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THESIS

LIGHTING A FIRE UNDER PUBLIC HEALTH AND SAFETY EDUCATION: INFLUENCE THROUGH RATIONAL CHOICE, REASONED BEHAVIOR, AND BEHAVIORAL ECONOMICS

by

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Many public health and safety education interventions have failed because practitioners did not apply effective methods of influence to alter individuals' actions. Identification of successful methods has been complicated by the lack of a theory to describe the factors that cause individuals to perform recommended practices.

This thesis investigated the methods that were responsible for success in individual-level public health and safety interventions. A comparative case study was conducted on a set of interventions that encouraged seat belt use, bicycle helmet wearing, and alcohol moderation. Each intervention was analyzed using a four-model approach encompassing rational choice, reasoned behavior, and both intuitive and reflective interpretations of behavioral economics in order to detect methods that might have influenced individuals to change their actions. Comparative analysis between case analyses permitted identification of the intervention methods that are correlated with successful health and safety programs in general.

The social forces of injunctive pressure and public commitment were found to be correlated with effective programs of influence. This thesis concludes that future public health and safety education interventions may achieve success by leveraging peer pressure and public commitments to elicit compliance with desired practices.

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LIGHTING A FIRE UNDER PUBLIC HEALTH AND SAFETY EDUCATION: INFLUENCE THROUGH RATIONAL CHOICE, REASONED BEHAVIOR, AND BEHAVIORAL ECONOMICS

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ABSTRACT

Many public health and safety education interventions have failed because practitioners did not apply effective methods of influence to alter individuals' actions. Identification of successful methods has been complicated by the lack of a theory to describe the factors that cause individuals to perform recommended practices.

This thesis investigates the methods that were responsible for success in individual-level public health and safety interventions. A comparative case study was conducted on a set of interventions that encouraged seat belt use, bicycle helmet wearing, and alcohol moderation. Each intervention was analyzed using a four-model approach encompassing rational choice, reasoned behavior, and both intuitive and reflective interpretations of behavioral economics in order to detect methods that might have influenced individuals to change their actions. Comparative analysis between case analyses permitted identification of the intervention methods that are correlated with successful health and safety programs in general.

The social forces of injunctive pressure and public commitment were found to be correlated with effective programs of influence. This thesis concludes that future public health and safety education interventions may achieve success by leveraging peer pressure and public commitments to elicit compliance with desired practices.

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A. BACKGROUND

The mission of public health and safety education is administered through interventions that attempt to influence individuals to perform beneficial practices. Interventions employ a variety of methods in their efforts to effect change within a number of health and safety fields. Fire and life safety education is one of the many fields that comprise public health and safety education.

Smoke alarms are among the most important safety devices promoted by fire and life safety education. Despite the substantial safety benefit provided by smoke alarms, many individuals fail to properly maintain these devices.[1] A multitude of fire and life safety education interventions have attempted to encourage smoke alarm installation and maintenance, but so far these attempts have proven unsuccessful.[2]

B. PROBLEM STATEMENT

The problem is that fire and life safety education practitioners do not know how to influence individuals to maintain smoke alarms or perform other recommended safety practices.[3] This issue is not limited to fire and life safety education, as researchers in other fields of injury prevention are similarly unsure of the factors that cause individuals to perform safety actions.[4] Until the factors that cause individuals to act in a safe manner are understood, successful intervention design will remain a mystery.

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[1] Marty Ahrens, *Smoke Alarms in U.S. Home Fires* (Quincy, MA: National Fire Protection Association, 2014), 7, http://strategicfire.org/wp-content/uploads/2015/04/Ahrens-Smoke-Alarms-in-US-Home-Fires-1.pdf.

[2] Lynne Warda, Milton Tenenbein, and Michael EK Moffatt, "House Fire Injury Prevention Update. Part II. A Review of the Effectiveness of Preventive Interventions," *Injury Prevention* 5, no. 3 (1999): 217.

[3] N. J. Thompson, M. B. Waterman, and David A. Sleet, "Using Behavioral Science to Improve Fire Escape Behaviors in Response to a Smoke Alarm," *Journal of Burn Care & Research* 25, no. 2 (2004): 185.

[4] L. B. Trifiletti et al., "Behavioral and Social Sciences Theories and Models: Are They Used in Unintentional Injury Prevention Research?," *Health Education Research* 20, no. 3 (2005): 298.

