grades 7 to 9) are quite low." According to the teacher, students are often stuck with almost the same knowledge learned in earlier years. Without qualified teachers, any books provided by the government do not help much. An increase of student-teacher ratio simply lowers the quality of the school overall. This poor quality was confirmed through my observation during the day of the National Educational Test exam. Students at Grades 6 and 9 need to pass this national test in order to graduate. I saw at least eight students (of ~50 total students) who were illiterate—they could barely read and write. And even more astonishingly, those students passed regardless.

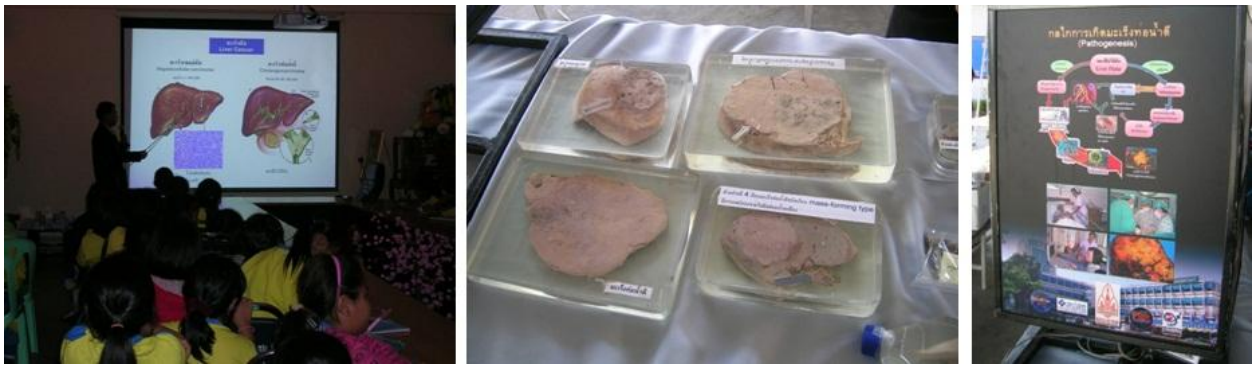
There is an extraordinary wide gap between rich and poor schools. After all, the village schools are only for poor families who have no other choices. A proof that both schools were not even close to standard is that all teachers in the Bannlawa and Benchamitrawitayakom Schools sent their children to private schools in the cities. I perceive this as a warning sign of self-

centeredness. From my perspective as an outsider, the teachers do not even respect their own work, so how could they teach students to have self-respect? I am saying this with no intentions to blame teachers for poor education, but rather blame the whole system that Thai people, particularly those in rural areas, experience. Every one of the ~12 teachers I talked to became a teacher either because of the job benefits (e.g., healthcare and retirement benefits), or because of the lack of other jobs and the ease of entering teaching education programs.

Both the Bannlawa and Benchamitrawitayakom Schools have limited governmental funds for school supplies and lunch. Each has its own system of distribution the available funds: The Bannlawa school provides every student free food, but without rice. Students either pay ~17cents (5 baht) for rice or bring their own rice. The Benchamitrawitayakom School provides free meals for only K-6 students. Junior high (Grades 7 to 9) students have to pay ~34cents (10 baht) for a meal—with rice included. However, they also have an option of eating outside school during lunch break.

Below are pictures during Sripa's activities with middle school students:

Figure 16: (Left image) Sripa provided a lecture about damage caused by the liver fluke infection. Students were also shown normal preserved livers against damaged livers (Middle image), and a poster of how cancer could be developed due to the liver fluke infection (Right image).

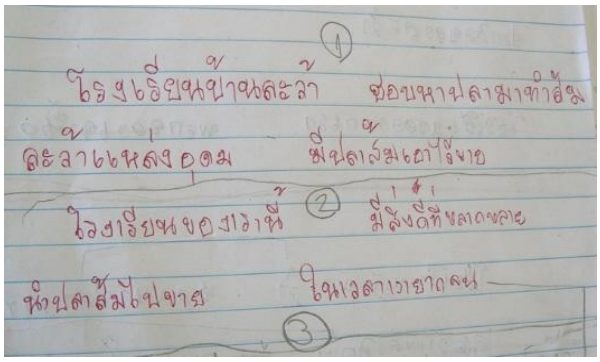


Through talking to students I learned that only a small number of students regularly eat undercooked fish, despite the fact that they all experienced seeing others eating it. Besides, many students were not used to the interview format where they had a chance to verbalize their thinking. Their answers often sounded like answers to test questions. Only a few of them were talkative and felt comfortable. The students often either tried to please me as a way to pay respect, or only said things in the way it ought to be in their opinions. Consequently, they often contradicted each other.

Thus, I decided to also spend time outside of the schools to talk to local adults. My first impression was that local villagers were vulnerable to exploitation due to gullibility and illiteracy. A lady showed me powdered drinks that her daughter spent large amounts of money (~$35) on. They were advertised as suitable for diabetics. Despite the difficulty associated to choosing the right drink, I was positive that those drinks were just regular sugary drinks. Nevertheless, I learned that diabetes was the local villagers' main concern. Future effective liver fluke infection control might involve liver diseases in diabetics and how it can complicate the development of liver and bile duct cancer in liver-fluke infected populations.

Villagers walking around selling pla-som (a raw fish wrapped in banana leaves) were everywhere, including in front of the Bannlawa School. The scene became familiar to me after a few weeks. A group of 8th grade students from this school even did a project on teaching others how to make pla-som, made a poster, and put it on a class door. Another 5th grade student showed me her poem written for a class project (Figure 17) about pla-som. She wrote it in a positive tone, shown by the words "like," "good," and implied that selling pla-som can positively help them earn money in the time of poverty. Technically, people can cook the fish before eating them. Yet, according to students and villagers, people rarely did so. "It was more convenient to just unwrap the banana leaves and eat pla-som as a snack" (Figure 15, bottom right), a student once told me. "Fishermen or farmers could just grab [the pre-made pla-som] on their way to work," another local villager reaffirmed the widespread practice of eating undercooked fish. If I were a local villager, I might think of researchers' liver fluke infection control programs as so distant from my reality, and very impractical. Big campaign posters posted throughout the Bannlawa village did not seem to influence the villagers' habit of eating undercooked fish.

Figure 17: A Student poem written on her own notebook (Left), and its literal English translation (Right).



People in the Bannlawa School, we like to catch fish to make pla-som.

Bannlawa has natural abundant resources, including pla-som.

Our schools have so many good things and we sell pla-som in a time of poverty

Human Vulnerability to Diseases or Sense-making in a Complex World?

Some of the comments from local villagers implied genetic factors may protect them from the liver fluke infection. A 5th grade student claimed, "I see my mom and dad are not infected by the liver flukes, so I followed their habit of eating raw fish." A mother was also perplexed that her parents were not also infected by the liver fluke when they always eat raw fish together with her and her children—a kindergarten girl and a 6th grade boy. She explained,

> You know it is the same fish that we ate—same raw fish. Supposedly those fish were infected by the liver flukes, how come they were not infected; while I and my children tested positive…I tried to fry it (raw fish) first, but then it tasted very different and not quite delicious. In the end, nobody ate it and I had to throw it away…

She made an interesting observation of her real world situation that cannot be explained scientifically. Maybe elders are immune to the infection, but there has not been scientific research done on the issue. To put it into scientific terms, she may speak about biological susceptibility (tolerance) factors—genetic factors—that put her parents at ease regarding the disease. But in her own terms, she may refer to her belief about chance or fate/destiny, similar to how an 8th grade girl explained the reasons why her uncle ate undercooked fish: "Whatever happen happens--" my uncle is not afraid of the infection and dying.

Students' understanding of cause-and-effect relationships was not quite linear. All interviewed students stated that the liver fluke infection is caused by eating some sort of raw

meat—although some students confused undercooked fish with any kind of meat. Yet, only a few students made a clear connection that the infection causes harm to bodily organs. In most students' views, damage to the human body is a completely different, perhaps separate, and unrelated story. The majority of students said variations of the following:

> For a person to actually have the disease [(i.e., the liver fluke infection)], it all depends on multiple things. For instance, does he/she have enough sleep?...Some people may get used to the eating and will never get the disease; while others who never actually eat undercooked fish, can get the disease… As I said, it all depends...

In a scientific term, the students may talk about human vulnerability factors (e.g., stress-induced sleep habits). But in their own terms, the students may generally talk about their views on causes of disease/illness in general that are not necessarily related to what a person eats. And this is more complicated than cut-and-dried linear causality. Thus, they indeed *think* that it is okay to eat undercooked fish.

All the students mentioned that it takes time for the liver fluke to develop, i.e., to accumulate and show symptoms. They all mentioned some kind of a threshold point at which the liver fluke infection occurs. Time in this case implies either amount of exposure or total number of undercooked fish exposure times. Few students said that eating only a few bites of undercooked fish each time is okay—a person needs to eat a lot of undercooked fish to get infected or show symptoms. To me, this is an interesting way of making sense of the consequences of the eating of undercooked fish. Without considering the human digestive system and the liver fluke proliferation inside the human body, this simplification makes perfect sense. There might be some truth in it, which is worthy of further research, if we were to understand children's conceptions of health and disease/illness. They may correlate the liver fluke infection with observable symptoms, when in fact the infection may be asymptomatic or may be apparent only during the incurable cancer stage. That said, the unclear line between liver fluke infection (i.e., *O.viverrini* infection) and liver and bile duct cancer (i.e., cholangiocarcinoma) in publicly available scientific knowledge confused people. In fact, the liver fluke infection serves as merely a risk factor for the cancer. Other factors of cholangiocarcinoma include "age, primary sclerosing cholangitis (PSC),… bile duct adenoma,…smoking, [and] hepatitis C virus infection…" (Malhi & Gores, 2006).

Symptomatologies

The two students who mentioned harm to bodily organs discussed both the short-term and long-term effects of the disease. One student was a 7th grade girl, Chom, and the other was a 5th grade boy, Dang. Chom was quick to point out that the picture of liver fluke cycle (see Appendix B) is incomplete and does not represent the wide range of symptoms ranging from "no symptom for the first time of eating undercooked fish, having red eyes the second, getting more severe stomach ache the third time, and eventually causing death." Dang on the other hand comfortably accepted that he regularly eats undercooked fish while knowing the negative effects of the liver fluke infection—"having an extended stomach and liquid coming out from the eyes, which is sometimes incurable." Yet, he is not afraid to eat undercooked fish; he is only afraid of parasites, and that there is nothing to worry about now because he will develop the symptoms when he is old.

However, some people did not feel comfortable talking about the liver fluke infection or their experiences having relatives with the infection altogether. There were certainly negative connotations/stigma associated to getting the infection. Some children teased their infected friends. Thus, it is hard to distinguish between not-knowing and not-telling even the general information about the liver fluke, let alone the combined symptoms of the disease.

