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Journal of Undergraduate Research

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University of Rochester

The *Journal of Undergraduate Research (jur)* is dedicated to providing the student body with intellectual perspectives from various academic disciplines. *jur* serves as a forum for the presentation of original research thereby encouraging the pursuit of significant scholarly endeavors.

From the Editors

Over the course of our history, the editorial staff at the Journal of Undergraduate Research has worked eagerly to collect and present the exceptional contributions of Rochester undergraduates and alumni to the greater academic community. Our past editors have introduced previous issues of *jur* by stressing research's benefits to undergraduate learning, the importance of sharing that research and the increasingly competitive and robust nature of undergraduate research at Rochester. While these proclamations remain entirely accurate, we are interested in highlighting another admirable feature in this address: passion. These young researchers are breathing new life and energy into the world of academic research - growing the bounds of our knowledge and understanding, developing even farther horizons towards which we must reach.

With the articles in this issue, we hope to communicate by example the breadth and vibrancy of undergraduate research that charges our campus. The topics explored in the following pages unfold fascinating questions, driving in-depth and rounded analysis and exploration. These researchers engage a diverse array of fields - from history to mechanical engineering to international health - structuring just a snippet of the striking research community here at the University of Rochester. In order to honor our researchers' achievements we challenge you, our readers, to take a close look at their work. Feel the energy with which these students dig into the material of their respective fields. Don't lose that feeling; let it sink in, nurse its vitality. Don't ever stop looking, questioning - do as these researchers did: find your passion, sift through the material, explore, develop questions and search for answers, and finally communicate your unique and valuable perspective.

Sincerely,

Christine Choi and Kyle Smith

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About the Journal

Professor Interview

Edwin van Winjgaarden, PhD
Professor of Public Health Sciences

jur: Could you tell me about your professional background and how you became involved in research?

van Winjgaarden: So I'm from the Netherlands originally. I grew up there and studied chemistry for one year and at that time in the Netherlands you graduate from high school, pick a major, and go to university and focus directly on that. So it's not like here where you have one or two years to orient yourself. Chemistry wasn't something I liked or was good at, but I did like the practical applications of chemistry. From an environmental perspective, if I could just show what we do chemistry-wise to the environment and come up with greener technologies, then I would save the world. So that didn't really work out (*laughs*) because of my own limitations, but I was really interested in environmental sciences. Then I switched fields to the department of sciences with a focus on environmental health, with one of the rationales at the time being if we want people to change—be better about the environment—then probably one of the best ways to start is to show how the environment might change them in terms of health. That's kind of where my interest was at the time. I pursued environmental health there as a major and got a master's degree in that. Then I moved to the United States as part of an internship, so I always tell students, "Go study abroad, you never know what happens." So that's how I came here. I did an internship in environmental health over at the Colorado State University in Fort Collins. I worked on electromagnetic field research there and while I was doing that, life happened. I got a girlfriend and I got married and she's been my wife for 13 years. The studying side, the research side, and the personal side all came together. What happened then was she moved to North Carolina and I followed her and got a job at UNC-Chapel Hill and continued my electromagnetic field research. What that's really about is looking at power lines and how that might affect human health. At the time there was quite a big concern about cancer, breast cancer, and also mental health. That's what I pursued as a student and that's what I pursued as a research assistant at Chapel Hill. I worked there for a year and then I did my PhD in epidemiology there and continued to do electromagnetic field research, then moving into childhood cancer research and how parental environmental

exposures may affect childhood cancer risk. That's what my dissertation research was about. I graduated in 2002 with my PhD in epidemiology and then I went into the private sector for a couple years. It's kind of conventional to do a post-doc after getting your PhD, but I didn't do that. I went into the private sector, primarily consulting, doing mostly environmental and occupational health consultant type work and I came to the U of R in 2004. I became an assistant professor in this department, at the time Community and Preventive Medicine, and now it's called Public Health Sciences. For some years I did some more of the childhood cancer research and then got involved here mostly in research on environmental exposures to metals, primarily lead exposure and mercury exposure. Lead exposure comes from gasoline and paints, so if a parent has a lot of lead exposure from environmental past activities, I'm interested in looking at that in relation to cognitive aging; whether past lead exposure may affect the speed at which your brain ages and potentially pre-Alzheimer's or pre-dementia. Mercury comes from fish consumption primarily, and in the United States methyl-mercury from the metal in your mouth. I'm trying to see how that affects childhood health. Those are the main lines of research I have been involved with since I came here, in terms of my own focus of research.

jur: What prompted your interest in first studying electromagnetic fields and then metals?

van Winjgaarden: With the electromagnetic fields, a lot of life happens and you can't plan it. The magnetic fields, I had not heard of before going to Colorado, but faculty there—some professors at the time—were doing that kind of research looking at melatonin, which is the "fall asleep" hormone. Melatonin may be an antioxidant and it may be anti-breast cancer risk and be involved in a variety of other health outcomes. So there we were actually studying magnetic fields and they asked me to do some field work to measure the magnetic fields in people's homes and try to correlate that with markers of melatonin production. I also did some research there for the Wyoming State Health Department looking at radon and cancer. I don't know that I had a real focus when I started doing that research. My master's degree research

in the Netherlands was in air pollution and respiratory function in elementary school kids. That was totally different, and that was because at that university, their strength was doing air pollution research. Oftentimes if you don't have a focus, what you will end up doing is probably what the strength is of the institution you are joining. Or if you do have a focus, you better make sure that what you like to do is the strength of the place and the program you are joining. For me, it kind of just happened and then at UNC they were doing a lot of magnetic field research as well, so I just kept doing that until another faculty member came along and said, 'Hey, you're interested in childhood cancer for your dissertation, I've got this data and I need someone to work on it,' so I said sure. I've been very much pragmatic about things. And the metals here, the University of Rochester has really started the field of neurotoxicology, primarily as it is related to lead exposure as well as mercury exposure. That kind of makes sense if you are an environmental epidemiologist to work at least part of your time in those areas because that is something we're really good at here at Rochester.

jur: How has the University of Rochester and the population of Rochester aided in your research in exposure to metals and pesticides?

van Winjgaarden: Lead exposure has always been a concern locally and there is a lot of research that's been done already. The Rochester Lead Cohort was started here in the late 1990s and it really laid the foundation for the CDC lowering their level of concern from 10mg/dL in the blood to 5mg/dL because that particular study showed that there really is no safe level of exposure. The only thing that's limiting us from setting a limit that's zero is practical concerns. You can't screen everyone and you can't treat everyone. It's just too costly and too cumbersome to do that. Rochester has been at the forefront of the lead research over many decades also from an animal research perspective. In terms of doing lead exposure in older adults, that hasn't been as much of a focus. Most studies have been done in cohorts that were recruited for other purposes and they measure lead and they were able to study it, so the local community probably was not quite as relevant from that perspective, but certainly the fact that Rochester, as a community, and the University of Rochester specifically has had this long history of lead research has been a main drive for that, including some of the faculty in environmental medicine who have been real trailblazers in that area of research. The mercury exposure research was actually not local at all because it was in the Seychelles which is an island nation off the coast of Africa, about 1,000 miles from anywhere. Some researchers from this university about 30 years ago started collaborating with their government on doing research there. So that did not have as much of a local community input, but that research was really initiated here, especially by people in neurology- Dr. Meyers, Dr. Tom Clarkson in environmental medicine, Dr. Phil Davidson in pediatrics. So they really started that research and it has been going on for over 30 years. We actually just got more government money to continue our research, so that's been great, but the local community probably hasn't had as much input on that but the findings from that study will have, or has had, a real impact on US regulations as well as how we look at fish consumption locally.

jur: We know that lead, mercury, and pesticides are harmful. From a public health perspective, why should we study this?

van Winjgaarden: That's a very good question. This is always the questions of the "so what?" and "if we already know so much, why do we need to know more?". And that's a very fair question. Every time we do a research proposal to get more money we need to address that. So with mercury, it's a relatively straightforward answer because the science on mercury toxicity levels from exposure by fish consumption are actually not conclusive. Our studies have suggested that methyl-mercury, the organic kind from fish, exposure doesn't seem to be doing anything harmful to the children in our population. But other studies have suggested otherwise. We're trying to figure out what are some of the factors which might drive susceptibility to mercury toxicity. What is it about our study population that may be different from other study populations to suggest toxicity? Our scientific method? Is it something that is actually inherent to the population, like genetics? Or nutritional factors? Or something that modifies mercury toxicity that might protect certain population? I think that there are a lot of scientific questions there that still need to be addressed, and without knowing the factors that may modify mercury toxicity, you can't really establish solid regulatory policies. You can't do one-size-fits-all and really affect people and communities that have no choice in the matter. They have to eat something or they don't really have any money to act upon anything. It really is important to continue to address that. With pesticide exposure, it's very much the same thing. If you don't use pesticides, unless you have alternatives, you don't have high levels of production to feed everyone. The question still is "what's the right balance?". Is there a way to avoid using pesticides, but if you have to use them, which ones would be reasonable and what exposure levels would be acceptable? If you go with the word "acceptable"—that's always tricky with environmental exposures. With some people, nothing is acceptable, and that may be rightfully so. It's mostly a question about dose-response, really. We have all these technologies that allow us to eat better, but at a cost. What's the cost-benefit to that? Which communities are disproportionately affected by pesticide use? Poor communities, which are also possibly exposed to other factors that modify toxicity. A lot of this research is about dose-response. How much exposure is too much? And susceptibility, so which communities are particularly susceptible to toxicity and can they be identified to better target interventions? Again, a one-size-fits-all policy probably doesn't work without having adverse consequences of that policy, economically or health-wise. With the bad stuff usually comes good stuff. It's pretty complicated and I think our research in the past has been very black box oriented. So you have an exposure and you have a disease or a health outcome, so let's just correlate them. And now we really have the scientific tools available to look at the mechanisms available in between and what may be impacting or interacting with these mechanisms. So a lot of work needs to be done.

jur: What are some of the current issues epidemiologists are trying to solve?

van Winjgaarden: I was just reading a paper yesterday that was

interesting. They used linguistic methodologies and a literature review to see which fields have been predominantly studied in epidemiology and which fields have not been so much studied, but should maybe be studied. The topics that have always been studied and published very well are cardiovascular epidemiology and infectious disease epidemiology. Environmental epidemiology has been around for a long time and has been considered important. But there are some emerging areas that haven't had as much attention and are really important: psychiatric epidemiology, mental health is one of them. The top burdens of disease and epidemiology haven't addressed that as much as I think it should. Social epidemiology and social determinants of disease are very important, and I think we all know that, but epidemiology hasn't focused as much on that or published on that as much. And injury epidemiology. I think that's an important area as well which is maybe more recognized now with concussions and sports injuries. There are areas that have always been studied very well- cardiovascular disease, chronic diseases. Infectious disease has always been there and I think people generally associate in public health with infectious disease. That's always been important and I think there are areas which should become more important, like social epidemiology. Also the field continues to develop methodologically, so there are statistical methods that have been developed over time and that now with better software we can actually implement, so the methodology used. We've always done great thinking for many decades but it hasn't always been applied in the real research setting because of limitations of software and I think we're now there that we can use the tools to bring those methodological advances forward. I think there's a lot of interest in causal inference and the interaction between what we deal with as epidemiologists and how we can actually impact the public's health, which is also very much a topic of debate. As epidemiologists, do we just do the research or do we have to be advocates? I think there are two camps on that and that's something that continues to be discussed. Is there any particular area specifically that epidemiology focuses on? I don't think so. I think my perspective is that epidemiology is primarily a toolbox, as an epidemiologist you are being trained to conduct good research with the methodologies that allow you to have solid causal inferences, or at least close to causal inferences, as well as tell others how to design their research properly with the right checks and balances. I think that applies to most fields of medicine and public health, but certainly there are areas that seem to be most important: infectious disease, cardiovascular disease, cancer. A lot of cancer research is done outside of epidemiology, which is kind of unfortunate because I think we have a lot to contribute there. I think we have a really big role going forward in big data. I really think we should be more involved there than what we have been because I think in the public health sciences, including health services research, we have a lot to offer in terms of big data and being able to analyze and how to translate that into findings that might be useful. If you would ask an average person, they probably would say that's a lot of data now. We should focus on that, try to make sense of that and apply epidemiologic methods to all the data that's currently being collected. There's actually one person who graduated with an interdisciplinary major, a couple of years ago, and she works at Google now. She had kind of an epidemiology plus statistics mixed major and she's

using that background now to do analytics at Google. For people training as epidemiologists or statisticians, there's a lot of places you can work: health departments, private sector, things like that, hospitals, medical settings. I think the future is pretty bright for epidemiologists. There are a lot of things we can do.

jur: Could you elaborate on why research is important in public health, and specifically epidemiology?

van Winjgaarden: Well, I'm biased (*laughs*). A lot of textbooks say that epidemiology is one of the foundations of public health. We generate the evidence and get the evidence base to at least show what risk factors might be so that if we know that we can develop interventions and study those interventions and whether that reduces disease burden. Without an evidence base you can't do proper public health. You need the epidemiology, you need the science to show which variables are linked and you need to have the science variable to show that if you're going to implement any kind of intervention—small or big, population or personal level interventions—whether they're actually reducing disease burden. That's why you need to do the research. Without the research, you're shooting in the dark. You might be really harming a population's health because you're implementing interventions that don't work. So not only does that harm health because instead of doing that you could have done something that actually would have worked with the proper evidence backing it up, and you waste a lot of money. Any public health research is necessary in that regard. Epidemiology focuses on the quantitative side along with statistics and health services research, but really any of the fields in public health—that includes some of these other majors that we have here—are really all working together to come up with a comprehensive knowledge base to implement interventions and try to improve the public's health, especially those that are disproportionately affected by risk factors. Science is the basis for anything. If you don't invest in science, you're probably going to see the consequences of that by lost life, lost productivity, a lot of consequences of not implementing the proper programs.

jur: Could you talk about your first research experience and how you would suggest an undergraduate could get involved in research?

van Winjgaarden: I've touched upon this a little bit, but you have to be a little bit opportunistic to see what's around you. Actually for most of my career, I've just written people. As an undergraduate, the only reason I got the job in Colorado was because I wrote professors to say, 'Hey I want to do an internship, is it a possibility to do that with your group?'. You never know, you may be a no but maybe you'll get a yes (*laughs*). I say you have to work hard and you have to show that you are really motivated and interested. You just have to kind of reach out to people. With that you obviously have to be a good writer and be respectful and show a good attitude, but that's worked for me because after that internship I just wrote other people about jobs. UNC was one of the places I wrote, but I wrote to researchers in California, and Scotland and England and a variety of places and I probably could have had three different jobs. You have to work hard, be productive, and communicate well, and just reach out. And that's true for

anything. One of the jobs I got after I graduated with my PhD was by emailing someone, and they responded. People generally are pretty nice and so if they see that you're motivated and they have some resources available, I think things will work out pretty well. And if they don't work out, it's for a reason. But you have to work hard and just not be too shy. You can't expect things to come to you, you've got reach out.

jur: What are some of the personal qualities of a good researcher?

van Winjgaarden: It kind of depends on your perspective, I guess. My philosophy has been of 'be open minded and willing to really help and work on anything.' I think that the standard paradigm is that of focus. If you want to be really successful in a particular area, you have to focus on the area soon, and often, and really not get too distracted by a lot of different things. There are some people, like probably myself, who like to do many different things, and that might work out well; it's worked out well for me, but generally it's not a recipe for having a real successful research career because most real successful researchers, they've focused really early on and it's just a few things they do and do really well. So if you're able to focus, you need to know what you want. If you don't know what you want, you shouldn't start a research career until you do. Once you do, you have to be willing to work more than 40 hours a week—so put everything you've got into it—and you have to have patience. Research funding is hard to get, research findings may not turn out the way you wanted, so at the end of the day you try to tell a story with research and in the basic sciences or clinical sciences, it's all pieces of a puzzle and you've got to be willing to invest a lot of time in putting those pieces together and sometimes you turn the pieces around and they don't fit and you put the piece away and you've got to try to find a different piece. That's probably the best way to describe it: research is about finding the right pieces to fit together, and sometimes finding those pieces is like a 2,000 piece puzzle, it takes a long time and you have to have patience and you have to connect with the right people who may know where to look better than you do when you first start out with your research. Instead of having all these thousand pieces, they might say 'start with these corner pieces there' or they may have some good advice. You have to connect with good mentors because they would have good advice based on their research experience based on them going through the process of how to become successful yourself. That's really how it works best, if you can connect with people who are successful and they pass it on to you, and you'll pass it onto the next person and that's kind of the collective knowledge that science is supposed to generate. It's not you by yourself in an office or a lab, it's really working together as a team with people who know more than you do, but you may have more novel thoughts than people who have been around may have. So you all have to work together. In terms of best qualities? Hardworking, patient, you have to be humble, and you have to be a good communicator. You have to get along with people. Obviously some people who don't get along with others are really successful and some might say that a lot of scientists are like that, but I think in this day and age, with interdisciplinary science and in the medical field trying to translate our research into real action, you've got to be able to communicate and work well as a team. I would say as undergraduates you really have to

think about that and try to get some experience working as a team.

jur: Do you have any words of wisdom or advice for undergraduates in general?

van Winjgaarden: I don't know that I'm old enough to have words of wisdom (*laughs*). Other than what I've said, you have to just listen to professors (*laughs*). That's probably one of the things that I'm sometimes surprised about, how infrequently students listen to professors. We do know a few things. We're not always right, but on average we do know a few things. We have suggestions about 'I wouldn't do this, or I wouldn't do that' or 'I would try to focus on this.' You should try to take that seriously, I think. We all as professors are very invested in the success of our students. Without students we wouldn't have careers. We wouldn't be here without being a student in the past, so we know how important it is for students to do well and we try to mean well and give good advice as students try to find their way and set up a career themselves. Take that advice from others, that would be one of my recommendations, along with of course work hard and get along well and reach out to individuals soon. Don't wait too long, don't procrastinate, which is a hard thing to do. Most people procrastinate. You can't plan on everything but you can certainly guide your path as you have a forward thinking mind, as you try to plan some directions. You can't plan specifics, but you can plan general direction. That's worked pretty well for me. I didn't plan to do magnetic field research, but I wanted to reach out to different individuals to see if I could work in these groups. There are broader things, more global things, you can do to make yourself successful and the details will get filled in by different individuals, different professors, different colleagues. Just work hard, listen, and don't procrastinate. That I think sums it up.

Mental Illness and The Great Detective:
Diagnosing Sherlock Holmes

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As one of the most prominent Victorian Era personas in the public mind, Sherlock Holmes is not only a unique fictional creation, but a character with an unparalleled dedication to his craft. His steadfast devotion to the study of criminology has led to Sherlock's widespread recognition as the greatest detective the world has ever known. Such an acknowledgment is certainly enviable, and it is partially for this reason that so many people, consciously or not, aspire to be like the Great Detective. Being that we are fortunate enough to know the intimate details of Sherlock Holmes' life more than we do of most men of great accomplishment, it is natural for us to attempt a thorough study of what makes Sherlock Holmes so prolific.

In an effort to understand a character of such importance, we often arrive at the notion that Holmes may not simply be a man gifted with great intellect, but also one plagued by mental illness. His fixated study of all things criminal may seem to one person to be an unwavering commitment to his work, while to another it may smack of Obsessive-Compulsive Disorder. His extended mood swings may come across as the result of a stressed life chasing criminals, or as manic-depressive episodes due to Bipolar Disorder. Holmes is certainly not a socialite. His blunt talk and seemingly disconnected manner when interacting with clients and friends alike may lead one to assert that he has Autism-Spectrum Disorder (ASD). Holmes' inability to cope with monotony and his use of cocaine to stimulate his mind in periods of boredom may suggest Attention Deficit Disorder or even underlying depression. At any given point in time, Holmes has been diagnosed with personality disorders, delusional disorders, depressive disorders and the list goes on.

Given that Sherlock Holmes possesses a brilliance that many aspire towards, it is only natural that we analyze his personality quirks, habits, and everyday mannerisms as clues to what makes him exceptional. However, without a thorough understanding of his psychiatric state, it becomes difficult to discern whether Holmes' late-night violin playing is a symptom of insomnia or an effective aide to concentration; whether his cocaine binging is indicative of a stifling addiction or an overactive and irresponsible mind simply seeking relief from boredom; and whether his unmatched apathy is the mark of a sociopath or a consummate

professional. Ultimately, Sherlock's eccentricities may be nothing more than personality quirks. It is, however, worthwhile to embark upon a clinical analysis of one of the world's greatest minds in order to separate his brilliance from his possible mental disorder, and to determine to what extent the former could occur without the latter.

Before beginning this investigation, one must consider Sir Arthur Conan Doyle's vision of Sherlock. As a physician in late Victorian England, Conan Doyle's representation of Sherlock was undoubtedly influenced, consciously or not, by the contemporary understanding of mental disorders. Psychiatry was a nascent field in Victorian England, and the medical profession's understanding of the causes of psychiatric illnesses was so vague that the classification and treatment of even the most common diseases were wholly ineffective. *The British Journal of Neurology and Psychopathology* recognized this deficiency in Victorian psychiatric knowledge as early as 1935. As an example, it pointed out that "brain fever" was a commonplace yet ambiguous term in that period. During the Victorian era, "brain fever" could have referred to any sort of ailment ranging from delirium, to loss of physical senses, to a state of extreme excitability. It did not help that literary exaggerations of "brain fever", Conan Doyle's included, were rampant in the popular literature of the time. For example, the condition was often used in novels to describe easily excited women, manifesting itself after a woman experienced an "emotional episode"[1] or other psychological stressor. She would be known to display symptoms of "flushing, trembling, quivering in every limb"[2]. In authentic cases, however, "brain fever" was described by Victorian physicians as being a state of delirium so intense that the subject would experience "universal anesthesia, with blindness, deafness, and closure of all centripetal avenues"[3]. This, however, is but one description, and in fact many physicians of that time described similar symptoms in patients with encephalitis[4], a generic infection of the brain that is wholly unrelated to psychiatric illness.

While it is doubtful that Conan Doyle used "brain fever" patients as inspiration for Sherlock Holmes, the aforementioned case, in which physicians failed to adequately classify a disease and the public failed to understand it, was a common scenario in

Victorian England. In fact, in the early Victorian period, people knew so little of mental disorders that physicians were being encouraged to look to *fictitious* accounts of mental disease for inspiration. In an excerpt from a large collection of British essays on mental disorders, Victorian physician Dr. Henry Halford writes:

> Thus have some of the descriptions of the poets, held to be imaginary, been realized in life. And it is possible, that if the physician were to collect and apply the brief notices of various disorders, he might…derive from them some useful hints to assist him in his own observations of disease[5].

Uncertainties within the medical community about the nature of mental illness and discrepancies between clinical descriptions and public perceptions made it difficult for even an educated doctor to sift fact from fiction and describe a given disease with completeness. As such, it is remarkable that Conan Doyle was able to construct a character so entirely believable and well suited to fulfilling the criteria for modern clinical disorders. Sherlock Holmes' diagnosis, if he merits one, seems to fall most convincingly into the class of psychiatric illnesses known as Personality Disorders, a category that would not exist in British psychiatric nosology until publication of the sixth *International Statistical Classification of Diseases* in 1949[6], nearly sixty years after the publication of *Study in Scarlet*[7].

Conan Doyle's seemingly extraordinary precognition, however, comes with the caveat that many nuanced psychiatric disorders had already been informally observed and described in his time, simply under different names. For example, by the time the *British Journal of Neurology and Psychiatry* had published its retrospective evaluation of "brain fever" in Victorian England, this condition was already being referred to by the "updated" term of Hysteria[7], which most closely resembles the modern diagnosis of Conversion Disorder[8]. "Cycloid personalities" were already being described as extroverts, with "an innate disposition for moodiness and oscillations of mood between elation and melancholia"[9]. Introversion was understood to be a personality common to "the schizoids". At first glance, such terms may seem to describe Victorian precursors to today's similarly named Cyclothymic Personality Disorder and Schizoid Personality Disorder respectively, yet Victorian classifications were very loosely defined. Victorian "Cycloids", for example, would be more appropriately diagnosed today as the more specifically defined manic-depressives. "Schizoids", too, were noted to "have an innate disposition to split in the psychiatric sense of the word"[10], a symptom that characterizes a psychotic disorder, such as Schizophrenia or Schizoaffective disorder, but does not encompass the entirely distinct Schizoid Personality Disorder. In fact, as we will soon see in the quest to diagnose Sherlock Holmes, a strong case exists for both Schizoid Personality Disorder and Cyclothymic Disorder.

As a final note on Victorian psychiatry before delving into Sherlock's mind, one should appreciate that, as inadequate as British psychiatric nosology was at the time, the treatment for such diseases was many degrees more pitiable. Most "lunatics" were confined to spend their entire adult lives in insane asylums without any real treatment. According to Dr. Henry Halford, the best hope for psychotic or delirious patients was often to occupy them with intense thinking about a certain subject they had been studying before becoming "insane", or to encourage them to engage in "the solace of music"[11], which apparently had been demonstrated to take many patients out of their delirium, if only for a period. Interestingly, two of Sherlock's trademark habits are playing the violin and intensely studying a given topic, usually criminology. Holmes often uses the violin as a prop to help him concentrate, which a modern clinician might see this as a mechanism by which Holmes is bringing himself out of one of his common obsessive states of concentration[12].

Watson himself says as much when he observes,

> One of the most remarkable characteristics of Sherlock Holmes was his power of throwing his brain out of action and switching all his thoughts on to lighter things whenever he had convinced himself that he could no longer work to advantage.[13]

Whether Holmes is "self-medicating" or simply self-indulging remains to be proven, though Watson's above remark does provide key evidence that Sherlock Holmes probably does not have clinically significant signs of another important disorder: Obsessive Compulsive Personality Disorder. While Watson does occasionally notice some obsessive tendencies in Holmes, such as his "catlike love of personal cleanliness"[14] which was one of his characteristics, the detective's ability to snap himself out of a mental rut puts a stop to most notions of a Holmes afflicted by Obsessive Compulsive Personality Disorder (OCPD)[15]. A hallmark of clinically significant OCPD involves a patient who is so perfectionist in his work that he cannot even complete simple tasks, something that does not resonate with Sherlock, who is a highly productive individual.

With OCPD crossed off the list, one looks to Holmes' unstable mood. On a superficial level, Holmes' notorious, repeated instances of extended melancholy and inactivity would seem to denote a clear depressive episode. Likewise, his intense involvement with a case might indicate a period of mania or hypomania, leading to a diagnosis of manic-depression, otherwise known as Bipolar Disorder. Watson often notes "The swing of his nature took him from extreme languor to devouring energy."[16] Given the option, a more likely diagnosis would be one of Cyclothymic Disorder, which for our purposes presents itself as simply a lesser expression of Bipolar Disorder. Both of these clinical diagnoses, however, would overlook the fact that they manifest as periodic mood swings *independent* of outside events. Holmes' emotional fluctuations, on the other hand, are almost completely dependent upon whether or not a pressing criminal mystery exists to be solved in London[17]. This crucial point must cause us to cast skepticism on at least the most common manifestations of mood disorders.

Outside of psychotic disorders, which are too severe for Holmes' character, and mood disorders, there exist Attention Deficit Disorder (ADD) and Attention Deficit Hyperactivity Disorder (ADHD). These are two very similar diseases that, among other benchmarks, are characterized by a need for mental stimulation[18]. Cocaine abuse is more prevalent in the population affected by ADD and ADHD, as it has a similar effect to the amphetamines in medications used to treat these conditions, such as Adderall and Ritalin. In a time when such medications did not

exist, it seems as though Holmes had found a more effective means of self-medication than the superficial routine of simple "intense thinking and engaging in music". Holmes, however, is undoubtedly not afflicted by the modern description of this disease, as his character is a distinct foil to the other defining and necessary conditions: ADD patients express an inability to focus, inattention, and forgetfulness.

Similarly, some have argued that Holmes' condition lies somewhere on the milder end of the spectrum of Autism disorders. From this position, one could make a strong case for Asperger's Syndrome. A patient who "lacks emotional reciprocity, fails to develop peer relationships, and who adopts an encompassing preoccupation with a restricted pattern of interest that is abnormal in intensity or focus"[19] might successfully be diagnosed with this condition. Sherlock Holmes' consistently apathetic responses to his closest friend's accomplishments, such as Watson's meticulous documentation of Holmes' endeavors and his marriage to Mary Morstan are more than convincing enough to fulfill the first criterion. Being that Holmes' only friend is Watson, and that one of the defining traits of Holmes' character is his passionate infatuation with his chemical experiments and his study of criminology, one could hardly debate the presence of the latter two criteria as well. Thus, Asperger's Syndrome seems to be a fitting diagnosis. There exists a caveat, however, that will be discussed later. Until then, one should press ahead, as no differential diagnosis is complete without considering all options.

As previously alluded to, Personality Disorders are perhaps the best description for Holmes' character. To classify him as having a Personality Disorder, one must first acknowledge that he has a marked difference from the norm in the way he perceives himself, other people, and events[20]. This is evident whenever Holmes walks into a crime scene, as one can acknowledge that his unique talent of perception is always the foremost trait that sets him apart. His favorite quip is "you see, but you do not observe"[21], and he continually perceives himself, not entirely without cause, as being superior to everyone in his presence. Clearly, Holmes understands the world differently than those around him. He also fits the second criterion for having a Personality Disorder, which is that the patient has a limited emotional range. As aforementioned, Holmes is unmistakably more apathetic than most. Given that Holmes' narcissism and apathy are brought up in one form or another in almost every adventure, one can accept that these two traits are stable over a long period of time. They are also distinctly independent of Holmes' occasional substance abuse. Finally, these traits are pervasive across a broad range of social situations[22], as Holmes' indifference to the emotions of others can be extended beyond his relationship with Watson. As an example, in the Adventure of Charles Augustus Milverton, Holmes' apathy shines bright, as he becomes engaged to the housemaid in order to gain access to the title character's house, only to shrug his shoulders upon being asked about her fate after his investigation was complete, with his only response being, "You can't help it, my dear Watson."[23]. The evidence therefore points towards a man afflicted by some sort of Personality Disorder.