C. RESEARCH QUESTION

How can we design successful individual-level interventions to improve public health and safety?

D. ARGUMENT AND METHODOLOGY

We must first understand the factors that cause individuals to perform health and safety practices before we can design successful individual-level interventions. Fire and life safety education research unfortunately does not provide sufficiently reliable data to investigate these factors.[5] Analysis of existing research from other health and safety fields, however, may permit discovery of the factors that drive health and safety actions.

This thesis performs a comparative case study of health and safety interventions that encouraged individuals to use seat belts, wear bicycle helmets, and moderate alcohol consumption. Each case is analyzed to identify the intervention methods and influential factors of individual action that are correlated with the outcome of that case. Because the determinant factors of health and safety actions have yet to be established, this thesis employs multiple models derived from the fields of rational choice, reasoned behavior, and two different interpretations of behavioral economics in an attempt to consider relevant routes by which intervention methods may influence individuals. Comparative analysis of the intervention methods associated with success in the specific cases drawn from these three health and safety fields may permit discovery of a set of common methods that are correlated with successful programs across multiple fields.

E. CONCLUSIONS AND RECOMMENDATIONS

The results of this study permit several informative conclusions regarding the methods that can be used to influence individuals. Injunctive pressure is a highly effective tool for producing change, provided that individuals believe they are liable to be judged negatively if they do not perform desired actions. Public commitments are also a viable means of achieving at least a temporary improvement in health and safety, but

[5] Van M. Ta et al., "Evaluated Community Fire Safety Interventions in the United States: A Review of Current Literature," *Journal of Community Health* 31, no. 3 (2006): 195, doi:10.1007/s10900-005-9007-z.

individuals may have to be occasionally reminded of these commitments to maintain compliance. The impact of these two methods reveals the power that social forces possess to guide the actions of individuals.

The findings of this comparative case study also inform conclusions about those methods that are not useful for improving individuals' health and safety actions. The use of economic incentives is not a sustainable method for producing widespread change, as the number of individuals who would have to be perpetually rewarded would render the costs impractical. Another conclusion of the present research is that salient injury threats are incapable of influencing individuals.

Achieving widespread change in individual-level health and safety is an ambitious and challenging goal. Through deliberate and targeted interventions, however, health and safety practitioners may be able to initiate a social reaction that spreads far beyond the limited reach of direct practitioner influence.

Practitioners should mount targeted interventions that light a fire within the public for health and safety by crowd-sourcing injunctive pressure and public commitments. Limited, practitioner-implemented interventions could exert injunctive pressure and obtain public commitments from incentivized or volunteer peer agents, who would then be directed to pressure their neighbors, friends, and family to perform desired health or safety actions and secure pledges committing to those practices. Admittedly, any intervention of this type would initially influence only a relatively small number of individuals. By kindling a flame of civic engagement, however, the resulting chain reaction could propagate an exponential, public-driven improvement in health and safety.

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I. INTRODUCTION

A. BACKGROUND

The mission of public health and safety education is administered through interventions that attempt to influence individuals to perform beneficial practices. Interventions employ a variety of methods in their efforts to effect change within a number of health and safety fields. Fire and life safety education is one of the many fields that comprise public health and safety education.

Fire and life safety education interventions are intended to teach civilians to prepare for their own safety against a wide variety of threats. The National Fire Protection Association (NFPA) describes the broad mission of fire and life safety education as "community fire and injury prevention programs designed to eliminate or mitigate situations that endanger lives, health, property, or the environment."[1] Fire and life safety education promotes responsible household habits such as safe cooking, space heater, candle, and cigarette use, smoke alarm installation and maintenance, family evacuation planning, civilian first aid training, and storage of disaster preparedness supplies such as food, water, and medicine.

Smoke alarms are among the most important safety devices promoted by fire and life safety education. Possession of a working smoke alarm has been found to reduce the chance of dying in a fire by half.[2] Without a functioning smoke alarm, many occupants have insufficient time to escape from a fire before conditions become untenable.[3]

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[1] National Fire Protection Association, "NFPA 1035: Standard on Fire and Life Safety Educator, Public Information Officer, Youth Firesetter Intervention Specialist and Youth Firesetter Program Manager Professional Qualifications" (National Fire Protection Association, 2015), http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=1035.