The misinformation about the symptom complex of a disease may be a result of their everyday colloquial expression of the term liver fluke infection. The local dialect of the term implies generality and ambiguity. Local villagers refer to the liver fluke infection as "ki-ka-teuk" (ขี้กะตืก), which means parasites, meaning that they use the term "ki-ka-teuk" to refer to other kind of parasites as well. The villagers also commonly have hookworm as a result of walking barefoot during work. Some people developed a routine of taking anti-parasitic drug (e.g., albendazole) yearly. And this certainly confused people; a few local villagers thought that they could easily get over-the-counter drug for the liver fluke infection treatment (i.e., praziquantel). This is not true. Nowadays, people need to have a fecal test before doctors can prescribe the drug, which would be given in dosages depending on the patient's weight. Plus, the liver fluke infection or *Opisthorchiasis* is translated to pa-yard bai-mai tub (พยาธิใบไม้ตับ) in Thai. Pa-yard means parasite; bai-mai means leaf; and tub means liver. Directed back translation of this composite word implies that the disease is caused by leaf-shaped parasites, which reside in the host liver. The term in no ways emphasizes the infection or damage to the liver. In addition, the villagers did not perceive the infection as a disease: In the common usage, they left out the word *disease* (โรค) that is normally put in front of the names of diseases for it to be grammatically correct. Consequently, they might not be aware of the *Opisthorchiasis* symptom complexity that is completely different from the general symptoms caused by other parasitic infections (e.g., hookworm and tapeworm infection).

Fate in Modernity

A quarter of the interviewed students mentioned the anti-parasitic drug that can cure the liver fluke infection. However, none of the students mentioned the drug's side effects, i.e., praziquantel can increase the people's chance of having cholangiocarcinoma (Pinlaor et al., 2008). Whether they did not know about the negative effects or they simply have faith in modern medicine is open to question. A 7th grade girl, Aum, thought that if people infected with the liver flukes take medicine continuously, they will *greatly* reduce the amount of the parasites at a given time, even while regularly eating raw or undercooked fish. I would assume all students roughly knew about the drug treatment, because both researched schools were participated in the Lawa Model program (2010), led by Banchob Sripa. The program offered free stool tests and anti-parasitic drugs to children whose feces contain the liver flukes, and that all students in the schools at that time participated in the program.

The communities certainly did not have good sanitation management. Almost all households in the researched villages used a septic tank system, requiring that the solids in the tank be pumped out periodically. Technically, the government agency was fully responsible for properly disposing of human waste. However, I had a chance to tag along with a couple who owned one of the few fecal suction trucks around the villages, and learned that they paid a fee to the company that had been awarded a government agency contract in order to work. The couples did not have to worry about where to dump the waste. There were no rules regarding how and where to dispose of the feces. Most of the time, they were asked to dispose the waste on farms

around the villages. According to the couple, they had a long list of people who wanted to have the feces deposited at their farms, because the feces serve as free, nutrient-rich fertilizer. It was a win-win situation for both the fecal matter collectors and the farmers. This solid waste management can surely perpetuate and proliferate the life cycles of *O. viverrini*, because liver fluke eggs can pass through the human feces and find their ways to water sources that contain a large number of fish. That is to say, modern sewage treatment systems are not available for preventing the spread of the liver fluke infection. The local villagers' regular way of disposing of the human waste is analogous to what they did in the old days—going in the woods and carrying shovel to cover up the waste.

Conclusions

It might seem that I learned everything there was to know about the conditions that created and perpetuate the *O.viverrini* infection in Khon Kaen, Thailand. However, the concepts I put together were based mainly on my attempt to make connections among bits and pieces of information. That is, the connections did not coherently arise from the people's own conversations, and I rarely heard their analysis of the situation. Thus, it is possible that I may have misinterpreted the meanings, or missed the subtle but significant point that sustains the behavior of eating undercooked fish. There was enough evidence showing that the obtained information was somewhat incoherent, and often contradictory. Few students quickly answered "no" when I asked if they eat undercooked fish. However, when I later asked "when was the last time you *tasted* undercooked fish? or "how undercooked fish tasted?" the answers seemed to indicate that they at least had eaten the undercooked fish at some point in their life. A boy's answer to the first question was that he just had it last week. I did not think that he intended to lie or put on a good show, but perhaps, he did not count having few bites as actually eating. Thai language has different words for trying a small amount of food and eating food as a meal (ชิม v. กิน). Or he may have been unconsciously trying to answer it *correctly*—trying to answer the way it should be and not the way it actually is. During my household visit, I asked an old lady if she ate undercooked fish, and again the answer was "no." However, I saw a raw fish dish inside her food cabinet. Thus, to really know their thinking and attitudes, I realized that I needed to spend more time knowing the people in context. This may help them open up and feel more comfortable expressing their ideas. Questionnaires and short interviews remain too superficial to develop an insight into deeper levels of the problems inherent in their thinking.

CHAPTER FIVE: DISSERTATION STUDY

This case study examines the worldviews of local villagers and the experiences that have shaped their attitudes toward life (and death) that determine if they choose to participate in the high-risk behavior of eating undercooked fish. I have employed qualitative methods because they can add personal and spiritual dimensions to opinions that cannot be obtained simply by using survey questionnaires and rigidly structured interviews with predetermined questions, set-up times and places. The case study gives voice to the local villagers; data were analyzed based on the meanings that the local villagers ascribed to them. The study was designed to reveal the fundamental cause of the liver fluke infection problem, i.e., the thinking that created and now perpetuates the problem. Differing viewpoints are elucidated along with the local villagers' background experiences and environments that led to those viewpoints. Most importantly, I explain how researchers' attitudes towards people's actions may contribute to prolonging the *O.viverrini* infection problem in Khon Kaen, Thailand.

This study was conducted over three months in 2013. The social and cultural phenomenon of people eating undercooked fish served as my "case." Based on the theoretical framework discussed in Chapter Three, I explore the possible application of this framework to empirical practice while identifying emerging issues. I selected eight participants, a number sufficient to conduct literal replications as well as theoretical replications, to ensure external validity (Yin, 2009). This study proceeds from the premise that significantly lowering the incidence of liver fluke infection cannot depend solely on scientific knowledge. The principal purpose of this study is thus to examine this key assumption of health science education in aiding human decision making.

Participants and Context

The eight participants in this case study were between the ages of thirty-one to sixty-seven. Besides the eight main participants, I talked to their family members between the ages of fifteen to ninety-two. Out of the eight participants, two are siblings, and the rest are distantly related through blood or marriage. All were socially close to each other. Note that all participants were selected from Bann Chok Chai village (pseudonym) for the practical issues of transportation and time. However, by doing this, I avoided other demographic factors that may potentially predict health risk factors, such as home addresses (Adler et al., 1993). There were not many varieties in surnames across the community. (Note: In Thailand, people with the same surname are related to each other by blood or through marriage.) However, the eight participants live in different households and thus a total of eight families participated in the research study. The participants' prime occupations varied within their common agricultural context. The participants consisted of five females and three males. All of the participants had eaten undercooked fish in the past. The participants' family structures varied (e.g., there were extended families and grandparent families); there was no typical family structure. One family could be referred to as a traditional nuclear family with father, mother, and children. However, their children worked faraway and came home only sporadically.

Basic demographic information on each of the eight participants (age, gender, prime occupation, marriage status, number of siblings, and number of children) is provided in the Table 1 below. I selected their pseudonyms.

Table 1: Demographic Data of Participants

Pseudonym	Age	Gender	Prime Occupation	Marriage Status	Number of Siblings	Number of Children
Ballerina	60	Female	Housewife	Married	6	2+1*
Vagabond—the delicate fighter	31	Female	Seller	Not married	3	1
Nerdy Brahmin	63	Male	Religious Leader	Married	9	Adopted 1
Superwoman	67	Female	Farmer	Widowed	8	3
Sweetheart	44	Female	Farmer/Gardener	Married	5	2
Peace	55	Male	Local Leader	Married	5	2
Scooby-Doo	54	Male	Teacher	Divorced	9	0
Grandma	60	Female	Babysitter	Married	4	2

*2 from her husband's prior marriage, and 1 from her own

These participants were diverse in age and covered a wide range of lifestyles of the people in the community. This provided detailed information about the people's thought system that may influence their eating of undercooked fish.

Generally, local villagers had the highest level of education that was required when they were of school age. Ballerina, Superwoman, and Grandma had 4th Grade educations. Vagabond had a 9th Grade education. However, due to globalization and urbanization, some had obtained either secondary-school (Nerdy Brahmin and Sweetheart) or high-school (Peace) diplomas through non-formal education. This type of education was comparable to General Educational Development (GED) degree in the United States, in which participants were required to attend lessons and pass a certain test. Scooby-Doo completed the Teachers' Professional Development program, which is equivalent to a bachelor's degree. That said, all of the participants except Vagabond and Scooby-Doo had little school experience.

All of the participants were Buddhists and were raised by their parents. Everyone more or less had health issues, except Peace. In Thai everyday conversation, however, if asked whether one has any types of disease, he/she will refer to long-term incurable diseases or diseases that required regular medication, which are called *identity diseases* (โรคประจำตัว in Thai). The two common identity diseases among the participants were diabetes and asthma. Ballerina and Grandma had diabetes, whereas Vagabond and Scooby-Doo had asthma. Nerdy Brahmin had both high blood pressure and asthma. Based on my conversation with the participants, Superwoman had occasional back/hip pain, and Sweetheart had uterine fibroids. Yet, these did not count as disease or *identity disease* in their minds. Similarly, the *O.viverrini* infection was not categorized as a disease, as mentioned earlier in Chapter 4.

I recruited several participants (Ballerina, Vagabond, and Grandma) in person. My host mother and I walked around the village, stopped by houses to explain the study, and asked people if they would be willing to participate. Later, participants were selected based on the information obtained from those first few participants, or from earlier field observations. Nerdy Brahmin was recruited during my observation of a house-warming ceremony. Scooby-Doo was recruited because he was the senior teacher of Bann Chok Chai School (pseudonym), and had the

longest teaching experience there. (Note: Nerdy Brahmin and Scooby-Doo were direct siblings.) Peace was recruited because he was a local leader and lived in an interesting structure of family, detailed later in *Results and Discussion*. Superwoman and Sweetheart were suggested by my host family as they contributed to a variety of lifestyle activities and represented the majority of local villagers who made a living farming.

Bann Chok Chai is a small village of approximately fifty families. In addition to households, more than half of its land area was agricultural land where people grew rice, plants and vegetables, or raised livestock (e.g., cows, pigs, and hens) (Figure 18). There were many small lagoons, and Kaeng Lawa lake was located nearby. The Bann Chok Chai School was located at the entrance to the village from the highway (translated as Friendship Road); whereas the local village hospital was located at the opposite end—outside the village area. People from more than five surrounding villages shared the same local hospital. There were two temples within the Bann Chok Chai village. Between five to ten households sold food in their front yards or open spaces. Food varied from pre-packaged traditional meals (e.g., beef noodle and pla-som), raw vegetables and fruits, to snacks (e.g., Lay's) (Figure 19). No license was needed to open a convenience store within the village. Some stores even sold liquor. There was essentially one cheap brand of liquor sold in the village. Bottles of opened liquor were placed on small, old wooden table tops next to a clear shot glass. Buyers would pour the liquid into the shot glass and drink it right away. A shot of liquor costs 5 baht (~15cents).

