

RESEARCH
ARTICLE

Consciousness and the Environment: Maharishi Technologies of Consciousness and the Incidence of U.S. Landfalling Hurricanes, 1851–2021

Kenneth L. Cavanaugh¹
kcavanaugh@miu.edu

Lee Fergusson^{2,3}
lee.fergusson@unisq.edu.au

¹Maharishi International University,
1000 N. 4th Street, Fairfield, IA
52557, USA

²University of Southern Queensland,
West Street, Toowoomba, Queen-
sland 4350, Australia

³Maharishi Vedic Research Institute,
PO Box 1620, Oxenford, Queensland
4210, Australia

SUBMITTED August 30, 2024
ACCEPTED December 17, 2024
PUBLISHED December 18, 2025

<https://doi.org/10.31275/20253535>

GOLD OPEN ACCESS



Creative Commons License 4.0.
CC-BY-NC. Attribution required.
No commercial use.

HIGHLIGHTS

A preliminary analysis suggested that a decade-long application of Maharishi Technologies of Consciousness coincided with a significant drop in U.S. landfalling hurricanes during 2006–2014, with hurricane counts rising after the practices stopped.

ABSTRACT

The purpose of this preliminary study is to explore whether application of consciousness-based procedures whose stated purpose is to influence the natural and social environment, referred to as *Maharishi Technologies of Consciousness* (MTC), can positively affect weather phenomena. The theoretical framework underlying these procedures is based on a field-theoretic view of consciousness derived from the ancient Vedic tradition of knowledge of consciousness from India as revived by Maharishi Mahesh Yogi. Seven peer-reviewed articles published in independent scholarly journals since 2016 have reported statistically and practically significant associations between the application of the two key modalities of MTC and the reduction of stress and tension in the field of *collective consciousness* of society, as measured by significantly reduced rates of U.S. homicide and urban violent crime, fatality rates from motor vehicle and other accidents, drug-related death, and infant mortality. The current study presents results of an *interrupted time series analysis* (ITS) of data from a quasi-experiment. The quasi-experiment was designed to empirically test, after controlling for other explanatory variables, whether application of MTC during a *demonstration period* 2006–2014 was associated with a reduction in the mean annual predicted count of landfalling hurricanes (*LFH*) striking the continental U.S. relative to the historical baseline mean 1851–2005. A second hypothesis was that the mean *LFH* count would increase after discontinuation of MTC during 2015–2021. Data for *LFH* and control variables were obtained from the U.S. National Oceanic and Atmospheric Administration (NOAA). A second (replication) study applied the same regression methods for count data (quasi-Poisson regression) to analyze a subsample of NOAA data for 1900–2021. For both analyses the empirical results were consistent with hypotheses (1) and (2). The observed decline of landfalling hurricanes during the 2006–2014 demonstration period was largely



coincident with an unexpected, historically unprecedented 2006–2016 period of reduced *LFH* that has been termed the *hurricane drought* by hurricane experts. We conclude with a discussion of potential alternative explanations and suggested directions for future research.

KEYWORDS

Maharishi Technologies of Consciousness, Maharishi Yoga, Maharishi Yagya, hurricanes, climate change, field theory of consciousness, Transcendental Meditation.

INTRODUCTION

There was a time in the not-too-distant past when claims about human behavior influencing weather were unthinkable. However, armed with multi-decade data and experience of how the release of manmade chlorofluorocarbons (CFCs) affect the ozone layer and moderate global temperatures (Abas et al., 2018) and how manmade levels of heat-trapping gases like carbon dioxide and carbon monoxide cause existential changes to the earth's climate and future (Sears, 2020), such questions about human behavior have moved into mainstream science.

It is now well understood that human actions, irrespective of their scale or location, can cause changes to weather events (such as high potential intensity storms), weather patterns (i.e., repeating weather events or conditions), and climate (i.e., the long-term average of weather patterns). Indeed, it is commonly accepted that human behavior is in fact the “dominant force of change on the planet” (Folke et al., 2021, p. 834). For example, Reed et al. (2022) show human-induced climate change caused increased storm rainfall rates and accumulated rainfall by 10% and 5% respectively during the 2020 North American hurricane season; Wehner & Sampson (2021) attribute changes in the magnitude of flooding during Hurricane Harvey to human behavior; and Reed et al. (2020) document anthropogenic influences on Hurricane Florence. These findings and understandings related to human behavior and the environment have “profound meaning for humanity and one that we are only beginning to fully comprehend. We now know that society needs to be viewed as part of the biosphere, not separate from it” (Folke et al., 2021, p. 834).

The purpose of this research is to explore if a different type of human behavior—application of *consciousness-based* procedures which have the stated purpose of beneficially influencing the natural and social environment, referred to as Maharishi Technologies of Consciousness (MTC)—can

affect weather phenomena. The nature of MTC is described below (and in greater detail in Appendix A). While such a proposition may have once fallen outside the purview of modern scientific inquiry and thus have not been considered worthy of serious empirical attention because it does not fit a prevailing worldview, that day has passed. Indeed, experience shows that many ideas summarily rejected when posited were later found to be correct when newer and more persuasive evidence came to hand.

One example of increased openness to scientific exploration of the hypothesized relationship between human subjective behavior and the weather is a study at Princeton University's Engineering Anomalies Research Lab (PEAR). Nelson (1997) analyzed 36 years of annual data from an observational natural experiment to test if weather can be influenced by the conscious or unconscious wishes of a group (in this case, participants in Princeton's annual commencement activities). Compared to rainfall in neighboring towns, Nelson reported a marginally significant reduction ($p = 0.049$) in rainfall during three days of scheduled outdoor activities but no difference for the day with scheduled indoor activities only.

In this paper, we rhetorically ask: if overt human behavior, such as the use of chemical compounds and industrial processes, can adversely influence weather events, could the reverse (i.e., a salutary influence) also be true for actions performed on a more subtle level of human behavior, from the level of consciousness?

Theoretical Framework

This research is based on Maharishi's field-theoretic view of consciousness and the relationship of human consciousness to the natural and social environment. This framework is derived from the ancient Vedic tradition of knowledge from India (*Veda* means “knowledge” in *Sanskrit*) as brought to light by the Vedic scholar and teacher, Maharishi Mahesh Yogi. In contrast to most contemporary theories of mind and consciousness originating in the West, this consciousness-based framework posits the existence of an interpersonal, nonlocalized dimension of consciousness that underlies both individual consciousness and the collective consciousness of society.

That the consciousness of all individuals is interdependent and deeply connected with the natural environment is consistent with not only the perspective of the Vedic tradition as revived by Maharishi but also with the wisdom traditions of many diverse cultures worldwide (e.g., Trnka & Lorencova, 2022). This view is also consistent with various

formulations of *panpsychism* in the Western philosophical tradition, which hold that consciousness or mind is a fundamental and pervasive feature of reality and is present everywhere (Goff, 2020; Goff et al., 2022).

It is said that Maharishi comprehensively revived the Vedic procedures for development of individual and collective consciousness, seeking to restore their full potency, and organized the teaching of his Transcendental Meditation (TM) technique and its advanced aspect, the TM-Sidhi program, to millions of people worldwide. He expressed the Vedic principles in terms that are testable and encouraged scientific research on their results (e.g., Dillbeck et al., 2020). Maharishi described his teaching of TM and its associated theory and practices as a science of consciousness, which he termed *Maharishi Vedic Science*. Maharishi did not describe his teachings as a religion. Rather, he emphasized that the practice of TM and its advanced techniques is suitable for all individuals regardless of religion, education, culture, language, or philosophy. It is said that TM is practiced around the world by people from a wide variety of religions as well as by those with no religion. As described below, he also inspired the application of MTC, consciousness-based procedures whose stated purpose is to positively influence social trends and the natural environment.

In the introductory and discussion sections and Appendix A of this article we present a summary of key principles of Maharishi's field-theoretic view of consciousness, including, where appropriate, quotations from Maharishi that provide information relevant for understanding his theoretical framework. It should be noted that these statements are not to be understood as statements of fact or belief of the authors of this study or propositions to be accepted without scientific or logical scrutiny; they are descriptions or summaries of propositions stated by Maharishi in his consciousness-based framework. The purpose of this paper is to empirically test two specific hypotheses derived from this theoretical framework, not to attempt to evaluate every assertion by Maharishi in his exposition of the framework. The latter is beyond the scope of this study.

In this framework, consciousness is viewed not as an emergent property of matter generated through functioning of the human nervous system, but rather as fundamental in nature (Nader, 2024). Indeed, *pure consciousness* is viewed as the essential nature of life—an unbounded, unified field of pure intelligence, beyond space and time—that gives rise to all expressed values in the universe, both subjective and objective (Maharishi Mahesh Yogi, 1996). This field of nature's intelligence is postulated to be the unified,

transcendental source of all the laws of nature that govern the evolution of human life, the natural and social environment, and the entire universe (Maharishi Mahesh Yogi, 1986). Recently, Harvard and MIT-trained neuroscientist Tony Nader, who worked closely with Maharishi for more than 20 years, has formulated the fundamental principles expressed in Maharishi's Vedic science of consciousness in an axiomatic framework of formal logic (Nader, 2015, 2024) and proposed that "consciousness is all there is."

This interpersonal, nonlocalized field of consciousness (*pure consciousness*, *pure awareness*, or *transcendental consciousness*) is said to underlie both individual consciousness and the collective consciousness of society. Collective consciousness is defined by Maharishi as the wholeness of consciousness of the individuals comprising the entire social group: family, city, province, nation, or the world. Maharishi proposed that there exists a reciprocal relationship between individual consciousness and collective consciousness in which each influences the other. Thus, for example, increased tension, stress, and strain in the consciousness of individuals in society is said to increase these qualities in collective consciousness, and vice versa. The aim of MTC is to positively influence the collective level of consciousness, which is seen as the principal determinant of societal quality of life and man's relationship with the natural environment (Maharishi Mahesh Yogi, 1977, 1978b, 1986).

As discussed in greater detail below (see Appendix A: Theoretical Model), Maharishi Mahesh Yogi (1968) proposed that when stress and tension build up in the collective consciousness of the nation, an imbalance in nature is created that, if left unchecked, can eventually result in the outbreak of natural disasters, violence, and other negative trends in national life. Maharishi Mahesh Yogi (1978b, p. 187) asserted that "When individuals begin to violate the laws of nature in their own lives, these violations cause negative influences in the collective atmosphere, which eventually turn into natural calamities." The resulting calamities and negative trends can serve to further increase societal stress, contributing to a possible vicious cycle (Alexander et al., 2011). Maharishi Mahesh Yogi (1978b, p. 88) further maintained that "Greater balance in nature is demonstrated by an absence of natural disasters and collective calamities, such as earthquakes, tornadoes, and famine." The purpose of MTC is described as the reduction of stress and tension in collective consciousness to thereby increase balance in nature and improve societal quality of life.

Given that the results of comprehensive published, peer-reviewed research on MTC is said to be consistent

with the hypothesis that application of these technologies of consciousness is associated with improvements in individual psychology, physiology, and behavior, and even improved trends in larger social units, such as the quality of life of cities and nations, the question addressed by the current study is whether there is empirical evidence to support the proposition that these technologies can also positively affect the environment.

Prior Research on MTC and Landfalling U.S. Hurricanes

The current study builds on unpublished prior research completed in 2010 by the first author that examined the possible association of MTC and the incidence of landfalling U.S. hurricanes using early preliminary data from the same quasi-experiment discussed in the current study. This 2010 pilot research analyzed time series (TS) data from NOAA on the annual count of landfalling hurricanes (*LFH*) for 1851–2010. Like the current study, the pilot research used *interrupted time series* (ITS) regression modeling for count data (see Methodology, Interrupted Time Series Study Design). Robust regression analysis for non-negative, integer count data (*quasi-Poisson* regression analysis) was used in the ITS analysis. Consistent with the study hypothesis, the regression results found evidence for a significant downward level shift in the mean annual *LFH* count predicted by the regression model during the demonstration period 2006–2010 relative to the historical baseline predicted mean 1851–2005. The incidence rate ratio (IRR) was estimated as $IRR = 0.347$, $z = -2.82$, $p = 0.002$ one-tailed, 95% CI [0.166, 0.723] (see Regression Modelling of Count Data). The analysis controlled for the total count of hurricanes formed each year in the North Atlantic basin.

As described below, the estimated IRR implies that, controlling for the total annual incidence of all hurricanes in the Atlantic basin, the predicted mean for the *LFH* annual count 2006–2010 was $(0.347-1)100 = 65.3\%$ lower than the corresponding mean baseline incidence rate (McCleary & Hay, 1980; Wooldridge, 2009).

This study extends and replicates the previous research by considering additional explanatory variables and empirically examines an expanded sample of annual data 1851–2021. The ten years of additional TS data includes four additional years (2011–2014) of the demonstration period. Also, the expanded data sample includes the post-demonstration period 2015–2021 during which the MTC treatment was discontinued by the researchers due to

operational considerations. This additional data permitted implementation of a *reversed* quasi-experimental design to analyze the TS behavior of *LFH* before, during, and after the 2006–2014 demonstration period (see Interrupted Time Series Study Design). The additional data allow us to replicate and expand the findings of the prior pilot research as well as to evaluate an additional research hypothesis that postulates that, controlling for other predictor variables, the mean predicted *LFH* incidence rate from the regression model would increase after discontinuation (reversal) of the MTC treatment.

Another objective of the current research is to describe a replication study (Study 2) that analyzes a 1900–2021 sub-sample of the NOAA hurricane data (see Appendix C).

Origins of the Quasi-Experiment

The hurricane seasons 2004–2005 were among the deadliest and most damaging in U.S. history. In 2004, six hurricanes made landfall on the continental U.S., three of them major (Saffir-Simpson category 3 to 5). Another five struck the U.S. in 2005, four of them major, including Hurricane Katrina. Katrina was the most damaging hurricane in U.S. history, causing an estimated \$186 billion of damage and 1,400 deaths (Knabb et al., 2023).

In the wake of the devastating 2004–2005 hurricane impacts, planning for the application of MTC began in November 2005 with Maharishi's inspiration and guidance. Prior to the beginning of the hurricane season in 2006, the application of MTC was introduced for the specific purpose of preventing or mitigating future hurricane disasters by reducing stress, strain, and tension in the collective consciousness of the U.S. A quasi-experiment was initiated that involved practice of *Maharishi Yoga*, the TM and TM-Sidhi program, by a large group at Maharishi International University (MIU) in Fairfield, Iowa.

The size of the MIU group increased exponentially in 2006 and through 2014 the group was near or above the theoretically predicted required size to positively influence U.S. national trends by means of Maharishi Yoga alone (1,725 participants, the square root of 1% of the U.S. population at that time). The group included up to 1,100 Vedic experts from India performing *Maharishi Yagya*, traditional Vedic performances intended to reduce stress and tension in collective consciousness and thereby promote greater balance in nature (see Appendix A for a more detailed description of *Maharishi Yagya*). The Vedic experts also participated in the group practice of the TM and TM-Sidhi program.