[2] Marty Ahrens, *Smoke Alarms in U.S. Home Fires* (Quincy, MA: National Fire Protection Association, 2014), 10, http://strategicfire.org/wp-content/uploads/2015/04/Ahrens-Smoke-Alarms-in-US-Home-Fires-1.pdf.

[3] Richard W. Bukowski et al., *Performance of Home Smoke Alarms: Analysis of the Response of Several Available Technologies in Residential Fire Settings* (Washington, DC: National Institute of Standards and Technology, 2007), 253, http://fire.nist.gov/bfrlpubs/fire07/art063.html.

Despite the substantial safety benefit provided by smoke alarms, many individuals fail to properly maintain these devices.[4] Although 96 percent of U.S. households report owning a smoke alarm, inspections of functionality indicate that only an estimated 77 percent of U.S. households have at least one working smoke alarm.[5] The percentage of U.S. households with sufficient smoke alarm protection is likely even lower, as current NFPA guidelines recommend a smoke alarm in every room used for sleeping, an additional smoke alarm outside of every sleeping area, and at least one smoke alarm on each level of a home.[6]

Several occupant actions are required in order to ensure adequate smoke alarm protection. Residents must install the proper number of smoke alarms in recommended locations, understand the characteristics of different smoke alarm detection technologies, test alarms every month, ensure that power is maintained to smoke alarms, and refrain from disconnecting smoke alarms when activated by causes other than fire.[7] Some experts have argued that new regulations and smoke alarm technologies will render occupant participation in smoke alarm installation and maintenance unnecessary.[8] The human element evident in the aforementioned activities, however, suggests that occupant participation will remain essential for the foreseeable future.

A multitude of fire and life safety education interventions have attempted to encourage smoke alarm installation and maintenance, but so far these attempts have proven unsuccessful.[9] Mass media, educational campaigns, and door-to-door canvassing have all been used to provide messages encouraging smoke alarm usage.[10] Non-

[4] Ahrens, *Smoke Alarms in U.S. Home Fires*, 7.

[5] Ibid.

[6] National Fire Protection Association, "NFPA 72: National Fire Alarm and Signaling Code" (National Fire Protection Association, 2013), http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=72.

[7] N. J. Thompson, M. B. Waterman, and David A. Sleet, "Using Behavioral Science to Improve Fire Escape Behaviors in Response to a Smoke Alarm," *Journal of Burn Care & Research* 25, no. 2 (2004): 180.

[8] Ibid.

[9] Lynne Warda, Milton Tenenbein, and Michael EK Moffatt, "House Fire Injury Prevention Update. Part II. A Review of the Effectiveness of Preventive Interventions," *Injury Prevention* 5, no. 3 (1999): 217.

[10] Ibid.

randomized studies of smoke alarm programs administered via mass media outlets such as advertising, direct mailings, and brochure distribution have not produced an increase in smoke alarm ownership.[11] While several studies of home, school, and community educational programs have reported positive effects, randomized and blinded studies of similar programs have not found a change in smoke alarm protection, indicating that the apparent gains in non-randomized and non-blinded studies may be the result of researcher biases.[12] Door to door smoke alarm installation programs provide temporary protection but are unable to encourage residents to maintain these devices, as subsequent inspections find many of these smoke alarms inactive with dead or missing batteries, disabled due to nuisance alarms, or vandalized.[13] An intervention that installed smoke alarms containing 10-year lithium batteries in high-risk households in Dallas, Texas experienced similar maintenance issues, finding 91.8 percent of smoke alarms functional two years post installation, with functionality rates dropping to 68 percent after four years, 35.8 percent after 6 years, 27.3 percent after 8 years, and 19.9 percent after 10 years.[14]

B. PROBLEM STATEMENT

The problem is that fire and life safety education practitioners do not know how to influence individuals to maintain smoke alarms or perform other recommended safety practices.[15] This is not surprising, given the unreliable nature of research in this field. Studies of individual-level fire and life safety education programs have been criticized for inconsistent design or performance measures, lack of randomness or controls, and inadequate sample size or follow-up time.[16][17] An absence of theory has been noted as a

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[11] Carolyn DiGuiseppi, Cynthia W Goss, and Julian PT Higgins, "Interventions for Promoting Smoke Alarm Ownership and Function," *Cochrane Database of Systematic Reviews*, no. 2 (2001): 7, doi:10.1002/14651858.CD002246.