Figure 18: Typical scenes in Bann Chok Chai village: a lotus pond (Top left), a bumpy road to poultry farm on the right (Top right), a farmer plowing rice (Bottom left), and a person walking cows (Bottom right).

Weather in Thailand consists of rainy, cool, and hot seasons. Yet, to me (a native Thai), they feel like moderately hot and humid, hot, and very hot seasons. The average temperature all

year round was about 87 °F. Because there was no air conditioning in the village, being home meant spending time outside on a porch. Typical Thai stilt houses have a ground space, protected from sun and rain, where people cook and relax during the day as air flows through nicely. However, I always felt drained and tired after sitting there doing nothing. Under the shady space, local villagers can easily see others walking by, greet each other, and invite others to eat with them. People two doors down the street can hear me laugh, due to the short distances between two houses next to each other and across the street.

The general atmosphere felt very homey—with a very quiet, slow paced life. (Well, it's not exactly like my home, being without noisy quarrels between me and my sisters fighting for a TV remote control, for example). There was no rush. People rarely openly argued with each other outside homes and I normally heard only the voices of nature, such as crickets chirping, cow's footsteps, and dogs barking. Being in the shady space under a stilt house (Figure 19), I sometimes heard rain dripping down the outside. I occasionally heard a car engine; about one vehicle passed by per hour, mostly pickup trucks carrying items for sale, ranging from live bullfrogs and big jars containing fermented fish, to well-packaged herbal medicine. If destinations are not within walking distances, local villagers normally use bicycles or motorcycles as transportation. A tuk-tuk service provided by a middle-aged local man, takes people to the city of Ban Phai, which was about a 15-20 minutes drive. The tuk-tuk, or auto rickshaw, can carry up to twelve people, and would run around the village with no fixed schedules whatsoever. Because fares were equally distributed among the passengers, individual round trip fares varied from ~$1 US with a full load of people, to ~$5 US roundtrip with only one passenger.

Figure 19: Local villagers lived in stilt-style houses where there were shady spaces on the ground floor for hanging out (Top left), taking naps (Top right), selling and cooking food (Bottom left), and washing dishes (Bottom right).

The general smell around the Bann Chok Chai village was not quite pleasant. On a regular sunny day, one often smelled smoke from cooking stoves and occasional trash burning. Local villagers' typical daily routines involved making the day's sticky rice (or sweet rice) for the family over a charcoal stove between 5:00-6:00am—even before having a shower and getting dressed, because the task took time. This produced a certain amount of smoke, which was my second most hated thing in the morning, as the smell really woke me up. The most hated thing had to be the live rooster wake up alarm, which sometimes started at 3:00am! The squawky noise was so loud and so close, as if it came from a hundred roosters playing as "The Worst Non-stop Rooster Orchestra." However, I am proud to say that the sound became background noise in my morning dream towards the end of my fieldwork—and not so much a nuisance. Even though my short-term house was not sound- and smell-proof, it was water- and mosquito-proof—sort of.

The smell also haunted me during the day outside home. Based on my observation, almost every household used charcoal stoves for cooking and heating food because "it save[d] a lot of money on electricity bills." Perhaps, so did the trash burning—villagers did not have to pay for waste collection. And because Bann Chok Chai village was an agricultural community, the smell of cow and pig manure wafted through the air. My plan of wearing the same pair of jeans all week often failed because of stepping on animal dung that also soiled my bell-bottom jeans. (Note: It was inappropriate to wear shorts on most occasions.) There were smelly, sometimes muddy and moldy, puddles of water near drains and along both sides of the street running through the village. Also, there were usually puddles beside houses that never properly drained and smelled like trash. Interestingly, in all my time there, I never heard a person complain about smells or any sounds. Every time the local radio broadcast went off, everyone would stop what they were doing and pay attention to what a speaker had to say. There were between five and seven loudspeakers spread throughout the village. Information was largely and quickly disseminated through this channel, in addition to small personal radios on which every household received national news and listened to Dharma talks. When one specific song, translated as "last light," was played through the speakers, everyone knew that his/her friend or family member had passed away. I vaguely recall hearing it in my morning sleep once and also on a few other occasions.

Study Questions

Restating the main purpose of this research study in a question style yields the following: What are the worldviews of local villagers that sustain the phenomenon of people eating undercooked fish? Implicit in this is understanding 1) the local villagers' reasoning, 2) their definition of health and well-being, and 3) their feelings or emotions that signify their values and meaning of life. This is done to understand their actions in terms of their thoughts and feelings. As the old wisdom saying goes:

Watch your thoughts; they become words.
Watch your words; they become actions.
Watch your actions; they become habit.
Watch your habits; they become character.
Watch your character; it becomes your destiny.

To understand what the eating of undercooked fish behavior really means and to grasp firmly the essential character of the local villagers that leads to their destiny, I chose to look at their

worldviews. Because their views cannot be solely expressed through words, I watched their actions and emotions in relation to those words to get at their true thinking, so that my hoping to make a difference and their hopes in life can become reality—and not simply stay as elusive dreams, i.e., we can synergistically create our destiny together.

Data Collection Procedures

Participant-Observation

My role in this research study was mainly that of a participant-observer, who participates in the local villagers' everyday life while observing their experiences. In order to develop rapport, I spent approximately a week with each participant, resulting in a total of eight weeks time for the eight participants. I tried to spend seven consecutive days with each participant. However, that rarely happened because I often chose to go with unplanned adventures (e.g., attending the 2013 annual merit day, or a funeral) and had some days off, in addition to my participants' other unplanned obligations. I lived with my host family in the Bann Chok Chai village throughout the study, but spent daytimes with the participants. Participant observation allowed me to "learn firsthand how the actions of research participants correspond to their words; see patterns of behaviors; experience the unexpected, as well as the expected; and develop a quality of trust with [my] others that motivates them to tell [me] what otherwise they might not" (Glesne & Peshkin, 1992).

Interviews

Interviews took place at participants' homes, workplaces, or public open spaces where they felt relaxed. I conducted two rounds of 45- to 60-minute interviews. The first round of interviews was conducted during my fourth day with each participant. This provided enough time for participants and researcher to get to know each other, thus fostering the flow of conversation. The second round was conducted on the last day of each visit to discuss what I learned from them—to confirm the accuracy of observations and ensure that their ideas and concerns were being heard. This served as quality control and helped rule out possible but false rival explanations (Yin, 2009). Some interviews were videotaped.

A set of interview protocols was used for the first round of interviews (See Appendix C for the interview guide). Interviews began with the participants' backgrounds: who they were as individuals, and their views about life. The second part of the interview focused on liver fluke issues: their scientific knowledge and experiences, and their attitudes. The third part addressed learning both inside and outside of school, and how people and their knowledge have evolved with respect to publicly available knowledge. The final part of the interview asked participants to explain their definitions of health, their beliefs about causes of illnesses, and their abilities to recognize and interpret symptoms of liver fluke infection.

However, in reality, the interviews were non-formal and unstructured, with no script. This is a well-accepted method referred to as the unstructured interview (Scapens, 2004). I knew every point by heart and strategically placed the questions in the midst of our conversations and actions, so that the *interviews* seemed less intrusive and less awkward for both of us. The order of the questions thus depended on circumstances that lent themselves to the questions. That said, not all concepts in the interview guide were asked directly; some concepts were given with a pointer, or without asking. Sometimes, their answers came under scrutiny because they contradicted their family members' words. Because I arbitrarily took pictures and video-recorded

events throughout the study, my interviews often went unnoticed. However, I made sure to follow the Institutional Review Board requirements from both the Khon Kaen University and the University of California, Berkeley. Plus, a case study is based on how I want "a better understanding of this particular case," which cannot be achieved through a predetermined guideline (Merriam, 1998).

Field Observation

Field observation was conducted throughout the study. This direct observation was used especially when attending public events (e.g., religious practices in a temple). I was also mainly an observer during times with my participants in public spaces, such as schools and hospitals. I also attended the liver fluke infection and cholangiocarcinoma educational program led by a Professor from Khon Kaen University and colleagues. This program was slightly different from what I had attended during my pilot study, because it was geared toward teachers. All participants were either teachers or educators.

Documentation and Archival Records

In addition to the thousands of pictures and many video clips I obtained for purposes of documenting the trip, I gathered site-produced documentation (e.g., controlling liver fluke infection curriculum proposed by National Health Security Office (NHSO) and others), and archival records (e.g., liver fluke related news from internet and census data). This documentation and archival records provided the historical trajectory for the state of the liver fluke infection problem that aided in my data analysis.

Trustworthiness

The credibility of the research is important in a qualitative study, so I ground my interpretations in the words and actions of the participants. I try to make my awareness explicit as much as possible, and acknowledge my personal bias that could affect my analysis. I also try reflecting on my personal background, values, and experiences that may influence my analysis. This is to compliment the participants' stories and experiences. My hope is that my analysis will be useful for readers in thinking about their own research interests. I believe the findings of this case study are not generalizable because of the unique and distinct nature of the participants and the settings. Nevertheless, I increase the validity of the study through this *reflexivity*. In Holloway and Wheeler (2002)'s words, reflexivity means "critically reflect on [my] own preconceptions and monitor [my] relationships with the participants and [my] own reactions to participants' accounts and actions" (Holloway & Wheeler, 2013).

Results and Discussion

I begin by summarizing the participants' stories. This is to describe the context in which they live and work, which I believe is a key component in the thinking that perpetuates the liver fluke infection problem. Each unique story is explained through my eyes in the hope of painting similar pictures in your mind, before getting into prominent themes that emerged from the data. I also discuss the participants' characteristics leading to my selection of their pseudonyms.

Summary of the Participants' Stories

Ballerina

Ballerina was a good-humored, heavily-built 60-year-old grandmother of a kindergarten girl. She has been unable to walk since 2008 after fracturing her left pinky toe and foot bones.