Given the example of Holmes' indifference to the woman he was about to marry, the most appropriate Personality Disorder to begin with is Anti Social Personality Disorder (ASPD). ASPD is most closely related to the popular notion of a "sociopath",

which, generally speaking, would be someone without scruples or even concern for other people. One might argue that Holmes' attitude in regard to the woman he was about to marry may not merit being chalked up solely to apathy, but could in fact be indicative of ASPD. Holmes does have a long track record of manipulating people with his renowned acting skills in order to gain access to certain places or information about particular events, but for the most part he misrepresents himself only for the benefit of the case, and so he has a higher purpose to which he endeavors. Similarly, though Holmes offers no explanation for his mishandling of the housemaid, he does go on to show that he at least holds a distinct set of morals, as he justifies his breaking and entering of Charles' house by stating, "I suppose you will admit that the action is morally justifiable yet technically criminal."[24] This happens on multiple occasions. When Holmes allows a remorseful thief to go free, declaring, "I suppose that I am committing a felony, but it is just possible that I am saving a soul"[25], he is once again allowing his higher ideals to dictate his actions, a trait completely averse to people with Anti Social Personality Disorder. Thus, Holmes holds his personal morals in very high regard, a trait that is not necessarily a virtue, but certainly not an indicator of a sociopath. Therefore, while we can comfortably say that Holmes fits the generic criteria for a personality disorder, we must move on from Anti-Social Personality Disorder to more convincing diagnoses.

Sifting through the vast array of personality disorders, one can immediately discard Paranoid Personality Disorder. The only trait that Holmes seems to hold with regard to this disease is that he has a demonstrated reluctance to confide in others, but this can be chalked up to his love of all things dramatic, as he enjoys nothing more than to relish in the "big reveal" upon showing others how he has successfully solved a case. Later in his adventures, Sherlock Holmes also shows that he holds intense suspicions that Dr. Moriarity is conspiring against him, but this turns out to be a fully justified paranoia, and therefore not indicative of a mental disease.

A more credible argument arises when arguing for Narcissistic Personality Disorder. One criterion, the requirement for excessive admiration, may not seem initially evident, as Holmes continually allows the London police to take credit for his hard work in solving high profile cases. In his own way, however, Holmes still manifests a need for admiration. When the possibility arises that Watson may leave Holmes during a case, this immediately precipitates a response from the Great Detective, "Stay where you are. I am lost without my Boswell!"[26] Holmes' incessant desire for a biographer is certainly indicative of someone who carries a large sense of self-importance on his shoulders and the excessive need for admiration that goes along with it. Another criterion, that Holmes be "interpersonally exploitive," can most appropriately be represented if one refers back to the example of his manipulative engagement to Charles' Augustus Milverton's housemaid. The frequency with which Holmes talks down to clients or the police certainly contributes to the third criterion, which is that he shows an "arrogant or haughty behavior or attitude"[27]. Watson, his closest friend, is quick to acknowledge this, when he vents, "I was repelled by the egotism which I had more than once observed to be a strong factor in my friend's singular character"[27]. A fourth condition is that Holmes should lack empathy, and by referring

back to the discussion of Asperger's Syndrome and Personality Disorders, one can see that this is indeed the case.

We have now established four criteria for Narcissistic Personality Disorder that are present in Holmes. A proper diagnosis requires five criteria to be met, however, and the fifth proves to be slightly elusive. The next criterion is that Holmes should believe he is special, and thus should associate with other special or high-status people. This is more difficult to argue. It is hard to find an example of Holmes actively seeking out the company of higher society or London's intellectual community, although Holmes' attitude would suggest that this is because he views himself as being above them, which actually might enhance the argument that he is a clinical narcissist, but which does little to support the fifth criterion.

There exists a second option, which requires Holmes to "have a grandiose sense of self-importance…expecting to be recognized as superior without commensurate achievement,"[28] but this is perhaps the least well supported of the six criteria mentioned so far. While Holmes expects to be treated as the most intelligent man in the room, there lies a substantial degree of difficulty in demonstrating why he should not merit it. Perhaps this is a quirk of fiction, as few men in factual history have been known to process information hand over fist as well as Holmes. After all, the privilege of crafting a character with as much intellect as one so desires is a luxury unique to writers, and one that Arthur Conan Doyle undoubtedly exploits in his construction of Holmes. That being said, Holmes meets four the five required criteria, with questionable eligibility for two more, and we can therefore classify him as borderline clinically narcissistic.

Lastly, and perhaps most appropriately, we arrive at Schizoid Personality Disorder. Defined as "a pervasive pattern of detachment from social relationships and a restricted range of expression of emotions in interpersonal settings, beginning by early adulthood and present in a variety of contexts,"[29] Schizoid Personality Disorder most appropriately addresses Holmes' most glaring deficit: his social life. One could easily argue that Holmes 1) neither desires nor enjoys close relationship, 2) almost always chooses solitary activities, 3) has little, if any interest in having sexual experiences with another person, and 4) shows emotional coldness, detachment or flattened affectivity. If one can find himself convinced of all four criteria, then an argument for Schizoid Personality Disorder may stand its ground against further scrutiny. Aside from his friendship with Watson, Holmes remains reluctant to show confidence in anyone else. Whether or not Holmes' relationship with Watson is significant enough to merit a discreditation of the Schizoid Personality Disorder diagnosis is ultimately left to the reader. One should keep in mind, however, that the friendship between the two, as enduring as it may appear, could simply be serving as a vehicle for Holmes' narcissism. As aforementioned, Holmes' need for a personal biographer could demonstrate an element of exploitation on Holmes' part, as is evidenced by the fact that Holmes rarely interacts with Watson outside of a case. When there is a lull in casework, Holmes chooses to lounge, play violin, watch a show in the theater, or abuse drugs, all activities that minimize his direct contact with Watson. Importantly, these activities are also all solitary, as even the most social of the aforementioned endeavors, going to the theater with Watson, mainly consists of hours of limited interaction.

Thus, the first two criteria appear to be fulfilled. With regard to the third criterion, Holmes' lack of sexual interest is feasibly the only discussed characteristic that proves to be entirely indisputable across all of his adventures, and thus deserves little analysis. Finally, Holmes' flattened affect, a distinguishing characteristic of Schizoid-type disorders, hides itself well from the untrained eye. Holmes undoubtedly exudes affability with clients, strangers, or anyone with whom it serves his interest to be genial. This demeanor, though, derives from Holmes' great ability as an actor to hide his true thoughts and expressions. Only those who know him well could attest to his strictness in affect, such as when Watson observes a peculiar spectacle of euphoria in Holmes by recalling, "I knew well that he would not depart so far from his usual austerity of demeanour unless there was a good cause for exultation"[30]. Watson reinforces this depiction of Holmes as an ascetic individual on multiple occasions, often documenting his idea of Holmes' character only when uncommon exceptions occur, such as with his observation "He burst into one of his rare fits of laughter, as he turned away from the picture. I have not heard him laugh that often, and it has always boded ill to somebody"[30]. Clearly, there exists a Schizoid element in the way Holmes habitually restricts his emotional displays, a quirk that manifests itself in a manner so extreme that even a fit of laughter merits documentation.

In retrospect, Sherlock Holmes appears to bear the burden of a cocktail of mental afflictions. Mood swings, obsessiveness, narcissism, and a distinct disinterest in interpersonal relationships all play a major role in shaping the man we know today as the Great Detective. To this point, however, a major aspect of psychiatric illness has been withheld, and it now deserves to be analyzed.

In modern evaluations, any given personality disorder lacks diagnostic merit if it does not "lead to clinically significant distress or impairment in social, occupational, or other important areas of functioning"[31]. This, then, introduces an entirely novel lens with which to look at Holmes' life. Whether or not he expresses the aforementioned personality quirks is one discussion. Whether they actually prove detrimental to Holmes' goals in life exists as an entirely different debate, and it remains to be shown one way or the other. The stipulation that Holmes be impaired in his personal happiness or in his functioning could initially prove to be a tough pill to swallow for those bent on diagnosing the Great Detective. For example, Holmes' narcissism, introversion, apathy, flatness of affect and lack of sexual desire are unique, but they do not seem to stop him from solving cases or pursuing his research, thus his occupational functioning remains intact. But before one jumps to the conclusion that Holmes has a clean bill of mental health, the social aspect of this requirement is an important one to consider. Holmes' does not seem to mind his lack of close personal friendships, but whether or not Holmes' social ineptitude proves to be a personal nuisance remains irrelevant in the diagnosis. Most people would agree that he has impaired social functioning, and thus the case for the presence of mental disease seems stronger.

Aside from his social woes, Holmes could also be shown to display mental illness if he has problems in "other important areas of functioning". In this regard, Watson does offer some sparse examples of his friend's idiosyncratic personality infringing on his personal well-being, such as when he recalls of Holmes, "It was one of his peculiarities that in his more intense moments he

would permit himself no food, and I have known him presume upon his iron strength until has fainted from pure inanition"[32]. Clearly working himself to death is an example of clinically significant obsessiveness.

Thus, there seems to be little doubt that Holmes does suffer from *something*, but the exact nature of this illness remains elusive. Ultimately, Sherlock Holmes' mental status remains ambiguous, but has been convincing narrowed down to a few likely choices. Of the initial contenders, "brain fever" and hysteria were certainly never real candidates. Similarly, for various reasons, we have rejected Obsessive Compulsive Personality Disorder, Cyclothymic and Bipolar Disorder, Psychotic disorders, Attention Deficit Disorder, Anti Social Personality Disorder, and Paranoid Personality Disorder.

Holmes' most likely diagnoses have been show to lie either with Asperger's Syndrome or Schizoid Personality Disorder, with Narcissistic Personality Disorder finishing as a respectable third contender. Aside from the evidence already presented for each condition, the fact that patients with personality disorders or Asperger's Syndrome are rarely in need of medication also lends support to these possibilities. (Patients with mood disorders and psychotic illnesses, on the other hand, usually require mood stabilizers and anti-psychotic medications respectively.) Therefore, even if Holmes were to live today and he were deemed to be afflicted by one of the aforementioned top three possible diagnoses, the bulk of his treatment would most likely derive primarily from personal therapy sessions, a management system not entirely different from Holmes' morning discussions with Watson. Thus, the fact that a patient can be afflicted by one these illnesses but continue to carry out daily activities while unmedicated seems to explain Sherlock Holmes' continued ability to function at a high level.

We have described the most likely afflictions, but even then, no one disorder explains all of Holmes' symptoms. Neither Personality Disorders nor Asperger's Syndrome account for Holmes' mood swings, his cocaine abuse, or his need to play the violin when concentrating. Thus, I propose that Holmes is afflicted by more than one disorder. For the sake of argument, if we meddle with our frontrunner diagnoses and combine them into the all-encompassing verdict of "Personality Disorder Not Otherwise Specified with Schizoid and Narcissistic Traits," then the only truly significant outlier remaining would be Holmes' mood instability.

In this regard, one should revisit Cyclothymic Disorder. This disease was earlier rejected because it usually instigates mood changes at seemingly random times, while Holmes' mood swings are nonrandom, instead dependent upon whether or not he is able to find something to preoccupy himself with. That being said, his manic-depressive episodes meet enough other criteria with regards to their length and intensity to classify him as suffering from some sort of unspecified mood disorder, Cyclothymic Disorder being the most likely. After all, Holmes does display classic hypomania – euphoric, intense periods of high activity -- when a new case presents itself. Similarly, his depressive states are all-too well known. Finally, Cyclothymic Disorder would explain Holmes' cocaine use and violin use, both of which could be seen as crutches that Holmes relies on to bring himself out of a depressive phase. Therefore, Holmes' second mental disorder

may simply be an atypical manifestation of Cyclothymic Disorder, which is uncommon but not unheard of.

Whether through pure brilliance or sheer luck, Conan Doyle, by drawing on his medical knowledge and creative prowess, was able to craft together one of the most believable, ambiguous, and eccentric personalities to grace a paperback. Through Sherlock Holmes' seamless transitions any given day from an apparent narcissistic genius in the morning, to a manic-depressive hermit in the afternoon, to an obsessive-compulsive detective in the evening, he has evaded psychiatric diagnosis since his inception. At best, one can offer a patchwork diagnosis that incorporates elements of Asperger's Syndrome and Schizoid and Narcissistic Personality Disorders, while also offering Cyclothymic Disorder as a second ailment that could explain Holmes' mood inconsistencies. Bearing all of that in mind, a definitive answer is a noble goal, but not necessary to appreciate Sherlock Holmes. In fact, by thwarting our best efforts to categorize his personality, The Great Detective has unearthed one more niche in the public psyche by which he can bury himself indefinitely, forever challenging the reader to understand what sets Sherlock Holmes apart from the rest of society.

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[5] Halford, Henry "Essay IV: Popular and Classical Illustrations of Insanity" Essays and Orations, read and delivered at the Royal College of Physicians, to which is added an Account of the opening of the tomb of King Charles I (London: G. Woodfall and Son, 1833), 56.

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[11] Henry Halford, "Essay IX: On the Treatment of Insanity, particularly the Moral Treatment" Essays and Orations, read and delivered at the Royal College of Physicians, to which is added an Account of the opening of the tomb of King Charles I (London: G. Woodfall and Son, 1833), 133.

[12] A hypomanic episode, as defined in the DSM IV, is "a distinct period of persistently elevated, expansive, or irritable mood, lasting throughout at least 4 days."

[13] Arthur Conan Doyle and Kyle Freeman, The Adventure of The Bruce Partington Plans. The Complete Sherlock Holmes. Vol. I. (New York: Barnes & Noble Classics, 2003), 430.

[14] Arthur Conan Doyle and Kyle Freeman. The Hound of The Baskervilles. The Complete Sherlock Holmes. Vol. I. (New York: Barnes & Noble Classics, 2003), 633.

[15] This is different than the more severe Obsessive Compulsive Disorder, a condition by which Holmes is certainly not afflicted

[16] Arthur Conan Doyle and Kyle Freeman, The Adventure of The Red Headed League. The Complete Sherlock Holmes. Vol. I. (New York: Barnes & Noble Classics, 2003), 217.

[17] While it is possible that Holmes displays a rare abnormal variant of Type II Bipolar Disorder, there are far more compelling diagnoses within the realm of Personality Disorders.

[18] American Psychiatric Association, Diagnostic and Statistical Manual of Mental Disorders, 65.

[19] Ibid, 63

[20] Ibid, 287

[21] Arthur Conan Doyle and Kyle Freeman, Scandal in Bohemia. The Complete Sherlock Holmes. Vol. I. (New York: Barnes & Noble Classics, 2003), 162.

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Dynamic Inhibition of the Rayleigh-Taylor Instability

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W henever two fluids are accelerated in to each other, the denser fluid will dominate and move through the less dense fluid – this is called the Rayleigh-Taylor Instability (RTI). An example of this is seen when two different density fluids are layered in Earth's gravity: if the denser fluid starts out on top of the lighter fluid, instabilities form at the fluid boundary and the two fluids will switch position or mix to reach a lower potential energy state. Mathematical analysis shows that the instability is caused by waves at the fluid interface and depends mostly on the relative density of the fluids (Atwood number). This analysis suggests that these perturbations (commonly called "fingers") can be reduced or eliminated by introducing destructive interference through vertical vibration of the system at the correct frequency and acceleration. This idea has been tested experimentally in the past with some success.

The earliest researched source of an experiment demonstrating the stabilization of superimposed liquids in a Rayleigh-Taylor system is documented in *Dynamic Stabilization of the Interchange Instability of a Liquid-Gas Interface* by G. H. Wolf.[1] Wolf theorized that the boundary of two liquids of differing viscosity, which is inherently unstable, can be stabilized with the introduction of waves perpendicular to the fluid boundary. However, it is not possible to suspend the mixing of the fluids indefinitely. This is a result of the smaller eigenfrequencies, which act to destabilize the boundary and promote mixing. In his experiments, Wolf derived several equations relating the acceleration and frequency of the vibrations to the shape and size of the fluid container, the viscosity of the liquids, and their relative densities. Wolf concluded that the experiment could be done with a multi fluid system as well as a gas-fluid system with the only limiting factor being the need for both substances to be incompressible.

More recently, a team at the Universidad de Castilla - La Mancha expanded upon Wolf's research. The design for a testing machine and procedure is published in their text, *Dynamic Stabilization of Rayleigh-Taylor Instability: Experiments with Newtonian Fluids as Surrogates for Ablation Fronts*, which also cites the most significant application of stabilizing the Rayleigh-Taylor Instability to be in inertial confinement fusion.[2]

In Inertial Confinement Fusion (ICF), a heavy spherical shell material is accelerated into a hydrogen core to compress it and ignite fusion. Laser bombardment from all directions turn both the shell and the hydrogen into plasma fluids. However, since the shell is denser than the core, the RTI prevents proper containment of the fusion material, and the pressures required for sustaining fusion have not been achieved. It may be possible to apply results of this research to the analogous situation of the two plasmas accelerated by lasers. A possible method based on this research is that pulsing the lasers could be used to drive the ICF system in a metastable way similar to the vibration of the fluid system examined here.

PROCEDURE
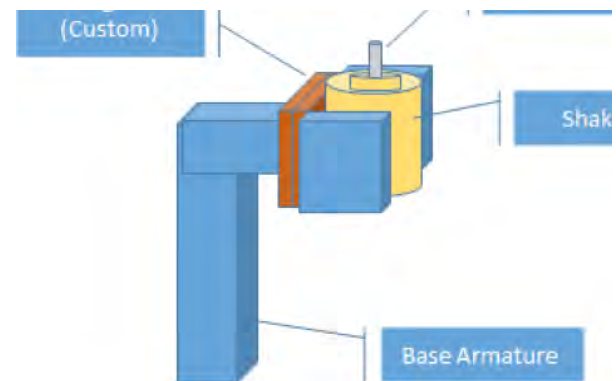
Figure 1. The testing apparatus. The bearing swivel allows the fluid system to be inverted.

An experimental apparatus for vibrating a fluid system was designed and fabricated. It consisted of an electrodynamic shaker capable of vibrations from 1Hz-6.5kHz with accelerations up to 90 G mounted to a bespoke armature with a ball bearing swivel. The armature was designed to allow complete smooth inversion of the electrodynamic shaker. A vertical cylinder was mounted to the vibrating armature of the shaker as the container for the fluid system. A function generator that allowed function shape, frequency, and amplitude to be precisely set was used to drive

the shaker. Additionally, two programs were written based on the equations presented by both Wolf and the UCLM team to calculate testing parameters.

After the assembly of the shaking apparatus, vibration parameters for stabilizing the system were determined based on Equations 1 & 2. The acceleration and frequency parameters calculated by the two methods differ due to Wolf ignoring viscosity and surface tension and instead basing his equations on a simplified model of only density. Both calculations generated a frequency vs acceleration graph, shown in Figure 3. Each point along these lines is a lower bound testing parameters for the shaker.

Equation 1 is the principle governing equation for acquiring our parameters, provided by the UCLM source, where b/g is the acceleration of the shaker in G's, ϖ is a dimensionless frequency, and K_C and K_m are also dimensionless values calculates based on K, a function of fluid properties. ϖ_T is a critical point where data transitions to a linear function.[2]

$$\left.\frac{b}{g}\right)_{lb} = \begin{cases} \left(\frac{2}{\kappa_m^{\frac{1}{2}}}\right)\varpi, & (\varpi < \varpi_T) \\ \left(\frac{8\pi}{\sqrt{27}}\right)^{\frac{1}{2}}\kappa_c^{\frac{1}{2}}\varpi^{\frac{1}{2}}, & (\varpi < \varpi_T) \end{cases}, \ \varpi_T = \frac{2\pi}{3\sqrt{3}}\kappa_c\kappa_m \qquad (1)$$

Equation 2 is the principle governing equation for acquiring our parameters, provided by the Wolf source, where b/g is the acceleration of the shaker in G's, ω is frequency, and D is the diameter of the tube used for testing fluids.[1]

$$\frac{b}{g} = \frac{(0.54\,Dg\omega^2)^{\frac{1}{2}}}{g} \qquad (2)$$

Having acquired the operational parameters, the fluids were inserted into the apparatus and the shaker was powered on. Using an accelerometer attached atop the apparatus, the acceleration was monitored and the drive settings of the shaker were adjusted.

Once the shaker was operating at the desired parameters, the assembly was inverted. In several early trials, a subjective determination was made for whether the RTI was inhibited, based on the time it took for the more dense fluid to move through the less dense fluid. If it was successfully inhibited, the point was marked as a valid stabilization point. In later trials, it became clear that attempting to qualify inhibition was unclear due to the highly variable nature of the stabilization parameters and difficulty in establishing a clear unmixed vs mixed boundary. Instead of attempting to declare a system stable, the inhibition should be quantified by duration. From then on, a timer was started at the inversion of the shaker system and stopped once the more dense fluid had collapsed into the less dense fluid.

RESULTS

After several unsuccessful attempts, dynamic stabilization of both a honey-air system and a SWS-101 Silicone oil-air system was achieved.

A honey-air interface was tested at exactly the parameters provided by both sets of calculations. Initially, no stabilization was achieved. However, based on the fact that our script output parameters for a curve of the lower bound of stability, the shaker was then operated at parameters above the curve at a frequency of 40 Hz and an acceleration of ~50 Gs. This acceleration value is well above the lower bound for stabilization at that frequency.

Successful inhibition and partial stabilization of the honey-air RTI system was recorded. For reference, the honey typically took ~6 seconds (a control time) to proceed to the bottom of the cylinder with no interference from the shaker. With the shaker operating at the parameters above, the honey took ~33 seconds to sink, a significant increase. Figure 2 shows that this data point is well above our predicted lower boundary of stabilization.

The most successful fluid system tested was a liquid-air system with SWS-101 Silicone Calibrating Fluid. This Silicone oil has a lower estimated surface tension and a lower viscosity than honey. This fluid system produced the longest recorded stabilization of the RTI of these tests. The results from several trials are shown below in Figure 2.
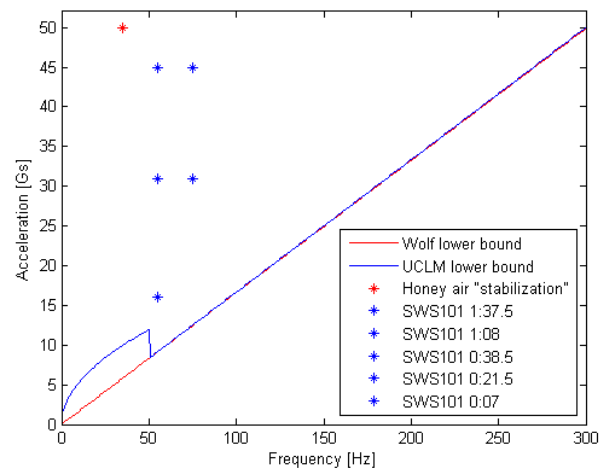

Figure 2. Lower bounds of stabilization are depicted for the Wolf and UCLM sources. Various

It is clear that as vibration parameters decrease towards those predicted as minimums by Equation 1, the time of stabilization decreases dramatically. It can also be seen that simply maximizing frequency and acceleration did not necessarily produce a more stable system. As is indicated in Figure 3, the peak stabilization time for 50Gs of acceleration did not occur at the maximum frequency of operation. It occurred close to 55 Hz for an acceleration of 50 Gs, not at the maximum testing frequency of 75 Hz.

Data was collected for a range of frequencies and accelerations, as shown in Figure 3. This data shows a clear trend wherein the time of stabilization increases with increasing acceleration for any given frequency. This agrees with the theory that the Equations 1 & 2 was based on and demonstrates that the values for acceleration and frequency generated are a lower bound of stabilization of the RTI. It was theorized that an upper bound of acceleration exists as well, which means that if the experimental apparatus is capable of producing high enough relative accelerations at any given frequency, a drop in stabilization duration would be observed. The data shows this slightly at the lower end of the frequency range that was tested, and this trend would become more clear if testing were performed for higher frequencies than the equipment was capable of supporting.

DISCUSSION

Preliminary trials with a water-air system were unsuccessful; the high relative accelerations required to stabilize the system
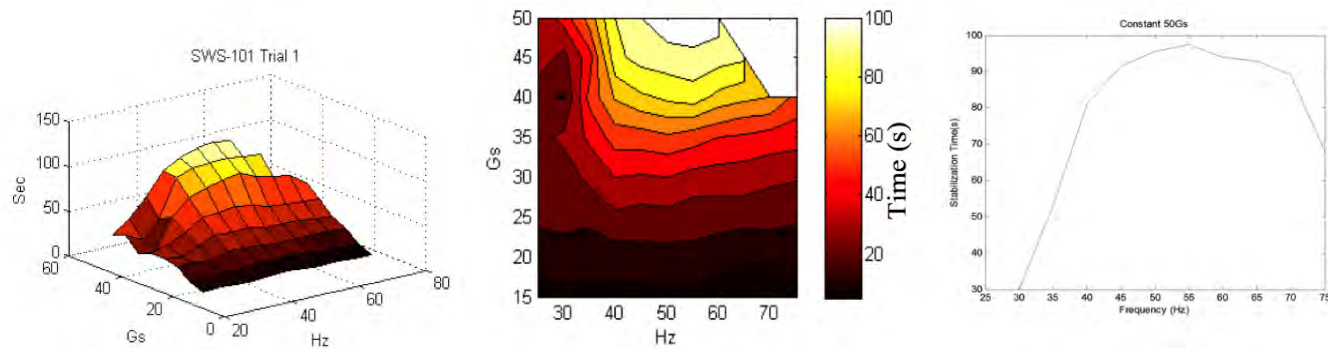
Figure 3. Three distinct views of our results. While the left image is all emcompassing, the right image clearly shows that when acceleration is held constant higher frequency does not imply longer inhibition

overcame the viscous forces holding the fluid together, resulting in frothing and aerating at the boundary. It was concluded that a more viscous fluid was needed, and after further examination of the Wolf paper it was discovered that he was unable to stabilize SAE90 (an relatively viscous fluid) due to similar surface aeration difficulties and that is why both he and the UCLM team chose a more viscous fluid, SAE140, with a viscosity on the order of several thousand cP for their final tests. It was then clear why a water-air system was unsuccessful; the viscosity of water is on the order of 1 cP. Due to the limited availability of highly viscous oils, honey was used because of its comparably high viscosity. While stabilization was achieved, the high surface tension of the honey became a problem and the honey crept down the sides of the container. In an effort to abate these effects, SWS-101 Silicon fluid was substituted due to its lower surface tension and similarly high viscosity. The result was the significant stabilization shown in Figure 3. This emphasized the effects of surface tension and the capillary effect, and raised questions about varying the diameter of the container to isolate and remove those effects.

A curious difference between the data collected in this experiment and the data of our sources is justification for stabilization. As a means of being precise, the data in this experiment was 3-dimensional, with the variables of frequency, acceleration, and time. The experiments of the sources cited were 2-dimensional, with the variable time eliminated by some indiscernible judgment as to whether or not the system was inhibited. This seems like a daunting task when presented with this data. One might decide that after some multiple of the control time (the time for the more dense fluid to proceed to the bottom with no vibration) the system could be called stabilized, but the sources gave no indicator. As a result, the decision was made to have the data remain 3-dimensional with potential for some more sophisticated conclusion to be drawn from the duration of inhibition.

After extensive testing of the SWS-101 Silicon fluid, a clear relationship between the frequency and acceleration of the vibrating fluid and the time it was stabilized was observed. Based on the data, there is a clear region of stability in which the fluid was successfully suspended upon air for over 90 seconds. The original goal of the experiment was to achieve suspension for an extended period which was achieved in the testing of the SWS-101 Silicon fluid.

Therefore, the experiment was a success, but there are many areas in which the process could be improved. The cylindrical container which housed the testing fluids had a small diameter (1.27cm) which was not controlled for and could have had effects related to surface tension. Several elements of the rotating apparatus could have been improved to allow for more consistent results, such as a rotation lock to provide a consistent final orientation. The plate riding on the axle also tended to work itself loose, and an improved design would have reduced play in the system and improved consistency. More time would have allowed for more iterations, which would have given us an opportunity to better control for error present as a result of the dataset being small.

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FACTORS AFFECTING DECISIONS DURING PREGNANCY IN HYPERABAD, INDIA

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Maternal and child deaths constitute a significant burden of India's health outcomes. It is estimated that India contributes to 25% of global maternal deaths, and despite efforts to improve maternal health, the maternal mortality ratio and infant mortality rate still remain high (Ministry of Health & Family Welfare 2005). Research has identified three key elements essential in improving maternal and child health: family planning, the use of skilled birth attendants, and access to emergency obstetric care (Pathak, Singh, and Subramanian 2010). The majority of adverse pregnancy outcomes could be prevented if women had access to these aspects of care throughout India.

Proximity to health centers, cost, and the desire to keep pregnancy private are some of the reasons why women do not utilize prenatal care services (Bredesen). In India, traditional and cultural beliefs play an important role in pregnancy-related care. Motherhood is considered a socially powerful role, and pregnancy is viewed as a phenomenon that does not require medical intervention. Often, individuals believe that it is only in the event of a problem that a visit to the doctor is warranted. Instead, during the childbearing period, an elder woman of the family or community provides guidance about beliefs, customs, and taboos during pregnancy. Such guidance can surround the types of food a woman should or should not eat, and the type of care they should receive (Wiley 2002, Choudhry 1997).