[12] Ibid.

[13] Warda, Tenenbein, and Moffatt, "House Fire Injury Prevention Update. Part II. A Review of the Effectiveness of Preventive Interventions," 224.

[14] G. R. Istre et al., "Preventing Deaths and Injuries from House Fires: An Outcome Evaluation of a Community-Based Smoke Alarm Installation Programme," *Injury Prevention* 20, no. 2 (2014): 101.

[15] Thompson, Waterman, and Sleet, "Using Behavioral Science to Improve Fire Escape Behaviors in Response to a Smoke Alarm," 185.

[16] Warda, Tenenbein, and Moffatt, "House Fire Injury Prevention Update. Part II. A Review of the Effectiveness of Preventive Interventions," 223.

inadequate sample size or follow-up time.'[16][17] An absence of theory has been noted as a common shortcoming among smoke alarm interventions and literature.[18] The lack of rigor in fire and life safety education is further demonstrated by the development and promotion of age priorities that have not been adequately justified.[19] Without reliable data or established theory to explain individuals' actions, it is unclear how a successful fire and life safety education intervention should be designed.

Researchers in other fields of injury prevention are similarly unsure of the factors that cause individuals to perform safety actions.[20] Although injury prevention has begun to adopt established health behavior theories and models in the development, implementation, and evaluation of interventions, these uses have failed to test if the models imported from health research are applicable to injury problems.[21] Until the factors that cause individuals to act in a safe manner are understood, successful intervention design will remain a mystery.

Discovering how to influence individual actions appears necessary in order to improve health and safety. An analysis of the decreasing repercussions of tobacco use and motor vehicle crashes observed over the past several decades asserts that these significant health and safety improvements were ultimately achieved as a result of legislative and policy solutions, driven by changing social attitudes that were themselves supported and influenced by individual-level interventions.[22] While this analysis identifies individual-level interventions as the causal factors that precipitate social change

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[16] Warda, Tenenbein, and Moffatt, "House Fire Injury Prevention Update. Part II. A Review of the Effectiveness of Preventive Interventions," 223.

[17] Van M. Ta et al., "Evaluated Community Fire Safety Interventions in the United States: A Review of Current Literature," *Journal of Community Health* 31, no. 3 (2006): 195, doi:10.1007/s10900-005-9007-z.

[18] Ibid.

[19] Timothy McNamara, "Questioning Risk-Based Fire and Life Safety Education Age Priorities," *Injury Prevention*, 2016, doi:10.1136/injuryprev-2016-042014.

[20] L. B. Trifiletti et al., "Behavioral and Social Sciences Theories and Models: Are They Used in Unintentional Injury Prevention Research?," *Health Education Research* 20, no. 3 (2005): 298.

[21] Ibid.

[22] Andrea C. Gielen and Lawrence W. Green, "The Impact of Policy, Environmental, and Educational Interventions A Synthesis of the Evidence From Two Public Health Success Stories," *Health Education & Behavior* 42, no. 1 suppl (2015): 20S–34S.

to effect widespread health and safety improvement, the factors necessary to produce the successful individual-level interventions that serve as catalysts at the beginning of this causal chain remain unknown.

C. RESEARCH QUESTION

How can we design successful individual-level interventions to improve public health and safety?

D. ARGUMENT AND METHODOLOGY

We must first understand the factors that cause individuals to perform health and safety practices before we can design successful individual-level interventions. Fire and life safety education research unfortunately does not provide sufficiently reliable data to investigate these factors.[23] The wider body of injury prevention, however, may contain studies with more thorough documentation and rigorous evaluation. Searching for such studies in the existing research of several health and safety fields could permit discovery of the factors that drive health and safety actions.

This thesis will perform a comparative case study of health and safety interventions that encouraged individuals to use seat belts, wear bicycle helmets, and moderate alcohol consumption. Each case will be analyzed to identify the intervention methods employed and the factors of individual action that were influenced by those methods to achieve the observed program outcome. Because the determinant factors of health and safety actions have yet to be established, this thesis will employ multiple models derived from the fields of rational choice, reasoned behavior, and two different interpretations of behavioral economics in an attempt to consider relevant routes by which intervention methods may influence individuals. Comparative analysis of the intervention methods associated with success in the specific cases drawn from these three health and safety fields could permit discovery of a set of common methods that are correlated with successful programs across multiple fields.