Organization of the Current Article

The remainder of this article is organized as follows. The Methods section describes the *LFH* data and control variables used in the regression analysis and provides a brief overview of the robust count regression procedures employed for analyzing the count data. Empirical findings are summarized in the Results section. The Discussion considers the empirical findings in relation to proposed explanations for the “hurricane drought” period of 2006–2016 and suggests possible future directions for research. Appendix A provides greater detail about the theoretical framework underlying the empirical analysis. Appendix B briefly describes other peer-reviewed studies that provide empirical evidence consistent with the hypothesis that consciousness may be a nonlocalized field. Appendix B briefly summarizes EEG and neuroendocrine research on the TM and TM-Sidhi program, research on *national mood* in behavioral finance. Appendix B also discusses research from the Global Consciousness Project at Princeton that investigates the field-like nature of consciousness using deviations from randomness displayed by random number generators (RNG) during designated events. Two independent quasi-experimental RNG studies reported highly significant deviations from randomness associated with group practice of the TM and TM-Sidhi program (Mason et al., 2007; Nelson, 2006).

In addition, Appendix C presents of the findings of a replication study based on a subsample of *LFH* data.

METHODS

Data Sources

TS data on the annual count of hurricanes (tropical cyclones) in the Atlantic basin that made landfall on the

continental United States 1851–2021 (*LFH*) and the annual number of North Atlantic hurricanes (*ATLHURR*) were obtained from the website of the Atlantic Oceanographic and Meteorological Laboratory (AOML) of NOAA (AOML, 2022a, 2022b, 2022c). The 2021 data for *LFH*, *ATLHURR*, and the number of named tropical storms (*STORMS*) in the Atlantic basin were provided by the National Centers for Environmental Information (NCEI) at NOAA (NCEI, 2022).

Data on the overall intensity, or power, of each annual hurricane season as measured by the Accumulated Cyclone Energy (*ACE*) index were obtained from NOAA (AOML, 2022a, 2022c; NCEI, 2022) and NOAA’s Climate Prediction Center (CPC) (Climate Prediction Center, 2021). The *ACE* index for individual storms is defined as the sum of the squared values of the maximum sustained wind velocity (in knots) measured at six-hour intervals while the storms are at least at tropical storm strength. The *ACE* index for an entire hurricane season is calculated by NOAA as the sum of all *ACE* values for all hurricanes and named storms converted to a scale in which 100 equals the median over a base period. Thus, the resulting annual *ACE* values account for cyclone intensity, duration, and frequency (U.S. Environmental Protection Agency, n.d.).

Data Description

Figures 1, 3 and 4 display TS plots of the numeric variables. Figure 2 shows the histogram for the *LFH* count data. Tables 1 and 2 report descriptive statistics for the variables used in the statistical analysis ($N = 171$). *LFH* is the annual count of landfalling U.S. hurricanes 1851–2021. *DEMO* is a binary indicator for the demonstration period of the quasi-experiment, where $DEMO = 1$ for the 2006–2014 demonstration period of the quasi-experiment and $DEMO = 0$ otherwise. *ACE* and *ATLHURR* are defined above.

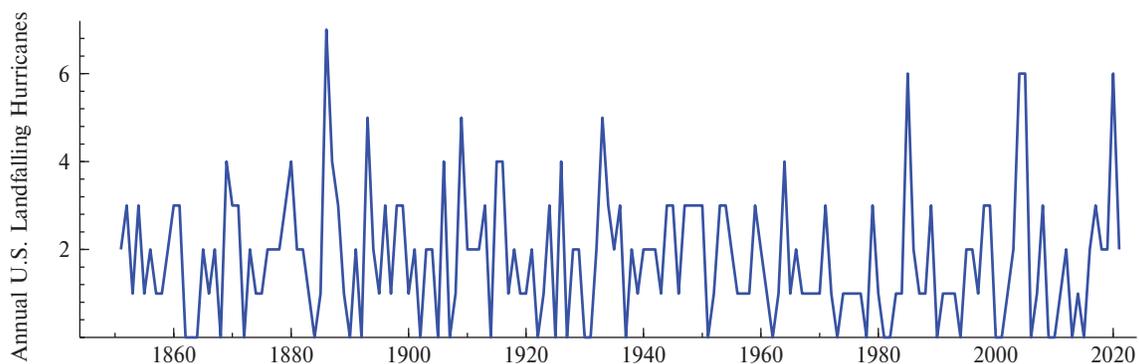


Figure 1. Annual number of landfalling hurricanes on the continental U.S. (*LFH*) 1851–2021.

D2015 is a binary indicator variable designating the post-demonstration period, where $D2015 = 1$ for years 2015–2021 and $D2015 = 0$ otherwise.

The plot of the annual count of landfalling U.S. hurricanes 1851–2021 in Figure 1 displays fluctuations around a relatively stable mean of 1.77 per year with periods of greater and lesser variability. The histogram of annual

landfall counts in Figure 2 shows that about 90% of counts are between 0 and 3 with the largest values at 1 and 2 plus an upper tail extending to the right with a maximum count of 7. Figure 3 shows that the plot of the annual count of hurricanes that formed in the Atlantic basin displays fluctuations in variability around a long-term, relatively stable mean. Figure 4 is the TS plot of NOAA’s accumulated cyclone energy index (*ACE*) for each annual hurricane season June through November. *ACE* reflects the intensity, duration, and frequency of tropical cyclone activity in the Atlantic basin. Descriptive statistics and correlation matrix are given in Tables 1 and 2.

Interrupted Time Series Study Design

As discussed in the Introduction, the current study analyzes TS data from a quasi-experiment. The MTC treatment program was introduced by the researchers during the demonstration period 2006–2014, prior to the beginning of the 2006 hurricane season, for the explicit purpose of investigating possible associations between MTC and changes in *LFH* incidence during the demonstration period

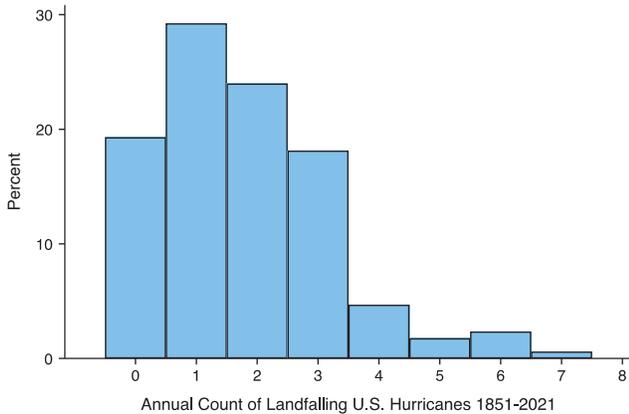


Figure 2. Histogram of annual count of landfalling U.S. hurricanes 1851–2021.

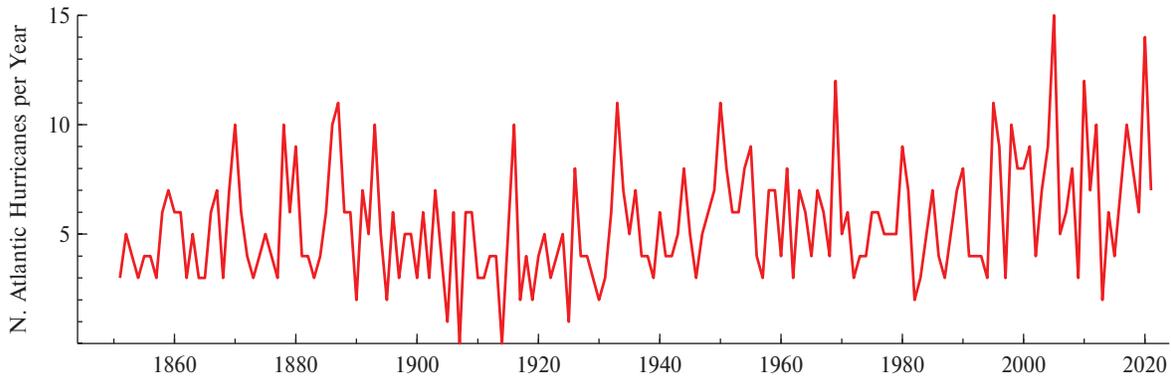


Figure 3. Annual number of hurricanes (*ATLHURR*) in the Atlantic basin 1851–2021.

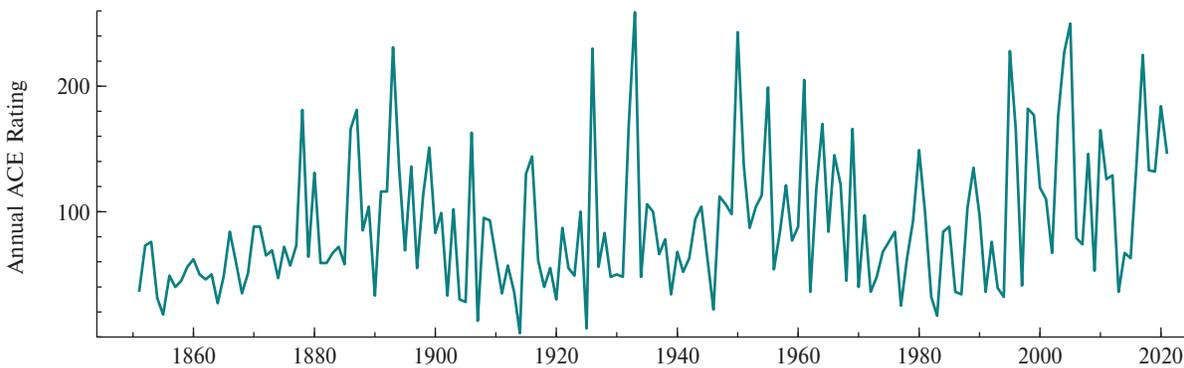


Figure 4. NOAA annual accumulated cyclone energy (*ACE*) index for energy released by tropical cyclones in the Atlantic basin during the annual hurricane seasons 1851–2021.

Table 1. Descriptive Statistics for Variables, 1851–2021

Variable	N	Mean	SD	Variance	Min	Max
LFH	171	1.772	1.439	2.071	0	7
DEMO	171	0.053	0.224	0.050	0	1
ACE	171	90.392	54.748	2997.357	3	259
ATLHURR	171	5.515	2.608	6.804	0	15
D2015	171	0.041	0.199	0.039	0	1

Table 2 Variable Correlation Matrix

Variable	ATLHURR (centered)	ACE (standardized)	LFH
ATLHURR (centered)	1.000		
ACE (standardized)	0.823***	1.000	
LFH	0.550***	0.543***	1.000

Note. N = 171. ***p < 0.001.

compared to the baseline, and post-demonstration periods. Thus, the current study satisfies the standard definition of a quasi-experiment rather than a natural experiment. Natural experiments contrast a naturally occurring event with a control condition and involve no researcher manipulation of treatments (Reichardt, 2019; Wooldridge, 2009).

The MTC treatment was applied during the demonstration period 2006–2014, followed by a reversal (discontinuation) of the MTC intervention in 2015–2021. At the outset of the study, the researchers anticipated the introduction of MTC might possibly be associated with subsequent changes in the mean level or trend of LFH, depending on whether the baseline TS was fluctuating around a stable mean or trending. These anticipated changes are those previously observed in each of the seven previously published quasi-experimental studies of the association of MTC with the TS behavior of a set of diverse U.S. social indicators (see Appendix A). For some of these seven prior studies, public *a priori* predictions about anticipated reductions in violent crime and other social indicators were announced and widely publicized in the press. During the quasi-experiment, however, researcher expectations with respect to mitigation of hurricane landfalls were not publicly expressed because there had been no prior peer-reviewed published research on this potential outcome.

The current study can be described as an interrupted time series study because introduction of the MTC treatment beginning in 2006 was expected to possibly change, or interrupt, the time series behavior of LFH displayed in the baseline period. The current study can also be characterized as a *reversed* quasi-experiment because the MTC treatment during 2006–2014 was reversed by withdrawal of the treatment program during the post-demonstration

period 2015–2021 (Reichardt, 2019). A reversed quasi-experimental design allows comparison of behavior of the time series before, during, and after the intervention, thus potentially increasing internal validity.

According to Reichardt (2019, p. 244), “A well-implemented ITS design can produce highly credible estimates of treatment effects, especially when the ITS design is implemented with supplements such as reversed or repeated treatment interventions and/or comparison time series.”

ITS modeling is said to be one of the strongest designs for the analysis of treatment effects of interventions in TS data from quasi-experiments (Bernal et al., 2017; McCleary et al., 2017; Reichardt, 2019). Also referred to as *impact-assessment analysis*, *impact analysis*, or *intervention analysis*, ITS designs have been extensively applied in numerous areas of scholarly and applied research including program evaluation in economics, health care research, epidemiology, public policy evaluation, and many others.

Regression Modeling of Count Data

Because the outcome variable of the study, the monthly incidence of landfalling U.S. hurricanes, is a non-negative integer count, key assumptions of OLS linear regression are not satisfied. For example, OLS assumes a continuous dependent variable with normally distributed regression errors. Thus, OLS is not appropriate for the count data examined in the current study (e.g., Cameron & Trivedi, 2013; Coxe et al., 2009). Therefore, we use a robust, modified form of count regression (quasi-Poisson regression) that does not assume the count data exactly follows a Poisson distribution.

ITS quasi-Poisson regression methods were used to analyze the possible relationship between MTC and annual counts of landfalling hurricanes striking the continental U.S. 1851–2021. The quasi-Poisson regression methods used in the current study are standard in the literature on analysis of count data and are appropriate for data in the form of non-negative integer counts such as LFH that are not necessarily Poisson distributed (Bhaskaran et al., 2013).

The count regression model for the current study, Model 1, can be expressed as

$$(\ln(\hat{y})) = b_0 + b_1 DEMO + b_2 D2015 + b_3 ATLHURR + b_4 ACE \tag{1}$$

In Equation (1), the variables *y*, *DEMO*, *D2015*, *ATLHURR*, and *ACE* are each a function of time, but the “*t*” subscript is omitted for simplicity. In Equation (1) *y* is the annual count of landfalling hurricanes, \hat{y} is the predicted value of *y*, or mathematically expected value of *y* conditional on the

values of the predictors and a constant (conditional mean). The expression $\ln(\hat{y})$ is the natural logarithm of \hat{y} and it is assumed to be a linear function of the predictors (Coxe et al., 2009; Hilbe, 2014).

The constant term, or regression intercept, in Equation (1) is b_0 . As defined previously, *DEMO* is a binary treatment variable for the quasi-experiment with regression coefficient b_1 . *D2015* is a binary indicator for the post-demonstration period 2015–2021 with regression coefficient b_2 . *ACE* and *ATLHURR* were also defined previously.

Note that independence of the predictor variables in Equation (1) is not a required assumption in quasi-Poisson regression (or OLS regression); rather it is assumed that no predictor variable is a perfect linear combination of other predictors or is constant (Wooldridge, 2009).

The regression coefficient for each predictor in Equation (1) gives the change in $\ln(\hat{y})$ associated with a one-unit change in that predictor, holding other predictors constant. Interpretation of the regression coefficients in Equation (1) can be challenging because most people find it more difficult to interpret regression coefficients for regressions with logarithmic outcome variables (Wooldridge, 2009). Therefore, it is useful to transform Equation (1) to a form that allow interpretation of the regression coefficients in terms of changes in \hat{y} rather than $\ln(\hat{y})$. This is accomplished by taking anti-logs (exponentiating) both sides of Equation (1) so that $\exp(\ln(\hat{y})) = \hat{y}$ and

$$\hat{y} = \exp(b_0) \exp(b_1 \text{ DEMO}) \exp(b_2 \text{ D2015}) \exp(b_3 \text{ ATLHURR}) \exp(b_4 \text{ ACE}) \quad (2)$$

where $\exp(a) = e^a$.