Though several studies have assessed factors that contribute to maternal and infant mortality, few studies have examined how cultural beliefs and perceptions of emerging western biomedicine contribute to the choice to seek prenatal care, an essential preventive care method. The goal of this study was to assess maternal behaviors surrounding pregnancy and to examine barriers and facilitators of care in Hyderabad, India.

METHODS

In order to meet study objectives, a semi-structured qualitative interview was used to survey women of reproductive age (≥18) in Hyderabad, India. Women were recruited from residential communities or local schools. Subjects were given an information letter about the study and verbal consent was obtained, in conjunction with quality research ethics. As a part of the consent process, women were informed that they were under no obligation to answer questions and could stop the interview at any point in time. To address confidentiality risks associated with data collection, no names or other personal identification information was noted. In each interview, the questions pertained to demographic information, behaviors during pregnancy, and information regarding how women made their health care choices during pregnancy. Statistical analysis was completed using IBM SPSS Version 22.0. Categorical variables were assessed using chi-square analyses. Furthermore, qualitative information was reviewed, and barriers and facilitators of care were identified.

RESULTS

Demographic information for the sample is discussed in Table 1. 76.5% of the women included in the study were aged 15-24 years at the time of marriage, and most respondents had at least a high school education, which was expected considering the urban sample. Nevertheless, there was variability in occupation in the sample, considering 36.5% of respondents were maids and 48.2% were working professionals.

The bulk of statistical analysis concerned prenatal care behaviors and cultural and decision-making influences. Table 2 displays these behaviors. Only 12.9% of women confirmed their pregnancy status using an at-home pregnancy test or with a doctor's visit. The majority of women followed doctors' instructions and used prenatal tablets (prenatal vitamins, iron tablets for anemia), but 80% of women did not understand the warning signs associated with complications of pregnancy. Furthermore, the majority of women in the sample sought care through a health care provider and delivered their baby in the hospital, contrary to what was expected from a sample with significant variability in education and socioeconomic status.

In order to examine cultural influences, women were asked if they avoided any behaviors or foods during pregnancy and if they ate more of a certain food item for the wellbeing of their baby. 82.4% of women answered that they did not avoid any behaviors. However, when asked about food avoidance, there was more variability in the responses. Interestingly, 40% of women avoided eating papaya due to the belief that papaya causes spontaneous

abortion. 74.1% of women also reported that they ate certain foods for the wellbeing of their baby. Examples of these foods included proteins and fresh fruits and vegetables. When women were asked : "Was there ever a time where your health provider told you to do something that went against your beliefs?", 78.8% of women answered no. This suggests that traditional beliefs are generally respected within the western biomedical system; essentially, the two can co-exist effectively. Cultural influences are displayed in Table 3.

The main goal of this project was to examine the factors that influence decision-making during pregnancy including proximity to care and familial influence. 53.1% of women reported that the nearest health center was in close proximity to their primary residence. As discussed earlier, proximity to care plays an important role in the utilization of prenatal care services. The last two questions examined women's autonomy in health care decisions. 57.6% of women reported that they consulted family in deciding where to deliver their baby. Similarly, 54.1% of women reported that family dictated their behavior during pregnancy. It was determined that family, health providers, cultural beliefs, and medical complications were all important facilitators to care. When women were asked about their decision to choose a hospital delivery, many answered: "it is the obvious choice," which suggests that prenatal care is considered to be important in this urban environment. Barriers to care included transportation, money, cultural beliefs and fear, which is consistent with the previous literature.

Results from chi-square analysis indicate that women's understanding of the warning signs associated with potential complications of pregnancy varied across socioeconomic levels (p<0.05). This is an important finding considering that all pregnant women should be informed of the risks and complications associated with pregnancy according to physicians in India (Navaneetham and Dharmalingam 2002). These results suggest that information is not being relayed effectively to all varieties of patients. It is thought that this stems from varied cultural roots. The potential dangers of pregnancy are not discussed amongst Indian women because it may be considered taboo to discuss potential complications during pregnancy.

DISCUSSION & CONCLUSION

Results indicate that most of the women in this urban sample utilized biomedical prenatal care services. Literature on health care utilization varies across India, and thus it is important to understand what women are doing in urban environments and to see if the importance of prenatal care has been emphasized in the local culture. Women in this sample believed that delivering in the hospital was the obvious and only choice, suggesting that the prenatal care movement is gaining prevalence across socioeconomic and education levels in Hyderabad. However, qualitative results did suggest that women of higher socioeconomic status had more autonomy in their pregnancy decisions, which stems from household dynamics and ability to access care. Overall, cultural beliefs serve as an essential facilitator in seeking prenatal care. And family, specifically elder women, play an important role in the decision-making process, as demonstrated through interviews and qualitative data analysis.

The biggest limitation in this study is sample size.

Nonetheless, this was a pilot study and sample size was less of a concern in designing methodology and interviewing women. This project was also confined to a specific region in India, and so the results cannot be extrapolated to the general population. Due to the nature of this year long independent study, expanding outside the range of Hyderabad was not feasible in the time frame allotted. However, there remains public health significance to this project. If we can better understand how women are making their prenatal health care choices, then we can better design interventions to reduce maternal and infant mortality. This study identified that there is a gap in the information being relayed by health providers to pregnant women, and thus future research in this area is warranted. Research is also warranted to further examine cultural decision-making influences during pregnancy.

TABLE 1: DEMOGRAPHICS

AGE	
20-29 yrs	20 (23.5%)
30-39 yrs	35 (41.2%)
40-49 yrs	26 (30.6%)
≥50 yrs	4 (4.7%)
AGE AT MARRIAGE	
10-14 yrs	12 (14.1%)
15-19 yrs	34 (40.0%)
20-24 yrs	31 (36.5%)
25-29 yrs	7 (8.2%)
EDUCATION	
No Education	19 (22.4%)
≤High School Education	18 (21.2%)
≥High School Education	48 (56.5%)
OCCUPATION	
Maid	31 (36.5%)
Professional	41 (48.2%)
Housewife	13 (15.3%)

TABLE 2: PRENATAL HEALTH BEHAVIORS

HOW DID YOU CONFIRM YOUR PREGNANCY?	
Pregnancy Test	7 (8.2%)
Doctor's Visit	4 (4.7%)
DID YOU FOLLOW YOUR DOCTOR'S INSTRUCTIONS? (n=81)	
Yes	71 (83.5%)
Sometimes	2 (2.4%)
No	8 (9.4%)
DID YOU USE TABLETS?	
Yes	66 (77.6%)
Sometimes	6 (7.1%)
No	13 (1.53%)
UNDERSTAND WARNING SIGNS?	
Yes	17 (20.0%)
No	68 (80.0%)
USE TRADITIONAL PRACTICES?	
Yes	34 (40.0%)
Sometimes	3 (3.5%)
No	48 (56.5%)
TYPE OF HEALTHCARE USED?	
None	3 (3.5%)
Health Practitioner	76 (89.4%)
Dai	6 (7.1%)
WHAT MONTH DID YOU START SEEKING CARE?	
1-3 months	73 (85.9%)
4-6 months	6 (7.1%)
7-9 months	2 (2.4%)
WHERE DID YOU DELIVER?	
Home	13 (15.3%)
Hospital	72 (84.7%)

TABLE 3: CULTURAL INFLUENCES

DID YOU AVOID ANY BEHAVIORS DURING PREGNANCY?	
Yes	15 (17.6%)
No	70 (82.4%)
DID YOU AVOID ANY FOOD?	
None	43 (50.6%)
Papaya	34 (40.0%)
Sweets	1 (1.2%)
Other	7 (8.2%)
DID YOU HAVE ANY FOOD ITEM FOR THE WELLBEING OF YOUR BABY?	
Yes	63 (74.1%)
No	22 (25.9%)
WAS THERE EVER A TIME WHERE YOUR HEALTH PROVIDER TOLD YOU TO DO SOMETHING THAT WENT AGAINST YOUR BELIEFS? (N=78)	
Yes	11 (12.9%)
No	67 (78.8%)

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Development of the Red Army's Infantry Tactics during World War II

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This paper analyzes the development of infantry tactics of the Red Army during World War II from 1941 to 1945. Accounts from German and Soviet soldiers, tactical field manuals, U.S. Army and intelligence reports, and previous studies written by military historians will be used to argue that the use of unconventional tactics by Soviet soldiers stranded in the rear by German encirclements contributed to the evolution of conventional tactics on the battle front lines. In the beginning stages of the war, Red Army infantrymen unsuccessfully used outdated conventional warfare tactics against the Germans at the front due to poor leadership in the officer corps, lack of tactical training, and lack of equipment. But behind enemy lines and cut off from the main body of the Red Army, stranded regular troops inside the German encirclements used successful unconventional warfare tactics that harassed and hindered the German war machine. These unconventional infantry tactics are explained through the description of the battle experiences of soldiers who engaged in combat with them, as well as their perception of success and the advantages of using these tactics in contrast to conventional warfare tactics. As the war progressed, these unconventional tactics and lessons learned on the battlefield would be applied successfully in major battles in the front lines by the main body of the Red Army, such as in the Battles of Moscow and Stalingrad. Reforms in the Red Army's officer corps and in infantry tactical training took place up to and after the Battle of Stalingrad in 1942, ultimately changing the course of the war with the implementation of modern conventional tactics. Details about the demise of the partisan movements and the use of unconventional tactics after the Battle of Kursk are explained, as well as the infantry tactics used in Operation Bagration and finally the Battle of Berlin.

I. Introduction

Literature about the Red Army's performance on the Eastern Front has been largely based on the accounts of the German Army (Wehrmacht) senior officers who were interviewed at the end of the war by the American military. Although these accounts contain an incredible amount of detail and insight on the Red Army's military doctrine of the period, they have also categorized it as uniform, simplistic, and non-evolving; a judgment which can be traced back to Nazi racial ideology and their bitterness about having been defeated in the war by Slavs and Communists. It is from these interpretations that the "myth of the Eastern Front" arises. The "myth" is essentially the stereotype of the Soviet common soldier, which characterizes him as a totally different human being with a fanatic dedication to Communism and Motherland, coupled with extreme bravery and cruelty bordering on bestiality and a complete disregard for the value of human life.[1]

According to German General Friedrich von Mellenthin, a fatalistic attitude enabled the average Soviet soldier to bear extreme hardship and privation, surviving for days without hot food or prepared rations and subsisting instead on wild berries and tree bark. Red Army soldiers' kinship to nature made them immune to cold, hot, and wet weather, to snowdrifts, darkness, and fog. These qualities also enabled them to use the terrain to their advantage and disappear underground without any visible effort.[2] With these natural instincts and their Communist ideology, Soviet soldiers were tough, obedient fighters who did not flinch when ordered to execute mass frontal attacks under heavy enemy fire, wave after wave, relying on their "superior" numbers and without any regard to the casualties on their side. In general, from the Wehrmacht's perspective, Soviet soldiers were mindless "barbarians" who would blindly follow orders from their political leaders and would not use their own initiative in their combat tactics.[3] This set of beliefs largely remained the basis for analyzing the Red Army's struggle against the Wehrmacht, not only for historians but also for the American defense and intelligence agencies until the fall of the Soviet Union.

At the end of the Cold War, new documents and reports from the Red Army's perspective became available for historians to analyze and compare with their previous beliefs. This new evidence not only refuted the "myth of the Eastern Front," but also paved way for a larger debate on the reasons behind the success of the Red Army, including how the Soviets consciously studied both their own methods and those of their opponents, modifying their combat tactics and techniques at all levels.[4] This paper will focus on the development of the Red Army's infantry

tactics on the Eastern Front from 1941 to 1945, including brief descriptions of Soviet tactics used during the Battle of Khalkhin Gol against the Japanese and during the Finnish War in 1939. Accounts from German and Soviet soldiers, tactical field manuals, U.S. Army and intelligence reports, and previous studies written by military historians will be used to argue that the use of unconventional tactics by Soviet soldiers stranded in the rear by German encirclements contributed to the evolution of conventional tactics on the battle frontlines. Isolated from Moscow's oversight and unsupplied, Soviet officers and soldiers behind German lines had to rely on initiative and imagination to innovate combat tactics to fight the Wehrmacht, enjoying a relative flexibility of command that the main body of the Red Army fighting on the frontlines did not have. The paper will also describe how Stalin's purge of the officer corps in the 1930s, the lack of tactical training and supplies, as well as the rigid command of the political commissars, were all detrimental to the Red Army's adoption of modern warfare infantry tactics until the late 1942 army reforms.

The terms of conventional and unconventional warfare tactics will be frequently used throughout this paper to describe the ways in which infantry attack and defense approaches were performed. The definition of conventional warfare used in this paper is the type of warfare in which combatants face each other with well-defined forces in order to rout or destroy their opponent, accomplished by reducing the opponent's armed forces and/or by acquiring strategic territorial gains, which ultimately leads the enemy to surrender. Included in this definition, there are two types of conventional offensive tactics described in this paper, outdated and modern conventional tactics. Given the context of World War II, outdated infantry tactics encompass the use of mass formations of infantrymen in frontal assaults (human wave attacks) at the squad, platoon, and company levels, accompanied by the supporting cover fire from artillery and tanks. This concept applies to tactics used in previous military conflicts, but more specifically to the First World War. On the other hand, modern infantry tactics refer to the small unit actions in which soldiers move from cover to cover, where groups of soldiers, as well as artillery or tanks, use suppressing fire on enemy positions while other groups attempt to flank, encircle, or envelop the target positions. In the case of defensive tactics, these approaches are less distinguishable from outdated and modern ones, as entrenchment and counterattacks were and still are the most common defensive tactic against enemy attacks.

The term unconventional warfare refers to the type of warfare where the objectives are not necessarily to destroy the opponent's forces or to acquire territorial gains, but to diminish the opponent's fighting capabilities, determined by such factors as supplies, morale, and troop numbers, in order to prolong the struggle until one of the combatants surrenders. Unconventional warfare can also be used as a complementary strategy when engaging an enemy in conventional warfare situations. In the case of unconventional tactics, there are still no defined lines between outdated or modern tactics. This type of tactics encompasses the use of hit-and-run attacks (guerrilla warfare), infiltration techniques in the rear of the enemy, and surprise night attacks, all of which have the purpose of inflicting the most damage to the enemy (in terms of supplies, weaponry, or manpower) and withdrawing as soon as possible in order to reduce one's own casualties.

II. 1938-40, Battle of Khalkhin Gol and Finnish War

In order to explain the inefficiencies and tactical incompetence in conventional tactics of the Red Army's infantry during World War II, some background information from the Battle of Khalkhin Gol and the Finnish War must be analyzed. Since its inception, the command and organizational structure of the Red Army, due to its political ideology of communism, enforced a lenient and "non-rude" relationship between officers and soldiers, as the Soviet Army was supposed to be comradely and open. This ideal and the fact that in 1938, officer cadets in their early twenties were given their commission in advance of graduation from Soviet military academies, would present discipline problems for soldiers. Records show that the most common breaches of discipline before 1941 involved rudeness or insubordination of soldiers, men in their thirties, to their young junior officers.[5] Such details involving discipline and the image of leadership upon infantrymen were vital factors for effective tactics during the conflicts that followed and the early months of the Nazi invasion. Soldiers needed to trust their officers' decisions during battle, which in this case meant that the older and more experienced men had to rely on and trust the "better judgment" of younger and less experienced officers, who were not very well versed in tactics and leadership skills.[6]

After the occupation of Manchuria in 1931, Japan considered the Soviet territories on the border its new imperial interests and began raids along Soviet territory that sparked the Nomonhan incident in May 1939, known to the Soviets as the Battle of Khalkhin Gol. Since 1925, the Imperial Japanese Army (IJA) had realized how the massed infantry formations from World War I on the battlefield were deadly anachronisms. Japanese commanders believed the new battlefield required the adoption of innovative conventional tactics that involved infantry cooperation with other combat arms like armor and artillery, night fighting and small unit maneuvering, and most importantly, the increased reliance on the independent decision making ability of junior and non-commissioned officers.[7] It became evident that with the recent advances in technology, infantry in modern warfare had to place a great emphasis on the use of cover and concealment, and reduce the distances covered in single dashes under enemy fire.[8] Not only the Japanese, but also the German, British, and American armies realized this and included these specifications in their tactical manuals at the time.[9] This was not the case with the Red Army. Due to Stalin's purges of the officer cadre in the 1930s, Soviet military theory was driven by the political officers, who still stood firmly in favor of the mass use of troops on the axes of the main offensive thrusts in the form of "wave tactics,"[10] based on previous combat experiences, primarily from the First World War.[11] The use of concentrated armor with supporting infantry was also neglected, which led leadership to distribute tank regiments among infantry divisions to serve merely as fire support for the infantry waves.[12] Soviet military thinking before the purge had actually recognized the importance of technology and how it affected traditional infantry tactics, as machine guns and artillery prevented the helpless infantry from advancing, requiring offensives to be led by tanks with the infantry supporting them and not the other way around. These new regulations brought by

military intellectuals were never implemented due to the purges, as Stalin distrusted the intentions of these officers and their new ideas of conventional modern warfare.[13]

At the time of the Nomonhan incident, Japanese High Command recognized the Red Army's imparity of battlefield efficiency caused by the purges, but although it initially benefited them, it also led them to underestimate their enemy at the later stages of the battle.[14] Japanese officers obtained their impression of the Soviet mind from a short, classified manual titled *How to Fight the Soviets*, which depicted the Soviet soldier as submissive, docile, and prone to blind obedience, who would show "little initiative in a dull-witted and stolid manner."[15] In the first encounters of the Battle of Khalkhin Gol, these beliefs seemed to be accurate due to the poor performance of Red Army troops, engaging in several frontal attacks with sheer numbers towards the same trench over and over again while suffering numerous casualties.[16] In addition, when the Japanese engaged in night attacks and in hand-to-hand combat, Soviets showed little inclination to defend themselves and were scared of their Japanese counterparts, who were experts in bayonet fighting and considered themselves worth five Soviets each.[17] However, there was a large asymmetry between the number of tanks and artillery guns the Soviets had compared to the Japanese, and ultimately, these numbers decided the fate of the battle. The well-trained Japanese infantry was unable to fight off the Soviets' massive assaults, which included massed formations of infantry and tanks that were accompanied by immense artillery cover fire, mainly due to the absence of numerous and continuous barrages from the IJA's side.[18] Japanese forces, going against their newly adopted army doctrine, were forced to fight in the outdated positional war the Soviets specialized in, as the IJA's infantry had to go on the defensive and entrench themselves with the hope of surviving the artillery barrages and then the numerous Soviet infantry and tank thrusts that eventually wore them down.[19] The outcome of the Battle of Khalkhin Gol was a clear Red Army victory against the IJA, won by sheer numbers and massive firepower from tanks and artillery. This victory would be detrimental to Soviet military doctrine because it kept commanders confident in their use of outdated conventional infantry tactics, and their continued use would present unexpected consequences in later conflicts, such as the Finnish War.

When the Soviet Union invaded Finland in late 1939, officers still led massive thrusts of Red Army infantrymen to overrun Finnish positions in sudden "hurrah!" charges after an artillery barrage, similar to the tactics used in World War I when soldiers crossed no man's land under heavy machine gun fire and mine placements.[20] The Finnish Army fought the Red Army to a standstill in the snow-covered forest swamps of Karelia, where they defended the fortified Mannerheim Line.[21] At the beginning of the invasion, warfare was largely positional and similar to the Battle of Khalkhin Gol, with the Soviets overwhelming Finnish trenches with massive thrusts of infantry, with tanks in a supporting role. Although the massive infantry wave attacks were successful in reaching their objectives by sheer amounts of men and material, the infantry was still not resolute in pressing home attacks and did not know how to disengage from enemy contact when necessary; nor how to fortify positions, overcome obstacles, or camouflage themselves, due to poor training.[22] As the war

moved northward to the large forest wilderness of Finland, the Red Army was unable to continue to use tanks to support their infantry movements and to execute efficient artillery barrages that could pin down Finnish troops. The Finnish infantry then began relying on the terrain to counteract the Red Army with different combat techniques. Many Red Army troops were not well equipped or trained to fight in deep snow and panicked when they were ambushed by Finnish ski-troops well trained in camouflage, tactics, and reconnaissance, who loomed like ghosts out of the foggy landscape.[23] The Finnish infantry, using daring small-unit hit-and-run tactics and snipers, attacked Soviet columns from the rear and cut them off from supporting reserve troops, enabling Finnish defensive emplacements furnished with machine guns and mortars to contain and finish off Soviet attacks; all unconventional tactics which, ironically, would later prove effective for the Soviets in the war against Germany.[24] The Red Army ended up suffering thousands of casualties while confronting the inferior military force of the Finnish due to the lack of supplies and outdated infantry tactics ordered by poorly trained commissioned and non-commissioned officers.[25] Even after the Finnish War, the lack of weapons and supplies remained a problem during training exercises and drills.[26] Repairs and spare parts for rifles and other equipment were also scarce, leaving many recruits without a weapon of their own, which, not surprisingly, showed up in the failed expectancy standards of rifle competence in the officer corps and soldiers.[27]

The Red Army's performance in Finland became the Nazi High Command's main point of focus for studying Soviet strategy and tactics for their preparation of Operation Barbarossa in 1941.[28] Although successful against the Japanese and the Finnish armies, the poor and outdated conventional tactics of the Red Army would prove to be no match for the German Army, which pushed back Soviet borders well into their territory and almost captured Moscow in only four months.

III. 1941 and Operation Barbarossa

When Nazi Germany invaded the Soviet Union in June 1941, the Red Army was completely surprised by the Blitzkrieg and its effectiveness in pushing back enemy lines, primarily because they were not trained on how to counter these modern tactics.[29] On the front lines, the Red Army was still using the same "wave" tactics that characterized it during the Battle of Khalkhin Gol and the Finnish War two years earlier.[30] Military training was still poor, inefficient and based on outdated tactics.[31] Infantrymen would charge and scream "hurrah!" against the invasion forces, wave after wave, until one of the sides would retreat, which in this case was the Red Army most of the time.[32] In an atmosphere of surprise and confusion, the Red Army at the tactical level remained rigid and strictly adhered to the orders contained in the field regulations. This inflexibility at the lower command echelons, fueled by the fear of doing something wrong and being punished for it, repressed the officers' self-initiative and imagination in the use of tactics. In order to avoid all personal responsibility and therefore dismissal, execution, or assignment to the penal battalions, officers and political commissars followed regulations to the letter and ended up destroying their entire units.[33] Accounts from Red Army soldiers at the front tell of how officers would order attacks without any previous artillery barrages to suppress

the enemy, or order the infantry to charge against a tank column without anti-tank rifles or even Molotov cocktails, as there was still a lack of supply of weapons and ammunition in the Red Army.[34] Officers and political commissars themselves did not participate in these suicidal frontal assaults used to attack and counter attack the Germans, as Soviet infantry regulations allowed them to participate and lead their troops "only in exceptional situations."[35] By now the reader may be wondering, why were Soviet officers using offensive tactics when they were supposed to be on the defensive? The answer lies in the 1936 Soviet Field Regulations. In this three hundred page document, only about twenty pages are dedicated to defensive tactics, because the Red Army's attitude towards defense defined it as "a temporary phenomenon in warfare to economize force, gain time, hold critical areas, or disrupt an advancing enemy, pending a resumption of the all-important offense."[36] To make matters worse, the already limited quantities of artillery denied the infantry adequate support, and the awkward use of small groups of tanks within the infantry lines proved useless against the German offensive.[37]

In comparison, German tactics were modern and used technological advances to their advantage. Their offensive tactics required squads to move in single columns and then deploy into skirmish lines upon encountering enemy fire, where machine gunners would deploy on the spot to protect the remaining riflemen, who in the meantime were moving towards cover at the right, left, and center. When each soldier had reached cover, they would usually fire independently or would concentrate on a single target if ordered to do so. If ordered to advance, they adopted a loose formation and flanked or enveloped enemy positions under the cover of their machine gunners, and once the position was taken, the squad reorganized quickly.[38] While on the defensive, German squads would dig in a frontage of foxholes, trenches, and ditches in a distance of 35 to 45 yards from the enemy, with machine gunners being stationed 50 meters or more behind riflemen. Machine gunners would concentrate their fire against attacking Soviet waves from a distance, while riflemen were concerned mainly with sweeping the terrain at very close range.[39] With this in mind, it is not surprising that Soviet wave tactics failed to overrun the highly disciplined Germans as they did with the Finnish and Japanese forces.[40] Of course, the technological advances in weaponry were the most important factors contributing to the Wehrmacht's offensive and defensive successes, but the Germans nevertheless had also placed their emphasis on the development of new tactics, and more specifically, in the self-reliance of small infantry units that became ever more important as the war progressed.[41]

German soldiers' accounts also talk about the numerous waves of infantrymen assaulting their defensive positions without any artillery barrages. Although Soviet artillery was not completely absent, their barrages were highly predictable based on their difference in timing between the infantry charges, permitting the Germans to react in time and engage the charging infantry.[42] Other Germans officers and soldiers reported that they were surprised at how uncoordinated and simple minded these attacks were, as few or no tanks were used to support them. When Soviet armor was dealt with, the infantry kept charging and became easy prey to German machine gun and mortar fire.[43] Both Germans and Soviets also reported that retreats were very common and that

sometimes, the Soviets would even attempt to "retreat" to villages in enemy territory, not knowing that the Germans had already captured them. These combat situations came to represent the general view of the Eastern Front at the beginning of the war, with the Soviets unsuccessfully defending against the technologically advanced Wehrmacht and its Blitzkrieg tactics. However, combat fought behind the German advance by stranded Soviet units and their unconventional tactics are less known, and are often mistakenly characterized as having a small effect on the advancing invaders.

The military strategy behind Operation Barbarossa focused on carrying out enormous encirclements within the extensive Soviet territory, with the purpose of surrounding countless Red Army units and forcing them to surrender in as little time as possible, hoping for Soviet capitulation before the Russian winter arrived. The strategy was very successful at the beginning of the operation, but attaining the advantage after encirclements was only half the battle. In the case where the attacking force secures the positional advantage after the encirclement and the enemy surrenders, the battle is over. But in the case where the enemy forces refuse to capitulate, the attacking force is obliged to clear the remaining forces in the rear, which most of the time are small defending pockets that waste valuable resources and time for the larger advancing army.[44] Unfortunately for the Germans, a lot of the Red Army units did not surrender and thousands of Soviet troops were trapped and stranded inside the pockets, cutting them off the main Red Army and supplies.[45] Soviet units did not immediately stop fighting or desert as it is commonly believed.[46] Most of them continued to fight and made their way eastwards towards the main body of the Red Army and to the front.[47] However, these units had to adapt to the situation and engaged the Wehrmacht unconventionally, using tactics that ranged from sabotage and hit-and-run ambushes up to insurgency[48] and infiltration.[49] Atrocities seemed to have also been used as a method to lower German morale and as a deterrent. Wehrmacht reports offer some examples of these atrocities, mentioning how some units, for example, were attacked in a series of night raids and bayoneted to the last man. Some corpses were found with more than 17 bayonet wounds and others with their eyes gouged out. Another report mentions how a battalion patrolling a forest became subject to sniper fire[50] from all sides and had to retreat immediately. The corpses from the men that had gone missing during the withdrawal were later found lined up and with their necks shot, suggesting that they were executed by the Soviets.[51] Ultimately, these units trapped behind enemy lines became the basis for the first partisan resistance units, as they took their weapons into the forests to resist the Germans.[52] The size of these bypassed Red Army units ranged from small squads to entire battalions and regiments, who still retained their military organization and their heavy weapons, like tanks and artillery guns.[53]

Alexander Poliakov's account serves as the best example of how these stranded units reacted to the German encirclements, as his battalion was caught inside a German pocket in the southwestern front and began combatting the Wehrmacht with guerrilla warfare. Poliakov mentions that his officers ordered that from that moment on, they would be engaging the enemy with guerrilla warfare in order to hinder his advance and to identify his strength and positions. The battalion had to raid enemy posts to solve the

problem of supplies and was strictly forbidden to take anything from the Soviet villagers, as their support would be vital in the fight.[54] Poliakov mentions that his battalion had never received any combat training in this kind of warfare,[55] but that it was not difficult to adapt their tactics and that the soldiers unanimously preferred them over the "hurrah" charges, as their officers were more flexible with the planning of attacks and the roles of each soldier.[56] For example, in ambushes, artillery barrages would serve to distract the German tanks from their route, while infantrymen let them pass unharmed[57] and would wait for the enemy infantry columns to enter the ambush site, in which Red Army soldiers would cause as much damage as possible and then leave.[58] Night attacks was also preferred by Soviet troops. Accounts from both sides explain that German soldiers never expected to be attacked at nighttime and that they were terrified of ambushes in the middle of the night, as they were not trained or prepared to fight any kind of guerrilla warfare.[59] But according to Poliakov, the driving factor behind the Soviet infantrymen's preference for unconventional tactics over the traditional wave attacks was the low casualty rate, which was much smaller than the one suffered by the troops fighting on the frontlines.[60]

Why were these unconventional tactics more successful? First, indiscipline was uncommon in these stranded units, because infantrymen were not ordered to run suicidal charges and also because officers were sharing the same toils soldiers were suffering.[61] Second, although some Soviet villages saw the Germans as liberators, this was not the case for most of them.[62] Villagers and civilians would aid these stranded units by giving them shelter, showing them the location of German positions, and sometimes increasing their manpower,[63] transforming these stranded units into a mixture of regular troops and partisans.