This happened when she and her family were returning from Kang Lawa Lake after playing and relaxing together. She was the last person in an overloaded car (Note: The law setting the maximum vehicular seating capacity has never been enforced in Thailand.), when a person closing the door accidentally crushed her foot. She has never been able to put her weight on the foot since then. She has freckles on her skin, perhaps from harsh sun exposure in her years of hard farming work. She normally remained in her special cradle all day. The cradle resembled a queen-size wooden bed frame without mattress or headboard. There was a 12''x12'' hole on one side of that she used as a toilet. Next to the cradle were a PVC-pipe water tap, a clean plastic paint bucket, and a wire used to dry cloths. This cradle essentially functioned as an all-in-one bed—bedroom, dining area, and bathroom. She was usually positioned lying on her tummy, bent at her elbows with her face looking out, occasionally rolling onto her side or back. A radio and cell-phone on the cradle served, according to her, as friends when her husband was away. Her daughter would come and go throughout the day to administer her diabetes drug injections or serve her food. Ballerina was helping herself as much as she could, even cooking on her cradle at times. I sat on the other end of the huge cradle most of the time, but sometimes was lazy enough that I mimicked her posture. The smell of urine was everywhere. Aside from seeing sadness through her eyes, I never saw her become frustrated or moody in spite of her physical pain. Perhaps she chose to escape from the pain by taking frequent naps. I learned from her friends that before the accident, she used to do aerobic dance. "We would turn on a song and dance together, and just enjoy. But since Ballerina cannot walk, we stopped the dance activities," claimed Superwoman. I selected her pseudonym based on this.

Vagabond

Vagabond was a quiet, light-skinned, slender young lady, and a caring person who often worried that I was thirsty. She often gave me free drinks and felt a bit offended that I never finished them. Since she was not a Bann Chok Chai village native (her husband was), I selected Vagabond as her pseudonym. She had one 5-year-old boy. In addition to her regular housewife chores, she sold papaya salad, drinks (e.g., soda and chocolate milk), and meatballs at her house. She also mended old clothes and crocheted white scarves used in Buddhist ceremonial events for a small amount of money. People around her were more talkative than she was. One whole day she could barely spit out words because of a sore throat that she thought was an asthma symptom. Nevertheless, she introduced me to other villagers and to many interesting activities. Her husband was a talented artist who worked mostly for temples around the area. His artwork ranged from painting concrete to resemble wood to painting traditional Thai murals or art stucco on the temple wall. Another old lady lived in a hut within her house area. The lady and Vagabond's family were not related through kinship—the lady had no family, so she allowed Vagabond's family to stay with her.

Nerdy Brahmin

In contrast to Vagabond, Nerdy Brahmin was very talkative. He was a tall, dark-skinned, muscular 63-year-old male Brahmin who loved to talk about religious-related ceremonies he had led (e.g., house-warming and wedding ceremonies). I felt he thought that I wanted to know everything about the procedures. I often zoned out in the midst of all the given information—with my eyes open of course. Interestingly, he had two distinct personalities inside and outside his home. As the only Brahmin in the village, he instructed people of what to do in all ceremonial events, e.g., giving speeches and debriefing about money donated to the temple. He and his wife sat separately and never talked to each other during ceremonies. He was always

well-dressed and calm. During our conversation at home, he said that he had to act "pristine," and it would "seem even more respectable not to bring his wife along at all." At home, he seemed to care more about his wife (e.g., whether she has something to eat). Nevertheless, all household chores were left to his wife, who mainly stayed home. The only activity I saw him and his wife do together was farming. Nerdy Brahmin often talked in numbers, such as number of people, and in particular, the amounts of money involved in certain events. He would always be busy jotting notes, making income expenditure accounts, and sometimes, arranging meetings on the phone. People visited him on a regular basis. However, he was just a regular guy at home. He loved to be a religious, peasant leader because "he watched what his father did and loved it." According to him, he, as a spiritual leader, had no special power (e.g., ability to see ghosts or talk to unseen spirits). Apparently, the responsibility was passed from generations to generations. Beside his wife, he lived with a 6-year-old boy—a son of his adopted son. There was a tension between him and his adopted son, which expectedly carried toward his grandchild, too. The fact that he and his wife did not have their own children became an object of ridicule with at least the head monk of the Bann Chok Chai temple (pseudonym).

Superwoman

Superwoman was a dark-skinned, 67-year-old, 5'5'' female who seemed healthy and happy with life. Even at her age, she could do all kinds of farming-related work, ranging from manually transplanting rice seedlings, to cleaning the chicken pen. She, however, had occasional back/hip pain. She told me that "once it happened, I had to take some rest. And if it stayed, then I would go to see doctors...If it's not severe, then they would give me drugs. Or else, they would inject drugs instead." She lived alone, and pretty much did everything by herself; hence, the origin of her pseudonym. Her husband passed away about ten years ago from cholangiocarcinoma, as did her father a few years ago. Her life was about work and making merit—meaning giving food to monks every morning, volunteering to help out at the temple, and sleeping over at the temple during Buddhist holy days. She would eat just about anything, including pla-som (raw fish dish). I saw she ate it with others during a gathering at the village temple. We would eat ice-cream and snacks that I brought together; however, I let her eat her favorite dish—grilled bullfrogs—by herself. She had three children: two of them lived nearby in the village where she could easily walk to meet them every day. In fact, she and her daughter shared food in almost every meal. The farm that she worked was in her daughter's household area. Her oldest son lived in different province, but came to visit her during special occasions.

Sweetheart

Sweetheart was a kind, generous 44-year-old woman, the mother of two grown-up sons. Based on age alone, I could be her middle child. Her older son was about the same age as my older sister. She was my only participant that I regarded as having a nuclear family; though both of her sons worked in separate Bangkok factories and could only visit during holidays. She and her husband were always busy with agricultural work (e.g., growing sunflower and lotus, and feeding pigs) on their 8-acre farm. However, her schedule was somewhat flexible—she could do tasks in any order, and took a short break whenever she became tired. I once helped her take away the tops of young sunflower trees. She explained that this would allow the trees to widen themselves first, instead of them growing taller right away. This involved a lot of repetitive bending the hips and back, and reaching, which very much exhausted me—even with my clumsiness and very slow speed. Thus, I later learned to find a comfortable spot to sit, watch her do all the work, and simply talk to her. A few weeks after my visit, I found out that my

sunflower mission failed. She consoled me with her laughter and pointed me to see the obvious difference in height between the rows I trimmed compared to her rows. I wonder whether this or her general generosity would result in the higher loss of revenue. She sold everything she grew (e.g., bamboos, chili, lime, and sweet basil) and gave them to buyers in a greater amount of what they asked for. She always estimated the price to the lowest tenth (not the nearest tenth!) and often told the buyers to go pick any plants they need in small amounts for free. This is why I named her Sweetheart. Yet, she hoped to pay off all her debts soon, and questioned me "what made poor people so different from the rich...Why were we so different?"

Peace

Peace was one of the two local village leaders of Bann Chok Chai. He was a grey-haired, skinny, tall, 55-year-old male, who always put on a gloomy, smiley face. He lived in a multigenerational household, and was not a native of Bann Chok Chai village. Peace lived with his father- and mother-in-law, his wife, daughter, son-in-law, and two grandchildren—one from his daughter and the other from his son who lived in another town. His 14-year-old daughter's son was a month old at the time, and his granddaughter was in 1st Grade. He and his wife were quite troubled by the amount of their debt. Peace preferred going back to the old days when there were little technological advancement, and not much inflation. "Right now I could barely buy anything with the amount of money I have," he claimed. I ironically selected Peace to be his pseudonym because each of his family members rarely talked to each other. It seemed to me that they avoided facing their problems head-on. The house was extremely quiet (especially with eight inhabitants) and each was always busy doing his/her own thing. It was awkward for me at first, but got better as time passed. His wife claimed that she was "unlucky" to have her daughter accidentally get pregnant at a young age.[6] As a leader, Peace attended meetings, distributed various plant species given by the government, and broadcast news to local villagers. Judging from how hard it was for him to lead his family, it made sense to me that no villagers came to consult with him during the week I did my fieldwork. To me, he was a reserved man who only answered what was asked of him—with no further explanations. Yet, I learned about him through his wife, who revealed her emotions and opinions more openly.

Scooby-Doo (the male Great Dane cartoon dog)

Scooby-Doo was an active, skinny, 54-year-old male who loved feeding homeless dogs and walked around all the time running school errands; hence Scooby-Doo. Shadowing him was the more tiring than for any other of the participants. As a direct observer, I often found myself watching him "running around" from far away. He coughed quite frequently every day. According to him, the cough was caused by allergies and asthma. He seemed to be a really nice teacher buying snacks and drinks for students, but turned into a petulant murmurer while coaching for the school volleyball team—certainly, he did not have speech impediment like Scooby-Doo the cartoon dog. Sometimes, he slapped his students' shoulders for their wrongdoing; while other times, he drove them to see their sick friends in the Ban Pai hospital. Nevertheless, to local villagers, Scooby-Doo was a respectable, good teacher, known as a "religious person" who regularly attended Buddhist services at the village temple. He technically lived alone in a huge Western-style house, but spent his daytimes with students, friends and families. He was once married for less than a year, and "figured that it was not what [he]

[6] "Thailand's teenage pregnancy is highest in Southeast Asia" (Lefevre, 2013).

desired," so he got a divorce and lived by himself afterwards. "I can talk to anyone, and eat everything—eating to live, not living to eat," he claimed. He seemed very much to enjoy eating spicy raw beef salad. Even though he did not start out intending to be a teacher, he "became in love with the profession." He told me that he initially wanted to be a pharmacist, but switched to the teacher education program after failing to get into a pharmacy program.

Grandma

Grandma was a skinny, short, dark-skinned 60-year-old who was the 24-hour babysitter of her one-year-old granddaughter. She had sold all her buffalo to be able to babysit her, although she preferred farming to babysitting a toddler, since, "working is easier because you can take a break at any time or leave the buffalo alone. You can't do that with kids." She lived as part of an extended family—with her older sister, husband, son, and three children. The two other youngsters were her sister Cookie's grandchildren. Orangy, a 16-year-old girl did not grow up with her parents. She was a child of unmarried parents who lived separately. Orangy was always the topic of Grandma's discussion with Cookie. Orangy worked in a factory, but left home and did not go to work after arguing with Cookie the week I was there. Grandma and Cookie believed that she went to live with "her girlfriend." However, Grandma and Cookie were worried about the motorcycle Orangy took with her as it was being purchased on an installment plan. The grandson, Chocolate, was in his 9th grade and played computer games whenever I saw him at home. Grandma's son, who was the father of the toddler, worked as a farmer in Israel, and her other son, who was gay, had been severely beaten by a gang during his college time in Bangkok and never graduated. He suffered severe hearing loss in the beating, and seemed to want to be left alone creating DIY (Do It Yourself) Buddhist altar offerings used for religious ceremonies. Grandma had diabetes and went to the city hospital to pick up drugs every month, and I went with her that month. She used that time to buy her toddler baby milk powder and disposable diapers as well.

Now, let's take a moment and try to reflect on your thinking and the lingering feelings that you may have.