Equation (2) is a nonlinear regression model that shows that the quasi-Poisson regression model in Equation (1) implies a multiplicative, rather than an additive relationship between changes in a predictor and changes in \hat{y} . In general (Coxe et al., 2009), holding other predictors constant, if a predictor x with regression coefficient b is increased by one unit, \hat{y} will be multiplied by the factor $\exp(b(x + 1))$ instead of $\exp(bx)$, where

$$\exp(b(x + 1)) = \exp(bx + b) = \exp(bx) \exp(b) \quad (3)$$

The expression $\exp(b)$ in Equation (3) is known as the *incidence rate ratio* (IRR) for variable x . For example, a discrete change in a predictor such as a one-unit increase in *DEMO* from 0 to 1, holding other predictors constant, the IRR is the ratio of two values for \hat{y} : (1) the mean regression predicted value for the annual incidence rate \hat{y} after increasing x by one unit divided by (2) the mean predicted incidence rate \hat{y} with x unchanged (Hardin & Hilbe, 2018).

Equation (3) implies that for a predictor with $\text{IRR} > 1.0$, a one-unit increase in that variable will be, on average, associated with a multiplicative increase in \hat{y} . A predictor with an estimated IRR less than 1.0 will be associated, on average, with a multiplicative decrease in \hat{y} . Likewise $\text{IRR} = 1.0$ indicates no association, on average, between a one-unit change in the predictor and \hat{y} .

When a binary indicator variable, such as *DEMO* (with coefficient b_1), is increased from 0 to 1, holding other predictors constant, the percentage change in \hat{y} is given by $(\exp(b_1) - 1)100$, or $(\text{IRR} - 1)100$ (McCleary & Hay, 1980; Wooldridge, 2009).

Statistical Estimation of Quasi-Poisson Regression Models

Equation (1) was estimated using the quasi-Poisson, or *quasi-maximum-likelihood*, method as implemented in the Generalized Linear Modeling (GLM) module of Stata 16.1 (StataCorp, 2019). As noted previously, quasi-Poisson methods are appropriate in the analysis of non-negative integer count data even when the dependent, or outcome, count variable may not actually follow a Poisson distribution. That such may be the case for *LFH* data is suggested by Figure 2 in which approximately 90% of observations are between 0 and 3. Even if the assumption is not entirely correct that the outcome variable in Equation (2) has a Poisson distribution, if the conditional mean is properly specified, the quasi-Poisson estimation method for count data provides consistent estimates of the predictor regression coefficients (i.e., that converge to their population values as the sample size grows) and are approximately normally distributed (Cameron & Trivedi, 2013; Winkelmann, 2008). However, if the *LFH* count does not actually have a Poisson distribution, the estimated standard errors (SEs) for the quasi-Poisson regression coefficients will be incorrect and robust SEs must be calculated to correct the SEs (Cameron & Trivedi, 2010).

Robust Newey-West SEs (Newey & West, 1987) are commonly used for calculation of robust SEs in TS studies of count data (e.g., Riley et al., 2022; also see Bottomley et al., 2019; Cameron & Trivedi, 2013). The Newey-West SEs (NW SEs) are consistent in the presence of heteroskedasticity (i.e., non-constant conditional variance) and autocorrelation of possibly unknown form (Cameron & Trivedi, 2010; Newey & West, 1987). Serial correlation in the regression residuals violates a key assumption that successive TS observations of the count outcome variable are independent. Also, count variables are often inherently heteroskedastic because the expected value of the conditional

variance changes as the expected value of the count variable changes (Cameron & Trivedi, 2013).

The robust NW SEs also help correct for the well-known upward bias of SEs for regression coefficients if the distribution of counts displays *underdispersion* relative to the Poisson distribution (Cameron & Trivedi, 2010). The upward bias for SEs of the regression coefficients results in downward bias for tests of statistical significance. Underdispersion violates the Poisson assumption of equidispersion, the equality of mean and variance of \hat{y} conditional on the explanatory variables. Underdispersion can result if a large proportion of counts fall in a relatively narrow range of count values (Hilbe, 2014) such as that displayed in Figure 3. Underdispersion is indicated by a value < 1.0 for the Pearson dispersion coefficient, defined as $(\text{Pearson } \chi^2)/df$.

In count regression several types of regression residuals are available for checking the adequacy of the estimated model. Deviance residuals were used in the current study, as recommended by Hardin & Hilbe (2018), McCullagh & Nelder (1989), and Pierce & Schafer (1986). Deviance residuals are said to possess superior properties for examining goodness of fit in GLM modeling (Cameron & Trivedi, 2013; StataCorp, 2019). The deviance residuals are approximately normally distributed, especially when adjusted for discreteness (Pierce & Schafer, 1986). Adjusted deviance residuals were primarily used in diagnostic checking of estimated models. As recommended by Cameron & Trivedi (2013), standardized Pearson residuals were also used to evaluate serial correlation of residuals.

Research Hypotheses for Model 1

Hypothesis 1

After controlling for other explanatory variables, application of MTC during the demonstration period 2006–2014 will be associated with a reduction in the mean annual predicted count of landfalling hurricanes striking the continental U.S. relative to the historical baseline mean.

Hypothesis 2

The mean predicted *LFH* count after discontinuation of MTC during 2015–2021 will increase relative to the mean predicted count during the demonstration period, controlling for other explanatory variables.

Hypotheses 1 and 2 make no predictions for the sign or significance of the regression coefficients for the predictor variables *ACE* and *ATLHURR*.

RESULTS

Results for Model 1

As described in the previous section, the regression model in Equation (1) was estimated using quasi-Poisson (i.e., quasi-maximum likelihood) count regression methods. The count regression estimates for Equation (1) are reported in Table 3.

One-sided hypothesis tests are reported for expressions involving *DEMO* and *D2015* because the research hypotheses are directional. The *p*-values for the other predictors, and all confidence intervals (CIs) in Table 3, are two sided. The null hypothesis tested by the standard normal *z*-test statistic in Table 3 is that the estimated regression coefficient in Equation (1) is zero. The same *z*-test statistic and *p*-value given for each regression coefficient in Equation (1) are reported for the variable's IRR. However, in the test of significance for IRR, the null hypothesis is $IRR = 1.0$, indicating no effect of a change in the predictor on the outcome variable (StataCorp, 2019). Strong underdispersion of the *LFH* count data, in which the conditional variance is less than the conditional mean, is indicated by a Pearson dispersion coefficient (Pearson $\chi^2)/df$. In the current study, the dispersion coefficient is substantially less than 1.0 (see Table 3), indicating the need for quasi-Poisson regression with robust SEs.

Diagnostic Checking for Model 1

Diagnostic plots and tests for the adequacy of the estimated Model 1 in Table 3 are satisfactory. No outliers are observed in the plot of residuals and other diagnostic plots. Both the *Pearson goodness-of-fit* (GOF) test ($\chi^2 (166) = 126.023, p = 0.991$) and the *deviance goodness-of-fit* test, ($\chi^2 (166) = 156.040, p = 0.699$) are significant, indicating good fit between the observed data and the predicted values from the model. Interpreting these GOF statistics can be confusing because a test result in both cases is deemed significant for $p > 0.05$ rather than the usual $p < 0.05$ (Hilbe, 2014). According to Hilbe (p. 77), “a $\text{Chi}^2 p > 0.05$ indicates that the model is considered well fit.” Cameron & Trivedi (2013) prefer the *deviance GOF* test. Hilbe (2014) notes that the Pearson test can be biased. The deviance GOF test has the advantage of being calculated using robust SEs.

Also, a *Wald* test of the overall significance of the model rejected the null hypothesis that all coefficients in the model (other than the constant term) were jointly equal to zero, ($\chi^2 (4) = 165.83, p < 0.001$ (StataCorp, 2019; Verbeek, 2012).

Table 3. Quasi-Poisson Regression Results. Dependent Variable is Natural Log of the Predicted Annual Count of U.S. Landfalling Hurricanes, 1851–2021 and 1900–2021.

Predictor	Model 1 1851–2021	Model 2 1900–2021
<i>DEMO</i> (binary treatment indicator)		
Coeff. estimate (SE)	–0.860 (0.149)	–0.757 (0.165)
IRR (SE)	0.423 (0.063)	0.469 (0.077)
z-ratio	$z = -5.78^{***}$	$z = -4.59^{***}$
95% IRR CI	[0.316, 0.567]	[0.340, 0.648]
<i>ACE</i> (standardized)		
Coeff. estimate (SE)	0.153 (0.081)	0.217 (0.109)
IRR (SE)	1.165 (0.094)	1.242 (0.135)
z-ratio	$z = 1.90$	$z = 1.99^*$
95% IRR CI	[0.995, 1.365]	[1.003, 1.538]
<i>ATLHURR</i> (centred)		
Coeff. estimate (SE)	0.104 (0.034)	0.075 (0.042)
IRR (SE)	1.110 (0.037)	1.078 (0.045)
z-ratio	$z = 3.11^{**}$	$z = 1.81$
95% IRR CI	[1.039, 1.185]	[0.994, 1.170]
<i>D2015</i> (post-treatment indicator)		
Coeff. estimate (SE)	–0.142 (0.115)	–0.053 (0.131)
IRR (SE)	0.868 (0.100)	0.948 (0.125)
z-ratio	$z = -1.23$	$z = -0.41$
95% IRR CI	[0.692, 1.087]	[0.733, 1.227]
Constant (intercept)		
Coeff. estimate (SE)	0.523 (0.062)	0.458 (0.089)
IRR (SE)	1.687 (0.105)	1.581 (0.141)
z-ratio	$z = 8.42^{***}$	$z = 5.13^{***}$
95% IRR CI	[1.494, 1.906]	[1.327, 1.884]
Model statistics		
No. observations (<i>df</i>)	171 (166)	122 (117)
(Pearson χ^2)/ <i>df</i> (Pearson χ^2)	0.759 (126.023)	0.808 (94.487)
Deviance/ <i>df</i> (Deviance)	0.940 (156.040)	0.969 (113.320)
Log likelihood	–255.477	–180.130
Akaike information criterion	520.954	370.260
Bayesian information criterion	536.662	384.280
Generalized R ²	0.344	0.348

Note. For Model 1, $N = 171$ and for Model 2, $N = 122$. Coding for *DEMO*: years 2006–2014 = 1, other years = 0. Coding for *D2015*: 2015–2021 = 1, otherwise = 0. SEs corrected using Newey-West procedure (Bartlett kernel, 10 lags). IRR = incidence rate ratio. Two-tailed p -values except one-tailed for tests involving treatment indicators *DEMO* and *D2015*. Generalized R² = squared correlation between y and \hat{y} . *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Another measure of goodness of fit recommended by Cameron & Trivedi (2013) is the correlation between the model predicted values and the observed *LFH* counts.

For Model 1 this correlation is relatively high (0.586) resulting in a generalized R² = 0.344. Similarly, the Nagelkerke measure of GOF is 0.330, while the Cox-Snell measure is 0.318. These are a few of the many proposed alternative measures of GOF. Cameron & Trivedi (2013) favor the generalized R-squared. However, they point out that these measures do not have the “proportion of variance explained” interpretation of the R² in linear regression.

Robust Newey-West SEs were used to correct the estimated SEs of the predictor regression coefficients. Ten serial correlation lags were used in the Newey-West adjustment for serial correlation, heteroskedasticity, and underdispersion. The generalized R², the squared correlation between predicted \hat{y} and the observed *LFH* count, is 0.344. This R² measure has been recommended for Poisson regression and other nonlinear models (Cameron & Trivedi, 2013; Wooldridge, 2009). This and other alternative R² measures for non-linear models have a different interpretation than that in OLS linear regression (Cameron & Trivedi, 2013; Hardin & Hilbe, 2018).

Tests of Research Hypotheses for Model 1

Test of Hypothesis 1

Consistent with Hypothesis 1 (see Table 3), the IRR of 0.423 for *DEMO* in Model 1 is significant and less than 1.0 ($p < 10^{-8}$). This implies that, controlling for explanatory variables, the mean predicted *LFH* count \hat{y} during 2006–2014 was $(0.423-1)100 = -57.7\%$ lower than the corresponding value of 1.687 during the 1851–2005 baseline. This large percentage difference between mean predicted \hat{y} for 2006–2014 as compared with that for 1851–2005 is an indication of strong practical, or substantive, significance.

The mean *LFH* count predicted by the regression model during 2006–2014, after controlling for predictors, is 0.714 *LFH* per year as compared with the baseline of 1.687 annually for 1851–2005. The predicted mean count is given by the IRR for *DEMO* in Table 3 (0.423) multiplied by the baseline expected count (1.687), where the latter is the the exponentiated regression constant term $\exp(b_0)$ (StataCorp, 2019). This calculation of the expected mean count follows from the definition of the IRR as the multiplicative factor by which the baseline value of \hat{y} is changed due to a 1-unit change in a predictor, holding other predictors constant.

Thus, consistent with Hypothesis 1, the mean of the *LFH* count predicted by the regression model is significantly

smaller during the demonstration period than during the prior baseline period 1851–2005, holding other predictors constant.

Test of Hypothesis 2

The quasi-Poisson regression results are also consistent with Hypothesis 2. The *lincom* command of Stata 16.1 was used to test whether the estimated regression coefficient for *DEMO* is significantly less than that for *D2015*, as implied by Hypothesis 2. The regression coefficient b_1 for *DEMO* is significantly smaller than b_2 for *D2015*, where $(b_1 - b_2) = -0.868 - (-0.142) = -0.726$, $z = -4.56$, $p < 10^{-5}$, with 95% CI $[-1.006, -0.430]$.

The predicted mean *LFH* count during 2015–2021 is given by the IRR for the constant term multiplied by the IRR for *D2015*, or $\exp(b_0)\exp(b_2) = 1.464$. Thus, consistent with Hypothesis 2, the predicted mean of the *LFH* count is significantly smaller during the demonstration period than during the subsequent post-demonstration period, holding other predictors constant.

By the laws of exponents, $\exp(b_1 - b_2) = \exp(b_1)/\exp(b_2) = (\text{IRR for } DEMO)/(\text{IRR for } D2015)$. Exponentiating the difference in coefficients gives $0.423/0.868 = 0.488$, indicating that the mean predicted *LFH* count \hat{y} for 2006–2014 is $(0.488 - 1)100 = -51.2\%$ smaller than the significant value of predicted mean \hat{y} during 2015–2021. This sizeable percentage difference between mean predicted \hat{y} during 2006–2014 and 2015–2021 thus is both practically and statistically significant.

Although the *D2015* regression coefficient in Model 1 is significantly larger than that for *DEMO* as predicted in Hypothesis 2, it is not significantly different from the coefficient for the 1851–2005 baseline. However, Hypothesis 2 did not predict that the coefficient for *D2015* would be greater or less than that for the baseline, only that the *D2015* coefficient would be greater than that for *DEMO*.