Before continuing to reference the use of unconventional warfare tactics on the Eastern Front, a brief note on the partisan movement must be introduced. The term partisan has been employed erroneously in the literature of the Eastern Front to include a wide variety of fighters who were fighting behind enemy lines, regardless of their status within the main body of the Red Army. Although stranded units initiated the Soviet partisan movement, not all of these soldiers stayed in the rear and became "partisans." While many rejoined the main body of the Red Army, others surrendered or were captured by the Germans. Paratroopers that were dropped behind the enemy lines also executed reconnaissance, sabotage, espionage, and terrorist operations, for which the Wehrmacht came to consider them "guerrillas."[64] Other types of early partisan units were composed of Communist Party functionaries, older Red Army reservists, NKVD troops, factory workers and other civilian volunteers. These quasi-civilian partisan units were armed with Red Army ordnance and sometimes wore old Soviet military uniforms or parts of them, confusing German troops about the fighters' original status.[65] When Wehrmacht troops captured any of these fighters, they were confused on whether they should treat them as prisoners of war or as guerrillas, because POWs were imprisoned and sent to labor camps, while guerrillas were executed on the spot. In an attempt to clarify the situation and establish a basis for separating the legal from the illegal, a series of directives were issued on July 3rd 1941 to distinguish between the statuses of these combatants. Proclamations made by the occupying forces

stated that all kinds of fighters that did not surrender by August 15 would be considered partisans and treated as such.[66] German consideration of all fighters in the rear as partisans could perhaps offer some explanation as to why most of the previous literature about the Eastern Front generalized the term partisan. During the following months, the occupation authorities would later catalogue these fighters as "bandits," due to the "psychological implications" for authorities and villagers alike. In the long run, these changing definitions altered the Wehrmacht's perception of these units, leading them to underestimate the harm caused by their operations.[67]

Soviet unconventional tactics, although successful in harassing and hindering the German advance, did not succeed in pushing the invaders back. Some German accounts mention that there were little or no "partisan" movements during 1941 as most of the Soviet stranded units eventually surrendered, and as 1942 began, these attacks in the rear were practically nonexistent.[68] Poliakov's account offers an alternative explanation for such "lack" of attacks, mentioning how these stranded units fought their way eastwards and eventually linked with the main body of the Red Army. Unfortunately for the Soviets, the soldiers experienced in unconventional tactics were then used in the same wave tactics of the front, leading to a repeat of the problems of indiscipline and the high casualty rates. Even with large numbers of enemy troops at their rear, the German High Command's confidence remained unchanged due to the Wehrmacht's superior technology[69] and the rapid successes of Operation Barbarossa, reinforcing the perception that the Red Army was weak and leading them to believe that their victory in the Soviet Union would be swifter than it was in France in 1940.[70]

IV. 1941-1942 and Battle of Moscow

By late 1941, the Wehrmacht kept advancing and pushing forward deep into Soviet territory with the help of the German Blitzkrieg, until eventually it reached the outskirts of the capital of the Soviet Union, Moscow. Across all fronts, the Red Army officer corps[71] was still inefficiently using its infantry manpower in suicidal "wave" attacks at the front, which eventually led to an exponential decline in morale and in discipline among infantrymen.[72] Entire companies would march abreast in columns of threes or fours, with an interval of five to ten paces between them, and without commands, soldiers within 50 yards of the German positions began their assault amid wild shouting. Row after row, the dense Soviet columns were mowed down.[73] Guns, ammunition, winter equipment for the coming winter,[74] and artillery,[75] were all scarce during this period of the war across the whole front for the Red Army. Soviet infantrymen reported that in some situations, they even had to hold tanks at bay with only their rifles and machine guns, as they were not supplied with any anti-tank weapons or Molotov cocktails.[76]

However, on the outskirts of Moscow and in the rear of the Wehrmacht, the situation was different. The German rear became constantly threatened by partisan movements, stranded Red Army units, and even POW escapees, who would prefer to remain in the rear engaging the enemy unconventionally rather than reuniting with their comrades at the front.[77] But by now the Red Army had already established communication with some of the newly raised partisan units, including paratroopers and stranded units.

In October 1941, Red Army personnel began to take active command in the functions of these "irregular" units, leaving political commissars and party members only political functions, making military operations more successful.[78] Cooperation between the irregular and regular troops became apparent when forces contacted each other on the field, as at certain battles German units were unsure whether infiltration tactics were being used by the Soviets or whether stranded units were following them closely in the rear.[79] This cooperation enabled Soviet forces to start succeeding in the containment of the German advance, as soldiers would share their experiences fighting the Germans and differentiating between successful and unsuccessful infantry tactics. Regular troops would rotate with irregulars on infiltration operations and both sides would benefit from the tactical experience.[80] It seems that it was at this point of the war, when the main body of the Red Army and its commanders began to see the advantages of using the unconventional tactics of the irregular units and then adapting them to the conventional environment they were in. The fighters at the rear of the German Army utilized unconventional tactics, which were fundamentally similar to the conventional tactics the Wehrmacht and other modern armies used. In other words, unconventional tactics were being incorporated into the conventional doctrine from one day to the next by the Soviet infantry, making the lines defining these two types of modern tactics become blurred as the war developed.

To better illustrate this point, it is necessary to analyze the contents of the *Partisan's Companion*, a guerrilla warfare manual first published in Moscow on 27 December 1941 containing the lessons from the Russian Civil War and the early partisan units of World War II.[81] In comparison to the Soviet Infantry Regulations, the *Partisan's Companion* was less ambiguous and better detailed on the execution of infantry assaults against the enemy. For example, the *Partisan's Companion* established the need for small-unit actions, requiring two squads of troops to be used in night raids, an assault and a cover group. The cover group would position itself in an advantageous position to suppress and distract the enemy while the assault group carried out the sabotage operation or the flanking maneuver on the German positions. Initiative and creativity were highly encouraged, as well as the element of surprise which required Soviet soldiers not to scream "hurrah!" when assaulting the enemy.[82] As it can be seen, the methods contained in this manual are quite comparable to the German modern conventional infantry tactics described earlier in this paper. In other words, Red Army soldiers were beginning to use modern infantry tactics after having experienced unconventional warfare techniques. Such circumstances suggest that the modernization of infantry tactics started in the lower levels of the Red Army, and then gradually spread across the ranks until it reached the highest levels of command. Still, it would not be until later in the war when the Red Army implemented these modern tactics, and would still consider them unconventional by definition until then.

Soviet High Command started to realize the effectiveness of the unconventional tactics these infantry units were using, and started to encourage other units to use them at the front during the Battle of Moscow.[83] In the early weeks of the battle, infantry tactics would be moved towards nighttime "hurrah" charges that caught the Germans by surprise in their trenches. These assaults quickly transformed into hand-to-hand combat and bayonet fighting that

eventually affected German soldiers psychologically, just as it had affected the Soviets during the Battle of Khalkhin Gol against the Japanese.[84] As these attacks became more successful and logistics improved, Soviet leadership began to furnish infantrymen engaged in these nighttime attacks with better winter equipment and better camouflage, temporarily replacing the "wave" tactics for infiltration and close quarters combat.[85] Reconnaissance in force was also widely applied across this front. German officers stated that Soviets were particularly adept at this reconnaissance operation, which normally took place during the night and under the cover of thunder or snowstorms. For reconnaissance in force, the Red Army employed forces at least in company strength, but also frequently in battalion and regimental strength. The main objective of these operations was not only to uncover the enemy's positions and true strength, but to capture strategic terrain and take prisoners.[86] The Wehrmacht's drawn-out defense fronts and widely separated strong points enabled Soviet soldiers to infiltrate their positions without difficulty, surprising the invading troops despite strong watchfulness over their defense lines.[87] Well camouflaged Soviet infiltration units would also lie in wait for hours and then ambush enemy reconnaissance patrols in order to prevent them from obtaining information from the terrain.[88] With the success rate of these unconventional operations on the rise, Soviet leadership started forming special units composed by people who knew the territory on the outskirts of Moscow well enough to create a series of tunnels and caves that would penetrate deep into the German lines.[89] These tunnels were then used by infantrymen to gather information, disrupt and disorganize the enemy positions and supplies. Sometimes soldiers remained dormant until a Soviet offensive took place within those positions, in order to surprise the German troops from the rear and cause them as much damage as possible.[90]

As Soviet offensive operations were being executed during nighttime, an effort was made to strengthen defenses for daytime combat. German soldiers recognized the Soviets had improved their skills in the use of feints, sham installations, and dummy material of all types, cleverly concealing the assembly of their artillery batteries from the Luftwaffe during the day so that they could use them by night.[91] Complex field fortifications and numerous earthworks of all kinds were constructed at high speed, and emphasis was placed on using infantry weapons against tanks, including anti-tank (AT) rifles and land mines.[92] In fact, the Red Army was the war's largest user of AT rifles, producing some 400,000 during the war. These rifles were first used in November 1941 when they were used against the German tanks in flank and rear attacks. Their disadvantage was that their fire had to be concentrated on the thinner plates of German tanks, located in the "belly" of the tank and therefore requiring expert marksmanship for their success. Nevertheless, the availability of these AT rifles was better than having no anti-tank weapons at all, therefore making these rifles instrumental in the defense of Moscow.[93]

When winter came in 1941, German troops were lacking sufficient winter equipment to maintain constant infantry and armored offensives. Moreover, their artillery, tanks, and aircrafts were now having trouble acquiring their targets due to heavy snowstorms and darkness that reduced visibility on the battlefield.[94] Winter favored the Soviets, and the unconventional

tactics mentioned earlier were used more often and were now being coupled with the lessons learned from the Finnish War. The Red Army created its own ski troop units that engaged the enemy with hit-and-run tactics and cut off the German infantry from their tank regiments, and then suddenly disappeared into the darkness of winter nights. Just as these ski troops gained importance when the Germans were successfully hindered from attacking Moscow, Soviet High Command started replenishing these light infantry shock troops across the whole front with the best equipment available, like sub-machine guns,[95] anti-tank rifles, and camouflaged winter clothing. Guidelines were even issued for the appropriate use of the tactics these units were using. For example, it was stated that no more than 12 infantrymen could take part in an ambush deep inside enemy territory.[96]

The experimentation with these new tactics gave the less trained and equipped Red Army in the Battle of Moscow a prospect of repelling the German advance. But the full potential of these tactics was not exploited, as they were later abandoned by Soviet leadership and would not be fully implemented until the offensive of 1942.[97] The tide of the battle therefore remained unchanged, as the Wehrmacht was still on the offensive and occupied the western territories of the Soviet Union. The Red Army was still not ready to produce an effective counteroffensive that could push the Germans back, for which modern conventional warfare tactics and technology were needed. However, by now German High Command recognized that the Battle of Moscow had become one of the turning points in the Eastern Campaign.

V. 1942-1943 and Battle of Stalingrad

By 1942, the Red Army had contained the German Blitzkrieg in the center, but was still under its threat on numerous fronts, including the important northern and southern fronts. The battles at the northern front would take place mostly in forests and small villages. Soviet bunkers and defense installations were so well camouflaged deep within the area that German airplanes could not identify them and destroy them, resulting in German troops constantly being ambushed during patrols. From these strong forest garrisons, Red Army units and partisans constantly raided German positions and cut them off from their supply lines. Radios were also starting to be distributed on the Soviet side.[98] This enabled communication between the larger partisan units and the Red Army, supplying both sides with information about military developments in their sectors and complementing their conventional and unconventional operations against the Germans. As in the Battle of Moscow, small troop movements and attacks were also primarily carried out under the cover of darkness, fog, and snowstorms. However, the Germans started learning from these unconventional attacks and started implementing them in their own battle plans, transforming the northern sector into a continuous battle of small scale assaults in forestlands that proved indecisive for both sides. For example, during the winter, both sides made wide use of commando teams who infiltrated the enemy's rear and carried out surprise attacks, and then resumed regular combat when the winter season ended.[99]

On the southern front, where the terrain was composed by large open fields and steppes, tank warfare and control of the airspace were both vital for battlefield superiority, not allowing the Soviets to contain the German advance with the infantry tactics that

had worked earlier. Soviet infantry would still suffer numerous casualties from the use of the wave attack, but also by the trial and error of different new tactics, as they soon realized how obviously ineffective the wave attack was. A German battalion commander noted how typically Soviet infantry would approach the Germans seated on T-34 tanks in order to avoid becoming exhausted by the march through deep snow. Without protection, the infantrymen became easy targets for German machine gunners and snipers, forcing the Reds to later place their infantry behind the tanks across open ground, which in turn slowed down and exhausted the infantry and allowed German anti-tank units to deal with T-34s. In desperation, Soviet infantry continued to assault in mass formations with scant regard for the loss of life and only using tanks as supporting weapons, not in massive main thrusts. The battalion commander also noted that these wave attacks would only have success when executed under the cover of darkness and with a silent approach, which ended up with hand-to-hand combat that the German soldiers feared.[100] However, Soviet leadership had already started a transformation in infantry training and to apply the lessons learned in Moscow, more specifically the ones regarding camouflage and reconnaissance. For example, a German account in July 1942 tells of how under intense heat and dust across the wide open steppes of the southern front, Soviet infantrymen would be carrying out reconnaissance patrols with excellent camouflaging equipment and disappearing immediately when noticed.[101]

In the battles on the outskirts of Stalingrad and in the early weeks of the city's battle, "hurrah!" charges were still part of Soviet infantry tactics, along with inefficient or non-existent supporting artillery barrages.[102] It was not until the middle period of the Battle of Stalingrad that these wave tactics would be transformed, although not replaced. Artillery barrages and snipers would help to suppress the Germans in their trenches and positions, enabling the charging infantry to reach the enemy and engage it in hand-to-hand combat.[103]

Although the Wehrmacht was successful in Stalingrad at the outset, the constant bombardments of the city created an opportunity for Soviet unconventional tactics to be employed in urban environments, as German tanks and artillery guns were unable to pass through the streets of the ruined city and give their infantry the appropriate support. This rubble and the destroyed buildings provided Soviet snipers and machine gunners with positions where cover could be exploited behind enemy lines, which kept the German troops suppressed and caused them psychological terror. Yet, the Wehrmacht was quick in identifying the key features of urban warfare and in implementing the necessary changes in tactics. In a document prepared by the 305th Infantry Division for the guidance of junior leaders, the following characteristics of urban warfare are identified:

> *"First, there is a great reduction in visibility. Second, the typically horizontal command structured is flattened, and the urban battle becomes a series of small battles in which the exercise of command even in small units becomes difficult. Third, there is a reduction in the effective use of one's own weapons. Fourth, there is a great difficulty in identifying the enemy's forward line, pockets of resistance and possible locations for ambushes. Fifth, there is a general weakening in the effect of one's own local successes. All leaders are to keep as close as possible to their men as their command tasks permit. Combat in a conventionally and*

organizationally structured regime is the exception: the formation of combat groups of all arms is the rule."[104]

The Soviet ambushes from the rear and flanks had taught the Germans the need of reserve troops, who were tasked to fine-comb the terrain behind the main advance for enemy units. These "annoying" delayed ambushes were seen as dishonorable and unacceptable engagements by German soldiers, enforcing their belief that they were facing a "barbarian" army, similar to the experiences of the Romans in ancient times.[105]

The Battle of Stalingrad became the turning point for the transformation of Red Army infantry tactics, as well as in the other branches, because they underwent restructuring and modernization during this period. This turning point is highlighted by the transformation of the officer corps into a professional and competent leadership group that occurred in November 1942. In addition, resisting the Germans on the other fronts had so far paid its dividend. Supplies of armor and artillery increased, communications improved, and staff work and logistics became more competent, levelling the battlefield in terms of equipment and ammunition.[106] With the German threat still strong, Stalin released his grip from the Soviet High Command and gave generals flexibility to implement their own strategies and combat regulations that enabled them to transform the Red Army into a competent conventional fighting force. The new strategies to be followed as considered by Marshal Timoshenko and General Zhukov can be found in their letters and reports captured by the Germans. In them, both officers recognized that the weakness of the German military doctrine laid in what they considered their strength, their reliability on their engines and weapons. The challenge was for Soviet forces to resist until winter arrived by destroying as much enemy material as possible and cutting off their supply lines, so that when the cold arrived and rendered the remaining machines useless, the Soviets could carry out a successful counteroffensive. Both senior officers also expressed confidence in the creativity and improvisation of the Red Army and how these qualities should be encouraged by officers at lower echelon levels.[107]

Soviet Infantry Regulations were also reformed and additional clauses were added in regards to tactical maneuvering at the squad, platoon, and company levels. The newly printed regulations of November 1942 required that commissioned and non-commissioned officers and troops alike to receive extensive tactical training involving flanking and enveloping maneuvers, and that officers should be distinguished with shoulder boards in their uniforms in order to gain the respect and discipline of their units.[108] In addition, they emphasized that success for the infantry required the cooperation between the arms (infantry, artillery, and armor), the feasibility of night attacks, hand-to-hand-combat, immediate infantry entrenchment upon securing positions, and winter combat.[109] Even though these regulations still included the wave attack as its primary method of assault, it was gradually abandoned as competent leadership started to fill the Red Army's ranks, and it would be only two months after the Regulations were issued when the control of the political commissars over military tactics was removed entirely.[110] Nevertheless, there were still rare cases in which commanders used these outdated tactics, but those who carried them out unsuccessfully were soon dismissed from command. For example, a Soviet officer's account from Stalingrad

reported that officers who led their units into the suicidal wave attacks were now being punished and relieved of command. He also noted that officers were now required to spend more time building a relationship with their men, sharing meals and the toils of war with them.[111]

One of the distinguishing tactical aspects of the Battle of Stalingrad that would surface out of this transition was the close quarters combat in house-to-house and block-to-block fighting. Lieutenant General Vasili Chuikov, commander of the defending 62nd Army in Stalingrad, during the battle once said that, "anyone studying the art of warfare must realize that it is no good being a pedant and clinging to abstract theories worked out in the departments of the academies."[112] Chuikov realized that the enemy's quantitative superiority in material, particularly in the air, did not bring him the same decisive success in urban areas as it did in open spaces.[113] Following the advice of his own men, Chuikov tasked his infantrymen to get as close as possible to the German units, sometimes as close as 10 feet away from them in order to prevent the German bombers from decimating entire Soviet units from above, as pilots became afraid of friendly fire.[114] Furnishing infantrymen with bayonets was now compulsory so that they could fight in the fierce hand-to-hand combat taking place during daytime and nighttime. Supplying Red soldiers with hand grenades or with Molotov cocktails for tank disposal also became compulsory. Soviet leadership also kept reinforcing to its troops the idea that Germans were afraid of these close encounters and that they were not trained to fight in this type of combat.[115] These examples show how tactics considered unconventional one day were considered conventional the next, because both sides quickly adopted and continued to improvise new ways of battling the enemy. Chuikov's 62nd Army also began using unconventional warfare tactics in tank warfare. Tanks would be deployed in low numbers inside the city, but these machines would be dug in as strong points or used to cover short distances in support of the infantry, methods which in fact were considered as guerrilla warfare. The Germans were not slow to pick up and adopt these same armor tactics, as these methods were frequently used by the Soviets throughout the battle.[116]

Entrenchment techniques and the building of defensive positions to contain the German attacks were other aspects of Soviet infantry tactics that were improved during the battle. Infantrymen were now better prepared psychologically and trained to fight against German tanks and to take cover from bombardments, keeping calm in their well-built trenches and tunnels within enemy lines. They were also more knowledgeable about how to fortify their high ground and place obstacles that would serve for offensive and defensive purposes against the enemy, especially when confronting tanks.[117] This improved training, successful conventional tactics, and decreased casualty rates served as morale boosters across the Red Army, because soldiers could now rely on their officers and their comrades to overcome any hindrance in combat situations.[118]

The study of the Battle of Stalingrad highlights the learning curve of the Soviet and German armies, because both sides were forced to adapt and change with the circumstances of urban warfare. The Germans were able to adapt more quickly due to their doctrinal emphasis on their junior leaders' initiative. As for the Soviets, the lessons were being learned since the beginning

of the battle, but the experimentation and implementation of new tactics did not take place until the command of the political commissars and poorly trained officers was reduced. Chuikov and other Soviet high ranking officers recognized that the battle would be won or lost by his junior leaders and that they had to be trusted.

When winter came in 1942, the already invisible snipers were further aided by the low visibility caused by the snow and darkness of winter nights, enabling them to get closer to the German trenches and disturb them from doing their daily activities. This included even their basic human needs such as defecating and sleeping.[120] Upon seeing the effectiveness of its snipers, Soviet High Command issued guidelines for their tactics, as well as better winter and urban camouflage to facilitate their task and penetrate deeper into enemy lines.[121] Regular Soviet infantrymen would also be furnished with better winter equipment and camouflage to enable them to carry out the nighttime attacks in the enemy trenches, and to carry out reconnaissance in force missions that included hit-and-run and sabotage attacks.[122] Complementing these attacks was the support of the partisan movements and the local population in combat operations, in the form of insurgency, sabotage and in reconnaissance operations, supplying the Red Army with the location of German emplacements.[123]

By 1943, the German offensive at Stalingrad had collapsed and morale among the Wehrmacht troops in the area plummeted. With the modernization of tactics and reforms in the officer corps across all the branches of the Red Army, the Soviets were able to push the Germans back from Stalingrad. Soviet tactics now included armor en masse attacks with infantry offering a supporting role in these attacks, and not the other way around as before.[124] With an increased level of proficiency and experience in infantry tactics, the Red Army stopped using the wave tactics and began applying the flanking maneuvers and encirclement tactics they had learned from their experiences fighting the Germans against them.[125]

VI. 1943-1944 and Battle of Kursk

After the Battle of Stalingrad in 1943, the Wehrmacht was now on the defensive and the Red Army on the offensive. Conventional tactics used by the Red Army were now up to date and paralleled that of the Germans. To increase its efficiency conducting these kind of tactics, the Soviet High Command reduced the size of infantry divisions and gave armor divisions more independence of action, offering flexibility to the commanding officers to use any tactics they deemed fit for fighting the Germans, with the hope of testing new ideas and concepts.[126] Commissioned and junior officers, since the reforms of November 1942, had their tactical training and coursework in military academies extended by one to two years.[127] Commanders now worked out the missions' coordination details with their subordinates and discussed the variants in defensive plans, a clear sign of progress in regards to officer-soldier relationships.[128] Infantrymen were now under constant tactical training and drills even at the front, where rifle handling, ballistics, camouflage, and penetration behind enemy lines were taught to all, as well as to how to withstand German heavy bombardments and manage themselves psychologically through them.[129] The effect of this tactical training was evident in the offensives following Stalingrad. Now, when Soviet infantrymen attacked villages filled with German troops, no more raids and

hit-and-run tactics were not used, because the objective was to liberate these villages and to occupy them. A Soviet paratrooper described how when his unit attacked a village and German fire confronted them, instead of running away and trying to ambush the village later, his unit remained calm and maneuvered tactically from cover to cover, diverted the enemy fire elsewhere and then flanked the German machine gun emplacements firing at them.[130] These attack methods proved that the Red Army had already gone through a definite change. The concentrated use of artillery and mortar fire in support of infantry and tank thrusts, the use of mass tank formations to lead attacks, followed closely by the infantry in deep wedges, exemplified the new methods of tactical deployment. In order to defend villages, the Germans now had to cover the outskirts with heavy weapons and initiate large-scale barrages when the enemy was on their sight, in comparison to earlier confrontations, in which mortar fire and machine gun emplacements were sufficient to stop the wave attacks.[131]

German soldiers also reported the widespread use of deception, ruses, and feint attacks by the Soviets to achieve their objectives. On several occasions, Red Army units, sometimes entire battalions, would dress up as German troops and infiltrate their lines, capturing prisoners and material. Some German-speaking Soviet soldiers would even dress and pose as German officers, give false orders and lead German soldiers into traps and ambushes. Several reports involving Soviet troops committing atrocities are also contained in German accounts, ranging from mass executions of soldiers to corpse mutilation.[132]

At the Battle of Kursk, primarily a tank battle, Soviet infantry and machine gunners were instructed to remain under the cover of their trenches while the tank battle raged on, and would only come out when the battle was either finished or when Soviet tanks and anti-tank guns were unable to destroy enemy tanks. The importance of the Battle of Kursk on Red Army infantry tactics lies in the fact that the battle became the final testing period of what each army had learned from the other after two years of fighting each other. They were two colossal elite armies with similar advanced equipment and experienced troops meeting head-to-head, leaving military strategy and tactics as the decisive factors that distinguished victory from defeat. Kursk proved that the Red Army was no longer the obliging enemy, and that the Wehrmacht was now the army on the defensive.[133]

As the war progressed, the Soviets developed concepts of mobile operations that surpassed anything the Wehrmacht had applied, including deep operations conducted on multiple echelons with combined-arms contexts.[134] The Red Army then became a flexible fighting force, which could tailor any battalion and/or units to address the specific needs of each battlefield, providing artillery, tanks, anti-tank guns, or infantry when the situation required it. Unlike the Wehrmacht, the Red Army was not completely fashioned for conventional warfare, giving it the needed flexibility to adapt and include unconventional units and tactics in the offensives that followed the Battle of Kursk.[135]

Partisan movements and unconventional warfare behind enemy lines were still of major importance at this point of the war. Gradually, irregular units behind the enemy lines, especially those with large numbers, joined the ranks of the main body of the Red Army. The Germans, since the beginning of Operation Barbarossa, always neglected the use of guerrilla tactics and never

really focused on anti-insurgency or anti-partisan operations, which permitted these groups to flourish after the Soviet victories and eventually to become a "second Red Army" behind enemy lines.[136] This neglect by German officers of guerrilla tactics persisted even after the war ended. Evidence of this neglect can be found in the contents of the American military manuals that were based on the consultation with German officers. Such military manuals placed little emphasis on anti-partisan warfare, considering it a hindrance rather than a threat. Chapters dealing with partisans treated them as "temporary obstacles" for the deployment of armies to their destinations, comparing them to the avoidance of aerial bombardment while armies were on the move.[137]

By November 1943, almost 94% of the partisan detachments had radio communications with the Central Staff in Moscow, a figure that clearly demonstrates the excellent coordination between the rear and the frontline units on their advances.[138] Partisans kept supporting the main body of the Red Army on the major battles, as at in Kursk, by cutting off the German supply lines and by revealing the actual strength of enemy and his positions, helping regular troops focus entirely on the conventional tactics required to push back the enemy.[139] The Red Army also made wide use of the non-partisan civilian population for intelligence missions. Before the offensive of 1943 took place, more than a dozen children from ages 8 to 14 years old were trained in scouting and detailed reporting under the supervision of infiltrated Red Army officers.[140]

By early 1944, this cooperation between the partisan groups and the main body of the Red Army had regained the occupied Soviet territory in the north, including Leningrad, the entire Ukraine, and the border territories near Poland and Rumania.[141] The movements and their activities were widespread across the remaining occupied territories, and they grew to such proportions that sometimes forced German withdrawal from entire regions.[142] In other sectors, partisan brigades were numerous and experienced enough in combat to join the Red Army in conventional operations. These brigades operated under the supervision of Soviet officers who gave them tasks that were usually assigned to other Red Army infantry units.[143] By autumn of the same year, the Wehrmacht no longer occupied territories within the Soviet Union, leading to the decline of these partisan movements and their demobilization, or sometimes to their incorporation into the ranks of the main Red Army.[144]

As 1944 went by, the Red Army was now about to embark on Operation Bagration and into enemy territory. At this point of the war, due to the help of the American lend-lease program and the massive industrial effort of the Soviet home front, the Red Army was fully supplied with enough ammunition, weapons, tanks, aircraft and other equipment to enable it to engage completely in successful conventional warfare offensives.[145] As mentioned earlier, the Red Army had adopted and perfected conventional tactics to a level superior to that of the Germans. Flanking the enemy and maneuver tactics were now the major principles in the infantry regiments. German encirclement strategies and tactics also began to be tested, in which tanks and other highly mobile units spearheaded attacks and encircled entire German units under the suppressive fire of Soviet artillery, while the Soviet infantry would comb these pockets and wipe out any resistance

left inside them.