[23] Ta et al., "Evaluated Community Fire Safety Interventions in the United States: A Review of Current Literature," 195.

E. GOAL

If a set of general methods correlated with successful health and safety interventions can be identified, these factors could be applied to design interventions in any related field. Fire and life safety education would benefit by using these lessons learned to create better interventions for increasing smoke alarm maintenance, instilling safe household kitchen and heating practices, and encouraging family evacuation planning. Pedestrian, cyclist, and motorist safety could be enhanced by a better understanding of the intervention methods that effect change. Knowledge of these factors would also benefit fields beyond traditional injury prevention.

The homeland security implications of these findings would be significant, enabling practitioners to guide individuals' actions to enhance public safety and mitigate the threats of terrorism and disaster. Interventions could be implemented to make members of the public more alert, increasing the likelihood that suspicious activity would be detected and reported.[24] Teaching civilians to locate and note secondary exits upon entering an unfamiliar space might allow some would-be victims to escape from an active shooter attack.[25] Encouraging individuals to prepare disaster kits containing food, water, and medicine could make communities more resilient during natural disaster, at the same time freeing first responders so they can mitigate the actual emergency, rather than use these resources to provide basic supplies to an unprepared citizenry.[26] With an increased ability to influence individuals, both homeland security and general health and safety could be improved. Although this thesis only purports to identify intervention methods that are correlated with successful public health and safety programs, future research could test and establish the causality of these relationships.

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[24] Stephen Flynn, "Recalibrating Homeland Security: Mobilizing American Society to Prepare for Disaster," *Foreign Affairs* 90, no. 3 (2011): 134.

[25] U.S. Department of Homeland Security, "Active Shooter: How to Respond" (U.S. Department of Homeland Security, n.d.), 4, http://www.dhs.gov/sites/default/files/publications/active-shooter-how-to-respond-508.pdf.

[26] Flynn, "Recalibrating Homeland Security," 137.

F. ORGANIZATION

This thesis consists of six chapters. The next chapter, II, conducts a literature review of the relevant research on behavior and decision making. Chapter III defines the methodology that will guide the comparative case study of seat belt, bicycle helmet, and alcohol interventions. Chapter IV analyzes selected studies to identify the set of intervention methods used in each case. Chapter V then performs a comparative analysis across these cases to infer which methods are correlated with the design of successful health and safety interventions in general. Chapter VI reports the findings of these analyses, draws conclusions based upon these findings, and makes recommendations to improve public health and safety interventions.

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II. LITERATURE REVIEW

This chapter reviews the literature on rational choice, reasoned behavior, and behavioral economics to present four interpretations of the factors that determine individual-level actions. The first two sections proceed in a straightforward manner, each suggesting a single model of individual action: rational choice describes how individuals make decisions, while reasoned behavior explains why individuals perform observed behaviors. The third section, which examines behavioral economics, is more involved and yields two models, one behavioral and one based on decision making, each derived from different interpretations of this field. A brief summary follows these three sections to conclude the literature review.

A. RATIONAL CHOICE

Rational theories of decision making attempt to predict which choice an individual will select from a set of available options. Central to these theories are the assumptions that individuals have complete information regarding all possible choices, and that individuals will always decide between alternatives in a rational manner.[27] Rationality here means that individuals are capable of using their complete information to calculate the optimal choice among all options, and that individuals will then select this option.[28] In short, rational choice theories claim that individuals will always correctly decide to do whatever is in their own best interest.

Rational decision making has changed over the centuries. The field has been developed by extrapolating from a set of assumptions and then testing to see how well the proposed theories fit known data.[29] The earliest incarnations of rational decision making were predicated on the assumption of riskless choice, whereby omniscient individuals would know with certainty the utility that they would derive from each option.[30] Under

[27] Ward Edwards, "The Theory of Decision Making," *Psychological Bulletin* 51, no. 4 (1954): 381.

[28] Ibid.

[29] Ibid.