In sum, the results of tests based on the quasi-Poisson estimates of the regression coefficients are consistent with both research hypotheses, and, as hypothesized, the significant changes in mean predicted \hat{y} for the demonstration and post-demonstration periods are in the opposite and hypothesized directions. The results for the test of both hypotheses are also practically as well as statistically significant.

An additional measure of practical significance for these findings is given by the comparison between the observed total of eight *LFH* during 2006–2014 and the mathematically expected total that would have been

observed if the 1851–2005 predicted mean had continued through 2014. Under the *counterfactual* assumption of a continuation of the baseline conditional mean during 2006–2014, an estimated total of 15.2 *LFH* would be predicted to occur during these nine years, as calculated by the number of years 2006–2014 multiplied by the 1851–2005 predicted mean of 1.687 *LFH* per year. Thus, the observed total of eight *LFH* was approximately 7.2 fewer, or 47.3% lower, than would be predicted by a (counterfactual) continuation of the 1851–2005 baseline rate during the demonstration period.

Figure 5 displays \hat{y} , the mean annual count of *LFH* predicted by the regression model for each of the three subperiods of the study: 1851–2005, 2006–2014, and 2015–2021. Above each bar is the predicted mean annual *LFH* count for that subperiod as predicted by the regression model. The p -values above both bars on the right indicate the significance of the expected count relative to the expected count for the previous period. The p -value for 1851–2005 is for the test that the baseline count equals zero.

Other Results: Model 1

The research hypotheses did not make any prediction regarding the sign and significance of the regression coefficients *ACE* and *ALTHURR*. However, consistent with intuition, the regression coefficients for both variables in Table 3 are positive.

As shown in Table 3, an increase of one unit for *ALTHURR* above its mean is associated with a significant predicted increase in \hat{y} of 11% relative to the predicted *LFH* count in 1851–2005 ($p = 0.002$). The IRR for *ACE* in Table 3 of 1.165 is not quite significant ($p = 0.058$). The IRR for *ACE* indicates that, holding other predictors constant, a one SD increase in *ACE* (54.78 *ACE* units) above its mean was associated, on average, with an increase in the predicted *LFH* count of $(1.165 - 1)100 = 16.5\%$ relative to the predicted baseline count of 1.687 per year.

The high correlation (0.823, $p < 0.001$ between *ALTHURR* and *ACE*) (see Table 2) makes it challenging to estimate the separate, *ceteris paribus* association of each of the two predictors with *LFH*. But inclusion of both predictors controls for the total combined influence of *ALTHURR* and *ACE* on the outcome variable \hat{y} and may serve as proxies for other predictors not included in the model.

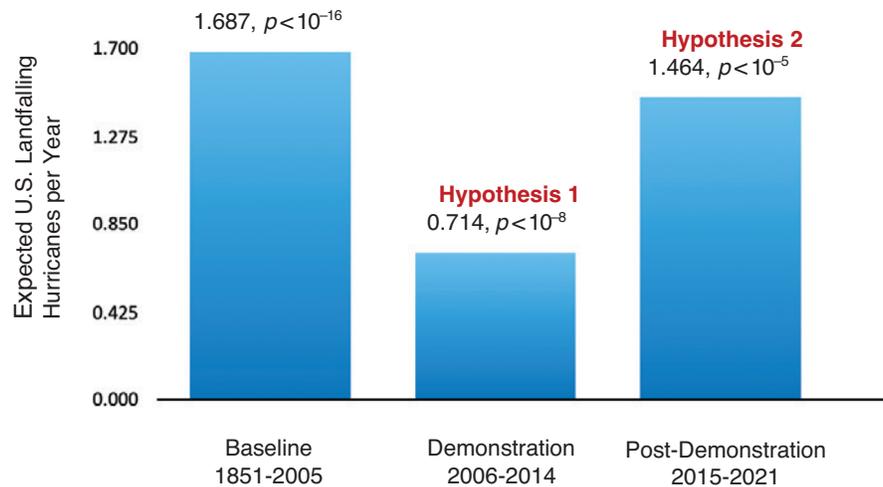


Figure 5. This Figure displays the mean annual count of landfalling U.S. hurricanes predicted by the count regression model for the baseline period, demonstration period, and post-demonstration period. The mean predicted annual LFH count is shown above each bar. The p -value above each of the two right bars is for the test of the difference between the mean for that period and the mean for the prior period. The p -value for 1851–2005 is for the test that the baseline predicted count equals zero.

Sensitivity Analysis: Model 1

Newey-West SEs

For Model 1, the conclusion for both research hypotheses are insensitive to the number of serial correlation lags used in calculation of the NW robust SEs. The quasi-Poisson regression results for Model 2 in Table 3 are based on NW SEs calculated with 10 lags. All other diagnostics for the estimated model are satisfactory.

An additional sensitivity analysis of the results for Model 1 is provided by a replication study involving re-estimation of Model 1 using a different data sample, as described in Appendix C.

DISCUSSION

Overview

The current preliminary study employed a reversed interrupted time series design to examine data from a quasi-experiment that was designed to investigate the possible association between the annual mean predicted count of landfalling U.S. hurricanes (LFH) and the application of Maharishi Technologies of Consciousness (MTC). As previously noted, Reichardt (2019, p. 244) pointed out that “a well-implemented ITS design can produce highly credible estimates of treatment effects, especially when the ITS design is implemented with supplements such as reversed or repeated treatment interventions and/or comparison time series”, as in the design of the current study.

The empirical results for both Models 1 and 2 are consistent with the predictions of Hypotheses 1 and 2. For each of the two estimated models for the NOAA hurricane data, 1851–2021 and 1900–2021, controlling for other variables, (1) the application of MTC in the demonstration period 2006–2014 was associated with a significantly lower mean for the predicted annual count of hurricanes striking the continental U.S. relative to the baseline mean rate and (2) discontinuation of MTC during 2015–2021 was associated with a significantly higher mean predicted count for LFH relative to that during the demonstration period. Thus, as hypothesized, a significant decline in the mean predicted count of LFH during the demonstration project was followed by a significant change in the opposite direction after discontinuation of MTC. These changes in opposite direction at the predicted times strengthen the evaluation of internal validity of the two studies. Model diagnostics are satisfactory for both models, and for both studies the results are statistically significant at the level $p < 0.005$, the proposed criterion for evaluating new statistical discoveries (Benjamin et al., 2018). This more stringent standard has been recommended because of the frequent failure to successfully replicate the results of studies that were deemed significant at the 0.05 level.

The results of Model 1 and Model 2 for Hypothesis 1 are also consistent with those from the prior unpublished pilot study using data from the sample period, 1851–2010. The data available at the time of the 2010 study permitted

testing for only Hypothesis 1 because the quasi-experimental treatment was not discontinued until 2015.

Note that we do not assert or imply that the empirical evidence demonstrates the existence of a causal relationship between the MTC treatment and the mean predicted *LFH* counts controlling for the explanatory variables. However, the empirical results of the current study do show a significant association (correlation) between MTC treatment condition and mean predicted *LFH* counts. These empirical results are consistent with causality, but further research is required to conclude the existence of a causal relationship.

The Hurricane Drought

As discussed previously, the application of MTC was initiated in 2006 for the purpose of mitigating future hurricane-related disasters, such as those in 2004–2005. Several features of the devastating 2004–2005 hurricane seasons were remarkable (AOML, 2022b): (1) The four major U.S. landfalling hurricanes in 2005 were the most in a hurricane season since 1851, the first year for which reliable NOAA data were available; (2) The years 2004–2005 are the only time in which five or more hurricanes struck the U.S. in two consecutive years; and (3) The 2004–2005 total of seven major hurricanes striking the U.S. was also historically unprecedented.

Despite prior forecasts of another severe hurricane season for 2006, the first year of the MTC demonstration period, no hurricanes, major or minor, struck the U.S. that year. This 2005 to 2006 decline in *LFH* was the largest observed drop from one year to the next since 1916–1917, and, according to NOAA data, 2006 was the only year since 1851 that the number of major hurricanes hitting the U.S. dropped from four to zero (AOML, 2022b).

The initial five years (2006–2010) of the nine-year demonstration period were the first since 1878 that no hurricanes made landfall along the Florida peninsula or U.S. East coast (AOML, 2022b). During the entire nine-year demonstration period 2006–2014 a total of eight minor hurricanes, but no major hurricanes, struck the U.S. The observed *LFH* total during 2006–2014 was 52.6% of the counterfactual projected total of 15.2 *LFH* for the same years.

Another unprecedented feature of the 2006–2014 demonstration period is that in 2010, although 12 hurricanes formed in the Atlantic basin (five of them major) none struck the U.S. As quoted in *National Geographic*, “This year was the

first time in recorded history that as many as 12 named hurricanes formed in the Atlantic without at least one of them making a U.S. landfall, said forecasters Phil Klotzbach and William Gray at Colorado State University” (Drye, 2010). Meteorologist Keith Blackwell, also as quoted by Drye, remarked “It was almost like we had a hurricane repellent over the U.S. East Coast and Gulf Coast. The storms were out there, but they just didn’t approach the U.S.”

The empirical evidence reported in this study indicates that the MTC demonstration period 2006–2014 was associated with a substantial and significant reduction in the mean predicted count of landfalling U.S. hurricanes, none of which were major (i.e., Category 3–5). This nine-year period of *LFH* quiescence with no major landfalling hurricanes was followed by two more years (2015–2016) of low activity, including no major *LFH*. One may speculate that the quiet level of hurricane activity in 2015–2016 may possibly be attributed to a lagged “carry over” effect of the prolonged 2006–2014 intervention. Such lags are almost always determined empirically in time series research, not predicted by theory.

This unexpected and historically unprecedented 11-year period 2006–2016, the longest such period since 1851, was termed the “hurricane drought” by hurricane experts (e.g., Hall & Hereid, 2015; Hart et al., 2016; Truchelut & Staehling, 2017). The longest recorded prior such period was the eight years 1861–1868 (Hall & Hereid, 2015). The drought ended in 2017 when four hurricanes made landfall on the continental U.S., including two major Category 4 *LFH*.

This hurricane drought was an extremely rare historical event. The mean waiting time for another such drought of even nine years duration, the length of the demonstration period 2006–2014, was estimated to be 177 years on the basis of simulation modeling (Hall & Hereid, 2015). After considering multiple possible explanations, some investigators, including Hall and Hereid, have attributed the drought simply to “luck.” For example, Hall & Hereid (p. 3482) commented it is remarkable that the hurricane drought “has occurred despite many of the intervening years being active by measures such as total storm count, major storm count, accumulated cyclone energy (ACE) and major landfalls on Caribbean islands.” They further remarked (p. 3482) that “A hurricane climate shift protecting the U.S. during active years, even while ravaging nearby Caribbean nations, would require creativity to formulate.” Thus, Hall and Hereid imply that it is unlikely that existing meteorological theory can successfully explain the hurricane drought.

It is beyond the scope of this study to explore the various proposed explanations for the 11-year drought in the landfall of major U.S. hurricanes. We simply conclude that the empirical findings of the current research indicate that the significant reduction in U.S. landfalling hurricanes, major and minor, during the 2006–2014 demonstration period of the quasi-experiment are consistent with the hypothesized effects of the application of MTC.

We also note that the Vedic perspective motivating the current study suggests that improved good luck, or in Vedic terms *support of natural law*, is a key predicted effect of the implementation of MTC at the societal or individual levels. For example, from the perspective of this study, more favorable behavior of hurricane activity is viewed as the holistic result of favorable changes in the functioning of the specific natural laws governing hurricane activity. These laws are those investigated by atmospheric science, meteorology, climatology, and other natural sciences. More favorable activity governed by these natural laws is predicted to result from the application of MTC, which, from the point of view of Maharishi's consciousness-based framework, is said to enliven the all-pervading field of pure consciousness, the unified field of natural law, at the basis of all natural laws governing the expressed activity on the surface level of life (see Figure A1 in Appendix A). In Maharishi's consciousness-based framework, MTC is hypothesized to enliven greater support of the laws governing the natural and social environment by decreasing stress and tension in collective consciousness and thereby reducing imbalance in nature. Our findings are consistent with such a view.

Possible Directions for Future Research

This section discusses additional possible explanatory factors that may be fruitful to consider in future research on the relationship between MTC and hurricane landfalls. First, it should be noted that the aim of the current study is not to identify a definitive statistical model of the relationship of MTC and the incidence of *LFH*, a task beyond the scope of the current research. The aim, rather, is to provide a preliminary exploratory analysis to suggest whether the hypothesized association between MCT and *LFH* incidence is statistically and practically significant and thus worthy of future research.

The most useful direction for additional research would be replication of these findings using a similar quasi-experimental design, perhaps in one or more other countries with high risk of hurricane-related disasters. Another future direction for research might be to explore the

degree to which the existing empirical results remain consistent with Hypotheses 1 and 2 after modifying the count regression model. Modifications might include, for example, different predictor variables that are suggested by meteorological theory and research.

For example, one potential additional explanatory factor is the phase of the Atlantic multidecadal oscillation (AMO), a long-cycle (approximately 50–70 years) quasi-periodic fluctuation in North Atlantic sea-surface temperatures (Klotzbach et al., 2018; Truchelut & Staehling, 2017). The positive AMO phase has been associated with higher levels of tropical cyclone activity in the Atlantic basin and more frequent *LFH*, and the AMO negative phase with lower levels (Klotzbach & Gray, 2008). AMO was in a positive phase 1995 to at least 1917 (Klotzbach et al., 2018), and thus, the AMO phase does not predict a reduction in the annual count of *LFH* during the 2006–2014 demonstration period.

Another possible explanatory factor is the El Niño Southern Oscillation (ENSO) phase of the annual North Atlantic hurricane season. Research discussed by Klotzbach et al. (2018) indicates that annual El Niño periods create vertical wind shear and other factors detrimental to hurricane formation. On average, during 1900–2017 approximately 1.75 more *LFH* occurred in La Niña seasons than in El Niño seasons (Klotzbach et al., 2018). During the demonstration period of the current study, the La Niña hurricane seasons were 2008, 2011, 2012 (with a total of eight minor *LFH*); the El Niño seasons were 2007 (one minor landfall) and 2010 (no *LFH*); and the El Niño neutral seasons were 2006 and 2009 (no *LFH*), 2013 (no *LFH*), and 2014 (one minor landfall). No major hurricanes (Category 3–5) made landfall during the nine years of the demonstration period 2006–2014. Only two of the nine years of the demonstration period were El Niño years that would clearly predict reduced *LFH* while the three La Niña years would typically be expected to result in increased *LFH*. Also, El Niño-neutral hurricane seasons, on average, have been associated with more Atlantic hurricanes and more *LFH* than El Niño years (Klotzbach et al., 2018). Thus, ENSO phase does not clearly predict a reduction in the annual count of *LFH* during the 2006–2014 demonstration period.

Other additional predictor variables might include, for example, those suggested by Elsner & Jagger (2013): the Southern Oscillation Index (SOI), which is inversely correlated with ENSO phase; the North Atlantic Oscillation (NAO), a measure of atmospheric *steering flow*; North Atlantic sea surface temperature (SST); and sun spot numbers, a measure of solar UV radiation (SSN). Using these four

predictors, Elsner and Jagger estimated a Poisson regression model of NOAA landfalling hurricane data 1866–2010. Their results indicated that SOI and NAO were significant predictors of *LFH* (positively and negatively related, respectively). SST and SSN were not significant predictors.