VII. 1944-1945 and Battle of Berlin

In late 1944 and early 1945, the Soviet Union invaded Germany and closed in on Berlin at a very fast pace, comparable to the one the Germans in 1941.[147] Newly trained reserve troops from all branches of the Red Army constantly came from the Soviet Union into the front lines, all of them now trained in the latest techniques of conventional warfare. Infantry training for these troops now had a special emphasis on tactics involving envelopment, flanking maneuvers and encirclements of enemy troops.[148] Soviet infantrymen reported that they were trained at the time that upon encountering German machine gun fire or being pinned down by bombardments, that they should advance on short rushes of 3 to 5 meters, then fall to the ground and crawl away for a couple of meters, and then repeat the whole movement until some flanking position was obtained or the enemy fire stopped.[149]

These tactics would be widely used in the battles on the outskirts of Berlin, where infantrymen gave support to advancing columns of tanks, which also counted on the support of heavy artillery and mortar barrages.[150] Infantrymen would be mounted on top of advancing tanks in order to move faster, but upon encountering German anti-tank units, the infantry would dismount the tanks and engage the enemy with suppressing fire and flanking maneuvers, while tanks tried to encircle them.[151] Tanks would not advance forward without any infantry support, and the infantry would do the same if it lacked tank support, as tank and infantry tactics were now closely related to each other and especially in close quarters combat situations.[152] German soldiers reported at the time endless moving formations of tanks followed by infantry, which were followed by more tanks followed by more infantry, and so on. At the same time, German positions were heavily bombarded by the Soviet artillery, not even allowing enemy soldiers to lift their heads. Soviet artillery barrages were not predictable anymore, and as the battle progressed, the intensity of the bombardment increased and machine gun and rifle fire would begin in the flanks. Soviet infantry and mortar units positioned themselves on the enemy's flanks, while tanks encircled their positions, leaving the Germans no way to retreat and no choice but to surrender.[153] Surprise night attacks were still being used, but instead of being executed using small-unit infantry hit-and-run tactics, night attacks were carried out in strength of up to a regiment and supported by artillery and tanks.[154]

Upon reaching the city of Berlin, it was now the Soviets using heavy aircraft, artillery and mortar bombardment on the German city, followed by tank encirclements and infantry combing street after street for remaining German troops.[155] Even though armor was now the main Soviet power thrust, riflemen were not reduced to just follow-up and mop-up troops. In fact, the Red Army infantry became an adversary more determined and more formidable than their British and American counterparts mainly due to their experience and tailored tactics to fight the Germans.[156] The same type of urban warfare used earlier in the Battle of Stalingrad was applied by the Soviets in Berlin, like house-to-house and block-to-block fighting, with deep entrenching and the use of rubble as cover.[157] Hand-to-hand combat was also still widely used by the Soviets and feared by the Germans.[158]

To prevent making the same mistakes the Germans committed

against snipers and the infantry methods of clearing buildings in the Battle of Stalingrad, the Red Army would hide its tanks in street corners and commence heavy artillery barrages on the main floors of buildings on the streets. At the same time, machine gunners and snipers would position themselves in locations to overview the bombardment and look for any retreating German troops. After most of the windows of the first floors of these buildings were shattered by shrapnel, the bombardment would now begin to strike higher floors of certain buildings, while Soviet infantrymen followed to clear up the building's first floors that had just been stricken with artillery fire. This process would be repeated street after street until the city was fully captured.[159]

In the final days of the Battle of Berlin, with the city's destroyed buildings and rubble preventing tanks entering the city's center, infantrymen would advance alone to finish off remaining German resistance, until the German army finally surrendered the city and the war in the Eastern Front was over.[160]

VIII. Conclusion

The development of the Red Army's infantry tactics during World War II is far more complex than previously believed. Soviet victory in the East, according to the "myth of the Eastern Front," was attributed to overwhelming numbers of tanks, and artillery followed by waves of poorly trained and limitless "cannon-fodder." The problem with that statement is not that it was untrue, but that it was only partly true, at least in the beginning.[161] The Red Army was unable to adopt modern infantry tactics like other foreign armies due to Stalin's purges of the officer corps. New military concepts and ideas brought by technological advances had become obvious for the new battlefield, but Stalin became suspicious of senior officers advocating for military reform and had them executed. In addition, the initial Soviet command structure that included political commissars in military decision-making limited the power of better trained officers and thus, emphasis on tactical training was neglected over political instruction.

The Battle of Khalkhin Gol and the Finnish War were examples of the Red Army's application of antiquated techniques and their scant regard for the loss of life while using them. Despite the fact that victories in both conflicts were achieved through the use of outdated tactics, they only served to prolong the introduction of much needed reforms. The lack of tactical training at all levels, trained leadership, and military material that was present in both conflicts persisted during the initial days of Operation Barbarossa.

When the Nazis invaded, the Red Army suffered humiliating defeats at the front lines, because it used wave infantry attacks that were doomed to fail against the more modern and advanced Wehrmacht. However, the stranded Soviet units trapped within the encirclements, including paratroopers, had success in hindering and harassing the German advance by using unconventional tactics. The struggle in the rear and its tactics had their own separate evolution, aided by the isolation that gave these soldiers flexibility to use their own initiative to experiment with different methods of combat. As some of these stranded units rejoined the main body of the Red Army on the front lines, their experiences of success against the invaders gradually began to spread among the troops. Such experiences, as well as the lessons from the Finnish War and the Battle of Khalkhin Gol, would shape the type of tactics used by the Soviets at the Battle of Moscow. These tactics included night attacks, hand-to-hand combat, snipers, and ski units used for hit-and-run attacks. Ultimately, the Battle of Moscow became the starting point for the "modernization" of Soviet infantry tactics through the use of unconventional warfare, although modern conventional tactics were not fully implemented yet.

Even after the successful defense of Moscow, the Red Army kept using outdated tactics due to the different terrain and unique battlefield features in each of the fronts. Upon realizing the imminent threat from the German offensive in 1942, Stalin released his grip on the Soviet High Command and allowed his generals to introduce whatever strategies and reforms were needed to push back the invaders. Field regulations were reformed and incompetent officers relieved from command. Emphasis was given to tactical training at all levels of command and political commissars were completely excluded from the tactical decision process. The loosening of the strict adherence to field regulations also allowed Soviet troops to improvise and use their own initiative to create new methods of combat.

The fruits of these reforms and the improvisation of tactics would not be enjoyed until the Battle of Stalingrad. Wave tactics were abandoned and incompetent officers were dismissed from command. New tactics involving close quarters combat and block-to-block fighting in urban environments sprang out of these changes. Unconventional tactics were being incorporated into conventional doctrine from one day to the next by both Soviets and Germans, making the lines defining these two types of infantry tactics become blurred as the battle raged on. Having resisted the Germans for more than a year, logistics and staff administration improved and offered sufficient supplies, weapons and ammunition to the troops on the frontlines.

After Stalingrad, the Red Army had already gone through definite changes in its makeup, elevating it to a par with the German Wehrmacht. As the two armies confronted each other at Kursk, both had accumulated two years of knowledge about each other's combat techniques, but the Soviets emerged as the victors. This battle marked the changing of the tide on the Eastern Front because the Germans were now on the defensive and the Soviets on the offensive. After Kursk, the Red Army became a modern flexible fighting force that could be tailored for any battlefield design.

Partisan movements were crucial to the Red Army's victories because of their efforts to cut off the German supply lines and hinder their advance with unconventional tactics. The importance of the cooperation between the partisan movements and the Red Army also extends to their usual alternating of roles, in which fighters from both sides were able to experience combat using different types of tactics against the Germans. Some partisan bands had grown into such vast proportions and were so experienced in combat that they were assigned and/or incorporated into the Red Army as regular units, further proving that differences between unconventional and conventional tactics became unclear.

Combat in the Battle of Berlin was in some ways similar to the Battle of Stalingrad. Throughout it, the Soviets continued to demonstrate how they had perfected German tactics and how they did not commit the same mistakes the Wehrmacht did in Stalingrad. German troops even tried to adopt the combat methods used successfully by the Soviets earlier, like snipers

and close-quarters combat, but it was already too late for them, because now it was their army that lacked the supplies, manpower, and territory necessary to fight off invaders.

Victory on the Eastern Front was achieved thanks to the dogged determination and bravery of the Soviet soldiers, as well as to the vast spaces of Russia and harsh winters. The neglect of the German armies in cleaning up for remaining Soviet troops after the encirclements also proved to be one of the decisive factors that contributed to Soviet victory in the long run. This is especially evident when considering that it was these same stranded units, who thanks to their experience fighting in the rear, played a part in the modernization of Soviet conventional infantry tactics. In the end, the Red Army and its leaders learned the lessons of modern war the hard way and at a great cost in human life, in a manner and scale that is still difficult for Westerners to comprehend.[162]

FOOTNOTES

[1] Dept. of the Army, Small Unit Actions during the German Campaign in Russia, (Washington, D.C.: Department of the Army, 1953), 2, 4.

[2] Dept. of the Army, Small unit actions, 2-3.

[3] Dept. of the Army, Small unit actions, 4.

[4] George F. Nafziger & Charles C. Sharp, Soviet Infantry Tactics in World War II: The Rifle Units of the Red Army from Squad to Company in Combat According to the Combat Regulations of November 1942,(Westchester: Nafziger Collection, 1998), 3.

[5] Catherine Merridale, Ivan's War, (New York: Metropolitan, 2006), 71.

[6] Roger R. Reese, The Soviet Military Experience: A History of the Soviet Army, 1917-199, (London, New York: Routledge, 2000), 97.

[7] Edward J. Drea, Nomonhan: Japanese-Soviet Tactical Combat, (Stockton: University Press of the Pacific, 1982), 19.

[8] To put things into perspective, the distance to be covered in a dash when under enemy fire by the Japanese Army was reduced from 50 meters to 30 meters. Red Army regulations for squad and platoon levels, even in 1942, stated that the distance covered should be from 50 to 40 meters, placing infantrymen in larger risks when under fire. Drea,Nomonhan, 19. Nafziger & Sharp, Soviet Infantry Tactics in World War II, 21, 23-24, 48.

[9] Stephen Bull & Gordon L. Rottman, Infantry Ttactics of the Second World War. Oxford, (New York, NY: Osprey Publications, 2008), 21-22.

[10] By 1940, 48, 733 officers were purged. Merridale, Ivan's War, 69. Hans Wijers, Eastern Front Combat. The German Soldier in Battle from Stalingrad to Berlin, (Mechanicsburg: Stackpole Books, 2008), 45.

[11] S.A. Tyushkevich, The Soviet Armed Forces: A History of their Organizational Development: A Soviet View,translated by CIS Multilingual Service, (Washington: United States Air Force, 1984), 250.

[12] Tyushkevich, The Soviet Armed Forces, 250. Wijers, Eastern Front Combat, 46.

[13] One of the victims of the purges was Mikhail N. Tukhachevskiy, who was Marshal of the Soviet Union, considered the outstanding Soviet military leader and strategist of the 1930s. He had played a prominent role in the Civil War and in the 1920s served as principal deputy to M. V. Frunze, then chief of staff of the Red Army. He became an advocate of the principle of mobility and attempted to develop a tank-aircraft team, with parachutists, infantry, and artillery in support. Stalin, however, thought otherwise and had him xecuted in 1937, and the 1936 regulations were never fully implemented. Harriet T. Scott, The Soviet Art of War: Doctrine, Strategy, and Tactics, (New York: Westview Press, 1982), 44, 56-58.

[14] Drea, Nomonhan, 14.

[15] This manual could possibly be the source from which the German officers obtained their impression of the Red Army. It is very similar to what the "myth of the Eastern Front" has promoted. Drea, Nomonhan, 30-31.

[16] Japanese commanders, like Major Kajikawa, referredto these tactics as conventional Red Army offensive tactics. They also considered the Soviet 82nd and 57th Rifle Divisions poorly trained, hastily organized territorial militia who were highly predictable in their repetitious tactics and offensive attempts. Drea, Nomonhan, 73, 88.

[17] Night attacks and hand-to-hand combat were also emphasized in Japanese infantry manuals at the time. The devastating effects these tactics had on Soviet soldiers would later be used to their own advantage when they fought against the Germans 2 years later. Drea, Nomonhan, 60-61, 75.

[18] Drea, Nomonhan, 61, 75-76.

[19] Drea, Nomonhan, 75-76, 87.

[20] Dmitrii Krutskikh, "Soviet WWII-Veteran Memoirs," I Remember, Infantrymen, http://english.iremember.ru/infantrymen/52-dmitrii-krutskikh.html, 1. B.H. Liddell Hart, The Red Army, (New York: Harcourt, Brace and Company, 1956), 86

[21] Michael Gress & Grau Lester, The Red Army's Do it Yourself, Nazi Bashing Guerrilla Warfare Manual.(Casemate 2011), Pg. xi.

[22] Reese, The Soviet Military Experience: A History of the Soviet Army, 1917-1991, 99-100.

[23] Merridale notes that due to the lack of ammunition and rifles, some infantrymen did not even handle rifle until an actual battlefield operation. Merridale, Ivan's War, 50, 58. E. Ben-Horin & M. Berchin, The Red Army, (New York: W.W. Norton & Company, 1942), 188, 190. Krutskikh, "Soviet WWII-Veteran Memoirs," 2.

[24] Ben-Horin & Berchin, The Red Army, 188, 190. Krutskikh, "Soviet WWII-Veteran Memoirs," 3.

[25] Reese, The Soviet Military Experience: A History of the Soviet Army, 1917-1991 99.

[26] Fred Virski mentions that "the infantry was a massof badly uniformed, badly booted men, whose guns hung from their shoulders by pieces of string! Even the bayonets, while on the march, were tied by rope to the rifles." Fred Virski, My Life in the Red Army, (New York: The MacMillian Company, 1949), 71.

[27] Merridale, Ivan's War, 67.

[28] Reese, The Soviet Military Experience: A History of the Soviet Army, 1917-1991, 98.

29 Dennis E. Showalter, Armor and Blood: The Battle of Kursk, the Turning Point of World War II. (New York: Random House, 2013), 17. Fred Virski mentions that when he underwent through officer training, almost no tactics or leadership skills were learned from it, as marching and saluting took most of the time used for officer instruction. Besides, this was the accelerated officer training that would make infantrymen comissioned officers, which explains that not only ground troops lacked these skills, but also leadership from above. Virski, My Life in the Red Army, 134-136.

30 Liddell Hart, The Red Army,136-137. I. Lyudnikov, "Soviet WWII-Veteran Memoirs," I Remember,Infantrymen, http://english.iremember.ru/infantrymen/40-ilyudnikov.html, 3. Merridale, Ivan's War, 106. Virski, My Life in the Red Army, 160

31 A report from August 1941, from Chief of Red Army Artillery, General N.N. Voronov, evaluated infantry, tanks and artillery. The section on infantry reads like a catalog of woes – all related to unpreparedness. It stated the following: "The infantry did not know how to get the best use of their weapons; sections and platoons were not used properly by their leaders. The men did not know how to fire and maneuver using basic squad tactics. Infantry commanders and soldiers did not know how to bring artillery and mortar fire onto the enemy. They did not know how to time the use of their fire. At the moment the Red Army did not know how to make use of its infantry in order to approach, attack and seize assigned objectives with the minimum of casualties. The infantry was slow toreturn fire, and slow to take up the use of camouflage. The infantry had a very unhealthy reaction to the appearance of enemy airplanes. The infantry did not have the means to engage enemy aircraft. Reconnaissance efforts were poorly organized. Without the help of local scouts they would not have learned anything of the enemy. " Reese, The Soviet Military Experience: A History of the Soviet Army, 1917-1991, 132.

32 United States Army European Command Historical Division, Russian Combat Methods in World War II. (Washington, D.C.: Department of the Army, 1950), 4.

33 John F. Antal, Combat Orders: An Analysis of the Tactical Orders Process, (Ft. Belvoir: Defense Technical Information Center, 1990), 76-77. Soviet regulations actually contain the wave attack in one of their clauses. It states that when at 50 to 40 meters from the enemy, a single infantry dash must be done even while under heavy enemy fire while soldiers scream "hurrah!" with the purpose of scaring off the enemy. Nafziger & Sharp, Soviet Infantry Tactics in World War II, 21.

34 Merridale, Ivan's War, 106. Virski, My Life in the Red Army, 138-40.

35 This fact can help explain why soldiers did not trust their superiors and therefore, indiscipline was a large problem during these battles. Nafziger & Sharp, Soviet Infantry Tactics in World War II, 8.

36 David M. Glantz, Soviet Defensive Tactics at Kursk, July 1943, (Fort Leavenworth, KS: Combat Studies Institute, 1986), 1.

37 Glantz, Soviet Defensive Tactics at Kursk, July 1943, 6.

38 Bull & Rottman, Infantry Tactics of the Second World War, 50-51 89.

39 Bull & Rottman, Infantry Tactics of the Second World War, 59.

40 Showalter, Armor and Blood, 33.

41 Bull & Rottman, Infantry Tactics of the Second World War, 141.

42 James Lucas, War on the Eastern Front, 1941-1945: The German Solider in Russia, (New York: Bonanza Books, 1979), 54.

43 Liddell Hart, The Red Army, 136-137. Lucas, War on the Eastern Front, 1941-1945, 136.

44 Rick Gutwald, Tactical Encirclement Reductions, (Fort Leavenworth, KS: US Army Command and General Staff College, 1986), 2.

45 Ben-Horin & Berchin, The Red Army, 208. Merridale, Ivan's War, 88.

46 Gutwald, Tactical Encirclement Reductions, 8-9.

47 Merridale Ivan's War, 95. Alexander Poliakov,

   Russians Don't Surrender, (New York: E.P. Dutton & Co, 1942), 26-27.

48 According to German accounts, some "partisans" engaged in terrorist activities that affected German headquarters and administrative departments among the population. Liddell Hart, The Red Army, Pg.155

49 German accounts talk of Soviet infantry infiltrating deep into the Wehrmacht's rear, dressed up as German officers and giving false orders. Also, artillery pieces and vehicles in the rear had to be abandoned immediately when a Red Army patrol was sighted, as German troops handling these were not trained in combat and the Soviet infantry would engage in hand-to-hand combat with them, an idea that terrified German soldiers. Lucas, War on the Eastern Front, 21, 53-54, 65, 97.

50 Soviet snipers and their innovative tactical use were highly effective before the urban battles in Stalingrad. Snipers would let the German tanks pass through and then fire at the infantry in the rear, strongly resembling the tactical deployment of Finnish snipers during the Finnish War. Frank Ellis, The Stalingrad Cauldron: Inside the Encirclement and Destruction of the 6th Army, (Lawrence, Kansas: University Press of Kansas, 2013), 297-298.

51 US Army ECHD, Russian Combat Methods in World War II, 91.

52 Gress & Grau, The Red Army's Do it Yourself, Nazi Bashing Guerrilla Warfare Manual, xii.

53 Edgar M. Howell, Soviet Partisan Movement, 1941-1944, (Washington, D.C.: Government Printing Office, 1956), 42. For instance, in the area of Army Group Center, 10,000 men under General Kulik operated very skillfully and could not be cornered. US Army ECHD,Russian Combat Methods in World War II, 104.

54 Poliakov, Russians Don't Surrender, 26-30, 63, 65. 55 An account from a Soviet infantryman, Ivan Kobets, also mentions that his unit was constantly orderedto do deep reconnaissance and sabotage in enemy territory, without ever having received such training previously. Ivan Kobets, "Soviet WWII-Veteran Memoirs," I Remember, Infantrymen, http://english.iremember.ru/infantrymen/31-ivan-kobets.html,

55 Poliakov does mention that one of the parachutist units he encountered told him that they were trained in light infantry tactics including ambushes, hit –and-run tactics, and sabotage. Poliakov, Russians Don't Surrender, 110.

56 Poliakov, Russians Don't Surrender, 47, 52-53, 60, 78-79.

57 Ben-Horin & Berchin, The Red Army, 200, 206. Poliakov also tells of an encounter he has with a Soviet parachutist unit that learned the German traffic signals used for tanks. Upon finding a moving German tank column approaching a crossroads, one

of the parachutists would dress up as a German traffic controller and misguide with his flashlight the entire German column to an entirely different route. Poliakov, Russians Don't Surrender, 106-107.

58 Poliakov, Russians Don't Surrender, 120, 155.

59 General Gunther Blumentritt recognized in his report named "State and Performance of the Red Army" in 1941, that Soviet infantry favored night attacks, and that after an attack, these highly mobile infantry units would disappear and appear on the next day attacking a different German unit, which within 40 to 60 kilometers of distance between the first attacked unit. Liddell Hart, The Red Army, 136-137. Poliakov, Russians Don't Surrender, 68, 73-74, 171.

60 Poliakov tells of a last minute meeting among the battalion officers and soldiers in which they were discussing whether to concentrate their attack with a single massive infantry charge at a point of a road where a German column was going to pass, or to distribute the attack in three different sections and attack it unconventionally; everyone in the meeting voted for the latter choice. In another ambush, Red Army soldiers lost no soldiers by making the Germans shoot each other with artillery barrages, as infantrymen would position themselves in the middle of German units and attack them. A German account in Lucas's book notes a similar event in his combat experience, as well as in General Blumentritt's 1941 report on the performance of the Red Army. Liddell Hart, The Red Army, 136-137. Lucas, War on the Eastern Front, 21. Poliakov, Russians Don't Surrender, 70, 95, 130-131, 140-142.

61 Poliakov mentions that infantrymen in ambushes waited until their commander ordered the exact moment to fire against German troops, disregarding the fact that sometimes they were only feet away from them. Poliakov, Russians Don't Surrender, 130-131, 158.

62 Some towns would become impregnable citadels controlled by partisans and civilians who opposed Nazi rule, based on German soldiers' accounts. The Wehrmacht would sometimes avoid such towns, as they never had any previous anti-insurgency training. Lucas, War on the Eastern Front, 61-62, 73.

63 Even political officers would teach civilians how to shoot and ambush German patrols. Poliakov, Russians Don't Surrender, 94-45.

64 Howell, Soviet Partisan Movement, 1941-1944,43-44.

65 Howell, Soviet Partisan Movement, 1941-1944, 45-49, 54.

66 Even civilian partisans that surrendered before the deadline were granted POW status. Paratroopers dropped later in the war would even be continued to be considered partisans. Howell, Soviet Partisan Movement, 1941-1944, 57-59.

67 It was not until December 1942 when guidelines regarding anti-guerrilla and anti-partisan warfare were given to the Wehrmacht with Hitler's instruction No. 46. Included in this instruction, was to avoid the use of the word "partisan" to describe the mix of regular troops and civilian fighters. The reason for which these groups were named "bandits" was due to the psychological effect it had on German soldiers, as first, they questioned the ability of Red Army troops to reach so deep inside enemy lines and cause that kind of havoc; second, knowing that they were not liked by the Soviet population, German soldiers felt threatened everyday and could suffer a decline in their morale; and third, it suggests

that partisans were not considered "legitimate soldiers", but mere outlaws. Lucas, War on the Eastern Front, 65.

68 Lucas, War on the Eastern Front, 1941-1945, 62.

69 Ben-Horin & Berchin, The Red Army, 207-208. The Pripet Marsh in the southwest and the very dense forests in the northwest did not enable the Wehrmacht to completely clean up the territory of Soviet troops. In addition, these same territories would be full of swamps and good ambush positions which the Soviet infantry used to wipe out German infantry columns. Lucas, War on the Eastern Front, 73-74. Poliakov also mentions an artillery barrage by the Germans which the Soviet infantrymen survived by taking cover, but after a long period of time, no German infantry showed up to check whether there were any survivors. Poliakov, Russians Don't Surrender, 82.

70 Ben-Horin & Berchin, The Red Army, 205-206.

71 According to one officer at the time, outdated combat regulations were still being instructed to the officer corps, with little or no tactical knowledge being imparted, leading officers to order full frontal assaults in open fields under fire of the German artillery and mortars. Nikolai Safonov, "Soviet WWII-Veteran Memoirs," I Remember, Infantrymen, http://english.iremember.ru/infantrymen/54-nikolai-safonov.html, 2.

72 Wave after wave of unsuccessful "hurrah!" charges were used without any previous artillery supportingfire, causing the Soviets a large number of losses. Mikhail Kuznetsov, "Soviet WWII-Veteran Memoirs," I Remember, Infantrymen, http://english.iremember.ru/infantrymen/53-mikhail-kuznetsov.html, 1. Merridale, Ivan's War, 159. Political officers would order these suicidal wave attacks at gunpoint to reluctant infantrymen. Daniil Zlatkin, "Soviet WWII-Veteran Memoirs," I Remember, Infantrymen, http://english.iremember.ru/infantrymen/50-daniil-zlatkin.html, 3.

73 Dept. of the Army, Small unit actions during the German Campaign in Russia, 32.

74 Alexander Werth, a British journalist visiting Moscow in late 1941, commented in his diary that infantrymen coming from Dnepropetrovsk towards Moscow came barefooted and with little amount of suplies left after battling the Germans across the front. Alexander Werth, Moscow War Diary, (New York: Alfred A. Knopf, 1942), 169.

75 There were some artillery guns available in the proximity of Moscow, but the artillery groups were uncoordinated and unskilled in the use of these guns for effective barrages, as they would be afraid of hitting their own infantrymen with shrapnel and would cease bombardment earlier than the "hurrah" charges, enabling the German troops to redeploy and repel the oncoming charge. Michael Parrish, Battle for Moscow: The 1942 Soviet General Staff Study, (Exeter: Pergamon-Brassey's International Defense Publishers, 1989), 45, 51. Other infantrymen accounts tell of a complete lack of artillery support before a chare took place, even though there were artillery guns in the same location where they were. Ivan Shelepov, "Soviet WWII-Veteran Memoirs," I Remember, Infantrymen, http://english.iremember.ru/infantrymen/57-ivan-shelepov.html, 1. Anatoli Stat'in, "Soviet WWII-Veteran Memoirs," I Remember, Infantrymen, http://english.iremember.ru/infantrymen/55-anatoli-statin.html, 3.

76 Shelepov, "Soviet WWII-Veteran Memoirs," 3. Stat'in, "Soviet WWII-Veteran Memoirs," 2.

77 An infantryman named Nikolai Moskvin tells for example, "It's

really satisfying to fight the Fascists this way," "We can get them on the roads, from hiding, with almost no cost to our own men." Merridale, Ivan's War, 145.

[78] Although during the war there were some political commissars that performed well as military leaders,most soldiers' accounts agree that in general, they were incompetent in infantry tactics. Soviet and German soldiers specifically attribute commissars with the use of wave tactics. Drea, Nomonhan, 50. Nafziger & Sharp, Soviet Infantry Tactics in World War II, 8. Poliakov, Russians Don't Surrender, 94-45. Wijers, Eastern Front Combat, 98.

[79] It has to be noted that the number of Red Army stragglers kept increasing as the German advance continued, as Germans still used encirclements for strategic purposes in their advance. Howell, Soviet Partisan Movement, 1941-1944, 68, 78-79.

[80] Howell, Soviet Partisan Movement, 1941-1944, 68, 79-81.

[81] Even though the manual used as reference for this paper is the 1943 edition, the claims stated are still supported. The only changes the 1943 version has in comparison to the 1941 edition are the inclusion of a political speech by Stalin, a brief chapter on German weapons, and a chapter on fighting on skis from the Winter War in Finland. Gress & Grau, The Red Army's Do it Yourself, Nazi Bashing Guerrilla Warfare Manual, xiii.

[82] Gress & Grau, The Red Army's Do it Yourself, Nazi Bashing Guerrilla Warfare Manual, 27-37, 152.

[83] The Battle of Moscow is considered to be the first German defeat of WWII, although it was won at a large sacrifice and Soviet territory was still under German occupation. Parrish, Battle for Moscow: The 1942 Soviet General Staff Study, ix.

[84] Red Army infantrymen were not well trained in tactics, but in hand-to-hand combat they were better off than the Wehrmacht troops. Because there was no "required need" to train soldiers in this kind of close quarters combat, civilians, peasants, and raw recruits were used in these nighttime attacks as well, giving the Red Army more manpower for these successful attacks. Similar attacks were organized in nearby villages, where Molotov cocktails were provided for the destruction of tank regiments. Merridale, Ivan's War, 120, 123. Shelepov, "Soviet WWII-Veteran Memoirs," 2. Werth, Moscow War Diary, 232.

[85] Parrish, Battle for Moscow: The 1942 Soviet General Staff Study, 14.

[86] US Army ECHD, Russian Combat Methods in World War II, 37, 47, 84, 86.

[87] US Army ECHD, Russian Combat Methods in World War II, 26-27.

[88] US Army ECHD, Russian Combat Methods in World War II, 87-88.

[89] Merridale, Ivan's War, 149.

[90] Parrish, Battle for Moscow: The 1942 Soviet General Staff Study, 14.

[91] US Army ECHD, Russian Combat Methods in World War II, 37, 47.

[92] US Army ECHD, Russian Combat Methods in World War II, 58-59.

[93] Bull & Rottman, Infantry Tactics of the Second World War, 196-198.

[94] Winter played a good role on providing cover for Soviet positions from bombardment, but Moscow's air defenses were what ultimately saved the city from the Luftwaffe. For example, on July 22, 194, air defense in Moscow protected the city and troops from the Blitzkrieg in an attack involving 200 German planes, of which only 12 to 15 reached the city. Ben-Horin & Berchin, The Red Army, 216. Lucas, War on the Eastern Front, 89.

[95] Soviet Infantry Regulations contained special clauses on the use of submachine gunners. Squads containing sub machine gun operators were used to make quick and sudden surprise attacks, inflict losses with fire, create panic, and disappear quickly without a trace. Their main tasks were assigned on the flanks or in the rear of the enemy, with the purpose of executing ambushes and cutting troops from supplies. Furnishing ski troops with submachine guns made them a deadly combination. Nafziger & Sharp,Soviet Infantry Tactics in World War II, 14, 32.

[96] Small unit actions were being implemented on "special units" first. Parrish, Battle for Moscow: The 1942 Soviet General Staff Study, 12-13, 32, 36, 41.

[97] Ben-Horin & Berchin, The Red Army, 209.

[98] US Army ECHD, Russian Combat Methods in World War II, 80-82.

[99] US Army ECHD, Russian Combat Methods in World War II, 82, 84-85, 105-106.

[100] Ellis, The Stalingrad Cauldron, 50-52.

[101] Ellis, The Stalingrad Cauldron, 300-301. This German account also offers an insight in Soviet unconventional tactics and in the qualities of Soviet infantrymen, as clearly Red Army soldiers could camouflage and resist any kind of harsh weather, not only during cold winters but also duringn hot summers. Wijers, Eastern Front Combat, 57.