[30] Ibid.

these conditions, individuals would simply select whatever choice provided the maximum utility.[31]

Current theories of rational decision making now assume that individuals maximize for expected utility when selecting the optimal choice from a set of options. This change was implemented to account for decisions under risk, whereby the outcomes associated with each choice are not certain, but can instead be predicted with a known probability.[32] The expected utility of a choice can be computed by enumerating all possible outcomes for that choice, multiplying the probability of each outcome by its utility, and then summing all of the outcome probability-utility products for that choice.[33] Because of the rationality assumption, it is expected that individuals will be capable of subconsciously and correctly calculating these expected utilities, and that they will then always select the choice that optimizes expected utility.[34] Therefore, according to contemporary rational decision making theories, individuals are aware of the probability of all possible outcomes, and will always select the choice that offers the greatest expected utility.

Rational choice is not universally accepted as a model of decision making. Critics of rational choice argue that the assumptions of rational calculation are implausible and contradict observation of actual human choices.[35] Studies of actual human decision making suggest that individuals are incapable of the probabilistic optimization calculations required by Expected Utility Theory.[36] In responding to these critics, proponents of rational choice assert that their theories are normative in that they identify optimal choice, and also claim that rational choice correctly predicts individuals'

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[31] Ibid., 382.

[32] Ibid.

[33] Gerd Gigerenzer, "Decision Making: Nonrational Theories," in *International Encyclopedia of the Social and Behavioral Sciences*, ed. Neil Smelser and Paul Baltes, vol. 5 (Oxford: Elsevier, 2001), 3305.

[34] Edwards, "The Theory of Decision Making," 392.

[35] Herbert A. Simon, "A Behavioral Model of Rational Choice," *The Quarterly Journal of Economics* 69, no. 1 (February 1955): 104, doi:10.2307/1884852.

[36] Amos Tversky and Daniel Kahneman, "Judgment under Uncertainty: Heuristics and Biases," *Science* 185, no. 4157 (1974): 1130.

decisions even if these theories do not accurately describe the processes that lead to those choices.[37]

B. REASONED BEHAVIOR

Reasoned models of behavior seek to predict whether or not an individual will perform a single behavior in isolation. A behavior is defined by four components: it is an action, performed on a target, in a specific context, at a given time.[38] Human behaviors are considered to be the reasoned products of an individual's beliefs regarding a constant set of determinant factors that contribute to the performance of each behavior.[39] Reasoned models of behavior assume that individuals always have an innate understanding of their own beliefs regarding every causal factor for each behavior.[40] It is thought that an individual's performance of a particular behavior results from a subconscious consideration of the strength of his or her beliefs about every determinant factor that influences that behavior.[41] Some theories purport to identify the causal factors that directly produce a specific behavior, while others describe the factors that generate intent to perform a behavior.[42]

Numerous reasoned theories have been advanced to explain human behavior. Prominent models in health research include the Health Belief Model, Social Cognitive Theory, and the Theory of Reasoned Action.[43] An early attempt to synthesize these models, known as the Theory of Planned Behavior (TPB), defines three distinct, causal

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[37] Gigerenzer, "Decision Making," 3305.

[38] Martin Fishbein, "The Role of Theory in HIV Prevention," *AIDS Care* 12, no. 3 (2000): 274.

[39] Icek Ajzen and Martin Fishbein, "The Influence of Attitudes on Behavior," in *The Handbook of Attitudes*, ed. Dolores Albarracín, Blair Johnson, and Mark Zanna (New York: Lawrence Erlbaum Associates, 2005), 193.

[40] Ibid., 194.

[41] Ibid., 195.

[42] Thomas L. Webb and Paschal Sheeran, "Does Changing Behavioral Intentions Engender Behavior Change? A Meta-Analysis of the Experimental Evidence," *Psychological Bulletin* 132, no. 2 (2006): 250–51, doi:10.1037/0033-2909.132.2.249.