Gains from an approach of adding additional or alternative explanatory variables to Equation (1), however, may be limited to the degree that the existing predictors (*ACE* index and *ATLHURR*) in Models 1 and 2 may serve as proxies for other proposed explanatory variables. This appears likely because *ATLHURR* is a measure of total hurricane activity in the North Atlantic basin, and *ACE*, as discussed previously, measures the frequency, duration, and strength of that activity. For example, the predictors SOI and NAO were significant predictors of the number of *LFH* in the analysis of Elsner & Jagger (2013). Thus, SOI and NAO are likely to be correlated with *ACE*, *ATLHURR*, or both.

There are, of course, other alternate explanations which might shed light on the postulated transformative features of MTC, including complexity theory (Sethi et al., 2021), chaos theory (Dantas-Torres, 2015), and nonlinear dynamical systems theory (Bucogen et al., 2022), but consideration of these alternative approaches are beyond the scope of the present study.

Implications and Applications

Although the findings of the current research, while preliminary, are anomalous from the perspective of the dominant physicalist paradigm of science, they appear worthy of future empirical investigation. To that end, Jahn & Dunne (1997, p. 204) emphasized that “good science, of any topics, can not turn away from anomalies; they are the most precious resource, however unrefined, for its future growth and refinement.”

The current study describes a novel, consciousness-based theoretical framework, a key stated purpose of which is to help us understand and improve the relationship between humankind and the natural environment. This study also provides a preliminary empirical investigation of the hypothesized contribution of an applied aspect of this framework, Maharishi Technologies of Consciousness, to averting environmental disasters, such as landfalling hurricanes. In our judgement, the preliminary findings of Study 1 and Study 2 described in the current article provide sufficient evidence to justify attempts to replicate of these findings with the support of governmental or private organizations looking for an evidence-based approach to the mitigation of hurricane-related or other natural disasters.

ACKNOWLEDGMENTS

This quasi-experiment was funded by grants from the Howard and Alice Settle Foundation to Maharishi International University. Financial support for the research and writing of this article was provided by the Dr. Tony Nader Institute for the Study of Consciousness and its Applied Technologies at Maharishi International University. The authors were solely responsible for the study design, data collection, analysis, writing, editing, and the decision to publish.

AUTHOR CONTRIBUTIONS

Kenneth L. Cavanaugh, Ph.D., MPA. Conceptualization, writing, editing, statistical modeling and analysis, graphics.

Lee Fergusson, Ph.D. Conceptualization, writing, editing, graphics.

Conflicts of Interest. The authors declare no conflict of interest.

Trademarks. Transcendental Meditation®, TM®, Maharishi Technology of Consciousness, MTC, Maharishi Yoga, Maharishi Yagya, Transcendental Meditation-Sidhi, TM-Sidhi, Maharishi Ayur-Veda, Maharishi Vedic Pandit, Maharishi Effect, and Yogic Flying are protected trademarks and service marks. All are used under license or with permission.

DATA AVAILABILITY

Data files and Stata software code are provided at the webpage for supplementary materials hosted at the Open Science Framework repository (OSF) at <https://osf.io/tvzqn>.

REFERENCES

- Abas, N., Kalair, A. R., Khan, N., Haider, A., Saleem, Z., & Saleem, M. S. (2018). Natural and synthetic refrigerants, global warming: A review. *Renewable and Sustainable Energy Reviews*, 90, 557–569. <https://doi.org/10.1016/j.rser.2018.03.099>
- Alexander, C. N., Orme-Johnson, D. W., & Walton, K. G. (2011). Preventing disasters and distress through the Transcendental Meditation and TM-Sidhi program. In R. Goodman & W. Sands (Eds.), *Volume 9: Consciousness-based education and government* (pp. 497–531). Maharishi University of Management Press.
- Alexander, C. N., Robinson, P., & Rainforth, M. S. (1994). Treating and preventing alcohol, nicotine, and drug abuse through Transcendental Meditation: A review and

- statistical meta-analysis. *Alcoholism Treatment Quarterly*, 11(1–2), 13–87. https://doi.org/10.1300/J020v11n01_02
- Anderson, D. R. (2008). *Model based inference in the life sciences: A primer on evidence*. Springer. <https://doi.org/10.1007/978-0-387-74075-1>
- AOML (Atlantic Oceanographic and Meteorological Laboratory). (2022a). *Atlantic basin: Individual years with the numbers in each category*. Retrieved July 16, 2022, from <https://www.aoml.noaa.gov/hrd-faq/#atlantic-tcs-by-year-satellite>
- AOML. (2022b). *Continental United States hurricane impacts/landfalls 1851–2021, Revised April 2022*. Retrieved July 16, 2022, from https://www.aoml.noaa.gov/hrd/hurdat/All_U.S._Hurricanes.html
- AOML. (2022c). *How many tropical cyclones have there been in each year in the Atlantic basin (pre-satellite era)?* Retrieved July 16, 2022, from <https://www.aoml.noaa.gov/hrd-faq/#atlantic-tcs-by-year-pre-satellite>
- Balay-As, M., Marlowe, J., & Gaillard, J. C. (2018). Deconstructing the binary between indigenous and scientific knowledge in disaster risk reduction: Approaches to high impact weather hazards. *International Journal of Disaster Risk Reduction*, 30, 18–24. <https://doi.org/10.1016/j.ijdr.2018.03.013>
- Benjamin, D. J., Berger, J. O., Johannesson, M., Nosek, B. A., Wagenmakers, E.-J., Berk, R., Bollen, K. A., Brembs, B., Brown, L., Camerer, C., Cesarini, D., Chambers, C. D., Clyde, M., Cook, T. D., De Boeck, P., Dienes, Z., Dreber, A., Easwaran, K., Efferson, C., & Johnson, V. E. (2018). Redefine statistical significance. *Nature Human Behaviour*, 2, 6–10. <https://doi.org/10.1038/s41562-017-0189-z>
- Bernal, J. L., Cummins, S., & Gasparrini, A. (2017). Interrupted time series regression for the evaluation of public health interventions: A tutorial. *International Journal of Epidemiology*, 46(1), 348–355. <https://doi.org/10.1093/ije/dyw098>
- Bhaskaran, K., Gasparrini, A., Hajat, S., Smeeth, L., & Armstrong, B. (2013). Time series regression studies in environmental epidemiology. *International Journal of Epidemiology*, 42(4), 1187–1195. <https://doi.org/10.1093/ije/dyt092>
- Bottomley, C., Scott, J., & Isham, V. (2019). Analysing interrupted time series with a control. *Epidemiologic Methods*, 8(1), 20180010. <https://doi.org/10.1515/em-2018-0010>
- Bucogen, G. G. B., Piccolo, M. C., Bohn, V. Y., & Huck, G. E. (2022). Using chaos theory fundamentals for analysing temperature, precipitation variability and trends in Northern Patagonia, Argentina. *Journal of Southern Hemisphere Earth Systems Science*, 72(3), 179–190. <https://doi.org/10.1071/ES22009>
- Cajete, G. (2000). *Native science: Natural laws of interdependence*. Clear Light Publishers.
- Cameron, A. C., & Trivedi, P. K. (2010). *Microeconometrics using Stata* (rev. ed.). Stata Press.
- Cameron, A. C., & Trivedi, P. K. (2013). *Regression analysis of count data* (2nd ed.). Cambridge University Press. <https://doi.org/10.1017/CBO9781139013567>
- Cavanaugh, K. L., & Dillbeck, M. C. (2017a). The contribution of proposed field effects of consciousness to the prevention of U.S. accidental fatalities: Theory and empirical tests. *Journal of Consciousness Studies*, 24(1–2), 53–86.
- Cavanaugh, K. L., & Dillbeck, M. C. (2017b). Field effects of consciousness and reduction in U.S. urban murder rates: Evaluation of a prospective quasi-experiment. *Journal of Health and Environmental Research*, 3(3–1), 32–43. <https://doi.org/10.11648/j.jher.s.2017030301.13>
- Cavanaugh, K. L., Dillbeck, M. C., & Orme-Johnson, D. W. (2022). Evaluating a field theory of consciousness and social change: Group practice of Transcendental Meditation and homicide trends. *Studies in Asian Social Science*, 8(1), 1–32. <https://doi.org/10.5430/sass.v8n1p1>
- Climate Prediction Center (CPC). (2021, May 20). *Background information: The North Atlantic hurricane season*. Retrieved April 19, 2024, from https://www.cpc.ncep.noaa.gov/products/outlooks/hurricane2003/August/background_information.html
- Coxe, S., West, S. G., & Aiken, L. S. (2009). The analysis of count data: A gentle introduction to Poisson regression and its alternatives. *The Journal of Personality Assessment*, 91(2), 121–136. <https://doi.org/10.1080/00223890802634175>
- Dai, T. (2011). Maharishi's formula for a prevention wing in the military—Applied and found successful in Mozambique: Case study, 1993–1994. In R. Goodman & W. Sands (Eds.), *Volume 9: Consciousness-based education and government* (pp. 447–453). Maharishi University of Management Press.
- Dantas-Torres, F. (2015). Climate change, biodiversity, ticks and tick-borne diseases: The butterfly effect. *International Journal for Parasitology: Parasites and Wildlife*, 4(3), 452–461. <https://doi.org/10.1016/j.ijppaw.2015.07.001>
- Dillbeck, M. C., & Cavanaugh K. L. (2016). Societal violence and collective consciousness: Reduction of U.S. homicide and urban violent crime rates. *SAGE Open*, 6(2), 1–16. <https://doi.org/10.1177/2158244016637891>
- Dillbeck, M. C., & Cavanaugh K. L. (2017). Group practice of the Transcendental Meditation® and TM-Sidhi® program and reductions in infant mortality and drug-related death: A quasi-experimental analysis. *SAGE Open*, 7(1), 1–16. <https://doi.org/10.1177/2158244017697164>
- Dillbeck, M. C., Barnes, V. A., Schneider, R. H., & Travis, F. T. (Eds.). (2020). *Scientific research on Maharishi's*

- Transcendental Meditation and TM-Sidhi program: Collected papers, volume 8.* Maharishi Vedic University Press.
- Dillbeck, M. C., & Cavanaugh, K. L. (2023). Empirical evaluation of the possible contribution of group practice of the Transcendental Meditation and TM-Sidhi program to reduction in drug-related mortality. *Medicina*, 59(2), 195. <https://doi.org/10.3390/medicina59020195>
- Dossey, L. (2013). *One mind: How our individual mind is part of a greater consciousness and why it matters.* Hay House.
- Drye, W. (2010, November 30). 2010 Hurricane season “strange”: Storms were numerous, but U.S. had “hurricane repellent,” expert says. *National Geographic*. Retrieved August 2, 2024 from <https://www.nationalgeographic.com/science/article/101130-2010-atlantic-hurricane-season-science-environment>
- Edmans, A., Fernandez-Perez, A., Garel, A., & Indriawan, I. (2022). Music sentiment and stock returns around the world. *Journal of Financial Economics*, 145(2A), 234–254. <https://doi.org/10.1016/j.jfineco.2021.08.014>
- Elsner, J. B., & Jagger, T. H. (2013). *Hurricane climatology: A modern statistical guide using R.* Oxford University Press. <https://doi.org/10.1093/oso/9780199827633.001.0001>
- Fergusson, L. (2016). Vedic science-based education, poverty removal and social well-being: A case history of Cambodia from 1980 to 2015. *Journal of Indian Education*, 41(4), 16–45.
- Fergusson, L., Wells, G., & Kettle, D. (2017). Principles and practice of sustainability in Maharishi Vedic Science. *Journal of Health and Environmental Research*, 3(3–1), 1–15. <https://doi.org/10.11648/j.jher.s.2017030301.11>
- Folke, C., Polasky, S., Rockström, J., Galaz, V., Westley, F., Lamont, M., Scheffer, M., Österblom, H., Carpenter, S. R., Chapin III S. C., Seto, K. C., Weber, E. U., Crona, B. I., Daily, G. C., Dasgupta, P., Gaffney, O., Gordon, L. J., Hoff, H., Levin, S. A., & Walker, B. H. (2021). Our future in the Anthropocene biosphere. *Ambio*, 50, 834–869. <https://doi.org/10.1007/s13280-021-01544-8>
- Gilbert, S. G. (2020). Precautionary principle. In P. Wexler, S. Gilbert, A. Mohapatra, S. Bobst, A. Hayes, & S. T. Humes (Eds.), *Information resources in toxicology: Volume 2: The global arena* (5th ed., pp. 489–494). Academic Press. <https://doi.org/10.1016/B978-0-12-813724-6.00045-1>
- Giroldini, W., Pederzoli, L., Bilucaglia, M., Caini, P., Ferrini, A., Melloni, S., Prati, E., & Tressoldi, P. E. (2016). EEG correlates of social interaction at distance (version 5). *F1000Research*, 4 (457), 1–22. <https://doi.org/10.12688/f1000research.6755.5>
- Global Country of World Peace. (2005). *Celebrating the dawn of a new fortune for all mankind.*
- Goff, P. (2020). *Galileo’s error: Foundations for a new science of consciousness.* Vintage Books.
- Goff, P., Seager, W., & Allen-Hermanson, S. (2022). Panpsychism. *Stanford encyclopedia of philosophy*. Retrieved August 1, 2024 from <https://plato.stanford.edu/entries/panpsychism/>
- Hagelin, J. S., Rainforth, M. V., Orme-Johnson, D. W., Cavanaugh, K. L., Alexander, C. N., Shatkin, S. F., Davies, J. L., Hughes, A. O., & Ross, E. (1999). Effects of group practice of the Transcendental Meditation program on preventing violent crime in Washington, D.C.: Results of the National Demonstration Project, June–July 1993. *Social Indicators Research*, 47(2), 153–201. <https://doi.org/10.1023/A:1006978911496>
- Hall, T., & Hereid, K. (2015). The frequency and duration of U.S. hurricane droughts. *Geophysical Research Letters*, 42(9), 3482–3485. <https://doi.org/10.1002/2015GL063652>
- Hardin, J. W., & Hilbe, J. M. (2018). *Generalized linear models and extensions* (4th ed.). Stata Press.
- Hart, R. E., Chavas, D. R., & Guishard, M. P. (2016). The arbitrary definition of the current Atlantic major hurricane landfall drought. *Bulletin of the American Meteorological Society*, 97(5), 713–722. <https://doi.org/10.1175/BAMS-D-15-00185.1>
- Harung, H., Travis, F., Blank, W., & Heaton, D. (2009). Higher development, brain integration, and excellence in leadership. *Management Decision*, 47(6), 872–894. <https://doi.org/10.1108/00251740910966631>
- Hilbe, J. M. (2014). *Modeling count data.* Cambridge University Press. <https://doi.org/10.1017/CBO9781139236065>
- Jahn, R. G., & Dunne, B. J. (1997). Science of the subjective. *Journal of Scientific Exploration*, 11(2) 201–224.
- Kettle, D., Wells, G., & Fergusson, L. (2017). Human development and capability: Reconstructed and fulfilled through Maharishi Vedic Science. *Journal of Health and Environmental Research*, 3(3–1), 79–89. <https://doi.org/10.11648/j.jher.s.2017030301.16>
- Kleinschnitz, K., & Travis, F. (2024). Testing the field nature of consciousness: A pilot test. *International Journal of Psychological Studies*, 16(2), 63–69. <https://doi.org/10.5539/ijps.v16n2p63>
- Klotzbach, P. J., & Gray, W. M. (2008). Multidecadal variability in North Atlantic tropical cyclone activity. *Journal of Climate*, 21(15), 3929–3935. <https://doi.org/10.1175/2008JCLI2162.1>
- Klotzbach, P. J., Bowen, S. G., Pielke Jr R., & Bell, M. (2018). Continental U.S. hurricane landfall frequency and associated damage: Observations and future risks. *Bulletin of the American Meteorological Society*, 99(7), 1359–1376. <https://doi.org/10.1175/bams-d-17-0184.1>
- Knabb, R. D., Rhome, J. R., & Brown, D. P. (2023). *Tropical cyclone report, Hurricane Katrina, August 23–30, 2005.*