[102] A Soviet infantryman reported that these wave attacks sometimes included up to 1000 men at once without any previous artillery support, and that most of the time these attacking groups would be destroyed to the last man. Nikolai Guzhva, "Soviet WWII-Veteran Memoirs," I Remember, Infantrymen, http://english.iremember.ru/infantrymen/47-nikolai-guzhva-.html, 2. German soldiers reported that artillery barrages and Soviet infantry wave attacks were predictable in their timing, making them easy to repel. Lucas, War on the Eastern Front, 1941-1945, 199. Showalter, Armor and Blood, 20-21.

[103] German soldiers reported that flanking maneuvers in Stalingrad were started to be used against them, although not for overrunning their positions but only as suppressive fire. They also mentioned that due to these prolonged combats where they were unable to move due to suppressive fire, sometimes the Germans themselves would also engage in the same positional warfare as it was used in WWI. Lucas, War on the Eastern Front, 1941-1945, 144. Wijers, Eastern Front Combat, 23, 98, 107, 111.

[104] Ellis, The Stalingrad Cauldron, 38-39.

[105] Ellis, The Stalingrad Cauldron, 39.

[106] Showalter, Armor and Blood, 20.

[107] Steven H. Newton, German Battle Tactics on the Russian Front, 1941-1945, (Atglen, PA: Shiffer Publications, 1994), 83.

[108] With better tactics and better officers, there was a rise in soldier morale in late 1942. New military decorations were also successful in increasing the morale of the troops serving in the Red Army. Merridale, Ivan's War, 160-164, 191.

[109] Nafziger & Sharp, Soviet Infantry Tactics in World War II, 5, 7-9, 18-24, 70-73.

[110] Nafziger & Sharp, Soviet Infantry Tactics in World War II, 8,

21, 48.

[111] Alexander Gak, "Soviet WWII-Veteran Memoirs," I Remember. Infantrymen, http://english.iremember.ru/infantrymen/45-alexander-gak.html, 2.

[112] Vasili I. Chuikov, The Battle for Stalingrad, (New York: Holt, Rinehart and Winston, 1964), 341

[113] Chuikov, The Battle for Stalingrad, 341.

[114] Ellis, The Stalingrad Cauldron, 40. German soldiers reported that they could hear Soviet officers shouting orders and hear the infantrymen talking all day, as they were only 30 meters away from them. German 'Stukas' did in fact inflict friendly casualties in some bombardments. Wijers, Eastern Front Combat, 84, 93, 96, 106, 109-110.

[115] Some of the Soviet infantrymen went 'berserk' when reaching the German trenches, which terrified the Germans even more, as for example, one Soviet soldier reported killing 3 German soldiers in a single attack with his bare hands. Gak, "Soviet WWII-Veteran Memoirs," 2. Merridale, Ivan's War, 173. Parrish, Battle for Moscow: The 1942 Soviet General Staff Study, 126.

[116] Ellis, The Stalingrad Cauldron, 44.

[117] Merridale, Ivan's War, 180. Lucas, War on the Eastern Front, 1941-1945, 203. Wijers, Eastern Front Combat, 61, 93.

[118] Merridale, Ivan's War, 199.

[119] Ellis, The Stalingrad Cauldron, 40.

[120] German soldiers' accounts tell of ow tankers could not move their tanks because of the low visibility, as when they opened the hatches of their tanks, snipers would kill them off instantly. Other soldiersreported that they could not even shave or eat comfortably, as Soviet snipers would prefer to attack the Germans when they were doing such activities. Wijers, Eastern Front Combat, 17-18, 92, 106, 107.

[121] Some of the guidelines included rules like "be patient and use anything as cover, even corpses, and remain dormant until the best opportunity arises tokill as much Germans as possible without compromising your position." Parrish, Battle for Moscow: The 1942 Soviet General Staff Study, 123, 128, Wijers, Eastern Front Combat, 19-20.

[122] Soviets would capture the German trenches by night, but the Germans recovered them in daytime. German soldiers reported that all Soviet equipment was moved under the cover of darkness and snow, as sometimes artillery units would be closer to their trenches than they were the day before. The reconnaissance and guerrilla patrols would take place daily and were wearisome to the German soldiers.Wijers, Eastern Front Combat, 115, 129.

[123] Gak, "Soviet WWII-Veteran Memoirs," 3. Parrish, Battle for Moscow: The 1942 Soviet General Staff Study, 120.

[124] Lucas, War on the Eastern Front, 1941-1945, 46. Merridale, Ivan's War, 213.

[125] Lucas, War on the Eastern Front, 1941-1945, 178. Wijers, Eastern Front Combat, 187.

[126] Lucas, War on the Eastern Front, 1941-1945, 48-49.

[127] Walter S. Jr. Dunn, Kursk: Hitler's Gamble, 1943, (Westport, CT: Greenwood Publishing Group, 1997),19. The new regulations and the tactics being taught were based on the previous experiences of the troops fighting the Japanese, Finnish, and Germans. Glantz, Soviet Defensive Tactics at Kursk, July 1943, 24, 62.

[128] Glantz, Soviet Defensive Tactics at Kursk, July 1943, 24.

[129] Klavdia Kalugina, "Soviet WWII-Veteran Memoirs," I Remember, Snipers, http://english.iremember.ru/snipers/21-klavdia-kalugina.html, 2. Nikolai Litvin, 800 Days In The Eastern Front: A Russian Soldier Remembers World War II, translated and Edited by Stuart Britton, (Lawrence, KS: University Press of Kansas), 2007, 12. According to one Soviet sniper's account, snipers had to go also through infantry training, which included entrenching and maneuvering tactics. Such training lasted 9 months and no soldier came to the front unprepared for combat anymore. Nikolai Nadol'ko, "Soviet WWII-Veteran Memoirs," I Remember, Snipers, http://english.iremember.ru/snipers/24-nikolai-nadolko.html, 2. Ivan Zabolotny, "Soviet WWII-Veteran Memoirs," I Remember, Infantrymen, http://english.iremember.ru/infantrymen/48-ivan-zabolotny.html, 4.

[130] Litvin, 800 Days In The Eastern Front, 32.

[131] US Army ECHD, Russian Combat Methods in World War II, 46, 76.

[132] US Army, Russian Combat Methods in World War II, 79, 89, 92.

[133] Glantz, Soviet Defensive Tactics at Kursk, July 1943, 1. Showalter, Armor and Blood, 270-273.

[134] Showalter, Armor and Blood, 270.

[135] Dunn, Kursk: Hitler's Gamble, 1943, 65.

[136] Lucas, War on the Eastern Front, 64. Merridale, Ivan's War, 254.

[137] F.D. Croning, Albert Kesselring, & G.C. Vanderstadt, Manual for Command and Combat Employment of Smaller Units (based on German Experience in World War II), (Washington, D.C.: Department of the Army, Office of the Chief of Military History), 1952, 36, 48-49, 256.

[138] Gress & Grau, The Red Army's Do it Yourself, Nazi Bashing Guerrilla Warfare Manual, xiv.

[139] Merridale, Ivan's War, 255.

[140] US Army, ECHD, Russian Combat Methods in World War II, 38.

[141] Lucas, War on the Eastern Front, 1941-1945, 50.

[142] US Army ECHD, Russian Combat Methods in World War II, 104.

[143] Howell, Soviet Partisan Movement, 1941-1944, 182, 189.

[144] This incorporation was possible due to the alternating positions that members of experienced partisan groups had with Red Army soldiers. As it was mentioned earlier in the paper, the lines between conventional and unconventional warfare were blurred as the war progressed. Lucas, War on the Eastern Front, 1941-1945, 62.

[145] Merridale, Ivan's War, 256.

[146] Litvin, 800 Days In The Eastern Front, 79, 91.

[147] US Army ECHD, Russian Combat Methods in World War II, 39.

[148] Ivan Garshtia, "Soviet WWII-Veteran Memoirs," I Remember, Infantrymen, http://english.iremember.ru/infantrymen/46-ivan-garshtia.html, 2.

[149] Evgeni Bessonov, "Soviet WWII-Veteran Memoirs," I Remember, Infantrymen, http://english.iremember.ru/infantrymen/42-evgeni-bessonov.html, 2. Garshtia, "Soviet WWII-Veteran Memoirs," 3.

[150] Wijers, Eastern Front Combat, 136, 270.

[151] Bessonov, "Soviet WWII-Veteran Memoirs," 1. Garshtia, "Soviet WWII-Veteran Memoirs," 4. US Army ECHD, Russian Combat Methods in World War II, 46.

[152] Litvin, 800 Days In The Eastern Front, 97. Wijers, Eastern Front Combat, 236, 302.

[153] German soldiers are reported to have started to rely on previously used Soviet tactics. Nighttime small-unit actions and even wave attacks were used against the Soviets in desperate attempts to break off encirclements. US Army ECHD, Russian Combat Methods in World War II, 85. Wijers, Eastern Front Combat, 220-221, 273, 282, 302-303.

[154] US Army ECHD, Russian Combat Methods in World War II, 47.

[155] Lucas, War on the Eastern Front, 1941-1945, 24. Wijers, Eastern Front Combat, 207.

[156] Showalter, Armor and Blood, 276.

[157] Wijers, Eastern Front, 207.

[158] Garshtia, "Soviet WWII-Veteran Memoirs," 4. Pavel Vinnik, "Soviet WWII-Veteran Memoirs," I Remember, Infantrymen, http://english.iremember.ru/infantrymen/44-pavel-vinnik.html, 4.

[159] Litvin, 800 Days In The Eastern Front, 129.

[160] Vinnik, "Soviet WWII-Veteran Memoirs," 3.

[161] Nafziger & Sharp, Soviet Infantry Tactics in World War II, 3.

[162] Antal, Combat Orders: An Analysis of the Tactical Orders Process, 77-78.

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Is Cumulative GPA predictable by objective factors? A case study from the students at the University of Rochester

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This paper follows a unique cohort of students who entered the University of Rochester in the fall semester of 2010 to examine the effects of objective factors that determine the academic experience of students, particularly their cumulative grade point averages (CGPAs). The study finds that there are significant differences in the CGPAs of students classified according to: with and without reasonable scores on AP exams, single and multiple majors, and gender – except for students classified according to: with and without standardized exam scores. Moreover, objective factors (i.e. standardized exam scores, average number of credits taken per semester, whether the student is pursuing a single major or multiple majors, and the student's gender) were found to significantly affect the student's CGPA. The findings of this study provide important insights that may be valuable to personnel in the university admissions office.

INTRODUCTION

The college admission process for prestigious US colleges and universities requires analysis of different features of the prospective students in the applicant pool. The analysis not only looks at indicators of a student's performance prior to entering college, but also looks at factors that could signal the student's potential performance in college. Level of intellectual capability as well as the student's academic background are considered to be some of the most important features of a student. Common objective indicators of students' capabilities include standardized tests, such as the SAT, ACT and the Advanced Placement (AP) exams. Generally, a better performance on standardized test (SAT or ACT) and higher scores on AP exams are indications of a more capable student. After moving on to college, the factors affecting college performance include the number of majors/subjects the student studies, the student's course load, and the student's gender. Some socioeconomic factors may also affect one's college performance. Thus, this study stems from a motivation to explore how pre-college and college-related factors contribute to the performance of students in college.

This study aims to predict college Cumulative Grade Point Average (CGPA) of students using objective factors that were assessed before students came to college, and other factors related to college life. For this purpose, a cluster sample of the students at the University of Rochester was used. The cohort of students who entered in the fall semester of 2010 was taken as the cluster sample. The data obtained comes from the office of the registrar at the University of Rochester, and includes each student's CGPA, the number of cumulative hours earned, the total SAT score (comprised of the Verbal score, the Math score and the Writing Skills score), the ACT composite score (comprised of English, Math, Social Science and Natural Science), the student's major(s), the scores on various AP exams, the different terms the student was enrolled in college, and the student's gender.

The structure of the paper is as follows. Section II describes the methodology and data. Section III provides descriptive statistics and conducts two sample t-tests of the difference in mean CGPAs of the relevant groups of students. Section IV, the heart of the paper, provides regression analysis of CGPA on objective factors. Section V puts forward some of the limitations of the paper, and Section VI concludes the paper.

METHODOLOGY AND DATA

CGPA was used as the single indicator of college performance. We examined the relationship between CGPA and the different factors previously mentioned using 2- sample t-test and multiple regression analysis. Multiple regression technique has been used in several other studies to examine the determinants of college performance. These included studying the impact of socio economics and demographic factors affecting CGPA (Erdem, Senturk and Arslan, 2007)[i], the impact of gender and age on CGPA of math students (AbuBakar, Bada and Adegboyega, 2012)[ii], the impact of high school inputs on the GPA of Connecticut college students (Russo, 2014)[iii], the effect of summer bridge programs on the GPA of first time science, engineering and mathematics students at Morgan State University (Dr. John Albert Wheatland Jr., 2002)[iv], and the relative importance of high school resources and peer group effects on CGPA (Betts and Morell,1998)[v]. While other studies have focused on many different aspects, this present study focuses only on the pre-college and college-related objective variables that are either indicators of a student's capability, seriousness, or scope for performance in college education. We

start with descriptive statistics of CGPA of the students. Then, we examine whether there is any difference in mean CGPA between students with and without standardized tests, students with and without a reasonable amount of AP scores, students pursuing single and multiple majors, and finally, students of different genders. A 2-sample t-test has been used to test the difference in mean CGPA according to these four bivariate issues.

In the multiple regression analysis, CGPA is regressed on two pre-college variables, two college study-related variables and one demographic variable. The construction of each variable is discussed below.

SATACT: The data collected for each student's performance on the standardized tests were used for the construction of this variable. The total SAT or ACT Composite scores were taken. If the student had reported both the SAT and the ACT, the higher score of the two tests was taken. To aid the comparison between SAT and ACT scores, all the ACT Composite scores of the students were converted to their SAT equivalent using the conversion scale provided by the ACT website[1]. After the conversion, if the student had two different SAT scores (which means the student reported both the SAT and ACT score) the higher one was taken. Thus, the variable SATACT is the best converted total SAT score of the student. However, this variable doesn't apply to the students without standardized tests.

DUMAP: The data collected for each student's performance in the Advanced Placement (AP) exams were used for the construction of this variable. The student's total AP score, which is the summation of the scores on different AP exams, was then calculated. This was done in order to capture both the number of AP courses taken in high school and the performance on these AP exams. Then, we arbitrarily chose a total AP score of 8 to be used as a cutoff[2]. This was done because a total AP score of 8 could both represent more familiarity with college material or the capability to master college material. Then, each student was assigned a value of either 1 or 0 according to this cut-off score. If the student had a total AP score of 8 or more, the student was assigned a value of 1. Otherwise a value of 0 was assigned to the student. Students who did not submit scores from any AP exams were assigned a value of 0 by default. This forms the dummy variable, DUMAP which is a binary variable consisting of only two possible values.

AVCREDIT: The average number of credit hours taken by the student per semester during college. The data collected about the number of cumulative hours earned and the different terms of enrollment were used to construct this variable. First, the total number of semesters that the student was enrolled in college was counted. Then the number of cumulative hours earned for the student was divided by the total number of semesters to get the AVCREDIT variable.

In addition to these three pre-college and college-related variables above, the following dummy variables were constructed.

DUMMAJOR: The number of majors a student is pursuing may be related with the student's motivation level or seriousness. It may also be related to the extra pressure the student faces. The data collected on major(s) was used to construct a measure of this variable. Depending on whether the student had a single major or multiple majors, a value of 1 or 0 was assigned. If the student was pursuing more than one major, then a value of 1 was assigned. Otherwise, a value of 0 was assigned. This forms the DUMMAJOR variable to account for whether the student was doing multiple majors.

DUMFEMALE: To analyze whether gender has an impact on academic performance in college, we include a dummy variable. The data collected about students' genders was used in the construction of this variable. Each student was assigned a value of either 1 or 0 according to the student's gender. Female students were assigned a value of 1, while male students were assigned a value of 0. This forms the dummy variable, DUMFEMALE, which is also binary with only two possible values.

As the data came from the cohort of entering students of the fall of 2010, this is essentially a cluster sample representing the population of all contemporary students at the University of Rochester. The number of students in this cohort is 1274. However, for implementation of this research, some of the observations were omitted from the sample. These included either students who were admitted but did not continue, or students who transferred out within their first year of study. This reduced the sample size to 1085. For regression analysis, we had to drop the students without standardized tests. This further reduced the sample size to 931.

DESCRIPTIVE STATISTICS AND DIFFERENCES IN MEAN TESTS

A. Descriptive Statistics and Difference in Mean Tests

Since there is an attempt to predict CGPA, the summary statistics of CGPA for the entire cohort of students entering the university in the fall semester of 2010 are described in the following table.

	CGPA
Maximum	4.00
Minimum	1.16
Mean	3.3254
Standard Error in Mean	0.0151
Standard Deviation	0.4977
Variance	0.2477
First Quartile	3.07
Median	3.44
Third Quartile	3.71
Inter Quartile Range	0.64

Table 1: Summary Statistics of CGPA

1 http://www.act.org/aap/concordance/estimate.html
2 A total AP score of 8 can come in several ways. It can be either two subjects with scores 5 and 3, or 4 and 4. It can also be more than 2 subjects with a lower score in each subject. A total AP score of less than 8 can happen with the student taking only one subject or more with a very low score in each subject.
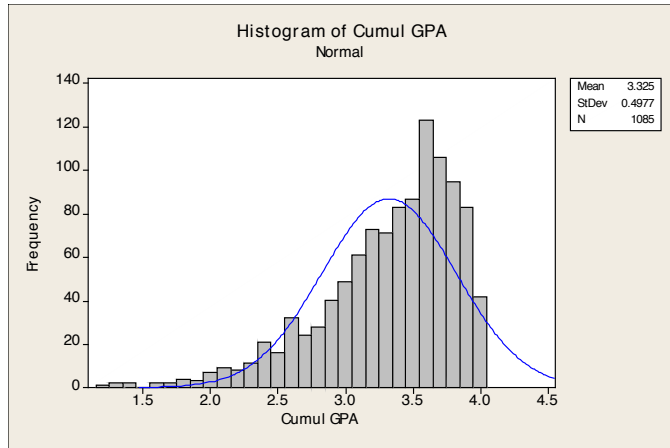
Figure 1: Distribution of Cumulative Grade Point Average

The figure above shows that the distribution of CGPA is not normal. It is skewed to the left with the median CGPA of 3.44 being higher than the mean CGPA of 3.3254. Although the range of CGPA is high from 1.16 to 4.00, it mostly concentrated around the median. The CGPA interval of 3.55-3.65 contained the largest number of students.

B. Differences in mean CGPA tests:

Then, hypotheses tests were carried out on the students categorized into the four different comparison groups (as described above), to find if there was any statistically significant difference in mean CGPA between the comparison groups. A two-sample t-test was used in the process. The number of students in each comparison group, the mean CGPA of the students in that group, and the standard deviations of CGPA in that group were used to carry out a two-sample t-test2-. The null hypothesis was: H_0 : mean CGPA of the two comparison groups is equal. The alternative hypothesis was: H_A : mean CGPA of the two comparison groups is not equal.

	No. of observations	Mean CGPA	Std. Dev. CGPA	T-Stat.	P Value
With standardized test	931	3.3299	0.4925	0.70	0.485
Without standardized test	154	3.2981	0.5290		

Table 2(a): Two-sample t-test of the difference in mean CGPAs of students classified according to with or without Standardized tests (SAT or ACT)

	No. of observations	Mean CGPA	Std. Dev. CGPA	T-Stat.	P Value
With reasonable AP scores	503	3.4158	0.4657	5.68	0.000
Without reasonable AP scores	582	3.2472	0.5115		

Table 2(b): Two-sample t-test of the difference in mean CGPAs of students classified according to with or without reasonable scores on AP exams.

	No. of observations	Mean CGPA	Std. Dev. CGPA	T-Stat.	P Value
Multiple majors	266	3.5477	0.3310	10.65	0.000
Single major	819	3.2541	0.5216		

Table 2(c): Two-sample t-test of the difference in mean CGPAs of students classified according to single major or multiple majors.

	No. of observations	Mean CGPA	Std. Dev. CGPA	T-Stat.	P Value
Female	522	3.3774	0.4633	3.35	0.000
Male	563	3.2771	0.5235		

Table 2(d): Two-sample t-test of the difference in mean CGPAs of students classified according to gender.

The results from the two-sample t-tests are summarized in tables 2(a)-2(d). Table 2(a) shows that there is a failure to reject the null hypothesis for the test of difference in mean CGPAs of the students with or without standardized tests. For this test, the difference in mean CGPA had a p value of 0.485, implying that there was no significant difference in mean CGPA. According to table 2(b), the null hypothesis of no difference in mean CGPA is rejected, as the p value is virtually 0, implying that mean CGPA of students with reasonable scores in AP exams is significantly different from that of students without reasonable scores in AP exams. Similarly, table 2(c) shows that mean CGPA of students pursuing multiple majors is significantly different from that of students pursuing a single major, as the p value of the test of difference in mean is 0. Interestingly enough, students with multiple majors have a mean CGPA much higher than that of students with single major. Finally, it is seen that the mean CGPA of female students is significantly different from the mean CGPA of male students, as shown by the t-statistics and p-value in table 2(d).

One important outcome of these tests is that the mean CGPA of the students without standardized tests is not statistically significantly different from the mean CGPA of the students with standardized tests. So, since regression is based on numeric values, and the variation of CGPA with variation in standardized test scores along with other determinants is desired, students without standardized test scores are excluded from the regression analysis

in the following section.

REGRESSION ANALYSIS

Cumulative Grade Point Average of the students, CGPA is regressed on the five predictor variables SATACT, AVCREDIT, DUMAP, DUMMAJOR and DUMFEMALE constructed before. The five variables are summarized as follows:

SATACT = All scores from standardized exams taken by the student converted to SAT score. Then, the highest SAT score chosen.
DUMAP = 1 if the student had a total score of 8 on AP exams, 0 otherwise.
AVCREDIT = Average number of credits taken per semester by the student.
DUMMAJOR = 1 if student is pursuing multiple majors, 0 otherwise.
DUMFEMALE = 1 if the student is a Female, 0 otherwise.

The hypothesized relationship between CGPA and its objective determinants is summarized by the following equation:

$$CGPA = \alpha + \beta_1 \, SATACT + \beta_2 \, DUMAP + \beta_3 \, AVCREDIT + \beta_4 \, DUMMAJOR + \beta_5 \, DUMFEMALE + \varepsilon$$

The coefficients of each of the variables in the regression equation are summarized in the table:

Predictor	Constant/ Coefficient Symbol	Constant/ Coefficient Value	Standard Error	T-Statistic	P Val
CONSTANT	A	0.8962	0.1428	6.28	0.000
SATACT	β_1	0.00053053	0.00007470	7.10	0.000
DUMAP	β_2	-0.02352	0.02696	-0.87	0.383
AVCREDIT	β_3	0.080185	0.004657	17.22	0.000
DUMMAJOR	β_4	0.11812	0.03083	3.83	0.000
DUM-FMEMALE	β_5	0.07190	0.02544	2.83	0.005

Table 3: Regression coefficients for the predictors

The estimated regression equation is reported as below:
CGPA = 0.896 + 0.000531 SATACT + 0.0802 AVCREDIT + 0.118 DUMMAJOR - 0.0235 DUMAP + 0.0719 DUMFEMALE, $R^2 = 0.395$

From the regression analysis, it is seen that the coefficients for all of the variables are statistically significant except for DUMAP. The coefficient of SATACT is only 0.00053, showing that for an increase of 100 points in SAT score, there was only a 0.05 unit increase in CGPA on average, with other things remaining the same. The coefficient of AVCREDIT is 0.0802. This implies that with other things remaining the same, for an increase of 1 unit in AVCREDIT, there was a 0.08 unit increase in CGPA on average. Similarly, the coefficient of DUMMAJOR is 0.118, implying that average CGPA of students with multiple majors is estimated to be 0.118 higher than that of students with single major. Thus, the positive impact of student's motivation level on CGPA outweighs the negative impact of the extra load of more courses or multiple majors. The coefficient of gender dummy is 0.0719.

Thus, controlling for other factors, a female student has a CGPA expected to be higher by 0.0719 than that of a male student. However, it is interesting to note that, when controlling for other factors, the impact of AP score does not have a statistically significant effect on CGPA. This may be because of its probable collinearity with DUMMAJOR and AVCREDIT, which are also indicators of the higher motivation levels of the student.

The coefficient of determination, R^2 of the regression is 0.395. This means that 39.5% of the variation in CGPA can be explained by the variation in the determinants used. Estimated coefficients are jointly significant as the P value of the F test is virtually zero (Appendix).

LIMITATIONS

There are quite some limitations in the analysis done above. First, the variable DUMAP was assigned a value of 0 for students who either did not take the Advanced Placement (AP) exams or who had low AP scores. However, this also included students who, although did not have any AP courses, had done similar rigorous courses during high school. These students were usually the international students coming from different educational backgrounds than that of the students in the United States. Second, for lack of data, high school CGPA of the students admitted to the university were excluded, which could have been another predictor of college CGPA. Lastly, only admission and university-related objective factors were considered in the analysis, which excluded external factors such as expectations of the student's family, available resources in the student's high school, and peer group of the student.

CONCLUSION

This paper examines the predictability of CGPA through some objective criteria in terms of two-sample t-tests and multiple regression analysis. The students categorized in different groups have different mean CGPA, and the differences are mostly statistically significant. On the other hand, the multiple regression explains nearly 40% of the variation in college CGPA. Such a goodness of fit may be reasonably good for a cross-section data set. However, a large part of the determinants of CGPA still remains unexplained. Thus, CGPA cannot be completely predicted by the above objective factors only. In addition to the factors conceptualized in this analysis, CGPA may depend on many other socioeconomic and idiosyncratic factors. Some of them are already indicated in the previous section. Notwithstanding with this limitation, this paper provides important insights that may be valuable for the personnel in the admissions office. First, as no single factor stands out as prominent in explaining CGPA, a holistic approach in evaluating the students for admission is a good one, as the current practice in this regard. One of the findings of the paper is of particular interest: the performance of the students who were admitted without any standardized tests is not statistically different from those students admitted with standardized tests. Moreover, although standardized scores have a relationship with CGPA, quantitatively it is not large. Thus, excessive emphasis on standardized test scores should not be desired in the student selection process. Difference in mean CGPA test shows that students with reasonable scores on AP exams perform significantly better than those without reasonable

scores. However, in the regression analysis, the coefficient of dummy for AP becomes insignificant as other factors are controlled for. Thus, in the absence of AP scores, other factors showing student's capability and potential should be considered dually for admission decisions.

ACKNOWLEDGEMENT

APPENDIX
Descriptive Statistics: Cumul GPA

Variable	Cumul GPA
N	1085
N*	0
Mean	3.3254
SE Mean	0.0151
StDev	0.4977
Minimum	1.1600
Q1	3.0700
Median	3.4400
Q3	3.7100

Variable Maximum Cumul GPA 4.000

Two-Sample T-Test and CI: CGPA with Standardized Test, CGPA without Standardized Test

Two-Sample T for CGPA with Standardized Test vs CGPA without Standardized Test

	N	Mean	StDev	SE Mean
CGPA with Standardized Test	931	3.330	0.493	0.016
CGPA without Standardized Test	154	3.298	0.529	0.043

Difference = mu (CGPA with Standardized Test) - mu (CGPA without Standardized Test)
Estimate for difference: 0.031851
95% CI for difference: (-0.058030, 0.121733)
T-Test of difference = 0 (vs not =): T-Value = 0.70 P-Value = 0.485 DF = 199

Two-Sample T-Test and CI: CGPA with AP, CGPA without AP
Two-sample T for CGPA with AP vs CGPA without AP

	N	Mean	StDev	SE Mean
CGPA with AP	503	3.416	0.466	0.021
CGPA without AP	582	3.247	0.512	0.021

Difference = mu (CGPA with AP) - mu (CGPA without AP)
Estimate for difference: 0.168609
95% CI for difference: (0.110378, 0.226839)
T-Test of difference = 0 (vs not =): T-Value = 5.68 P-Value = 0.000 DF = 1080

Two-Sample T-Test and CI: CGPA with Multiple Majors, CGPA with Single Major
Two-sample T for CGPA with Multiple Majors vs CGPA with Single Major

	N	Mean	StDev	SE Mean
CGPA with Multiple Majors	266	3.545	0.331	0.020
CGPA with Single Major	819	3.254	0.522	0.018

Difference = mu (CGPA with Multiple Majors) - mu (CGPA with Single Major)
Estimate for difference: 0.290598
95% CI for difference: (0.237040, 0.344155)
T-Test of difference = 0 (vs not =): T-Value = 10.65 P-Value = 0.000 DF = 714

Two-Sample T-Test and CI: CGPA Female, CGPA Male
Two-sample T for CGPA Female vs CGPA Male

	N	Mean	StDev	SE Mean
CGPA Female	522	3.377	0.463	0.020
CGPA Male	563	3.277	0.524	0.022

Difference = mu (CGPA Female) - mu (CGPA Male)
Estimate for difference: 0.100273
95% CI for difference: (0.041477, 0.159070)
T-Test of difference = 0 (vs not =): T-Value = 3.35 P-Value = 0.001 DF = 1080

Regression Analysis: CGPA versus SATACT, AVCREDIT, DUMMAJOR, DUMAP, DUMFEMALE
The regression equation is
CGPA = 0.896 + 0.000531 SATACT + 0.0802 AVCREDIT + 0.118 DUMMAJOR
- 0.0235 DUMAP + 0.0719 DUMFEMALE

Predictor	Coeff	SE Coeff	T	P
Constant	0.8962	0.1428	6.28	0.000
SATACT	0.000053053	0.00007470	7.10	0.000
AVCREDIT	0.080185	0.004657	17.22	0.000
DUMMAJOR	0.11812	0.03083	3.83	0.000
DUMAP	-0.02352	0.02696	-0.87	0.383
DUMFEMALE	0.07190	0.02544	2.83	0.005

S = 0.383994 R-Sq = 39.5% R-Sq(adj) = 39

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	5	89.221	17.844	121.02	0.000
Residual Error	925	136.393	0.147		
Total	930	225.614			

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MALARIA AND MUTANT MOSQUITOES: THE FAILURE OF TEHCNOLOGICAL APPROACHES TO DISEASE ERADICATION

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I n the autumn of 2012, geneticist Hadyn Parry, who is also the chief executive of the English biotechnical company Oxford Insect Technologies, lectured at a conference showcasing innovative technologies in London. Speaking to a rather large crowd of scientists, businessmen, and public health professionals, Parry discussed an innovative new method of disease vector control: modifying the genetic structure of mosquitoes to render them incapable of producing viable offspring.[1] At this conference and elsewhere, Parry and his colleagues boasted about the effectiveness of his technique in eradicating dengue fever from certain regions. Yet considering the long history of failures in disease eradication through biomedical means, one must remain skeptical of such claims.