Perhaps, you feel sorry for these people, or you may gradually develop an understanding of their situations. You might think that the liver fluke infection surely cannot be of great importance to them, because of the many other problems in their lives. In my view, this type of thinking is at the heart of the problem. Isn't life a struggle for *everyone* at some point? With good intention, we researchers often unknowingly plant our ideas of a "good life" in other people's minds, making it conform to our view of a "good life." Consequently, we fail to change their behaviors and feel impotent in improving their *tough* situations. However, not everyone cares about living a long life or being rich—factors that many Westerners take very seriously. Most local villagers were prepared to die at any time. They were fully aware that money cannot stop death, and cannot be brought with them after they die. Thus, changing their eating behavior might require an understanding of their fundamental thinking about life. The following section identifies and discusses prominent themes emerged in the study.

To be or not to be—that is the question

I use this popular line from Shakespeare's play Hamlet to express the local villagers' personal feelings about life and death. This phrase in the literal sense means hesitating between life and death, i.e., pondering about the fundamental nature of human existence. However, it can also refer to how we humans have a flaw in our judgment of choosing between the two

seemingly opposite realities (e.g., life and death). And lastly, it can refer to the fact that we often put more value on one over the other and choose to think that we have to select one and only one.

Life and Death

If life is a struggle, why we decide to cling to life and suffer rather than end the pain? Seeing local villagers work hard under challenging conditions, I can't help but to come up with a plausible answer underlying their sustaining actions. I believe the answer lies within their experience of seeing suffering as a normal part of life.

Their life was pretty simple and unchanging, and they neither got too excited about newborns nor too sad about the dying:

While some local villagers did get excited about having babies, others perceived babies as a burden. Feeding their grandchildren milk powder, Peace and his wife often mumbled, "Do you know how long does it take for a baby to grow up and be able to help his/herself?...How much money does it take?" "It took us quite some time and a good amount of money to raise her [referring to their older grandchild] as big as you see," Peace complained while handing his kindergarten granddaughter money to get some after-school snacks. "And now we have another one," Peace's wife echoed his opinion while letting out a long sigh of despair. Also, Groucho (Vagabond's husband's stepfather) revealed a wry sense of humor during his visit for lunch after plowing a rice field together with Vagabond's husband and others:

> Babies do not like to be born in rich families. They are afraid that they will get too comfortable. Look around you, like [Apple, the dentist in our village], she's been hoping to have a baby, but she doesn't seem to have any luck with it….Only poor families have many kids…I don't really know why.

Have you ever felt the more you want something, the more it eludes you, and the less you want, the more you have it? That's exactly how most local villagers felt about life. Groucho jokingly reflected on the meaning behind his use of the word "no luck." Typically, we would think that the local villagers must not be careful enough (e.g., forget to take birth control pills). They probably have little knowledge of birth control, or have not tried hard enough. But what if it were otherwise, what would you do? Perhaps we should suspend our judgment a bit while *we* gain a wider perspective. Peace's wife said that her latest unexpected grandchild was born as a result of her 14-year-old daughter's switching the brand of her pills. The pregnancy forced the daughter to drop out of high school.[7] Similarly, Grandma's one-year-old unexpected granddaughter caused her daughter-in-law to leave Israel and live apart from Grandma's son.

World Bank economist Herman Daly, and Nobel-Prize laureate Herbert Simon called this phenomenon "invisible foot" and "bounded rationality," respectively. *Bounded rationality* means that "people make quite reasonable decisions based on the information they have. But they don't have perfect information, especially about more distant parts of the system" (Meadows, 2008). As outsiders, researchers automatically are positioned outside of the local villagers' bounded rationality and have "an overview" perspective; thus perceiving having many children as an obvious problem that would surely further depress their situations. However, looking from a

[7] All Thai schools and even universities (maybe, with an exception in some private schools and universities) do not allow pregnant students to be enrolled in classes.

local villager's perspective, researchers' telling people the negative consequences of having too many children might not be morally right; consequently, leading to their resistance to change. What would this do to people who are a product of unwanted pregnancies? What about abortion rate and the number of orphans? Preventing individuals from trapping themselves in a position of bounded rationality is not likely to make much difference because the same system will *self-organize* (Meadows, 2008). This is analogous to Durkheim's idea that an individual "leaving" a society does not change the fact that this society will still contain suicide (Durkheim, 2010b). This is because events (e.g., having many children, suicide, and eating undercooked fish) "are the outputs, moment by moment, from the black box of the system." We can only know what goes in and what comes out, yet we feel so "compelled to force the lid." But to understand *why* this happens, we need to look at *systems structure*, i.e., look in the black box, in order to redesign its operating system (Meadows, 2008). In sum, looking at the local villagers' thinking indirectly addresses social factors of those behaviors.

The perception of death as a relief was prevalent in the Bann Chok Chai village. An 80-plus-year-old lady said to me during the visit of Smokey (a 56–year-old dying person suffering from cholangiocarcinoma who lived next to Ballerina's house) that Smokey would die very soon and "go to a comfortable place (ไปสบาย in Thai)", leaving the living behind to suffer with their own lives. This old lady, Ballerina, and my host mother further implied that mourning for Smokey would surely be short, because his death was expected. Ballerina said that Smokey, her husband's brother, had been smoking and drinking for almost all his life. When I mentioned Smokey to my host mother while we were watching television, she said that "well, we are not so sad about Smokey because everyone kept telling him to stop smoking and drinking, but he didn't believe us…We all know that he will die soon. And it is not like an accident you know." (Note: Other risk factors of cholangiocarcinoma, such as smoking and drinking, were greater concerns than the prolonged liver fluke infection.) In fact, Smokey's death brought fortune to his family, because a private life insurance company paid the family—according to Ballerina—a good amount of money for funeral and other costs.[8] The day after his death, his relatives showed no great remorse, but instead argued about how to distribute the money. Smokey's two sons, who had different mothers, also argued for their shares.

Smokey's passing reaffirmed Shakespeare's argument that "being" and "not-being" are all in our perception. Gandhi also stated that, "[b]irth and death are not two different states, but they are different aspects of the same state." They are "one thread, the same line viewed from different sides," said Lao Tzu, the founder of philosophical Taoism. Buddha taught us that there's a moment of rising, standing, and cessation—a beginning, middle, and end. The two opposite ends seem to be completely opposite from each other, but through looking in the middle, we will see that the two states are not distinctly different after all. The middle is represented by old age and sickness. My host mother and I visited Smokey at his home the week before he passed away. He was lying alone on his back, on a cradle (similar to Ballerina's but with no holes and twice as large as hers) in his front yard under the shady space. There was a blood stain on his pillow and grilled pork with sticky rice in plastic bags on his far right—not within his reach, however. Apparently, someone left it there, concerned that he could starve to

[8] Most local villagers had life insurance. They would pay a private company a certain amount of money per month, so their loved ones would be paid when they die.

death due to his inability to cook and find food himself. With his fragile features and fatigue, Smokey did not have enough strength to chase flies away so they were all over his face. Next to him on the ground was smelly trash. His yellow eyes were fixated on one spot in the air while complaining that he had no money to get medicines—although, many local villagers did not believe so. He allowed my host mother to move his loincloth to have a clear look at his bloating belly. While I felt this was distressing and pitiful beyond words (which I was not proud of), he seemed to show no emotions and pain. Ballerina told me that his wife passed away a few months ago from liver cancer. Ballerina believed this had much to do with the wife's drinking and smoking, and her morally bad actions (e.g., beating up her teen son), rather than the liver fluke infection. Smokey and his two sons had poor relationships, so they weren't normally around. Hence, he lived alone, looking up to the sky all day. However, people across the village frequently stopped by to visit, talk, and feed him. To me, Smokey was "dead even while still alive." [1Timothy 5:6] I started to ponder if "[t]here is as little reason to deplore the one [i.e., death] as there is to be pleased over the other [i.e., birth]," as Gandhi suggested.

Alright, here came the moment of truth! The evening before his judgment day, as Christians would say, arrived. A few days earlier, Smokey was sent to the Ban Phai hospital through the county ambulance service. He was there for only one night. While a doctor thought that it would be best for Smokey to be sent to a bigger hospital in the city of Khon Kaen, his daughter-in-law (Smokey's older son's wife) thought it would be best for him to spend his last minutes at home, where she and other local villagers could take care of him without having to worry about their housing and transportation burdens. It looked like as if Smokey had a party that evening, because there were approximately 30 people during an hour I was there, chatting and greeting each other with a smile. There was a small feast for visitors with local villagers' typical food (e.g., papaya salad with fermented fish, and spicy raw beef salad). This reminded me of Jesus' Last Supper, but on the other hand, an American-style baby shower. Encouraging statements like "don't be afraid, Smokey. Face [death] bravely," "You go first, we will follow you *there*," "Don't worry about anything here. We'll take care of it for you," were everywhere. I asked a lady "what's there," and she said with certainty that "*there* was heaven. It must be up there," pointing her finger to the sky. She must have compartmentalized her belief about cycle of birth and death determined by kamma in Buddhist teaching and that about *heaven* [9] in popular culture. With watery eyes, ninety-two-year-old Smokey's father (who lived with Ballerina because of frequent fights with Smokey) came in to take a peek at Smokey's sleeping body. Everyone's around encouraged him to forgive (อโหสิกรรม in Thai) Smokey for any bad actions Smokey did to him. In fact, every individual came only to forgive Smokey—some said it out loud, some not. Most local villagers in the scene, excluding me, had strength and courage to sit with Smokey at his last minute. They were neither frightened nor did they show great sorrow. There's only a sign of acceptance of a peaceful cessation of life. Certainly, Smokey's life was in the memories of many local villagers and me, i.e., the life of "non-being" is stamped in the heart of the "being."

Seeing suffering and death as normal, local villagers did not pay attention to any particular diseases. This started to make sense to me: If death is expected, the cause(s) leading to

[9] According to the Buddha, heaven and hell exist in our own mind, and are determined by our own kamma, and that, heaven and hell are where there's happiness and suffering, which vary from person to person. Heaven and hell, however, occur both in this world and the world-beyond.

death will not matter much. All eight of my participants mentioned death-related events when I asked them about health and community problems, and that they were very comfortable talking about the events. Ballerina said, "what can we do, you know? Farmers work hard and die easily." During a family visit, Vagabond's mother told Vagabond about a toddler who died when a car driven by her uncle accidentally backed up over her in a nearby village. Nerdy Brahmin encouraged me to stay indoors during rainy days because a number of cattle and farmers had been killed by lightning strikes. My host mother did not allow me to pick up any cell-phone calls during rainy days, which I, of course, picked up when she wasn't around. (This was probably why she often missed my calls.) Superwoman and Sweetheart did not like to specify types of cancer, but instead grouped all types as "cancer"—similar to how local villagers grouped an *O.viverrini* infection into a parasitic infection. Only when I asked which cancer they were talking about, then they would pause to think and try to specify cancer symptoms, or organs that were affected by that cancer. For instance, Sweetheart said, "it was cancer that eats human nervous system (มะเร็งกินเส้น in local dialect)." Superwoman and Sweetheart often ended the sentence with "something like that," or "some sort of X cancer," or "I don't really know medical terms."