- NOAA National Hurricane Center. https://www.nhc.noaa.gov/data/tcr/AL122005_Katrina.pdf
- Maharishi Ayur-Veda Foundation. (1999). *Maharishi Jyotish and Maharishi Yagya programmes*. Maharishi Vedic University Press.
- Maharishi Foundation International. (2014). *Transcendental Meditation: Fundamentally unique—documented by extensive scientific research*. Maharishi Vedic University Press.
- Maharishi Mahesh Yogi. (1964). *The Vedas: Source of the subtle science*. Spiritual Regeneration Movement.
- Maharishi Mahesh Yogi. (1968). *Purification of the world's atmosphere*. Videotaped lecture, Squaw Valley, California.
- Maharishi Mahesh Yogi. (1977). *Creating an ideal society*. MERU Press.
- Maharishi Mahesh Yogi. (1978a). A time of crisis: Environment. *World Government News*, 9, 5–13.
- Maharishi Mahesh Yogi. (1978b). *Enlightenment to every individual, invincibility to every nation*. MERU Press.
- Maharishi Mahesh Yogi. (1986). *Life supported by natural law*. Age of Enlightenment Press.
- Maharishi Mahesh Yogi. (1991). *Maharishi Ayur-Veda: Global campaign to create a disease-free society in every country*. Maharishi Vedic University Press.
- Maharishi Mahesh Yogi. (1995). *Maharishi's absolute theory of government: Automation in administration*. Maharishi Ved Vigyān Vishva Vidyā Peetham.
- Maharishi Mahesh Yogi. (1996). *Inaugurating Maharishi Vedic University*. Maharishi Vedic Vishwavidyalaya Press.
- Maharishi Mahesh Yogi. (2008). *Maharishi Mahesh Yogi's Transcendental Meditation Sidhi programme of Yogic Flying*. Maharishi Vedic University.
- Maharishi Vedic University. (2008). *Maharishi Mahesh Yogi's Transcendental Meditation Sidhi programme of Yogic flying: Experiences of Yogic flying in the light of the forty values of the Vedic literature—the total constitution of the universe*. Maharishi Vedic University Press.
- Maharishi Vedic University. (2017). *Yogic flying resources*. Maharishi Vedic University Press.
- Mason, L. L., Patterson, R. P., & Radin, D. L. (2007). Exploratory study: The random number generator and group meditation. *Journal of Scientific Exploration*, 21(2), 295–317.
- McCleary, R., & Hay Jr R. A. (1980). *Applied time series analysis for the social sciences*. Sage.
- McCleary, R., McDowall, D., & Bartos, B. J. (2017). *Design and analysis of time series experiments*. Oxford University Press. <https://doi.org/10.1093/oso/9780190661557.001.0001>
- McCullagh, P., & Nelder, J. A. (1989). *Generalized linear models* (2nd ed). Chapman & Hall/CRC. <https://doi.org/10.1007/978-1-4899-3242-6>
- Nader, T. (2015). Consciousness is all there is: A mathematical approach with applications. *International Journal of Mathematics and Consciousness*, 1(1), 1–65.
- Nader, T. (2024). *Consciousness is all there is: How understanding and experiencing consciousness will transform your life*. Hay House.
- NCEI (National Centers for Environmental Information). (2022, August). *Annual 2021 tropical cyclones report* (pp. 7). <https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202113#north-atlantic>
- Nelson, R. D. (1997). Wishing for good weather: A natural experiment in group consciousness. *Journal of Scientific Exploration*, 11(1), 47–58.
- Nelson, R. D. (2006). TM resonance aggregation. *Global Consciousness Project*. Retrieved August 18, 2024 from <https://noosphere.princeton.edu/tm.resonance.html>
- Nelson, R. D. (2019). *Connected: The emergence of global consciousness*. ICRL Press.
- Newey, W. K., & West, K. D. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica*, 55(3), 703–708. <https://doi.org/10.2307/1913610>
- Noori, N., de Jong, M., Janssen, M., Schraven, D., & Hoppe, T. (2021). Input-output modeling for smart city development. *Journal of Urban Technology*, 28(1–2), 71–92. <https://doi.org/10.1080/10630732.2020.1794728>
- Ombati, M. (2017). Rainmaking rituals: Song and dance for climate change in the making of livelihoods in Africa. *International Journal of Modern Anthropology*, 1(10), 74–96. <https://doi.org/10.4314/IJMA.V1I10.3>
- Orme-Johnson, D. W. (2021). Transcendental Meditation in the treatment of mental and physical conditions. In M. Farias, D. Brazier, & M. Lalljee (Eds.), *The Oxford handbook of meditation* (pp. 717–746). Oxford University Press. <https://doi.org/10.1093/oxford-hb/9780198808640.013.35>
- Orme-Johnson, D. W., Dillbeck, M. C., Wallace, R. K., & Landrith, G. S. (1982). Intersubject EEG coherence: Is consciousness a field? *International Journal of Neuroscience*, 16(3–4), 203–209. <https://doi.org/10.3109/00207458209147147>
- Orme-Johnson, D. W., Alexander, C. N., Davies, J. L., Chandler, H. M., & Larimore, W. E. (1988). International peace project in the Middle East: The effects of the Maharishi Technology of the Unified Field. *Journal of Conflict Resolution*, 32(4), 776–812. <https://doi.org/10.1177/0022002788032004009>
- Orme-Johnson, D. W., Dillbeck, M. C., & Alexander, C. N. (2003). Preventing terrorism and international conflict: Effects of large assemblies of participants in the Transcendental Meditation and TM-Sidhi programs. *Journal*

- of *Offender Rehabilitation*, 36(1–4), 283–302. https://doi.org/10.1300/J076v36n01_13
- Orme-Johnson, D. W., & Fergusson, L. (2018). Global impact of the Maharishi Effect from 1974 to 2017: Theory and research. *Journal of Maharishi Vedic Research Institute*, 8, 13–79. <https://doi.org/10.1177/0022002788032004009>
- Orme-Johnson, D. W., Cavanaugh, K. L., Dillbeck, M. C., & Goodman, R. S. (2022). Field-effects of consciousness: A seventeen-year study of the effects of group practice of Transcendental Meditation and TM-Sidhi programs on reducing national stress in the United States. *World Journal of Social Science*, 9(2), 1–38. <https://doi.org/10.5430/wjss.v9n2p1>
- Pierce, D. A., & Schafer, D. W. (1986). Residuals in generalized linear models. *Journal of the American Statistical Association*, 81(396), 977–986. <https://doi.org/10.1080/01621459.1986.10478361>
- Rabinoff, R. A., Dillbeck, M. C., & Deissler, R. (1989). Effect of coherent collective consciousness on the weather. In R. Chalmers, G. Clements, H. Schenkluhn, & M. Weinless (Eds.), *Scientific research on Maharishi's Transcendental Meditation and TM-Sidhi programme: Collected papers, volume 4* (pp. 2564–2565). Maharishi Vedic University Press.
- Radin, D. (2006). *Entangled minds: Extrasensory experiences in a quantum reality*. Paraview.
- Radin, D. (2013). *Supernormal: Science, yoga, and the evidence for extraordinary psychic abilities*. Crown Publishing.
- Reed, K. A., Stansfield, A. M., Wehner, M. F., & Zarzycki, C. M. (2020). Forecasted attribution of the human influence on Hurricane Florence. *Science Advances*, 6(1), eaaw9253. <https://doi.org/10.1126/sciadv.aaw9253>
- Reed, K. A., Wehner, M. F., & Zarzycki, C. M. (2022). Attribution of 2020 hurricane season extreme rainfall to human-induced climate change. *Nature Communications*, 13, 1905. <https://doi.org/10.1038/s41467-022-29379-1>
- Reichardt, C. S. (2019). *Quasi-experimentation: A guide to design and analysis*. The Guilford Press.
- Riley, T., Nethery, E., Chung, E. K., & Souter, V. (2022). Impact of the COVID-19 pandemic on perinatal care and outcomes in the United States: An interrupted time series analysis. *Birth*, 49(2), 298–309. <https://doi.org/10.1111/birt.12606>
- Schneider, R. H., Grim, C. E., Rainforth, M. V., Kotchen, T. A., Nidich, S. I., Gaylord-King, C., Salerno, J. W., Kotchen, J. M., & Alexander, C. N. (2012). Stress reduction in the secondary prevention of cardiovascular disease: Randomized, controlled trial of Transcendental Meditation and health education in Blacks. *Circulation: Cardiovascular Quality and Outcomes*, 5(6), 750–758. <https://doi.org/10.1161/CIRCOUTCOMES.112.967406>
- Sears, N. A. (2020). Existential security: Towards a security framework for the survival of humanity. *Global Policy*, 11(2), 255–266. <https://doi.org/10.1111/1758-5899.12800>
- Sethi, M., Sharma, R., Mohapatra, S., & Mittal, S. (2021). How to tackle complexity in urban climate resilience? Negotiating climate science, adaptation and multi-level governance in India. *PLoS One*, 16(7), e0253904. <https://doi.org/10.1371/journal.pone.0253904>
- StataCorp (2019). *Stata: Release 16. Base reference manual*. StataCorp LLC.
- Travis, F., & Orme-Johnson, D. W. (1989). Field model of consciousness: EEG coherence changes as indicators of field effects. *International Journal of Neuroscience*, 49(3–4), 203–211. <https://doi.org/10.3109/00207458909084826>
- Trnka, R., & Lorencova, R. (2022). Indigenous concepts of consciousness, soul, and spirit: A cross-cultural perspective. *Journal of Consciousness Studies*, 29(1–2), 113–140. <https://doi.org/10.53765/20512201.29.1.113>
- Truchelut, R. E., & Staehling, E. M. (2017). An energetic perspective on United States tropical cyclone landfall droughts. *Geophysical Research Letters*, 44(23), 12.013–12.019. <https://doi.org/10.1002/2017GL076071>
- U.S. Environmental Protection Agency (EPA). (n.d.). *Climate change indicators: Tropical cyclone activity*. Retrieved April 19, 2024 from <https://www.epa.gov/climate-indicators/climate-change-indicators-tropical-cyclone-activity>
- Verbeek, M. (2012). *A guide to modern econometrics* (4th ed). Wiley.
- Walton, K. G., Cavanaugh, K. L., & Pugh, N. D. (2005). Effect of group practice of the *Transcendental Meditation* program on biochemical indicators of stress in non-meditators: A prospective time series study. *Journal of Social Behavior and Personality*, 17, 339–373.
- Wehner, M., & Sampson, C. (2021). Attributable human-induced changes in the magnitude of flooding in the Houston, Texas region during Hurricane Harvey. *Climatic Change*, 166, 20. <https://doi.org/10.1007/s10584-021-03114-z>
- Wells, G., Fergusson, L., Kettle, D., & Bonshek, A. (2017). Responding to climate change: The contribution of Maharishi Vedic Science. *Journal of Health and Environmental Research*, 3(3–1), 63–78.
- Winkelmann, R. (2008). *Econometric analysis of count data* (5th ed.). Springer.
- Wooldridge, J. M. (2009). *Introductory econometrics: A modern approach* (4th ed.). South Western.

APPENDIX A

THEORETICAL FRAMEWORK

The theoretical model guiding this research is informed by systems science (Noori et al., 2021). Input-output modeling allows understanding of any system as a *process*, with throughputs serving as the source of interdependent mechanisms responsible for transforming inputs into outputs. In our case: (1) inputs to the model are Maharishi Yoga and Maharishi Yagya; (2) pure consciousness—said to be the *Unified Field of Natural Law*—serves as the throughput processing resource for transforming mechanisms; and (3) output, the three hypothesized effects of these technologies on individual, social, and environmental life.

The model in Figure A1 is therefore organized into these three system elements, with brief descriptions of each supported by indicative theoretical and empirical research to provide evidence of mechanisms and output. The following

sections detail the input, throughput, and output of the model as a way of building the case for the focus of this study, output #3, which posits the possible effect of MTC on the environment, specifically on hurricane formation and landfall events in North America.

The two input (or dosage) variables ❶ tested by this research are branches of Veda and the Vedic literature. Each has been explained by Maharishi as generating coherence and harmony in individual, social, and environmental life, and Maharishi proposed that each represents a type of human behavior or practice that generates one or multiple salutary outputs ❸, all mediated by the processing mechanisms ❷ of pure consciousness.

Among the better known and well researched MTC is the TM technique (Dillbeck et al., 2020). The following sections introduce Maharishi Yoga and Maharishi Yagya, whose combination in this study is the subject of our empirical investigation.