In recent years, Parry and his associates at Oxford Insect Technologies (Oxitec) have collaborated with the University of São Paulo in Brazil to transform Moscamed, an insect research facility in the city of Juazeiro, into an "entomological assembly line".[2] In this damp, noisy laboratory, technicians produce millions of genetically-modified *Aedes aegypti,* a species of mosquito that is the principle vector of dengue fever. Armed with miniscule glass needles, technicians insert a foreign gene into the black eggs of the *Ae. aegypti.* Upon activation, this gene causes the overproduction of a protein normally responsible for the maintenance of healthy new cells, bringing lethal consequences to the mosquitos. These genetically-modified *Ae. aegypti* (labeled OX513A) are then nourished with goat's blood and fish food mixed with the antibiotic tetracycline, which keeps the lethal gene at bay.[2]

Parry's hypothetical situation is as follows. Once millions of mutant eggs are packed into plastic containers and distributed across the dengue-ridden Brazilian countryside, the hatched *Ae. aegypti* will have no access to the antibiotic. Within a matter of days, genetically modified *Ae. aegypti* will fall dead from the skies, but not before the males mate with the unmodified females, passing on the lethal gene to resulting progeny.[2] Thus, the pairing will result in zero rather than the regular five-hundred viable offspring. Furthermore, with the local population of mosquitoes overwhelmed with OX513A, it will be far more probable for a female *Ae. aegypti* to mate with a genetically-modified male than an unmodified one. "So for the mosquito," Parry boasts, "it's a

dead end."[1]

Just as Parry was received rather warmly by the professionals attending his showcase in London, the researchers at Moscamed were applauded by the dengue-stricken families of Juazeiro as they ventured out into the Brazilian countryside to release millions of OX513A. Such a warm response to foreign scientists may seem rather peculiar when field trials include conducting unprecedented tests in small villages of two to three thousand individuals. Yet, dengue, a hemorrhagic fever that results in severe nausea and bleeding, along with pain so excruciating that it is referred to colloquially as "break-bone fever," occurs at alarming rates in Juazeiro.[2, 3] "People are dying here, and this mosquito is resistant to many insecticides," explained Giovanini Coelho, the coordinator of the Brazilian Ministry of Health's National Program for Control of Dengue. He added, "We really do need something better than what we have."[2] Thus, the families of these small villages, having witnessed the devastating effects of dengue, were more than happy to cooperate when the researchers at Moscamed explained that OX513A "are friendly bugs that protect…against dengue."[2]

However, when Parry announced in London, "I'm hoping that soon we'll be able to get some funding together so that we can get back and start looking at malaria," the professionals in the audience should have been more hesitant in praising this ambitious geneticist.[1] This paper will demonstrate that Parry's "solution," which focuses primarily on attacking mosquitoes and malarial parasites, is reminiscent of twentieth-century vertical campaigns, namely the World Health Organization's Malaria Eradication Program, which failed to take into context the wider social circumstances of this infectious disease. In the midst of renewed enthusiasm sparked by the World Health Organization and the Gates Foundation regarding the eradication of malaria, one must remain cautious about new technologies in order to prevent past failures from repeating themselves.[4, 5]

Any public health professional with extensive knowledge of their field's history should have been cognizant of the striking parallels between Parry's words and those of the twentieth-century arch-eradicationist Frederick L. Soper. In 1947, while attending a conference in Mexico City as the newly-elected director of the Pan

American Health Organization, Soper found himself "forced into predicting the end of malaria in the world during the next 10 to 15 years."[6] This rash proclamation signaled the beginning of, what historian Nancy Leys Stepan dubs, "the paradigm confrontation between Western biomedicine and disease, with the victory going to the disease."[5]

Had these two men not been separated by the barriers of time, it seems probable that Hadyn Parry and Frederick L. Soper would have found themselves as colleagues, banded together against a common foe: the *Aedes aegypti*. This eerily elegant mosquito, jet black with a white-speckled thorax and white rings surrounding its legs, serves as the principle vector of not only dengue fever, but also yellow fever. As Soper found himself becoming intimately involved in international efforts to eradicate malaria, he publicly admitted that he was not an expert malariologist and did not serve on the World Health Organization's Expert Committee on Malaria. Instead, this hard-headed arch-eradicationist claimed he was an expert on the control of insect vectors, much like Parry. Having controlled *Ae. aegypti* with residual insecticides in urban Brazil as part of an effort to eradicate yellow fever from South America, Soper thought it was acceptable to consider malaria and yellow fever as analogous situations.[5] In 1959, Soper remarked on the early shortcomings of the Malaria Eradication Program in Southeast Asia in an address he presumptuously titled "The Epidemiology of a Disappearing Disease." In the address, Soper suggested that "the situation of malaria eradication in certain countries of Asia at the present time bears considerable resemblance to that of yellow fever eradication in Brazil in 1930."[7] He asserted that there was "an essential identity of the malaria program with that of yellow fever," believing that the eradication of malaria simply required "disciplined teams of anti-mosquito workers and thorough supervision of the work done."[5, 7]

What Soper failed to understand is that, "apart from being an insect-transmitted disease, malaria is not like yellow fever at all, and presents quite different challenges to its control."[5] As discussed above, *Aedes aegypti* serves as the principle vector of yellow fever, although a couple of different species of the genera *Aedes* and *Haemogogus* are capable of transmitting the disease as well.[8] In stark contrast, malaria can be transmitted by at least thirty to forty different mosquito species of the genus *Anopheles*.[5, 9, 10] This complex situation is simplified when one simply considers the anthropophilic, or human-preferring, *Anopheles gambiae* as the principle vector of malaria in many regions.[9] One must also consider that *An. gambiae* is a species complex, "meaning that it is made up of several races or variants with different transmission capabilities, which add to its differential impact."[5] While this paper will only provide comparisons between *Aedes aegypti* and *Anopheles gambiae*, the reader should be cognizant of the extensive list of setbacks any malaria eradication effort would face in considering the disease's diverse range of mosquito vectors.

The transmission of an infectious disease such as malaria, yellow fever, or dengue fever requires a certain density of mosquitoes. The precise number depends on the transmission capabilities of the mosquito species, otherwise referred to as the vectorial capacity, which is determined by the anthropophilic behavior of the species, as well as its own susceptibility to the disease in question. Historian Randall M. Packard remarks that *An. gambiae* is perhaps the most anthropophilic of mosquitoes, with 80 to 100 percent of its blood meals coming from humans, as opposed to less than 50 percent in other *Anopheles* species. Furthermore, *An. gambiae* is highly susceptible to malaria, meaning "that in malaria endemic areas a high percentage of female *An. gambiae* will be infected with malaria and, in turn, a high percentage of their blood meals will result in the injection of malaria sporozoites."[9]

In contrast, the degree to which *Ae. aegypti* prefer human blood as opposed to that of other mammals is not yet clear. Entomologists Willem Takken and Niels O. Verhulst remarked that, "of the three important disease vectors, *Ae. aegypti, An. gambiae s.s.*, and *Cx. quinquefasciatus*, there are surprisingly few studies on the host preference of *Ae. aegypti* compared with the other two species. The behavior of *Ae. aegypti* has been studied extensively in the laboratory, but behavioral field studies with this mosquito are rare."[11] In an extensive series of studies regarding the susceptibility of *Ae. aegypti* to yellow fever, Ricardo Lourenço-de-Oliveira of the Memórias do Instituto Oswaldo Cruz compared the susceptibility of 23 strains of Brazilian *Ae. aegypti* to that of American, African, and Asian strains. While infection rates reached 48.6 percent in a few strains of Brazilian *Ae. aegypti*, with even higher susceptibilities to sylvatic forms of yellow fever, the entomologists found that, in approximately 60 percent of the Brazilian strains, the infection rate was lower than 13 percent. In contrast, *Ae. aegypti* strains from regions in Asia where yellow fever is endemic were found to have infection rates ranging from 47 to 64.4 percent.[12,13] This combination of questionable anthropophilism and low susceptibility to yellow fever yield a Brazilian *Ae. aegypti* strain with a particularly low vectorial capacity. As these inefficient vectors must swarm at high densities to facilitate significant disease transmission, these mosquitoes were the perfect victims for the early twentieth-century yellow fever eradication campaigns of Soper and his colleagues.

On the other hand, when residual insecticides similar to those used by Soper and his colleagues were applied to malaria eradication campaigns, the results were less impressive. The high susceptibility of *An. gambiae* and its anthropophilic behavior make it a highly efficient malaria vector. In fact, *An. gambiae* is so efficient that, "in areas where *A. gambiae* are present and transmission occurs throughout the year, a person may receive up to 1,000 infective bites a year."[9] Consequently, malaria transmission can be maintained at low densities of *Anopheles gambiae*, resulting in significant setbacks for malaria control programs solely based upon the species' elimination.

Such setbacks, along with an extensive list of biological, social, political, economic and cultural difficulties, led to the inevitable failure of the Malaria Eradication Program. Initiated in 1955 during a "period of immense enthusiasm," the Malaria Eradication Program (MEP) and its formal demise in 1969 "is by now well-known in public health circles, if not more generally."[5] Based on the premise that residual insecticides could lower the density of *Anopheles* vectors enough to interrupt the transmission of malaria, "the MEP was specifically conceptualized as a universal, technical intervention that did not have to take on the almost impossible tasks of improving the social and economic conditions in which people in areas of endemic malaria lived."[5] Despite initial successes, it became evident by the mid-sixties to even the most insistent eradicationists that complete eradication through such methods was impossible. The goal of eradication was abandoned

and, consequently, malaria returned in areas where it had been controlled, often in epidemic form.[5, 9]

Parry and his colleagues, by considering the situations of malaria and dengue fever as analogous, run the risk of repeating Soper's mistakes. As those involved in the MEP discovered, depending upon the comparative vectorial capacities of the *Ae. aegypti* and *An. gambiae* strains in question, techniques which may halt disease transmission in the former may fail to accomplish the same in the latter. As discussed above, since there have been surprisingly few field studies of the host specificity of *Ae. aegypti,* the degree to which the species prefers human blood as opposed to the blood of other mammals is not yet clear.[11] However, even if the species is of questionable anthropophilism, certain strains of *Ae. aegypti* may still demonstrate a high vectorial capacity in respect to dengue fever, provided they prove to be highly susceptible to the virus that causes the infection. Further studies performed by Lourenço-de-Oliveira et al.[12] demonstrated that experimental dengue fever infection rates among 23 *Ae. aegypti* strains from 13 different Brazilian states were particularly high.[13] Likewise, in a study conducted by Massamba Sylla of Colorado State University, Senegalese strains of *Ae. aegypti* were determined to have an infection rate of 73.9 percent.[14] Thus, despite being referred to as "the yellow fever mosquito," it appears that *Ae. aegypti*, at least in certain regions, is a far more efficient vector of dengue fever than of yellow fever.

As the dengue vectorial capacities of certain *Ae. aegypti* strains, particularly those in Brazil where Oxitec has performed some of its initial field trials, are comparable to those of *An. gambiae* strains in terms of malaria, it seems reasonable to assume that Oxitec's technique would have similar effects when applied to malaria control. Yet, even if one grants Parry and his colleagues the benefit of the doubt and ignores mounting evidence that this reduction of *Ae. aegypti* has little to no effect on the eradication of dengue fever, there is still an extensive list of biological, social, political, economic and cultural factors which could lead to the failure of such methods to eradicate malaria. For the sake of brevity, this paper will primarily detail those of a biological concern.

One such factor is tetracycline, the antibiotic that is laced into the mixture of fish food and goat's blood that is fed to OX513A in order to keep the autocidal genetic sequence inactive. As discussed above, Oxitec's method of disease vector control is based on the premise that the genetically-modified mosquitoes, once released into the field, will have no access to the tetracycline found in the laboratory and, consequently, will fall victim to the autocidal sequence within their own genome.[2] However, should the mosquitoes have access to this antibiotic in the field, the lethal gene will remain inactive, allowing the millions of released mutants, along with all of their progeny, to survive. Certain species of mosquitoes, including *Ae. aegypti,* have been found to breed in sewage treatment plants, septic tanks, and cesspits, all of which often contain moderate levels of tetracycline. John Mumford of the Imperial College London, a leading figure in the field of genetically-modified insects, asserted in a criticism of Oxitec, "it would also be prudent in a risk analysis to seek evidence of the levels of tetracycline in the environment that would be likely to be encountered by released mosquitoes and their offspring… If there are points of high tetracycline concentration then the risk

analysis would need to consider a risk management measure that would deal effectively with it."[15]

An additional factor that has hampered disease vector control by other methods is "the immigration of females already inseminated by fertile males outside the release area."[16] In insect populations isolated to a confined habitat, such as those of *Ae. aegypti* on the Cayman Islands where field trials with OX513A were first conducted with questionable success, such concerns are irrelevant, as the release area is contained enough to avoid the immigration of external insects. Even in less isolated insect populations, such as screwworm species *Cochliomyia hominivorax* which inhabited expansive ranges of North America until its eradication, this obstacle can be overcome by releasing sterile insects in large-scaled rolling programs. However, as leading medical entomologists Chris Curtis and Morten H. Andreasen grimly asserted at a conference regarding the control of insect vectors, "finding the capital for this seems unlikely for a program directed against *An. gambiae*, which extends over huge areas of rural Africa and threatens the lives of the children of the poor, but not cash crops which accountants see as a worthwhile investment."[17]

Another factor involves logistical concerns. Parry and his associates at Oxitec readily admit that their method of disease vector control is unlikely to result in population collapses. Rather, based on unpublished results from field trials in the Cayman Islands and Brazil, the corporation claims that the introduction of OX513A will reduce *Ae. Aegypti* populations by approximately 80 percent. This should be quite concerning, as millions of genetically-modified mosquitoes would need to be released every few weeks indefinitely in order to sustain any sort of population suppression. As Oxitec's mosquitoes are patented, "this system locks communities and nations into a permanent scheme of repeated ongoing payments to Oxitec once releases begin."[18] Furthermore, as environmental advocate Eric Hoffman discussed in a criticism of Oxitec, disease prevalence could rise if releases were halted, as the mosquito populations in the region would rebound. "The company has yet to provide data on what would happen to mosquito populations or prevalence of disease if releases were halted," Hoffman reported.[18]

What should be of the greatest concern to those who so eagerly applauded Parry in London last autumn, or the misled citizens of Juazeiro, are studies which demonstrate that there is little to no correlation between the population levels of *Ae. aegypti* and the prevalence of dengue fever in humans. According to a report published by Thomas W. Scott et al., since *Ae. aegypti* "persist and effectively transmit dengue virus even at very low population densities," infection rates of dengue fever among human populations are, at best, weakly correlated with the density of *Ae. aegypti* populations.[19] Such data is consistent with mounting evidence suggesting that, although Oxitec's method of disease vector control may be able to reduce *Ae. aegypti* populations by approximately 80 percent given ideal conditions, such reduction is not enough to sufficiently halt the transmission of dengue fever.[19] Certainly, if the technique were applied to the case of *An. gambiae* and malaria, such problems would persist, if not amplify.

Thus, in the campaigns of Parry and his colleagues, one can already detect the beginnings of failure. Fortunately, a few individuals closely associated with Oxitec seem to recognize the

company's limitations. "This is not a panacea," Giovanini Coelho of the Brazilian Ministry of Health explains, "I am not saying that this alone will solve the problem."[2] Yet, with the Gates Foundation and the current Director-General of the World Health Organization enthusiastically encouraging this revival of the eradication ideal, one must remain cautious about new technologies in order to prevent history from repeating itself.[5] While the work of Hadyn Parry and his associates at Oxitec may initially seem promising, his biomedical solution is reminiscent of earlier twentieth-century vertical campaigns, chiefly the MEP, which failed to take into account the wider societal narrative of this infectious disease. While genetically-modified mosquitoes may become an important facet for future efforts in malarial vector control, Hadyn Parry, his colleagues, and the parade of technological-minded eradicationists continually fail to realize that without the implementation of a socio-ecological approach, such biomedical responses to malaria may prove to be fruitless.

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I am NOT your Gay Best Friend: Examining the phenomenon of heteronormative accessorization of the contemporary gay man

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There is an epidemic sweeping the Millennials and bleeding into older generations. It thrives off of heteronormative social structures, spreading primarily via the heterosexual white female. Its victims, upon infection, are classified by the term "gay best friend." Epidemiological jargon aside, this trend threatens the gay male community in a way never before seen. Straight girls are latching onto gay boys as if they were pets, and claiming them as their personal gay best friends—also known by the acronym GBF. As GBFs, gay men are expected to go shopping with their straight female, serve as the sassy best friend who will always back her up, and be on call 24/7 to let her blow off steam about some boy she is hopelessly in love with. This essay will examine the problematic structure of this new fad by analyzing the oppressive institutions it perpetuates through a faux-acceptance of homosexuality

Before unpacking the gay best friend phenomenon, I want to clarify that this is not an attack on heterosexual women. Nor is it meant to show disdain towards public acceptance; the United States is arguably experiencing the least homophobic period in its history, thanks in part to this trend. Rather, I would like to constructively critique the trend to promote the construction of healthier and more equal relationships.

Having said that, the first question that needs to be answered is: what exactly is a gay best friend? Consider the character Stanford Blatch, played by Willie Garson, from the popular television show *Sex and the City*. Stanford serves as a two-dimensional prop to support the over-the-top personality of Carrie Bradshaw (Sarah Jessica Parker), throughout the show's 1998-2004 television run. Stanford can be seen as one of the first prototypes of the now solidified GBF model; seventeen years ago, before any US state legalized marriage equality, Stanford was already helping Carrie put together stylish outfits, listening to her endless trouble with on-and-off boyfriends, all the while throwing in a humorous dash of sass. When Carrie questions whether the idea of monogamy is becoming antiquated, Stanford fires back "I can't even commit to a long distance carrier" ("The Monogamists"). This dramatic persona embodies the expectation embedded in the enigma of the gay best friend.

Stanford Blatch was probably not the first spark leading to today's flaming trend, yet his position as an early televised example might hint as to how the gay best friend came about in American society. It should not be a shock to recall that, until recently, homosexuality itself was a crime; the man on the United States two-dollar bill personally oversaw the revision of a Virginia law so that "whosoever shall be guilty of…sodomy with man or woman shall be punished, if a man, by castration" (Jefferson 325). Homosexuality was also considered pathological first overtly and then covertly, until finally escaping psychopathology discourse in 1987 (*Diagnostic and Statistical Manual of Mental Disorders*). As exemplified, of the roughly 400 years this country has been developing, only the last 50 or so have seen a shifting public opinion toward gay men.

The first glimmer of what was to become the GBF plague appeared in the late 1940s with Mattachine Society founder Harry Hay. A pioneer of the modern gay rights activism, Hay "[began] promoting his concept of 'the Homosexual Minority'. Under his guidance in 1950, the Mattachine Society stated that it was 'possible and desirable that a highly ethical homosexual culture emerge, paralleling the emerging cultures of our fellow minorities'" (Norton 5). In his book *The Myth of the Modern Homosexual*, Rictor Norton comments on Hay pulling the male homosexual into the public spotlight. "The words *minority* and *culture* triggered major disputes," he writes, "but no one seemed to dispute the fundamental fallacy of the view that a minority culture has to make a contribution to its 'parent culture', that it be of value to the society at large" (Norton 5). Norton goes on to argue that many historians and social constructionist writers in the 1980s and 1990s "have largely failed to recognize the difference between attitudes toward homosexuals and the experience of queers" (Norton 11). Norton provides the tools to dig through layers of misrepresented historiography, and we unearth a heteronormative parasite that latched onto the homosexual male upon his birth into the public sphere. The collective understanding that the value of homosexual minority lies in its service to heterosexual dominance reveals a framework of oppressive power relation that, as Norton argues, was at no point challenged. As such, the GBF phenomenon appears to stem from homosexual submissiveness to dominant heteronormativity.

With some clarification of the GBF's origin, the next question to ask is: who sustains this idea of gay men as accessories and why? Based equally on personal experience and popular culture research, the answer to the former is straight, white women, especially those in the years of adolescence. The harder question is why straight, white, teenage girls? This discussion considers the majority; the characteristics "straight", "white", "teen", and "girl" do *not* represent the full spectrum of those who put their gay male friend(s) on a leash. However, for the sake of deconstructing the phenomenon, unpacking why straight white teen girls take the forefront of this trend best illuminates underlying reasons.

Systematic unpacking of the straight, white, teenage girl's positionality reveals a fatal combination that explains her accessorizing of the gay man. Earlier, analysis of Norton's *The Myth of the Modern Homosexual* demonstrated how heterosexual dominance has built homosexual culture as subservient, explaining the "straight" part of the straight white teenager. What about being white? How does white privilege factor in here? Renowned race studies author Bell Hooks provides some insight into white privilege's relationship to this phenomenon. In her book *Belonging: A Culture of Place*, Hooks explains that a fundamental piece of white privilege is "the denial of white supremacy by mouthing slogans like 'heritage not hate'…fail[ing] to see that their refusal to acknowledge what 'heritage' means to black folks is itself an expression of white racist power and privilege" (Hooks 10). White people are therefore predisposed by their privilege to overlook their supremacy over others. Social equality allows them to blindly navigate the world. As such, white girls are more likely than girls of color to subconsciously oppress "minorities", such as homosexuals.

Adolescence, the "teen" piece of the "straight white teen girl," is the easiest of these characteristics to analyze. Anyone who has made it to the other side of puberty knows how tumultuous these years can be; latching onto any proverbial rock becomes vital to survival. What better than a boy experiencing all the confusion of adolescence and coming to terms with a non-normative sexuality? His hyper-vulnerability makes him a convenient person to turn to as a last resort, as it is highly unlikely for him to have much of a social life or self-confidence under the constant torment of his peers.

Now, all that remains is the gender aspect. Why are girls far more involved in the GBF trend than their male counterparts? In her seminal feminist book *Communion: The Female Search for Love*, Bell Hooks describes modern female consciousness as "more than ever before fac[ing] the reality that we live in a male-dominated society." Furthermore, she writes, "many women like it like that, as long as they derive benefits from men and no negative side effects," such as unrequited love from a male partner, intimate partner violence, and patriarchal oppression (Hooks 167). Because of this desire for male companionship sans overt patriarchy, straight women are drawn to the gay man, who suffers from similarly oppressive normative structures. The gay man embodies the internalized comfort of male attention that Hooks describes, without imposed sexual and emotional pressures. Gay men present women with the alluring promise of a "benevolent patriarchy" (*Communion* 165).

It is evident that the foundation of the GBF idea is problematic in its structure, but what is equally concerning is what the trend puts out into public discourse. The gay best friend perpetuates the accessorization of the homosexual man, watering down the gay experience into a two-dimensional comedy sketch.

The term "accessorization" is essentially a facet of the broader idea of objectification, developed for the purposes of analyzing the gay best friend. Rather than merely an object, the accessorized gay man holds a significant place as something both needed and disposable, vital to modern social humanity yet himself inhuman. A gay best friend's heterosexual dominatrix owns him. It is "a societal rule of thumb that you don't compare things to ownership…[by] referring to an out gay man or men as 'my gay' or 'my gays,' you limit his full agency" (Easton). While Easton makes a sound argument in the denial of agency via forced ownership, I argue that there is more at risk than gay men's agency. Their very existence is in jeopardy of being invalidated. One's existence stems in part from experiencing and exhibiting emotions, which constructs a boundary that separates organic life from artificial intelligence. But as gay best friends, gay men are denied that fundamental part of existing. They are not allowed to express their emotions, lest those emotions bring humor to the overlord's day or castigate someone she dislikes. In *SundanceTV's* article "10 Reasons Girls Need Gay Best Friends," Alida Nugent drives this point home, explaining that "gay male friends…use their stunning vocabulary to slice people open with a machete of words that will leave me with the great joy of laughing so hard liquid comes out of my nose" (Nugent). Here, the gay man's whole purpose is centered on bringing joy to she who possesses gay best friends. But what about when gay men genuinely do not like someone? Many a time I have said unkind things to my girlfriends about people I do not care for, and I have been consequentially reprimanded for "being a bitch." This leads me to conclude that gay men expressing their feelings through a "machete of words" is only acceptable when it pleases those higher up in the social food chain. The silencing of gay men's emotional conversations when they serve no purpose to the dominant party reinforces systemic heterosexual oppression over a still-subservient gay community.

Emotional invalidation is, unfortunately, merely one example of a multitude of unjust actions done under the guise of GBF phenomena. For example, we are inherently expected to be available at our master's every beck and call. As an article in *Teen Vogue* illustrates, "A few years ago, all the popular, pretty girls were walking hand in hand with a preppy jock. Now you'll see them in the hallways with a Mulberry bag on one arm and a Johnny Weir look-alike on the other" ("Hot Topic: Gay Best Friend"). In a nutshell, this article implies that gay best friends have the mobility and function of a purse. Not to put down a perfect statement accessory, but I do not find it radical to claim that gay men are worth more than a handbag.

Gay men are also forced to silently endure a lonely position as a gay best friend, for they are sucked into a sphere in which they are constantly reminded that they do not belong; "the notion of the 'gay best friend' works to calcify the idea of gay as *other*" (Easton). It is disheartening to realize, growing up in a binary heteronormative society, that one does not belong fully to either the straight male community or the female community. It is emotionally devastating to resort to being an accessory to finally feel acceptance.

Most toxic of all, however, is the denial of gay men's ability

to challenge heteronormativity. Let's revisit the *SundanceTV* article, this time focusing on the fourth reason "girls need gay best friends: Parades!" A legacy of resisting homophobia and oppression at the hands of heteronormative, gay pride parades are demoted to "glitter and lots of shirtless men" at the hands of GBF perpetrators (Nugent). Posing a challenge to heterosexual dominance is irrelevant to the straight white girl, because it does nothing to benefit her. And so opposition to homophobic oppression, a cornerstone in the gay identity, is dubbed null and void in one fell swoop. The recipients of gay best friendship unknowingly seek out the stereotypical benefits of surrounding themselves with gay men while simultaneously rejecting the less glamorous side of the homosexual experience. After all, who *wants* to witness and endure the cruelty of a society built off of the rejection of his existence? But this is not an excuse to deny the ugly side of being gay. To do so is to value gay men the way one does tissues: they are appreciated when they are of use and thrown away when their usefulness runs out. The GBF's title may have the word "friend" in it, but his treatment shows he is anything but.

This paradox of being called a gay best friend without being treated as one speaks to a broader social renovation. Gone are the days where gay men can be legally killed for their sexual orientation. American society is undergoing public transition as more states legalize marriage equality and outrage sparks in those that choose to hold onto antiquated legal homophobia. But fret not patriarchal conservatives, this change in public discourse does not equate to equality for the queer community. Rather, society is entering the era of faux-acceptance of the queer community, and its champion is the gay best friend.

There are a number of levels at which the gay best friend maintains this faux-acceptance, the first being a redefinition of what it means to be gay. People do this simply by creating the term "gay best friend." The mere existence of a title meant to apply to any gay person inherently assumes a universality of being gay that erases the authentic individual self. This echoes the previous argument, namely that the structure of the GBF is set up to afford a level of acceptance to the gay man in exchange for placing priority on his gay identity. Lauren Duca's article in *The Huffington Post* captures the problematic labeling inherent in calling someone a GBF. "Gay men feel a lot of pressure to be everything the 'gay best friend' concept assumes them to be" and, though "many of the things gay [best friends] are associated with—cleanliness, interior decorating, [etc.]—are totally positive…it's not fair to push your preconceived notions on someone" who may identify himself differently than you have defined him (Duca). The gay man turns in his self-made identity at the door, and is issued a heteronormative definition of his new identity.

This homogenizing of the gay male community into a herd of sassy interior designers erases individual identity, while also collectively erasing the identity of a gay community through systematic isolation. Being a gay best friend inherently assumes that the straight white girl comes first and the gay community comes second, if at all. Consider classic GBF characters such as Elijah from the HBO series *Girls*, Kurt from *Glee*, or, perhaps best, the Sassy Gay Friend from the popular YouTube series by the same title. Actor and comedian Brian Gallivan portrays an over-the-top, scarf-wearing character who interacts with characters from

classic literature such as plays by William Shakespeare, exhibiting how "[their] fate[s] could have been avoided if [they] had a sassy gay friend" ("Sassy Gay Friend"). Cue the upbeat music of the stereotypical gay nightclub, complete with Gallivan's character swiveling his hips and making sassy faces at the camera. In each of the many comedic 3-minute videos, Gallivan interrupts a character's poor decision with a series of banter that inevitably steers the character down a better path. However, the *Sassy Gay Friend* is always only a supporting character (in his own series, no less!) designed to benefit the given protagonist. Whether he is saving Desdemona from murder at the hands of Othello, or helping Miss Havisham put her traumatic past behind her, the Sassy Gay Friend is only valuable in what he does for others. I understand, of course, that this YouTube series is meant solely for comedic value and not for social analysis, but it reveals an underlying theme of the gay man as estranged from the gay community. This can be seen just as easily with Glee's character Kurt, whose only interactions with other gay men occur either with love-interest Blaine or closeted bully David Karofsky. These gay characters are never depicted within a greater gay community; instead they are extras in a world of straight people. They are portrayed as cut off from the gay community, and said community is effectively starved out of existence.