With this being said, the term *cholangiocarcinoma* did not have a word-for-word translation in Thai, which further confused local villagers. The word was translated to be liver cancer—sometimes, bile duct cancer. The terms "liver" and "bile duct" were rarely put together as one cancer (i.e., liver and bile duct cancer) in everyday Thai language. That is to say, when local villagers referred to liver cancer, it can mean cholangiocarcinoma. During my conversation with Sripa, he told me that it was safe to take local villagers' use of the word "liver cancer" to mean cholangiocarcinoma. However, I often had a feeling that my participants and I were not talking about the same cancer. Undoubtedly, most local villagers believed that drinking and smoking were leading causes of *liver cancer*. I suppose there are good reasons why medical students have to spend years understanding medical terminologies. Yet, to regular people, like me and local villagers, the naming was a total confusion that I will not get into for the time being.

Suffering was frequently seen through the eyes of animals everywhere and every day. Because Bann Chok Chai village was an agricultural community, local villagers raised livestock and killed them for food or money. Superwoman's daughter had a farm that raised thousands of chicken for one of Thailand's agro-industrial food companies. The chicken transport process was quite horrible—foul odor, squawky sound, and the scene of chickens running around dead-end stables, trying to escape their impending slaughter. Some chickens were too shocked to "face death bravely," to borrow the lady's encouraging words to Smokey, and decided to give up their lives at that time; whereas, most chickens allowed workers to grab them by their legs and hang them upside-down along with four of their peers in one's hand. Chicken feathers wafted through the hot, humid air. Chicken containers were so small that they left no room for chickens to move. According to a worker, chickens whose legs are not properly aligned by gravity would die by the time they got to slaughterhouse, because they would get pinched by others and had no way to fight back. Hearing the story of how a group of men hit a cow in the head for funeral food disturbed me so much that I lost my appetite that evening. More typical and less gloomy scenes had to be killing fish, maybe because there was no sound involved, or because the scenes were so frequent that I became used to it. Fish taken out of the water would experience breathing difficulty and slowly pant. Soon, their breathing came to a complete stop. What I did not understand was that when a person cleaned still-living fish. Raspy, a 60-plus-year-old man,

intensified my feeling by scraping scales from the tail to the head with a knife while the fish was trying to squirm out of his grasp. He then dissected its abdomen in half and removed the entrails. However, I sadly admitted that the experiences did not stop me or the local villagers I met from eating meat. And I believe this is "the root of all that is wrong with the world"—the fact that "some lives [do] matter less," extending Paul Farmer's use of the word "lives" to include animals' for a clearer picture.

Beyond a Reasonable Doubt (Without a Doubt)?

Local villagers tended to think that their lives were equally important as their deaths. Certainly, humans and animals are not quite comparable because we humans possess higher levels of intelligence—we have the ability to think. Most importantly, we have the ability to question our purpose in life, and to choose our thinking and/or actions when it comes to suffering. Nevertheless, "some [human] lives matter less"—based on one's own perspective. I would hesitate to say that my life matters more than the life of the president, let alone the life of a local villager in comparison to any famous person. I asked my participants that if they could have one wish to come true, what that would be. All my female participants (Ballerina, Vagabond, Superwoman, Sweetheart, and Grandma) said variations of the following:

> I don't hope much. In fact, I don't expect anything in particular for myself. I only want to have enough [referring to food and money] to live each day…**I only live day by day waiting to die**…When that time comes, I must be done paid off my bad kamma. But for one wish I can have: I would want my family to be happy, and comfortable.

While the family part was understandable, they seemed to answer my question in a calm and dispassionate way. I supposed it was their polite way of saying to my face, "wake up, girl. The thinking of Aladdin rubbing the lamp for wishes is very unrealistic." More surprisingly, they mentioned their own death as if it would not matter much to their loved ones, and that, they had no doubt that others would surely adjust to their absence. Also, Groucho (Vagabond's husband's stepfather) compared a farmer in northeastern part of Thailand to an iron man "who has *iron bone*, deserves hard work," and supposedly is free from human emotions unlike other *humans* elsewhere. That is to say, for many local villagers, life isn't always better than death, and vice versa—following Shakespeare's argument that death might be no more than a kind of sleep, albeit an unceasing one.

This belief in equality of life and death withheld local villagers from ending lives or holding onto the others dying as ways to escape own suffering. This was due to their Buddhist beliefs about *kamma*. Ballerina's husband said, "I was born to pay back my past bad kamma… I live on a borrowed time…now trying to do good things for I will be born again *in the middle of gold and money* (กองเงินกองทอง in Thai)." Buddhists believe that everyone's life is fair under the natural, never-failing law of justice—the theory of kamma. This is similar to Christians' beliefs about "one reaps what one has sown," except that actions could happen in one's previous existence and consequences could be seen in one's next existence. That is to say, there are no sure ways to escape suffering but to accept and get over it. Cheating death can only happen if that person stores enough good kamma. On the other hand, cheating on life by killing themselves, or taking revenge by killing others does not end the story. They simply set the stage for more bad things to come in the next life cycle—probably the reasons why Hamlet hesitated to kill Claudius. Shakespeare creatively presented a domino effect that happened within a single existence, starting with the death of Hamlet's father and ending with the death of Hamlet.

While Hamlet was known to overthink, these local villagers (most Thais I'd say) underthink and overlook things—they were two sides of the same coin. Yet, both cases led to the same result, i.e., acting too little. Scooby-Doo and Vagabond never doubted that their cough may have been caused by air pollution in the village. Each simply thought that the cough was a result of his *identity disease*, not realizing that the naming of the disease was *after* the fact. The majority of the local villagers I met told me that the liver fluke infection was not their concern, and they were more concerned with the *identity diseases* (e.g., diabetes, and high blood pressure) they had. When I mentioned the liver fluke infection, Sweetheart was quick to say that there was nothing much one could do about the situation:

> The liver fluke infection is caused by eating undercooked fish, right?...We were told by many doctors…So, for one who does not eat undercooked fish and gets the infection, all you can do is accepting it…But for those who eat it because they are not afraid to die, then nothing we can do about that either.

Certainly, Sweetheart did not think further that infected people could perpetuate the life cycles of *O.viverrini*, and serve as a threat to the community. She, along with all local villagers I met, never questioned that the infected populations could pollute water sources under their current poor sanitation systems (by passing liver fluke eggs through feces). On the other hand, we researchers never thought that the liver fluke infection could be caused by something other than eating undercooked fish, or that local villagers' perception of death could lead to many harmful health behaviors, including eating undercooked fish. To the local villagers, the liver fluke infection, and in turn, liver and bile duct cancer problems are individual problems. Consequently, there were no actions to be done on their part.

The examples of local villagers' underthinking were everywhere. For families in which some adult members loved to eat undercooked meat, separate sets of food were prepared for children. This can surely confuse young children who may think that they can eat undercooked meat only when they become grown-ups. Whereas, adults thought that by separating food, they did not *cause* their children to eat undercooked meat and get the liver fluke infection. However, as an outsider, I believed this could set bad role models for young children. When I asked my participants what they thought about life, *all* of them said out loud that "I do not think much about life. Just do what I gotta do." Interestingly, I saw at least three of the monks from the village temple smoking in public places. The head monk openly smoked, played with his cell-phone, and rudely joked with ladies on numerous occasions during Buddhist ceremonies. Yet, local villagers thought it was okay. Nerdy Brahmin and Scooby-Doo said that they used to get angry of the monks' inappropriate actions and even tried to expel some out the village. However, according to the two, they were only a small minority of people, and that most local villagers did not agree with them, so those monks had to stay. "Plus you know, thinking about this stuff and feeling bad about it, only polluted my mind and I didn't feel any better. In the end, I just ignored them altogether," Nerdy Brahmin claimed. "As long as people have something to hold onto, and to pay respect, I think it is good enough," Scooby-Doo said. "Plus, it is not like they [referring to monks] involve in any sort of sexual partnership you know," Nerdy Brahmin provided his excuse for inaction.

"To be and not to be—that is the answer," borrowing the title of one of Douglas Harding's books. The Buddha told us to take the *Middle Path* (the *Middle Way*). Thinking too much and thinking too little were like the two extremes. He compared this with too-tight and too-loose ropes. Pulling it too tight, it can snap and break. Letting it too loose, it will be unable to

support anything.[10] That is to say, it is not that *more* or *less* is better—it is the balance between the two that gives us the perfect result. We researchers must let go of trying to control others' behaviors, and find a way to convince local villagers to first start to care for themselves and be aware of their thinking. I believe in no superstars, but normal individuals. According to John Stuart Mill, "[with] respect to his own feelings and circumstances, the most ordinary man or woman has means of knowledge immeasurably surpassing those that can be possessed by anyone else…He is the man most interested in his own well-being." That is to say, their expectation of death did not have to amount to ignorance. It could amount to the development of a mind that fears nothing (not even death), the mind that strives for full human potential!

Que Sera Sera (What will be, will be)

Local villagers had a great deal of patience; therefore, I am not entirely sure if I mistook their silence/inaction for ignorance. Grandma never complained about waiting in line at the hospital. She chose to go early at 5am and accepted the long waiting time. This patience also applied to the local villagers' regular work. When I was walking in the pond to pick up lotuses, I felt exhausted from the water dragging me in the opposite direction, in addition to being scared of spikes underneath my brand new boots that were sucked on muddy soils. Yet, with her worn-out shoes, Sweetheart never complained a word! The process of growing silk (spinning, dying, making patterning, and weaving), not to mention growing mulberry leaves to feed silkworms and transporting materials for the process (Figure 20), seemed very tedious and boring to me. It took at least a month to make one simple silk sarong. I would rather buy simple, inexpensive cotton clothes and be happy with life. Scooby-Doo explained how local villagers developed their patience:

> Agricultural work makes people stay calm, be patience—knowing to wait for rain and for plants to grow…waiting for the results. This is not like factory jobs where people compete for positions and punching a clock to get paid. People do it by hearts. They do it whenever they please, [take a break when needed, and] do it together with others…. If for some reasons, one cannot plow the rice when it's time to do so, others will do it for them….People [referring to the older generations] like us would help each other and take turn….But we are getting old and things drastically change nowadays.

In Groucho's words,

> things change, and younger generations like to work indoor…either in factories or as office persons. They like to look pretty without [getting freckles from] harsh sun exposure, and to dress nicely….Now, we gradually suffer with less people to help out at farms.

Adding to these ideas, Superwoman made me think about another side of having many children I had not thought before:

> Our grandparents tended to think that having many children meant having more hands to help when needed [and in turn more money.] [This was] because food was so easy to find in our village, with frogs, insects, and fish everywhere. Children would be okay….No, they [our grandparents] would be wrong nowadays, because youngsters think differently.