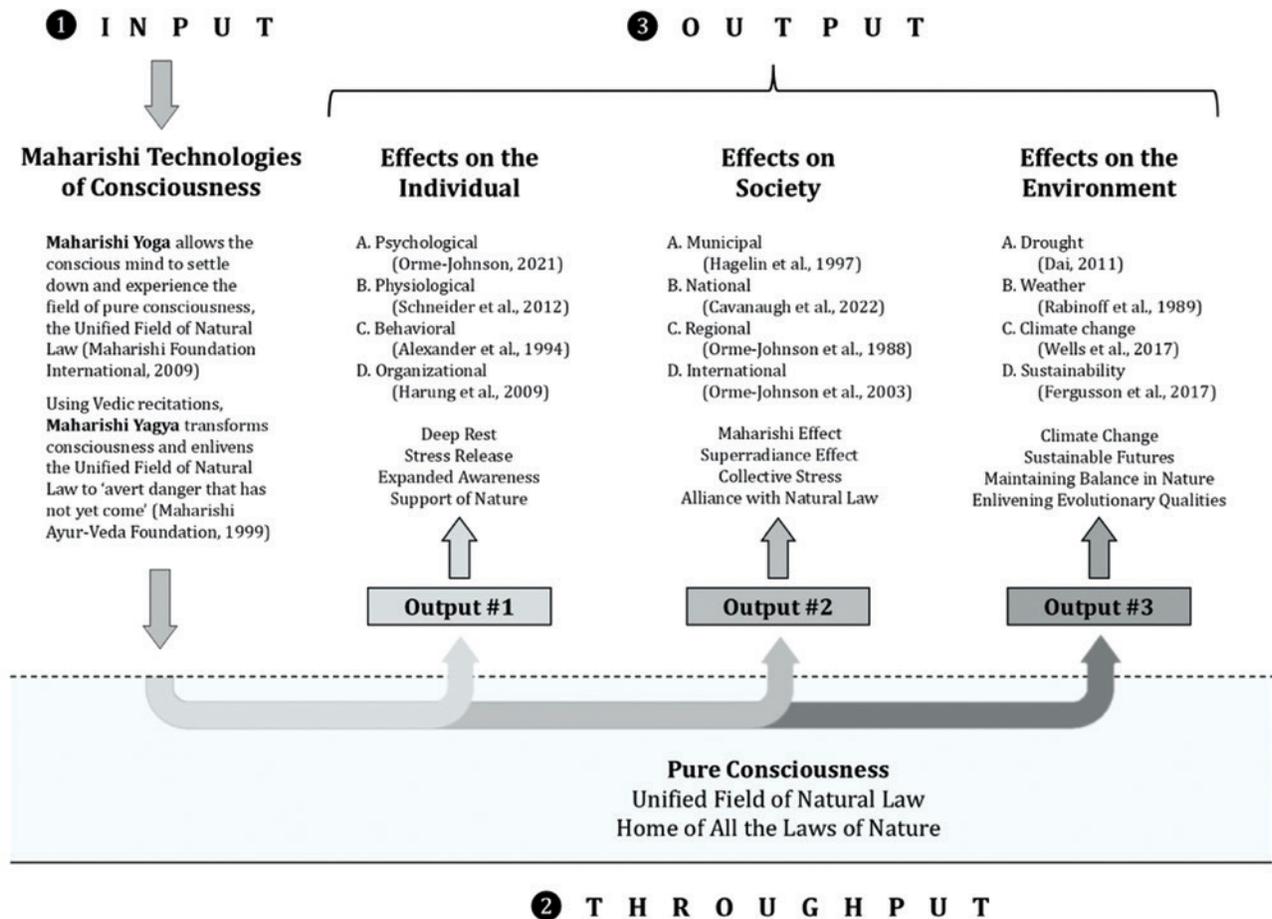


Figure A1. Theoretical model of Maharishi Technologies of Consciousness and their relation to individual, social, and environmental outcomes.

Maharishi Yoga

In this context, *Yoga* refers specifically to group practice of Maharishi's Transcendental Meditation and TM-Sidhi program, including *Yogic Flying* (Maharishi Vedic University, 2008).

Transcendental Meditation is that system of meditation taught by Maharishi and his certified teachers. It is practiced twice a day for about 20 minutes in the morning and evening but does not require other specific changes to lifestyle or belief system. Transcendental Meditation is described as a simple, effortless, and natural mental technique for allowing the conscious thinking mind to quieten and the body to experience deep rest. The regular practice is said to result in the experience of pure consciousness, a silent, peaceful, and harmoniously integrated state of awareness where the individual is fully awake but also deeply rested. Maharishi explains that because of this deep state of rest, physiological stress is released from the system and awareness is expanded, resulting in improvements to psychophysiological health, behavior, and the way individuals interact with those around them, for example, in the family or workplace. According to Maharishi, in

a very systematic, spontaneous manner the practice of Transcendental Meditation enlivens all levels of the dynamism of Natural Law, all levels of creativity of Natural Law, in the conscious mind. The infinite organizing power of Natural Law spontaneously begins to be a living reality of all thought and action in daily life. (Maharishi Foundation International, 2014, p. 24)

Such an experience is said to result in *support of nature* or greater alignment between individual action and the actions of natural law throughout the universe as conducted reliably by the laws of nature. Of relevance to this research is Maharishi Mahesh Yogi's (2008, Foreword) explanation that the more advanced TM-Sidhi program, including *Yogic Flying*, "demonstrates the ability of the individual to act from the unified field and enliven the total potential of natural law in all its expressions—mind, body, behavior and environment." Maharishi thus went on to explain:

It needed a scientific age for the world to appreciate the significance of the philosophy of Yoga and its practical application in creating

integrated individuals, integrated nations, and an integrated world family. Yoga means union, the union of the individual awareness with the unified field of all the laws of nature in the state of transcendental [i.e., pure] consciousness. (Maharishi Vedic University, 2017, p. 4).

In this way, the TM and TM-Sidhi program "inspires the Laws of Nature to uphold all thought, speech, and action: support of Nature Law increases in daily life with regular practice," according to Maharishi Mahesh Yogi (1995, p. 283).

Maharishi Yagya

A second key aspect of MTC is Maharishi Yagya. Maharishi Yagya consists of traditional "Vedic performances to restore environmental balance and promote individual and collective health" (Maharishi Mahesh Yogi, 1991, p. 73). Maharishi further explained that Yagyas are performances based on Vedic recitations designed to

promote health, happiness and success. Maharishi Yagya creates the desired effect from the level of the unified field...the deepest and most comprehensive level of life, from where nature governs the activity of the entire universe. Maharishi Yagya[s] ensure maximum support of nature by harmonizing the rhythms of individual and collective life with those of the cosmos. (Maharishi Mahesh Yogi, 1991, p. 89)

Maharishi Mahesh Yogi (1964) first spoke about Yagyas in the 1960s when he introduced the concept of watering the root of life [i.e., cultivating the experience of pure consciousness] to nourish and sustain all branches of learning and life; he explained how this practice upholds the evolution of life. In this context, by "evolution" Maharishi means the progressive, life-supporting aspects of life governed by natural law which are said to be stimulated and enlivened through the performance of specific Yagyas. Thus, from the perspective of Maharishi's theoretical framework, Maharishi Yagya can be described as a collection of unique Vedic transformative techniques designed to maintain and balance the relationship between individual, social, environmental, and even cosmic life. Of note is UNESCO's statement that the specially trained Vedic pandits (i.e., Vedic experts) who perform Maharishi Yagya are "Masterpieces of the oral and intangible heritage of humanity" (Global Country of World Peace, 2005, p. 3).

In Maharishi's theoretical framework, Maharishi Yagya can therefore be defined as Vedic performances that create life-supporting effects to amend or avoid any unwanted tendency before it manifests, based on the Vedic principle described in the *Yoga-Sūtras* (2.16) as: "Avert the danger that has not yet come" (Maharishi Ayur-Veda Foundation, 1999, p. 14). To that end, one of the key reference books of Vedic literature states: "Performance of Yagyas on a regular basis is beneficial to man and bestows peace" (*Vishnu Purāna*, 1.6.28). In contrast to the Vedic performances of others, Maharishi Yagyas are said to be always performed by trained *Maharishi Vedic Pandits* from the level of pure consciousness. Thus, Maharishi Yagya is postulated to provide

a powerful technology to help avert or minimize problems and enhance success in all areas of life.... The correct performance of a Maharishi Yagya from the level of pure consciousness by properly trained Vedic Pandits [experts] is essential. Only Maharishi Vedic Pandits have been thoroughly trained in India, under Maharishi's guidance, to be deeply grounded in the Vedic Tradition and to perform from that silent level of expanded consciousness which will ensure the most powerful and correct results. (Maharishi Ayur-Veda Foundation, 1999, p. 15)

Pure Consciousness: The Unified Field of All the Laws of Nature

Pure consciousness is described by Maharishi as the home of all the laws of nature—the unified field of natural law—and thus stands as the central switchboard of laws of nature which govern the ever-expanding universe. For this reason, Maharishi Mahesh Yogi (1995) described pure consciousness as the *Constitution of the Universe* in which all the computational functions of nature are performed. Maharishi explained that action from this level of life is action in accord with nature, and both Maharishi Yoga and Maharishi Yagya are said to be technologies which harness this level of pure potentiality and direct it for improvement in all aspects, and at all levels, of outer life.

Contemporary theory in physics advances the notion that the unified field is a "field of complete self-referral dynamism at the basis of Nature's functioning [giving] rise to a new, unified understanding of the fundamentals of creation" (Maharishi Vedic University, 2017, p. 7). Specifically, quantum physics proposes that all the forms,

phenomena, functions, and mechanisms in nature (i.e., the expressions of force and matter fields throughout the universe) can be understood in terms of different underlying quantum fields, all of which are superimpositions of one, unified, single field—the supersymmetric unified field of natural law. "This complete unification of all the different quantum fields, as described in Superstring Theory," it can be argued, "has the fundamental and profound implication that the Unified Field is a purely self-interacting field. All phenomena in Nature are said to be generated sequentially from the modes of self-interacting or self-referral dynamics of the Unified Field" (Maharishi Vedic University, 2017, p. 7). It is these sequentially generated modes of the unified field which are said to be harnessed and utilized in Maharishi Yoga and Maharishi Yagya to create change in the individual, society, and the environment.

For both the practitioner of Maharishi Yoga and pandit of Maharishi Yagya, performance is said to occur from within this level of nature's functioning, pure consciousness. To that end, Maharishi said, "we want to have our awareness fully awake to that level of reality which is in total self-referral. Being self-referral, it's transcendental. Being transcendental, it is the basis of all life" (Maharishi Vedic University, 2017, p. 7). Thus, Maharishi explained that pure consciousness is like a seed: it is hollow inside (i.e., unmanifest), but is also the source of innumerable branches, leaves, fruit, and flowers of the tree (i.e., the manifest universe). By aligning their awareness to this level of life, practitioners and pandits are said to gain access to the total field of natural law, to all the laws of nature, and thus "gain commandment to whatever extent" of the "administrative intelligence and energy of the whole diversity of the universe" (Maharishi Vedic University, 2017, p. 7). Pure consciousness can therefore be called the source of all transforming mechanisms responsible for the three outputs schematically represented in Figure A1 and described in the following sections, of which output #3 is our primary focus.

Effects on the Individual (Output #1)

Maharishi's practical example of the ability of Yoga to influence individual life is the TM-Sidhi program in which outer action is stimulated by inputs to pure consciousness (Maharishi Vedic University, 2017). The same mechanism of generative inputs applies to all three outputs in Figure A1. Indeed, Orme-Johnson (2021) has recently explained the transformative mechanisms (i.e., throughputs) associated

with harnessing the intelligence and energy of pure consciousness in reference to output #1 for the individual.

An extensive body of more than 340 peer-reviewed published studies examine the hypothesized psychological, physiological, behavioral, and organizational benefits associated with practice of the TM and TM-Sidhi program. For example, Dillbeck et al. (2020) and Orme-Johnson (2021) have reviewed the research on this program in the treatment of psychological and physiological conditions and the promotion of well-being. These beneficial effects are said to be a result of the active mind settling down and the body becoming deeply rested, as indicated by reductions of physiological stress markers.

Schneider et al. (2012) investigated the salutary effects of TM on hypertension and reduction of strokes, heart attacks, and associated mortality; in earlier research Alexander et al. (1994) examined its benefits related to treating and preventing alcohol, nicotine, and drug abuse; and Harung et al. (2009) explored its role in improving organizational leadership. Comprehensive surveys of these and other effects can be seen in Dillbeck et al. (2020). Thus, changes to individual life and capability through the Technologies of Consciousness form the platform upon which the next two outputs—social and environmental—can be understood.

Effects on Society (Output #2)

One of the most dramatic examples of transformative mechanisms of the unified field can be seen in the Meissner effect of quantum superconductivity. In an ordinary electrical conductor, incoherent, disordered electrons allow penetration and perturbation by an external magnetic field. In a superconductor, the coherent collective functioning of electrons spontaneously repels an external magnetic field and helps it maintain its impenetrable status. In this example, a small number of coherent system elements functioning together results in the entire system defending itself against external disturbing influences.

A parallel Meissner effect is hypothesized to occur in social systems, such as a city or country, where a small number of individuals practice the TM and TM-Sidhi program together in a group. The individuals in a such a group are said to harness the intelligence and energy of pure consciousness, as indicated by increased brainwave coherence, and thereby spontaneously create a national armor, reduce the influence of collective stress, and set society in a more life-supporting and evolutionary direction. The theory and evidence for what has become known as the *Maharishi Effect* (also referred to as

the *Superradiance Effect*) has been documented and explained elsewhere (e.g., Orme-Johnson & Fergusson, 2018).

The Maharishi Effect is predicted to occur when either at least one percent of a social unit (city, region, nation, or indeed the world) practices TM or when at least $\sqrt{1\%}$ of a social unit practice TM and TM-Sidhi program together in a group. This suggests the effect of coherence created by group practice of Maharishi Yoga, like the effect of Maharishi Yagya performances, is transmitted to the surrounding population from the most basic level of nature's functioning, pure consciousness. Outputs associated with the Maharishi Effect resulting from group practice of Maharishi Yoga have been observed at each of the following structural levels of society: municipal, national, regional, and international.

At the municipal level, Hagelin et al. (1999) reported the results of a prospective quasi-experiment in which the practice of the TM and TM-Sidhi program by a group of approximately 4,000 participants was proposed to be large enough to generate the Maharishi Effect for Washington, D.C. between June 7 and July 30, 1993. The group practice was associated with a 23% reduction in violent crime ($p < 2 \times 10^{-9}$). The observed reduction in crime exceeded the 20% predicted decline that was lodged with an independent review board of scientists and public leaders, the D.C. police, and publicized in the press prior to the quasi-experiment (Hagelin et al., 1999).

At the regional level, Orme-Johnson et al. (1988) found the size of a group practicing the TM and TM-Sidhi had a statistically significant on quality of life in Jerusalem and Israel as well as on the then war with Lebanon. "Cross-correlations and transfer functions indicated that the group has a leading relationship to change on the quality-of-life indicators, supporting a causal interpretation" (Orme-Johnson et al., 1988, p. 776). Months before the study began, study predictions were lodged with leading independent scientists in the U.S. and Israel.

At the international level, data also suggest that between 1983 and 1985, ranging for periods between eight and 11 days, when three separate groups of 5,500, 6,000, and 8,000 practitioners of the TM and TM-Sidhi program were formed, a 72% drop in global terrorism ($p < 0.025$) was recorded. Also, an average drop of 32% in international conflict occurred (p values ranged from < 0.005 to < 0.025) (Orme-Johnson et al., 2003).

These studies at the municipal, regional, and international levels investigated the effects associated with group practice of Maharishi Yoga. In addition, as discussed

below, seven studies of the combined application of MTC, including both Maharishi Yoga and Maharishi Yagya, all at the national level, have been published in peer-reviewed journals.

At the national level, interrupted time series analysis was used to test the hypothesis that practice of the TM and TM-Sidhi program by a group of a theoretically predicted size (in this case $N = 1,725$, approximately the $\sqrt{1\%}$ of the U.S. population) would decrease stress and tension in the larger population, as measured by reduced trends in monthly rates of homicide during the demonstration period 2007–2011 (Cavanaugh et al., 2022). The group also included up to 1,100 Maharishi Vedic experts practicing Maharishi Yagya. Controlling for pre-intervention trends, seasonality, and autocorrelation, a reduction in trend relative to the baseline trend, at the predicted time and in the predicted direction, was evident ($p < 0.001$) with large effect size. This decrease in trend indicated an average decline of 19.3% in homicide rates during 2007–2011. Also, consistent with hypothesis, this reduction was followed by increases in homicide trends 2012–2016 ($p < 0.0001$) after the group fell below the required size of 1,725. Alternative explanations for these collective effects, apparently independent of behavioral interactions, were discussed and found to be implausible.