[43] Martin Fishbein et al., "The Role of Theory in Developing Effective Antidrug Public Service Announcements," in *Mass Media and Drug Prevention Class and Contemporary Theories and Research*, ed. William Crano and Michael Burgoon (Mahwah, NJ: Lawrence Erlbaum Associates, 2002), 90.

factors that contribute to intent to perform a behavior.[44] Those factors are attitude toward the behavior resulting from a cost-benefit analysis, perceived norms of acceptable social behavior and perceptions of important referent's opinions about the behavior, and perceived self-efficacy to enact the behavior.[45] It is believed that the relative importance of these three factors is different for each population-behavior pair.[46] The TPB also proposes that individuals hold personal beliefs regarding each of the three determinant factors for each behavior.[47] An individual's intent to perform a behavior is produced by the combined strength of his or her beliefs about each determinant factor, with the contribution of each belief modified by the relative weight of the associated causal factor.[48] The TPB assumes that this review and calculation of belief strengths and the importance of each determinant factor occurs subconsciously, and precedes every behavioral impulse that a person may have.[49]

The Integrative Model of Behavioral Prediction (IMBP) attempts to provide a generalized model that encompasses all relevant factors identified by previous behavioral models to predict actual behavior. The IMBP extends the Theory of Planned Behavior by asserting that the three necessary and sufficient factors for performance of a behavior are the TPB's intent, which is comprised of attitude, subjective norms and self-efficacy, along with requisite skills and an absence of environmental barriers.[50] By adding this additional layer to the model, the IMBP describes a model of observed human behavior, rather than just intent.

Proponents of the IMBP assert that this reasoned model can be used to predict and even change human behavior. This is accomplished by conducting surveys among the

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[44] Ajzen and Fishbein, "The Influence of Attitudes on Behavior," 194.

[45] Ibid.

[46] Fishbein et al., "The Role of Theory in Developing Effective Antidrug Public Service Announcements," 92.

[47] Ajzen and Fishbein, "The Influence of Attitudes on Behavior," 194.

[48] Ibid.

[49] Ibid., 195.

[50] Fishbein et al., "The Role of Theory in Developing Effective Antidrug Public Service Announcements," 92.

target population to learn about their abilities, beliefs, and intentions regarding the desired behavior.[51] If individuals lack the necessary skills or are faced with environmental barriers that prevent a desired behavior, then behavioral prediction and change will depend upon those factors.[52] When skills and environmental barriers are not a problem, however, then behavioral prediction and change are accomplished through intention.[53]

Prediction and change of behavioral intent under the IMBP requires quantification of the relative importance of the three determinant factors that contribute to a population's intent to perform the behavior under study. To identify these weights, surveys must assess the strength of individual's beliefs regarding each of the determinant intentional factors (attitudes, subjective norms, and self-efficacy), and also record whether or not the individual has performed or intends to perform the behavior.[54] This data is then analyzed to discover how strongly each of the three determinant factors is correlated with actual or intended behavior.[55] The IMBP then assumes that these correlational relationships represent three causal chains that contribute to and directly determine the likelihood that an individual will intend to perform a behavior.[56]

Once the extent to which attitudes, subjective norms, and self-efficacy are correlated with the behavior for a population are known, prediction on the individual level can then be accomplished by examining the strength of a single subject's beliefs regarding these three factors, modified by the correlational weight of each factor to determine the likelihood. Advocates for the IMBP suggest that successful behavior change programs can be created by first applying the IMBP to identify the dominant

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[51] Martin Fishbein and Marco C. Yzer, "Using Theory to Design Effective Health Behavior Interventions," *Communication Theory* 13, no. 2 (2003): 168.

[52] Fishbein et al., "The Role of Theory in Developing Effective Antidrug Public Service Announcements," 92.

[53] Ibid.

[54] Fishbein and Yzer, "Using Theory to Design Effective Health Behavior Interventions," 169.

[55] Ibid.

[56] Ajzen and Fishbein, "The Influence of Attitudes on Behavior," 195.

factors that cause a population to perform a particular behavior, and then designing interventions that influence individuals' beliefs regarding those dominant causal factors.

Although the literature contains many studies that report evidence in support of the IMBP and other reasoned, intention-based theories as predictors of actual behavior, only a small number of these studies may offer reliable results. A meta-analysis of almost two hundred studies using the Theory of Planned Behavior did find a significant association between intention and behavior.[57] The significance of this result is reduced, however, because the studies analyzed in this meta-analysis lacked controls and were correlational in nature, thereby unable to establish causation.[58] The bulk of these studies employed cross-sectional designs that did not assess an individual's intentions and behaviors at different points in time, which allows multiple possible explanations for the correlation between intention and behavior; while proponents of the IMBP could suggest that the intention-behavior correlation occurred because intention caused behavior, an equally valid explanation could argue that individual's self-reported intentions were produced by and followed from their behaviors.[59]