Similar to the conditional "love" of a totalitarian parent, faux-acceptance in a heteronormative society pressures the gay men to work for equality. In other words, the straight world will allow gay people in if they abide by heteronormative rules. Take the idea of gay marriage, for example. As Michael Warner so cleverly puts it in his book *The Trouble with Normal: Sex, Politics, and the Ethics of Queer Life*, "if marriage is so fundamental to a program of rights, why did gay men and lesbians resist it over the twenty-five year period of their most defiant activism?" (Warner 87). Marriage, in the opinion of many queer theorists such as Warner, is an example of this conditional acceptance of gay men—assimilation, as some call it. The conforming to heteronormative institutions presents, for Warner, an example of the queer community finding validation in exchange for the rejection of their queerness. The gay best friend is one such conformer, finding approval from the straight world by following the orders of heterosexual women. This brings about a discussion of the "good gay" versus the "bad gay," in which the good gay wants the monogamous marriage with children while the bad gay wants to stay single and sleep around. Society accepts the good gay, but only because he rejects what it means to be gay. This is not to say promiscuity is paramount to being gay, but instead that normativity is dangled in front of the gay community as a door to a false sense of acceptance. The expectations put upon the gay best friend mold him into what society deems acceptable, and so he is misled to reject non-normative behavior with the promise of a friendship that will never be truly requited.

The gay best friend phenomenon is picking up speed at a time when circumstances are the best they've ever been for the LGBTQ+ community. However, thanks to the unique social environment, this trend poses novel threats to gay men. Faux-acceptance replaces homophobia in modern discourse, encouraging the gay best friend to assimilate into heteronormative society by deflating the gay male experience from a diverse and rich sense of self to a two-dimensional supporting sitcom

character. The idea of the gay best friend reinforces heterosexual dominance covertly by accessorizing gay men behind a promise of companionship and validation. The gay best friend is a trap for the gay male community, tempting them to reject their identity and thus preserve the heteronormative dominance. We cannot fall for this trap; we cannot sacrifice what has been fought for so long to build. Existence of the embracing gay community is fantastic, but labeling a gay man as a gay best friend is not a genuine embrace. Those who wish to truly celebrate gay culture must begin seeing their gay friends as friends. Not *gay* friends.

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More Access, Fewer Abortions: The Case of the Netherlands

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Although Roe v. Wade legalized abortions in the United States in 1973, the practice is still controversial. The US has one of the highest abortion rates compared to other industrialized countries at 20 abortions per 1,000 women aged 15-44 in 2008. To get a better understanding of the paradox of a country with strong anti-abortion sentiments and a high abortion rate, I studied the Netherlands, a country with one of the lowest abortion rates in the world. Before the 1960s, family planning, contraception and abortion were illegal and taboo in the Netherlands; however, people became supportive of the practice during the economic boom and radical social changes of the 1960s. People became less isolated in pillarized communities, demanding freedom from the church and embracing their sexuality. Modern contraceptives and reliable birth control also helped propel legislative support for family planning by legalizing contraceptives and lowering barriers to family planning. In 1981, abortion came into the spotlight and was legalized as a last resort method of family planning.

Background—Abortion in the United States

Since the 19th century, abortions in the US have been common and an "open secret" among women (Reagan 1997). In fact, family members and friends would exchange the names and addresses of doctors who were willing to perform abortions. During the Great Depression and World War II, women of all classes started entering the workforce because of financial pressures (Reagan 1997). Abortion rates grew to unseen levels because pregnancy meant the losses of their jobs. After WWII, there was an attempt to bring women "back home, to be proper wives and mothers" (Solinger 1998). Abortionists were put on trial, by mostly male judges and juries that viewed abortion as immoral. Abortionists were often forced to testify against each other, and these trials pressured doctors to stop offering abortions (Solinger 1998).

Due to these trials, doctors became hesitant or flat out refused to give abortions. Some even stated that a woman can carry out a pregnancy with breast cancer or cardiovascular disease (Solinger 1998). However, women still demanded abortions; therefore, hospitals formed abortion boards to determine whether or not they would provide an abortion to the patient based on the ratio of births to abortions performed at the hospital, and the woman's sexual history (Ginsburg 1998). By looking at abortion through a lens of what they believed was scientific objectivity, many physicians thought they had reached a level of legal compliance (Solinger 1998). Unsurprisingly, women stopped seeking abortions at hospitals.

Unfortunately, even as the number of abortions performed at hospitals fell, the number of women seeking abortions increased (Reagan 1997). Even with efforts to "re-domesticate" women, more women were entering the workplace and going to college (Reagan 1997). Women began delaying child-rearing to continue their educations and careers. Therefore, many turned to illegal abortions.

Abortion was a booming business in the 1950s and 60s. Women paid hundreds to thousands of dollars to be blindfolded and driven to unknown locations where a mysterious person performed an abortion (Schoen 2013). Many times, these abortionists had no medical background and were originally mechanics, bartenders or real-estate agents (Reagan 1997). These experiences helped shape the result of Roe v. Wade a decade later.

Expectedly, many women ended up in hospitals after illegal abortions due to infections or other complications. The overwhelming number of abortion complication cases resulted in hospitals dedicating wards specifically to these patients (Schoen 2013). As doctors witnessed women die from receiving illegal abortions, they soon realized the necessity for legal change. They were among the first supporters of legalizing abortions (Reagan 1997).

After legalizing abortions in fourteen states, abortion activists such as the Society for Human Abortions (SHA) and the National Abortion Rights Action League (NARAL) started to take the battle to the courts (Ginsburg 1998). By 1971, there were seventy criminal and civil cases pertaining to abortion (Ginsburg 1998).

The Supreme Court ruled in 1973 in Roe v. Wade to legalize all abortions in the first trimester and allow abortions with state restrictions on the second trimester (Blackmun 1973). With this ruling, pro-abortion activists believed that the battle over abortion rights was over, and the only questions remaining were the details of how to make abortions accessible (Fried 2012). As a result, the grassroots activism fell apart (Ginsburg 1998).

January 22, 1973, the day Roe v. Wade was decided, was the

day many anti-abortion or right-to-life activists joined the cause (Ginsburg 1998). Before the decision, their numbers were small. The decision provoked and convinced many who were on the fence to join the pro-life cause. Over the years, the National Right to Life Committee (NRLC) made it difficult for doctors to perform abortions, for patients to receive abortions, and for clinics to provide abortions by creating hassles and passing stringent legislation (Ginsburg 1998). Its tactics include picketing clinics, harassing abortion clinic workers and women seeking abortions, and were as extreme as murdering doctors who perform abortions (Ginsburg 1998).

It was not until the late 1980s when the pro-abortion or pro-choice movement gained significant presence (Fried 2012). However, by this time, pro-life supporters had already made it difficult for many patients, doctors, and hospitals to practice.

Currently, there is a shortage of physicians practicing abortions and medical students interested in the field (Aksel, Fein et al. 2013). As of January 2014, over half the states in the US have "excessive and unnecessary" barriers on abortion ("Induced Abortions", 2014). Nevertheless, in 2011, the abortion rate in the United States was 16.9 abortions per 1000 women between the ages of 15-44. This is high, considering that many industrialized nations were able to reduce the abortion rate to about 10 abortions per 1000 women. Despite the strong anti-abortion sentiment in the US, the restrictive legislation, and the shortage of legal abortion providers, the US has one of the highest abortion rates in the industrialized world. If these factors do not reduce abortion rates, what does?

Why do we care about abortions?

There are two reasons why abortion is an important topic: morality and public health. The moralistic problem with abortion is based on whether the fetus is considered a person. Many conservatives and religious leaders believe a fetus is a person, thus abortions are immoral because it involves killing people.

From a public health perspective, abortions are important because they are the most invasive birth control method and thus, can cause infection, injury, and death if done illegally. Even though abortions are safer than pregnancy when done in a proper, sterile medical setting, cultural, social and religious stigma and harsh abortion laws push women towards illegal and unsanitary procedures. The process of deciding on and receiving an abortion causes psychological stress, and if women decide to keep the baby, pregnancy can affect a woman's career opportunities, financial stability and reputation, which can lead to higher stress and lower health.

In the United States, different states have differing laws on abortion. There are states where an abortion is easy to obtain and others where it is almost illegal. Restrictive laws impact low-income women to a greater degree than women with higher incomes. Although studies show that most poor women who want an abortion obtain one, it comes at a higher cost: delays due to lack of pregnancy test access and financial costs of the procedure (Boonstra 2007). In fact, 18-35% of women who want an abortion continue their pregnancy because of Medicaid cuts (Boonstra 2007). Patient Protection and Affordable Care Act (PPACA) had increased access to contraception; however, a recent Supreme Court case limited this expansion, bringing uncertainty to those who would benefit (Liptak 2014).

Comparative Studies

Multiple comparative studies since the 1980s show that the

Table 1: Rate of legal abortions in select countries with complete reports by year

Country	1996	2003	2008
United States	22	21	20
Netherlands	7	9	8
Germany	8	8	7
Switzerland	N/A	7	7
Czech Republic	21	14	12
Slovakia	20	13	11
Israel	14	14	13

Note: Rates are number of abortion per 1,000 women aged 15-44.

United States has one of the highest abortion rates compared to other industrialized countries like the Netherlands, Germany and Switzerland and less industrialized countries such as Israel (Table 1). In 1996, the United States abortion rate was similar to Slovakia and the Czech Republic, but by 2008, the two countries had about 40% lower abortion rate than the US (Table 1). Thus, many researchers question why are the abortion rates in the US so high, even compared to less affluent countries? What feasible changes can help lower the abortion rate in the US? To answer these questions, I will look at one of the countries with the lowest abortion rate: the Netherlands.

Questions:
- Why do women in the US and the Netherlands get abortions?
- Do they have different reasons for getting abortions?
- What other social, cultural or religious factors might play a role in understanding the differences in abortion rates between the two countries?

Methods

I have reviewed existing abortion policy, reproductive health and historical literature of the Netherlands and the United States. I have also conducted primary source interviews with a doctor, and two professors in the Netherlands to further my understanding of Dutch culture. With this information, I have identified how the Dutch views on contraception and abortion evolved on the household, community and political level in the latter half of the 20th century.

I used the social ecological model to evaluate how the Netherlands reduced its abortion rate to one of the lowest in the world. The social ecological model shows how multiple factors impact behavior and help explain social change as a result of multiple levels of influence. The levels include: public policy, community, organizational, interpersonal, and individual (Figure 1).

The model is based on the idea that the individual is influenced by and can influence their social environment. Using this model, I will determine how the social change in the community, the fall of pillarization, and the changes within families helped influence abortion laws and policy in the national level, and consequently, decreased the abortion rate. Additionally, I will also determine how lessons from the Netherlands can be used in the United States to lower the abortion rate.

Culture, Politics and the Path to Legal Abortions in the Netherlands
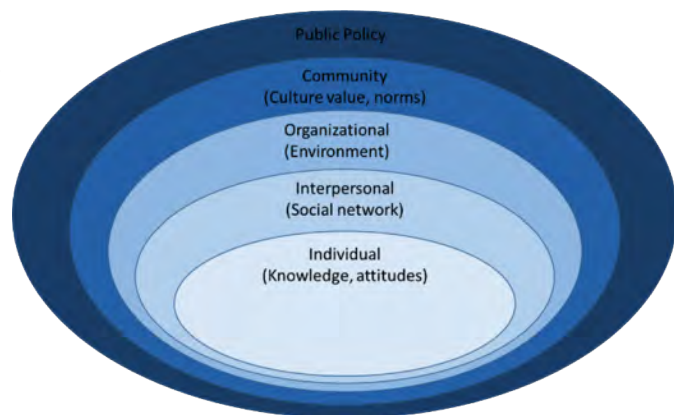
Before the 1960s

Figure 1: The Social ecological model (Glanz 2008)

Figure 2: A group of Dolle Mina protestors with "Boss in own belly" on their stomachs. http://www.isgeschiedenis.nl/nieuws/dolle-mina-en-het-baas-in-eigen-buik

Before the 1960s, Dutch society was organized in a system known as "pillarization" or social compartmentalization; there were four pillars: Catholic, Conservative Protestant, Socialists and Neutrals (Janin 2012). The pillars allowed people from different religions to identify as Dutch. Bram Mellink, a Dutch historian at the University of Amsterdam, explains that "[The pillars were characterized by a] high degree of self-organization [within] these groups, leading to a religious-ideological separation of schools, public broadcasting organizations and even hospitals along religious lines."

This policy came from religious tension in the 16th to 18th century when the Protestants in the northern parts of the Netherlands and the Roman Catholics in the southern parts fought for control of the government and religious institutions (Lechner 2007). To prevent hostility, pillarization allowed each religious community to follow separate but parallel paths. This also meant both Catholic and Protestant representation were in government. Privately, however, religious prejudices continued to exist within the communities (Janin 2012).

The Church was the center of life. Everyone in the community went to church and followed the Church's teachings. The Church guided most aspects of family life including the number of children and which school children went to. Family planning, contraception, and abortion were illegal and taboo under the Church, and doctors did not prescribe them (Janin, 2012). According to Monica van Berkum, a Dutch citizen who was a student in the 1960s, "When I was young, the Church had a lot of influence on our lives. [It] was forbidden to take contraceptives and every year the priest came to visit my Mom to ask if there was again a new child coming… That is why my parents had so many children" (Berkum 2015). Therefore, the birth rate was high in the Netherlands compared to other European countries (Noordhuizen, 2010).

1950s-60s

From the 1950s, the Netherlands saw a great modernization and industrialization of the country. The Netherland's GDP rose rapidly from 4,470 euros in 1950 to 17,950 euro per capita in 1996 (Noordhuizen, 2010). This was due to the rapid development of trains, bridges and telegraph connecting people across the country and challenged the pillars that the society was built upon (Lechner 2007).

As the average income rose, poorer families were able to afford college for their children for the first time through government subsidies and cheap loans. This rise in education brought about discussions on topics that were once taboo. These college-educated youths wanted a better life than their parents and, in effect, changed the nation's values. The growth of wealth and fulfillment of basic needs initiated conversations about "post-materialistic values such as personal autonomy, self-actualization and tolerant values," in the younger generation; this led to an increase of the non-religious population (Inglehart, 1977). They demanded democratization and independence from the Church and started movements such as the Flower Power movement. James Kennedy, an American professor of Dutch history from the University of Amsterdam stated, "The rise of consumer culture, education and the welfare state gave people a sense that they were independent of moral communities that governed their sexual lives." (Kennedy 2015). Along with these movements, women demanded control of their own bodies and sexuality through contraception, birth control and abortions.

Rebellions and protests against the Church were widespread. An organization called Dolle Mina (Wild Mina) organized protests and rebellions against the Church for free-sexual behavior and pleasure (van Zoonen 1992).

Dolle Mina organize[d] funny and rebellious actions, as you can see [in figure 2], where they wrote 'boss in own belly' on their stomach…The Flower Power Movement and the Provo's and student movements discovered other ways of living and pleaded for free sexual behavior and pleasure. Later, this became stronger and stronger amongst feminist women, who reclaimed their bodies back for themselves, with even the so called 'fuck-strikes' (Berkum 2015).

The Catholic Church fought against these progressive movements with "Ethisch reveil" (Ethical reveal) movements, which encouraged family values and purity in girls. However, these movements only pushed the youth further away and decreased the religious population. Monica remembered,

The church didn't understand the democratization movement of the young and stood at the conservative side in many aspects: politically, morally and also regarding liberation of women… And of course, there was the debate on sexual pureness; you should keep yourself pure and virgin for the only one you love and would marry, especially women and girls, of course…[However,] the revealing of the sexual abuse in the church made [the protests] stronger. And, in general, the wider emancipation movement provoked a strong secularization in the Netherlands. When I was young, most people went to church;

nowadays, this counts for a very small minority. The role of the church [was] marginalized out of the country (Berkum 2015).

Later, the Church tried to change with the times in an attempt to bring back the young population. Unfortunately, this method was proved futile. Kennedy, an American professor from University of Amsterdam, explains:

The Dutch church was overeager in introducing reforms, which alienated some and caused unrealistic expectations among others. But you could also say that communitarian "pillarized" church life—which did not encourage a deeply personal spirituality—translated poorly in a culture where one could choose one's own lifestyle. The Protestant churches underwent a parallel process of decline, but that process had started earlier and at the same time they were able to adapt to change somewhat better (Kennedy 2015).

The Church lost following from both the conservative and progressive groups, isolating them out of power. By 2009, only 58% of the population classified themselves as religious (Central Intelligence Agency).

Unlike many other cultural revolutions of the era, the Netherlands' revolution was relatively smooth. Mellink, a Dutch historian, justifies this as a result of, "the strong belief that modernization was unavoidable among Dutch cultural elite" (Mellink 2015). Kennedy agrees with Mellink and describes that "the more rapid rate of break with traditional sexual morality made the pro-life movement weaker in the Netherlands," making it possible to liberate conversations about sexuality (Kennedy 2015).

PATH TO LIBERATING SEXUALITY

There were many forces pushing the Netherlands towards legalizing abortions. However, prior to legalization, the nation needed to be able to speak openly about sexuality. This happened in two ways: through the media and through the population boom in the late 1960s and 1970s.

Media played a big role in publicizing family planning. By 1965, there were two million television sets in Dutch households, making television a common medium. It portrayed sexuality as a "healthy and normal part of life, both for adults and adolescents" and emphasized the responsibility that came with sexual behavior (David and Rademakers 1996). Television shows talked about abortions in an open and frank way that attracted teenagers and young adults through teen-friendly TV shows (David and Rademakers 1996). Family planning, which once was a taboo in society, became a common topic.

Industrialization led to the growth of cities. In the 1960s, the Central Statistical Bureau projected that the population would grow to 21 million people by 2000, and the Dutch felt that the unchecked population growth would lead to overpopulation and stress to the nation's resources (Hardon 2003). Family planning was proposed as one of the potential solutions to slow the growth of the population (Ketting and Visser 1994).

As sexuality became an increasingly common topic, people began to demand access to effective contraception. The modern birth control pill was available to the public in 1963 and made it easier for women to access birth control (Ketting and Visser 1994). Before the pill, contraception was unreliable and therefore many physicians did not prescribe contraception in fear of sharing the burden of an unwanted pregnancy or a possible abortion (Ketting and Visser 1994). However, when a reliable contraceptive method was introduced, physicians were more open to the idea of family planning, and it became an integral part of the family doctor's practice (Ketting and Visser 1994).

Organizations such as the Dutch Neo-Malthusian League and the Dutch Association for Sexual Reform (NVSH) pushed hard for the legalization of the birth control pill and other contraceptive methods such as the IUD (Hardon 2003). NVSH described sexuality as an "integral part of the human existence," and its membership reached 200,000 members by 1964 (Hardon 2003). Even though the birth control pill was not yet legal, the group gave free pills to its members.

By 1971, contraceptives such as the birth control pill, IUD and diaphragm were free for all citizens through the national health insurance system, and by 1973, contraceptive sterilization was also included in the list (Ketting and Visser 1994). In addition, family planning services by both the family physician and the family planning clinic were subsidized by the government (Ketting and Visser 1994). This was symbolic because it meant that the government supported family planning, now considered a civic duty, not a private one.

The progressing openness about sexuality was a major factor in legalizing abortions. It was essential that the nation support contraception before abortion debates started because abortion was discussed as another method of family planning and contraception.

When debates over abortion legalization started, opponents and supporters of the bill repeatedly stated contraceptive methods such as the pill, IUD and diaphragm were the best ways to combat unintended pregnancy and thus, the government should provide more contraceptive services instead of abortion services (Noordhuizen, de Graaf et al. 2010). Abortion legalization took 14 years due to a strong minority called the Christian Democratic Party (CDA) that controlled just enough votes to stop its legalization (Noordhuizen, de Graaf et al. 2010).

Because politicians could not fulfill the citizens' desires for legal abortion services, they passed every legislation that improved family planning and contraceptive services to appease abortion supporters (Ketting and Visser 1994). Sexual education was stressed and very liberal contraceptive practice laws were passed instead of the legalization of abortion (Noordhuizen, de Graaf et al. 2010). As a result, the Netherlands spent more money on family planning and contraception services than any other nation (Ketting and Visser 1994). Abortions, although available, were believed to be a last resort due to its illegal status.

From 1971, abortions were provided by request by a network of free-standing clinics. From 1971-73, abortion rates increased (Figure 3) (Hardon 2003). Although abortions were technically illegal,

Figure 3: Abortion Rate in the Netherlands 1970-2012

the government and courts tolerated the practice (Hardon 2003). After peaking at 1973, abortion rates rose again in 1978 due to the fear that birth control was unsafe (Figure 3) (Ketting and Visser 1994). When abortion was finally legalized in 1981, demands for abortions did not increase because they were given to women as requested since 1972 (Ketting and Visser 1994). Instead, abortion started to rise again in the 1990s due to increasing numbers of immigrants and people from Eastern European countries looking for safe and legal abortions (Figure 3) (Hardon 2003).

The Netherlands started from having one of the most restrictive abortion policies to one of the most liberal in three decades. Its successes are accredited to a national emphasis on family planning and government-funded reliable contraception. Unlike the United States, abortion is considered a part of family planning and thus supported by the nation as a last resort. The positive and open view of sexuality and contraception allowed the Netherlands to have one of the lowest abortion rates in the world.

COMPARISONS BETWEEN THE NETHERLANDS AND THE UNITED STATES

FAMILY PLANNING AND CONTRACEPTIVE USE

The use of contraception in the Netherlands increased dramatically since the 1960s. By 1980, 60% of Dutch women aged 15-44 bought oral contraceptives from pharmacies, compared to the United States around 10% (Ketting and Visser 1994). Currently, 67% of Dutch women and 73% of US women use any type of contraceptive (World Contraceptive). Perhaps the most shocking is that contraceptive sterilization of both males and females was the second most used contraception in the Netherlands in the 1970s (Ketting and Visser 1994). This method was free through the national health insurance by 1973 (Ketting and Visser 1994). The percentage of citizens who wanted sterilization increased until 1986, when the reliability of the pill increased dramatically, and people wanted to have children later (Ketting and Visser 1994).

Contraception and abortions are free to all citizens in the Netherlands under the Dutch national health insurance (Ketting and Visser 1994). Abortion is not yet free to all citizens in the United States. Low income families can receive family planning services, contraceptives and abortions through Medicaid which fund seven thousand safety-net health centers which include Planned Parenthood and other federally qualified health centers (Planned Parenthood). The prices are determined on a sliding scale (Planned Parenthood). After the passage of the Patient Protection and Affordable Care Act (PPACA), 28 states have extended Medicare eligibility for family planning, and new insurance policies must include contraceptive services (State Policies).

REASONS WHY DUTCH AND US WOMEN HAVE ABORTIONS:

In a survey from 1983-87, the most cited reason for Dutch women to seek abortions was that they "already had as many children [they] want" (25%) (Bankole, Singh et al. 1998). This was only the sixth most cited reason among US women. In the United States, the most cited reason for seeking abortions is that "having a child would change life in a way [she] does not want" such as her education or career (76%) (Bankole, Singh et al. 1998). Reasons such as "not [being able to] afford a child right now" (68%) and "not wanting to be a single mother" (51%) were the second and third most cited

Table 2: Percentage of women citing multiple reasons for seeking an abortion by reason

Reason	Netherlands, 1983-1987 (N=230)	United States, 1987-1988 (N=1,900)
Already have as many children as wants	25	26
Having a child would change life in a way does not want	N/A	76
Cannot afford a child now	11	68
Not ready for responsibility	20	31
Has problems with husband or partner	16	u
Husband/Partner does not want child	N/A	23
Does not want to be single mother	N/A	51
Too young to have child	13	30
Does not want parents (or others) to know	N/A	31

U = unavailable, because a combined category covered more than one reason

reasons why US women wanted abortions (Bankole, Singh et al. 1998). These reasons continued to be major motives for seeking abortions in another survey in 2004 (Finer, Frohwirth et al. 2005).

REASONS WHY DUTCH AND US WOMEN DELAY ABORTIONS

In the Netherlands, second trimester abortions, abortions up to 22 weeks, were not legalized until 1981. When comparing reasons for delaying abortions in the Netherlands and the United States, clear differences can be seen. In the Netherlands, the most cited reason is relationship problems with the partner (40%) (Loeber and Wijsen 2008). Specifically, Dutch women cited the lack of a stable partner, their partner leaving them or their partner being aggressive (resulting in rape for some). The close second reason was because they felt it was "too early to have children" (35%) (Loeber and Wijsen 2008). On the other hand, for US women, the most frequent reason for delaying an abortion was financial (36%) (Finer, Frohwirth et al. 2006). In the Netherlands, this is not a factor because abortions are financed by the government-sponsored national health insurance. The second most cited reason was because the women took a while to decide whether she wanted to keep the pregnancy (Finer, Frohwirth et al. 2006). One shocking difference between Dutch and US women is that 13% of US women stated they received a second trimester abortion because they could not get an earlier appointment, something that is not stated by Dutch women (Finer, Frohwirth et al. 2006).

From a small-scale study of clinic files of abortion patients in the Netherlands, more than a third of them were non-Dutch residents from other countries who came to the Netherlands just for an abortion. From those patients, 42% cited that the pregnancy was too early and 23% cited problems with their relationship (Loeber and Wijsen 2008). Some state that these non-Dutch women seeking abortions in the Netherlands is the reason abortion rate in the Netherlands has been going up in recent years (Figure 3) (Hardon 2003).

PERCEPTION OF SEXUALITY IN THE NETHERLANDS AND THE UNITED STATES

NETHERLANDS:

As the country industrialized, sexuality was perceived as a necessary part of life, and thus, all people needed to learn how to take responsibility for their sexual behaviors (David and Rademakers 1996). Dr. Josee Wajon, a Dutch physician explained, "Sex education starts at a very young age. A lot of parents start with this even

before their children go to school (before 4 years of age). There are books available for small children to help parents to talk about this subject" (Wajon 2015). This education continues throughout a child's life and in different forms. One example is a prime-time television show called "Sex with Angela," where a popular rock star explains topics such as oral sex and sexual orientation (David and Rademakers 1996). These shows educate the youth how to practice safe sex and were able to increase the percentage of people who used the pill in addition to a condom during their first intercourse from 9% in 1990 to 24% in 1995 (David and Rademakers 1996). With such emphasis on contraception, abortion is a last resort for when contraceptive methods fail.

UNITED STATES:

Some socially conservative people in the United States do not support family planning and contraceptive services due to political, religious, or personal reasons (Publicly Funded). Kennedy and Mellink expressed that the Netherlands did not have strong, conservative political or religious leaders like the United States today. Therefore, there has been a long battle to funding contraceptives, family planning and abortion services using public funds in the US.

For similar political, religious, and personal reasons, sex education for teenagers is a highly controversial topic. Even though the majority of teenagers in the United States receive some form of sex education, they vary in emphasis and teaching (Landry, Singh et al. 2000). There are two main types of education: abstinence only, which teaches to abstain from sexual activity until after marriage, and a more comprehensive education, which teaches about different types of contraceptive methods and how to stay safe (Landry, Singh et al. 2000). A 2004 NPR survey showed that the majority of American parents wanted a more comprehensive sexual education in school and 80% believed sex education in school will help them discuss the topic with their children (Sexual Education).

In the United States, about half of sexually active women do not want a child, and thus require contraceptive services. However, because contraception is not freely available, over 25% of sexually active women who do not want a child rely on public funds for abortions (Publicly Funded). 75% of these public funds are through Medicaid, which fund safety-net health centers such as the health department and Planned Parenthood clinics (Publicly Funded). Unfortunately, more than half of these centers reported that they were unable to provide certain contraception due to financial reasons (Publicly Funded).

RECOMMENDATIONS

The Netherlands and the US have very different approaches and policies towards family planning, contraception and abortion. Many of these differences are due to social pressures and perspectives; however, I believe the United States can learn lessons from the Dutch experience.

From the start, the Dutch people had a more positive approach on sexuality and contraception. This helped remove stigma behind such topics and led to more open and honest conversations. In the United States, family planning is still a private matter, despite its public consequences.

Instead of focusing on abortion, a topic of much controversy, the topic of interest should be reproductive health and family planning. This is much less controversial. In the Netherlands, talk-ing about family planning and sexuality started the push towards contraception and later abortion. The US public still does not talk about this important topic.

FUTURE DIRECTION

In 2010, President Obama included contraceptives as a preventative service provided without co-pay under the PPACA (State Policies). This included all new insurance policies as of August 2012. In addition, all companies and institutions must provide free contraceptives under the law. This was met with backlash from conservative politicians and Christian schools and businesses, leading up to the Supreme Court case Burwell v. Hobby Lobby (Liptak 2014). The court ruled in favor of Hobby Lobby, allowing for-profit institutions exemption from the contraceptive mandate on religious grounds (Liptak 2014). It would be interesting to see if the increased access to contraception under the PPACA has changed the abortion rates in the United States.

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