Seven additional related studies on the combined effects of Maharishi Yoga and Yagya were published in independent peer-reviewed journals beginning in 2016. Although Maharishi Yagya was not highlighted in the original published papers, each of the seven studies report statistically and practically significant associations between the combined application of both modalities of MTC and the reduction of stress and tension in the field of collective consciousness of society, as measured by significantly reduced monthly rates of U.S. urban violent crime, U.S. fatality rates from murder, motor vehicle and other accidents, drug-related death, and infant mortality (Cavanaugh et al., 2022; Cavanaugh & Dillbeck, 2017a, 2017b; Dillbeck & Cavanaugh, 2016, 2017, 2023; Orme-Johnson et al., 2022). Results of these studies on national public health indicators has been described elsewhere in Cavanaugh et al. (2022) and Orme-Johnson & Fergusson (2018).

Collectively, these studies are consistent with the hypothesis that when a sufficiently large number of individuals practice Maharishi Yoga together in one place, or this practice of Maharishi Yoga is supplemented by Maharishi Yagya, these subjective technologies of consciousness will be associated with improvements in the quality of life

in that social setting. These consciousness-based technologies—subtle human behavior on the level of consciousness (Maharishi Yoga and Yagya)—are said to positively benefit society and the world at large (output #2) by harnessing the intelligence and energy of pure consciousness.

Effects on the Environment (Output #3)

Consistent with the input-output model of Figure A1, Maharishi's view of the relationship between human behavior and the environment is encapsulated by the following statement:

Pure consciousness is a field of infinite correlation pervading the whole of nature... any negative or positive impulse at any single point [within pure consciousness] is instantly transmitted to the entire field and accordingly [that impulse] damages or enriches all life everywhere....The relationship between man and nature is indivisible. Only such unity with nature can guarantee that in our actions we will always protect nature and in turn be protected by it. (Maharishi Mahesh Yogi, 1978a, p. 9)

If the relationship between human behavior and nature is indeed "indivisible," then changes in one must affect changes in the other. According to Maharishi, it is the impulses of life generated from the field of pure consciousness that affect life everywhere, including impulses of life which are either positive or negative. Thus, Maharishi maintained that "by the wrong doings of man on earth the whole atmosphere becomes strained" (Maharishi Mahesh Yogi, 1968). By contrast, practitioners of the TM and TM-Sidhi program are said to create coherence and harmony through the Maharishi Effect:

People who don't meditate create an atmosphere of stress and strain and tension. As the stress increases the laws of nature working for the evolution of everything, their action becomes strained. In the areas where people are very strenuous, flowers don't bloom in full. The earth becomes less fertile. Undue rain, undue heat, epidemics, hostile tendencies. All these begin to develop, and as they develop, the functioning of the natural laws for the evolution of everything becomes more and more strained.

But there is a limit to which the world's atmosphere could be strained. It is like you

stretch a rubber band and there is a limit to which it can be stretched, beyond which it only can break. And it breaks. All these wars—some fighting going on here and there—all these are the expressions of the unbearability of the atmosphere for any more increase of stress and strain. It must break.

It is the experience of all the people; if not of us, of people of the previous generations. There is a world war and then the war is over, maybe in two years, five years, whatever. And then there is a lull for 20, 30 years. In that 20 or 30 years the people in the world have again strained the atmosphere, and then the breaking point comes, and it breaks. (Maharishi Mahesh Yogi, 1968)

The hypothesis that MTC might be able to influence drought, weather, climate change, and sustainability is consistent with well-developed theory, anecdotal evidence, and preliminary published or unpublished research. Anecdotal evidence includes, for example, reported effects associated with the introduction of group practice of Maharishi Yoga in war-torn Mozambique in the early 1990s (Dai, 2011). By the invitation of the national government, group practice of the TM and TM-Sidhi program was introduced in the armed forces in 1993–1994. This program was credited by the government with bringing immediate and unexpected rains that ended the most serious drought in a century. A similar phenomenon was observed in Cambodia during a time of crisis (Fergusson, 2016).

In published research, the early work of Rabinoff et al. (1989) explored the impact of group practice of the TM and TM-Sidhi program on weather events; Wells et al. (2017) examined the implications of this knowledge and practice for climate change; and Fergusson et al. (2017) explored

the principles of Maharishi's Vedic knowledge to sustainability science. It has also been noted that the so-called *Precautionary Principle* of sustainability science (Gilbert, 2020) is consistent with the Vedic principle of averting danger before it arises (Kettle et al., 2017).

Certainly, the proposition that human behavior affects the weather, and is interactive and interdependent with it, is not a foreign idea in most indigenous cultures (e.g., Balay-As et al., 2018). This view is consistent with that of John Muir, who wrote about the interconnectedness of the world when he said, "When we try to pick out anything by itself, we find it hitched to everything else in the Universe" (Gilbert, 2020, p. 489). Such a relationship between man and nature is what Cajete (2000) calls "native science." Indeed, for many thousands of years, according to the principle of interdependence, indigenous peoples in all parts of the world have adopted the view that human behavior, including unseen, subtle, and directed behaviors, affect weather events, weather patterns, and climate. Such directed behaviors toward changing the environment include skills, attitudes, conceptions, beliefs, values, capabilities, practices, and traditional ways of solving problems (Ombati, 2017).

Moreover, farmers annually face the seeming vagaries of weather, never knowing if the current year will bring beneficial or disastrous environmental conditions for their crops. But Maharishi Mahesh Yogi (1978a) pointed out that when the sunshine, rain, and seasons come and go without reference or connection to the needs and behaviors of society, it is because the environment is in a state of imbalance in which there is a lack of coordination among the various separate elements of life. He emphasized that these seemingly separate elements can now be properly coordinated by re-establishing balance through his technologies of consciousness. Such coordination is an underlying theme and proposition motivating the present research on landfalling hurricanes in the U.S.

APPENDIX B

OTHER EMPIRICAL RESEARCH ON CONSCIOUSNESS AS A FIELD

EEG Studies

Research on Maharishi Technologies of Consciousness (MTC) that also reports empirical evidence said to support the possible existence of consciousness as a nonlocalized field includes EEG experiments examining effects of group practice of Maharishi Yoga (TM and TM-Sidhi program) (Orme-Johnson et al., 1982; Travis & Orme-Johnson, 1989). For example, an ITS study reported significant increases in EEG coherence between pairs of different subjects practicing TM at precisely the same time when 2,500 people were participating in group practice of the TM-Sidhi program more than 1,000 miles away (Orme-Johnson et al., 1982). A related randomized study by Kleinschnitz & Travis (2024) found significant evidence consistent with possible field effects associated with group practice of TM.

Gioldini et al. (2016) provide a list of other EEG studies investigating brain-to-brain interaction at a distance.

Neuroendocrine research: Maharishi Yoga

Empirical evidence of possible neuroendocrine-mediating factors involved in the findings of Orme-Johnson et al. (1982) and Travis and Orme-Johnson (1989) are reported by Walton et al. (2005). Time series regression analysis was used to investigate the dynamic relationship (i.e., Granger causality) between changes in the size of a large group practicing the TM-Sidhi program and subsequent overnight excretion rates of neurochemical markers of reduced stress in six non-meditators outside the group. The authors reported that immediately following increases in the daily size of the TM-Sidhi group ($N = 77$), as hypothesized, the natural log of the daily overnight excretion rate for the stress hormone cortisol decreased ($p = 0.004$), the log excretion rate for a metabolite of serotonin (5-HIAA) increased ($p = 0.03$), and the log ratio of 5-HIAA to cortisol increased ($p < 0.001$). All of these changes are in a direction indicating reduced individual stress. These changes in excretion rates, in the opposite directions at the predicted time, are consistent with those found during individual practice of TM.

Alternative explanations for these results were reported to be implausible.

Global Consciousness Project

Nelson (2019) reported empirical results from the Global Consciousness Project (GCP) that are said to be consistent with the hypothesis of a shared *global consciousness*. An outgrowth of previous research at Princeton's Engineering Anomalies Research Lab (PEAR), for more than 20 years GCP has been empirically investigating the relation between global consciousness and physical systems. GCP research examines correlations between major global events and increased order (decreased randomness) in the behavior of a global network of random number generators (RNG).

For example, Nelson (2019, p. 195) described research by Bryan Williams that reported significantly increased orderliness (decreased randomness) in the RNG global GCP network ($p < 0.0005$) associated with 110 events of large group or global synchronized practice of meditation or prayer that had the stated intention of promoting world peace, global harmony, or healing of the Earth and nature.

Consistent with promising results of a preliminary 2001 RNG study of the effects of group practice of the TM and TM-Sidhi program, Nelson (2006) found a significant cumulative increase in orderliness of the output of the RNG ($p < 0.01$) during synchronized group practice of these consciousness-based technologies by large groups at Maharishi International University (MIU) and Washington, D.C., respectively. Data were collected for seven consecutive Saturdays in July-September 2006. The total number of participants varied from 2,116 to 2,492. Deviations from randomness were reported to be greater when the total size of the groups was near maximum.

A second RNG study further investigated effects associated with group practice of the TM and TM-Sidhi program. Mason et al. (2007) reported significant, cumulative deviations from randomness ($p < 10^{-5}$ for both studies) during 94 total hours of meditation data from two separate experiments at MIU. Stronger effects ($p < 10^{-6}$ for both studies) were found during a sub-period when participants practiced an advanced aspect of the TM and TM-Sidhi program known as *Yogic Flying*. Data for the study were obtained from a local RNG at the meditation site, unlike the global network of RNGs used by Nelson (2006). The participants (659 on average) were not aware of the study or the RNG. Cumulative deviations from randomness were not significant for

baseline data, but significant drift was found in the post-test control period, indicating possible “carry over” or lagged effects.

The authors address a list of ten potential alternative explanations, but concluded none could plausibly account for the observed results. The direction of anomalous cumulative deviations were similar to other RNG research involving prayer, meditation, and sacred sites, namely deviations in the direction of increased orderliness of RNG activity that involve an increase in the proportion of zeros, rather than ones.

The extensive body of other empirical (and theoretical) research on the hypothesis of a nonlocal dimension of consciousness is discussed in Radin (2006, 2013) and Dossey (2013).

Research on *National Mood*

Common expressions referring to the concept of a collective aspect of consciousness, or “group mind” or “national mind,” include “public opinion” or “national mood” in public opinion polling, “employee morale” in business, and “investor sentiment” in finance. Studies motivated by such concepts include empirical research in behavioral economics that investigate the relationship between national mood and stock market performance. The sentiment of popular songs on online music sites were used as a proxy indicator of national mood (Edmans et al., 2022). Related studies have also examined the association between stock market activity and mood-affecting events such as weather disasters, outcomes of sporting events, and aviation disasters.

APPENDIX C

REPLICATION: STUDY 2

As a replication study, we re-estimated Model 1 using the NOAA data for 1900–2021 ($N = 122$). The data for this period are generally regarded as being of higher quality than the 19th-century data. The quasi-Poisson QML regression estimates for Model 2 are shown in Table 3.

The regression results remain consistent with both research hypotheses (see Table 3). For Model 2, Hypothesis 1 is the same as that for Model 1 except the baseline incidence rate is 1900–2005 rather than 1851–2005 in Model 1. Consistent with Hypothesis 1, the regression coefficient for *DEMO* is significantly less than that for the 1900–2005 baseline (regression intercept) with a significant difference of -1.215 , $z = -5.19$, $p < 10^{-6}$, CI $[-1.674, -0.756]$. The IRR for *DEMO* of 0.469 indicates that mean predicted \hat{y} during 2006–2014 is $(0.469-1)100 = -53.1\%$ lower than 1.581 *LFH* per year, the baseline mean predicted value of \hat{y} during 1900–2005.

Likewise, consistent with Hypothesis 2, the regression coefficient for *DEMO* is significantly less than that for *D2015*. Subtracting the *D2015* coefficient from that for *DEMO* gives a significant difference of -0.703 , $z = -4.48$, $p < 10^{-5}$, 95% CI $[-1.011, -0.395]$. Thus, the mean *LFH* count predicted by the regression model during the demonstration period of 0.742 is lower than the predicted mean count of 1.500 for the post-demonstration period. The latter count is given by $0.948(1.581)$, the IRR for *D2015* multiplied by the baseline expected *LFH* count. Exponentiating the difference between regression coefficients yielded 0.495 which implies that \hat{y} during 2006–2014 is $(0.495-1)100 = -50.5\%$ lower than \hat{y} for 2015–2021.

Thus, in summary, the results of the empirical analysis for Model 2 are consistent with both Hypotheses 1 and 2 and display both a high level of practical as well as statistical significance.

Based on a counterfactual continuation of the 1900–2005 baseline *LFH* incidence rate of 1.581 annually, a total of 14.2 *LFH* would be predicted during the nine years of the demonstration period as compared with the observed total of eight. The observed total was 56.2% of the counterfactual total ($8/14.2 = 0.562$). Thus the observed total *LFH* was $(0.562-1)100 = -43.8\%$ percent lower than the counterfactual expected total count.

In Model 2, unlike Model 1, the IRR for *ATLHURR* (1.078) is non-significant as shown by the 95% CI for IRR in Table 3 which includes 1.0, indicating the IRR is not significantly different from 1.0 ($p = 0.07$). The non-significance may be due in part to the high correlation of *ATLHURR* with *ACE* (see Table 2). Compared with *ATLHURR*, *ACE* provides a more comprehensive measure of tropical cyclone activity, including intensity, duration, and frequency. The IRR estimate for *ACE* (1.242) with $p = 0.047$ in Model 2 is similar to that for Model 1 (1.165). A one SD increase in *ACE* is associated, on average, with a 24.2% increase in the expected *LFH* count.

Diagnostic checks for Model 2 are satisfactory. As in the case of Model 1, the hypothesis of good fit between the regression predicted values and observed data was not rejected by the deviance GOF test for Model 2, $\chi^2(117) = 113.320$, $p = 0.579$. The Pearson GOF test likewise indicated a good fit, $c^2(117) = 94.487$, $p = 0.938$. As discussed previously, for both the deviance and Pearson tests the hypothesis of $p > 0.05$ indicates good fit (Hilbe, 2014). A measure of the “overall significance” of the model is given by the Wald test of the null hypothesis that the regression predictors were all equal to zero. This test was rejected, ($\chi^2(4) = 157.29$ ($p < 0.001$)).

Another measure of GOF favored by Cameron & Trivedi (2013) is the correlation between the model predicted values and the observed *LFH* counts. As in the case of Model 1, this correlation is relatively high (0.590) resulting in a generalized R-squared = 0.348. Similarly, the Nagelkerke measure of goodness of fit (GOF) is 0.336, while the Cox-Snell measure is 0.324. These are a few of the many the proposed alternative measures of GOF.

As in the case of Model 1, robust Newey-West SEs (10 lags) were used to correct the SEs of the regression coefficients. Sensitivity analysis found that the findings for Hypotheses 1 and 2 continued to be highly significant when the number NW lags was varied from 5 to 15.

Note that because Model 1 and Model 2 are estimated using different data samples, the AIC and BIC cannot be compared for the two models (Anderson, 2008).

In sum, for Model 2, as in the case of Model 1, the results of the current replication study using 1900–2021 data remained consistent with both research hypotheses. For both Model 2 and Model 1, tests of the two research hypotheses are also substantively, as well as statistically, significant. Diagnostic tests indicate statistical conclusion validity for both models (Reichardt, 2019).