On top of that, "powder milk became popular…my baby did not like breast milk—my daughter said," Peace's wife told me. And Sweetheart said "we have less natural, locally available food,

[10] Depending on where one reads the story, situations vary from walking the ropes, pulling the rope tied to a boat, to setting ropes in musical instruments.

because farmers use chemical fertilizers, which cause animals to become extinct." She further added that "all plants and animals we have in farms are grown and raised…[i.e.,]they are not natural." "Even though we know that chemicals are not good for our health, we have no choices but to use it…Or else we wouldn't have survived," Grandma desperately admitted. Now, you get the picture of the vicious cycle local villagers were in. Assuming the same food demand, but without the young workforce and with high rates of inflation, in addition to local villagers' poor education, the only door that seemed to open for them was to purchase chemicals to accelerate plant growth, and to earn small amounts of money to survive—yet, not enough to make ends meet. As a result, they had to worry about debt. Peace's family had to borrow money from several private sources at high interest rates, only to rotate the money around. The very action of using chemicals then haunted them later like a looping effect. Ballerina and Sweetheart believed chemical fertilizers were the cause of unknown diseases in the village, including many types of cancer. Remember, I was trying to tell them that human feces should not be used as fertilizer, too!

Figure 20: Below is two 2x2 pictures, left and right. Reading in a "z" pattern within each picture shows the step-by-step procedure of making silk sarong—starting from growing silk, to weaving cloth using a hand-made loom.

If I were to put in their positions, I would likely not know what to do either. As an outsider, I gradually became less certain about the situation.

> Que sera sera. Whatever will be, will be. The future's not ours to see. Que sera sera. What will be, will be.—Jay Livingston and Ray Evans

The Buddhist teaching of concentrating the mind on the present moment started to make more sense. Dealing with things one minute at a time made local villagers' lives more bearable than they might seem on the surface. As a result, they had patience and were able to endure hard work and bear suffering. In Ballerina's words,

> I am happy with life. I will tell you the simple secret…All you gotta do is changing your thinking…I was initially sad when I knew I couldn't walk…but now knowing that I have my daughter taking care of me, I see no reasons to become sad. If I get sad, my daughter and people around me would be sad also….Having

> a needle sticking to my skin every day is no fun, believe me, but I become used to it, knowing that it gives me energy...

Some might say that local villagers chose to escape suffering by becoming shortsighted and developing a so-called cheerful fatalism. However, I would say they are too farsighted, despite the visible cataracts clouding their eyes. I believe they hope too much for their next existence. By thinking that everyone is going to die some day, they became too receptive to anything that life threw at them. Living with uncertainty (e.g., don't know when rain will come and how many animals they would get from each birth—in turn, how much money they will get) throughout their lives, many local villagers developed a strong mind with great capacity to face challenges. Realizing how little I understand life, I thought there maybe something more to life than worrying about food that could cause harm to local villagers.

CHAPTER SIX: CONCLUSION

This thesis has discussed educational efforts to lessen the frequency of liver fluke infections, and subsequent cancer, in the villages around Khon Kaen. The continued existence of the infestation, and the deaths that it causes, are of great concern. However, the persistence of the problem does not indicate that educational efforts have been useless. Most villagers have some knowledge of the connection between eating undercooked fish and the liver fluke infection, although many continue to eat undercooked fish. Regarding children, the villagers I met did not feed undercooked fish to their *young* children. However, once the children are old enough to develop their own eating preference, they have freedom to choose what they eat. I suppose the situation is similar to young children growing up with parents who smoke. Parents would not allow their children to smoke, and tell them disadvantages of smoking. However, the children are free to make their own decisions when they grow up and are capable of getting cigarettes. That is to say, the ongoing cultural and demographic changes present opportunities as well as problems.

The situation can obviously be improved. Better sanitary infrastructure and waste-handling practices can contribute. Educational programs should not be abandoned, but can be made more effective. Because the adults' perception of life and death plays a big role in their decisions to engage in the eating undercooked fish, education may be made more effective if it gets at their worldview. One should note that education goes both ways—both the population affected by the liver fluke and the government agencies sponsoring health programs need to possess more and better information on the problem and on ways of addressing it. However, the goal of this case study is to illustrate the underlying problems of public health research.

Summation

Promoting health, prolonging life, and preventing disease are major goals in Western society today. While these are noble goals, public health researchers often neglect individuals' own definitions of health and well-being, and that they may not wish to extend life in ways that lower their quality of life. Also, diseases often occur without obvious warning symptoms, thus making them difficult to prevent. Although avoiding cancer risk factors may lower the risk of some cancers, it does not guarantee that any one individual will be healthy and not contract cancer. In this thesis, I use the liver fluke infection in Khon Kaen, Thailand to illustrate these points. For most local Thai villagers in this study, health means having a meaningful and enjoyable life, which starts with the mind. Living a healthy life does not require a pain- or disease-free body. To them, suffering, struggle (both physical and mental), and even death are normal—that's what makes *life* worth living. Consequently, medically determined causes of death (e.g., the liver fluke infection or smoking) do not matter much. In the local villagers' views, the relationship between medical causes and effects on organ function is neither one-to-one nor linear. More importantly, one's virtue (*kamma*) plays a significant role in determining if one will have disease/illness, and which disease/illness one will have. That said, the local villagers believe that their willpower and actions to prevent diseases are not sufficient to prolong life. And even though lowering risk factors in preventive health care makes sense, this medical model for prevention leaves room for many legends surrounding unexplained diseases and illnesses.

That is to say, science cannot explain health (and suffering) on the fundamental level of our existence, and of the existence of our diseases. On the other hand, religion cannot explain health (and suffering) in terms of genetics or social hierarchy. A new way of thinking about

health that incorporates both scientific rationalism and religion is suggested. This takes into consideration people's desires/needs to lead a meaningful life within the public health research agenda of reducing certain diseases and/or problems.

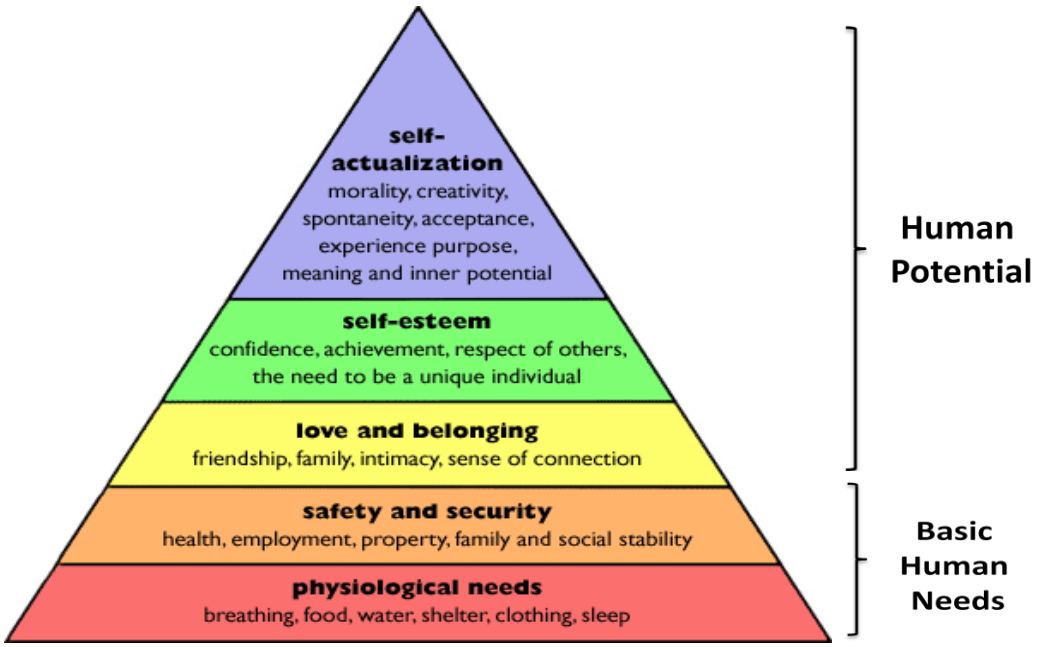
Possible Leverage Points

Instead of setting national objectives for improving *health* of all people, perhaps we can be a little bit more specific by selecting *happiness* as the ultimate goal of human beings. [11] Regarding decreasing the liver fluke infection problem, there must be a change in the local villagers' meaning of life, as well as a change in the way researchers approach the problem. However, I believe this can be done without changing anyone's values, but by "get[ting] the system to operate around real values" (Meadows, 2008). Seeing local villagers being happy with life and being at ease with themselves despite their deprived surroundings, I mused and questioned "what is my highest aspiration in life?" Regardless of how much money we and others have in our pockets (referring to income and income inequality), or what our circumstances (as known as social determinants of health), I believe we all want to achieve happiness as located in our minds—whether we like to believe it or not. I intentionally leave the term *happiness* open to interpretation, not only because it might be impossible to objectively define, but also because happiness should mean different things to different people depending on their situations. Just as *health* "is a multi-dimensional concept" (Chatterji et al., 2002), *happiness* has multiple layers of meaning. Happiness has been frequently discussed in the field of positive psychology (e.g., ordinary happiness), philosophy (e.g., *eudaimonia* and *hedonia*), and religion (e.g., peace of mind). However, there is little agreement about the real nature of happiness. For clarity, happiness here refers to the inner feeling that occurs when one achieves his or her full potential—as in the Abraham Maslow's (1943) self-actualization stage (referring to the top pyramid in Figure 21). However, your personal definition of happiness would be acceptable as long as it means more than the state of being happy and does not encroach on the happiness of others.[12]

[11] Using happiness as a health objective could possibly drive economic development in a very different way—similar to the support of using Gross National Happiness (GNH) as an economic indicator in place of Gross Domestic Product (GDP). Alternatively, happiness framework could work alongside this new style of economic development, proposed by the former King of Bhutan, Jigme Singye Wangchuck (1972).

[12] Perhaps new word needs to be invented, but that is beyond our discussion here.

Figure 21: Human Potential; Maslow's Hierarchy of Needs



("The Broken Road - Maslow's Hierarchy of Needs," 2013)

Happiness as a Novel Lens into Human Behavior

The happiness concept arguably follows the WHO's definition of health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 1989). This is because I believe happiness is a result of synchronicity of physical health, mental health, and social well-being, i.e., it cannot be discussed separately on each dimension of health. Using happiness as the gold standard may discourage the disease-based model of medicine and cause people to look at health more holistically. That is to say, one can achieve happiness without having a disease-free body—and a disease-free body does not always bring happiness. More importantly, the happiness concept takes into account one's meaning and purpose of life. What makes one achieve happiness must be meaningful to that person.

I believe happiness can serve as a better indicator of population health than life expectancy and mortality rate. This is because happiness gets at the quality and values of life. It indirectly measures things that make life worthwhile (e.g., how patient you are, and how many meaningful friends you have), and not simply numbers with no meaning. Since life and death are equally important for some people, such as the local Thai villagers, a high death rate (mortality rate) may not indicate a poor-quality health. Similarly, long life expectancy may not indicate high-quality health.

The happiness concept not only gets at population health, but also takes into account any form of inequality (e.g., power, resources and opportunity)—implied by the life expectancy and mortality rate—that can be seen through quality of healthcare, sanitation system, food availability, and so on. This is because true happiness does not occur at the expense of others' happiness. Happiness can only occur when we fulfill ourselves while bring happiness to others and try to remove others' suffering (so-called *maitri* and *karuna* in Buddhist teachings). Luckily,

we humans are not in competition in the realm of happiness. That is to say, happiness does not compete! This follows Lao Tzu's ideas that "highest good is like water. Water benefits all creatures, but does not compete." Happiness starts from within. It has the potential to benefit all humans *at once*, and can be distributed and shared widely on a mass scale. In our globalized world where everyone is connected by mass media, the existence of suffering under the weight of inequality says a lot about the hearts and minds of the advantaged (i.e., their happiness levels) that drive the inequality in the first place. The world is a relative place. For example, there will always be someone whose work is perceived to be a low-end job. Yet, the world needs those people (e.g., farmers). Without them, we would be naked and hungry, and there would be no high-end jobs. Any social position is worthy if we realize that there is nothing lacking. Thus, if those in high-end jobs ignore people in low-end jobs who are struggling to meet basic human needs (Figure 21), they do not deserve our praise. Or if we ourselves concentrate on the worst things, such as on things that cannot be fixed (e.g., social class), it is our own hearts and minds that need to be fixed! The happiness concept really gets at this essential character of individuals. Happiness does not separate people: Rich or poor, black or white, sick or healthy, hungry or full, we all have an equal chance to achieve happiness. I believe global health equity can be achieved under the happiness framework simply because happiness does not compete.

Harmful health behaviors can be changed within the happiness framework, because the harmful health behaviors are always a threat to communities; hence, encroaching on the happiness of *others*. Eating undercooked fish serves as a bad role model, especially to young children. If the children get infected by the liver fluke and get sick, this will limit their capacities to achieve their full potential and thus, their happiness levels. And it will influence their parents' happiness levels and so on. Even though the causes of cholangiocarcinoma are largely undetermined, knowing that the act of eating undercooked fish can start a chain of bad effects, everyone in the communities might not be willing to ignore the others' eating undercooked fish. Some might be willing to give up their jobs of selling pla-som (raw-fish dish). Some might decide to give up eating undercooked fish entirely—similar to how health effects of secondhand smoke have changed the way we perceive smoking and reduce the large number of smokers. The bottom line: Most adults rarely intend to hurt children, but often do so unintentionally. Knowing that harmful health behaviors could limit children's human development, adults may not be willing to let the harmful health behaviors pass by. As a result, children would neither see the eating undercooked fish as normal, nor eat undercooked fish when they become adults.

Future Directions

However, from the bottom up, the happiness framework would only be effective when the citizens are thoughtful. As Robert Pirsig said,

> I think if we are going to reform the world, and make it a better place to live in, the way to do it is not with talk about relationships of a political nature, which are inevitably dualistic, full of subjects and objects and their relationship to one another; or with programs full of things for other people to do. I think that kind of approach starts it at the end and presumes the end is the beginning. Programs of a political nature are important end products of social quality that can be effective only if the underlying structure of social values is right. **The social values are right only if the individual values are right. The place to improve the world is first in one's own heart and head and hands, and then work outward from there** (Pirsig, 2009).

If every one of us—politicians, researchers, people living in urban and rural areas—does what we think is best for others, and not only for ourselves, the world might be a better place. As cliché as it may sound, it all starts with you. I believe religion/spirituality, as defined as one's

desires/needs to lead a meaningful life, can play an important role in educating our hearts and holding up the morality of the nation. Our world is in a crisis of consciousness, of what Einstein (1954) called *a kind of delusion of consciousness*. If we value peace of mind and a meaningful life as the ultimate goal, our world might have a markedly differently life-style and development. I suppose there are two sides to everything. Religions seem to have caused violence and war throughout the history of mankind. However, I think "there is something eternal in religion that is destined to outlive the succession of particular symbols in which religious thought has clothed itself," as Durkheim suggested (Allan, 2005). I interpret the "religious thoughts" to be our human longing to lead a meaningful life, which will always be with us—regardless of the names of religions. So maybe the way to catch up with the progress of science and relieve suffering around the world (including the many atrocities that occur in the name of religion) is for us to bring the *concept* of religion/spirituality into our scientific conversations to find the middle ground, where religion can be used to support increased happiness and public health.

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Appendix A: Questionnaire (pre- and post-test)

Section I: Motivation and behavioral skills related to the liver fluke infection.

Food Dish [13]_____	Very little (Very hard)	Somewhat little (Somewhat hard)	Neutral	Somewhat much (Somewhat easy)	Very much (Very easy)
Motivation					
How much do *you* like to eat this food dish?					
How much do *people who are important to you* like to eat this food dish?					
How much do people who are important to you encourage you to eat this food dish?					
How much do people who are important to you encourage you to buy this food dish?					
How often do *you* eat this food dish outside home?					
Behavioral Skills					
How easy or hard is it for you to find this food dish where you usually shop?					
How easy or hard is it for you to buy this food dish where you usually shop?					
How easy or hard for you is it to store this food dish in your home?					
How easy or hard for you is it to make this food dish?					
How easy or hard is it for you to serve this food dish to members of your household?					
How easy or hard is it for you to make this food dish *a part of the way you eat*?					

Images shown to students: (From left to right) 1)Som-tom, 2)Yum-kai-mod-dang, 3)Pla-som, 4)Jaew Bong, and 5)Grilled fish

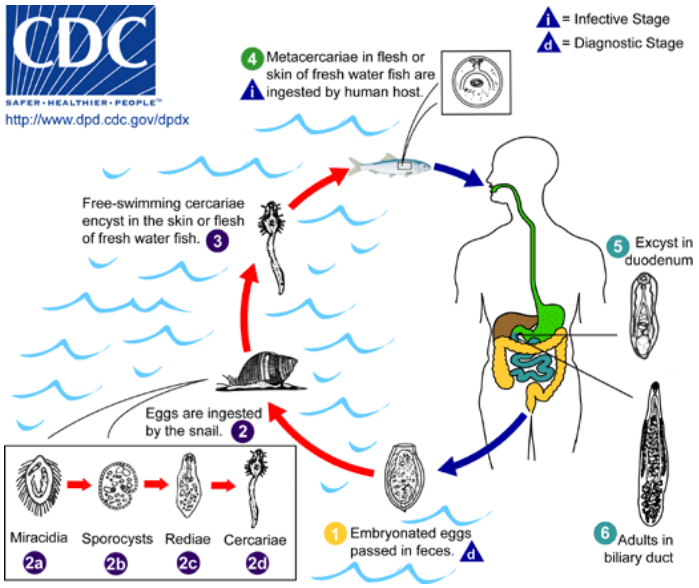
[13] For all the questions, students were shown images of uncooked fish dishes (see pictures above)

Appendix B: Interview Guide—Pilot Study

Interview Guide for the First Round

Emphasize that I'm not here to judge whether your responses or attitudes are right/wrong, good/bad

1) What is your daily routine? Could you walk me through your normal days? (when and where you normally go, eating meals, what's your habit? What are places that you'd like to go?)
2) What do you usually eat?
    a. What influenced this decision, people? Information sources?
3) Do you cook? How often?
4) Do you eat fish you catch? How do you eat it? Under what circumstances you don't eat fish you (or your family member) catch.
    a. Tell me about last time you eat fish.
5) Explain what you see here as much as you can:



6) Tell me about you
    a. Where do you live, what do you do, how old are you, who do you live with, have siblings, etc.

Interview Guide for the Second Round

During the interviews students are asked to describe and explain hypothetical situations. These phenomena are presented in terms of a hypothetical situation. The students are then prompted with 4 alternative rationales to see if they'd like to change their decisions. Lastly, I probed to see if the students still considered the rationale for the behavior acceptable even if

(a) the headmen (local leader) objected or (b) the situation was in a different province (presumably different kind of fish.) The studentts were asked to make an evaluation (ok/not ok) of the others' behavior/rationale, and to give their reasons for their evaluations:

In a community, parents love to eat koi-pla and love to share them with their children because it is delicious. Until one day, the dad finds out that he has X, while the mom does not have X. They still continue to share koi-pla to their children. Is this OK or not OK? Why? (X = liver fluke, diarrhea, cancer)

- What if the only main source of protein comes from koi-pla, and parents want their children to have this essential nutrient? Is this OK or not OK? Why?
    - (a) the headmen (local leader) objected or
    - (b) the situation was in a different province and (presumably different kind of fish.)
- What if children beg their parents as they really like the taste of koi-pla and parents want to please them? Is this OK or not OK? Why?
    - (a) the headmen (local leader) objected or
    - (b) the situation was in a different province and (presumably different kind of fish.)
- What if fish are really "fresh" in the sense that the parents catch it themselves and make koi-pla right away? Is this OK or not OK? Why?
    - (a) the headmen (local leader) objected or
    - (b) the situation was in a different province and (presumably different kind of fish.)
- What if the parents gave their children koi-pla because they were boys? Is this OK or not OK? Why?
    - (a) the headmen (local leader) objected or
    - (b) the situation was in a different province and (presumably different kind of fish.)

Students are asked to elaborate their responses as much as possible.

Appendix C: Interview Guide—Dissertation Study

Interview Guide for the First Round

0) Before we get into more serious questions, I am interested in people's eating habits. Would you mind if I take a look at your food cabinet?

Emphasize that nothing can go wrong with your answer because I'm not here to judge your opinion. Feel free to be silent at any time.

1) Could you please tell me a little bit about your personality? How would you describe yourself? (e.g. beliefs, thoughts, goals) What others think of you? Was that similar or different from what you think of yourself?
2) What do you think about life? And me being here right now? Does everything make sense (or require explanations)? Why?
3) Have you ever experienced situations that cannot be described in words?

____

4) Have you heard about liver fluke infection? Please tell me as much as you can about the liver fluke. (e.g., your experience, its causes and consequences, how did you first hear about it, what do you think about it (what's your take on it)?) If you were to explain it to a young child, what would you say?
5) Why do some people eat uncooked fish and others not eat it? What do you think about them? Could it possibly be both depending on situation?
6) Is the spread of the liver fluke infection someone's (or everyone's) fault?

____

7) What do you think about local schooling nowadays? Comparing the value of formal education v. informal education (knowledge learned in everyday life).
8) Would you say you learn every day? Any story that you'd like to share?
9) Do you think things change? People change? What about you?

____

10) What does the word 'health' mean to you?
11) What causes illness?
12) What is the first thing you do when you feel sick? What is your take on it?