Even where longitudinal studies are employed, the possibility still exists that a third unknown variable is responsible for causing the apparent association between intent and behavior.[60] A different meta-analysis of reasoned behavior-based interventions presents more reliable results by limiting study selection to longitudinal, experimental designs.[61] By assessing an individual's intentions and actions before and after the intervention, and by featuring a control group that did not receive the treatment, these studies provide more convincing evidence that "a medium-to-large change in intention leads to a small-to-medium change in behavior."[62] It is important to note, however, that despite the presence of a control group, differences compared to the experimental group

[57] Christopher J. Armitage and Mark Conner, "Efficacy of the Theory of Planned Behaviour: A Meta-Analytic Review," *The British Journal of Social Psychology* 40 (2001): 485.

[58] Webb and Sheeran, "Does Changing Behavioral Intentions Engender Behavior Change?," 251.

[59] Ibid.

[60] Ibid.

[61] Ibid., 253.

[62] Ibid., 249.

could still be caused by a third, unknown variable, rather than by the intervention that was the focus of the study.[63]

C. BEHAVIORAL ECONOMICS

Behavioral economics incorporates findings from psychology in order to describe the underlying processes of individual action.[64] The psychological concepts of bounded rationality and Dual System Theory are core aspects of behavioral economics that are explored by the first two subsections in the review of this field.[65] The third subsection introduces the source of disagreement within behavioral economics, while the fourth and fifth subsections examine the competing views of the heuristics and biases program and the fast and frugal heuristics program in detail.[66] The final subsection in this review of behavioral economics describes choice architecture, a collection of methods that influence individuals by leveraging heuristics described by the two different interpretations of behavioral economics.

1. Bounded Rationality

Bounded rationality asserts that humans have finite cognitive abilities and must therefore use simplified methods when making decisions or contemplating behaviors.[67] This argument was first advanced by Simon as a criticism of classical economics' rationality provision that assumes humans possess unlimited time and infinite computational ability to examine all options and calculate expected probability in order to optimize choice selection when making decisions.[68] Instead of maximizing every choice as in rational decision making, behavioral economics proposes that boundedly rational humans simplify the decision making process by using heuristics and shortcuts that use

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[63] Ibid., 260.

[64] Alain Samson, ed., "The Behavioral Economics Guide 2015 (with an Introduction by Dan Ariely)," 2015, 1, http://www.behavioraleconomics.com/BEGuide2015.pdf.

[65] Alain Samson, ed., "The Behavioral Economics Guide 2016 (with an Introduction by Gerd Gigerenzer)," 2016, 102–6, http://www.behavioraleconomics.com/BEGuide2016.pdf.

[66] Ibid., 12.

[67] Herbert A. Simon, "Rational Choice and the Structure of the Environment," *Psychological Review* 63, no. 2 (1956): 129–38.

[68] Ibid., 129.

only a subset of the available data in order to achieve satisfactory, rather than optimal, results.[69]

The vocabulary of behavioral economics contains duplications and conflicts. Theories that incorporate bounded rationality are also known as nonrational theories due to their rejection of the assumptions of classic rational theories.[70] Unfortunately, confusion has been introduced by some scholars who use the term bounded rationality to refer to rational theories of optimization under constraint.[71] For the purposes of this thesis, however, both bounded rationality and nonrationality will describe the view of humans having finite time and cognitive abilities, whose decisions and behaviors are produced by heuristic shortcuts.

2. Dual System Theory

Dual System Theory describes the function of the human mind as if it were comprised of two distinct systems. System 1 provides rapid, automatic, intuitive, and involuntary responses to stimuli in the environment, while system 2 is responsible for deliberate and intentional thought.[72] System 1 is believed to instigate most behaviors and cognitive processes, while system 2 will sometimes be aroused to monitor and possibly even overrule system 1.[73] Most human behaviors may be enacted either automatically by system 1, or deliberately by system 2.[74] Reflective and deliberate thought, however, is only performed by system 2.[75] Good moods, time pressure, and states of mental occupation increase the likelihood that future behaviors will remain within the purview of

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[69] Gerd Gigerenzer and Wolfgang Gaissmaier, "Heuristic Decision Making," *Annual Review of Psychology* 62, no. 1 (2011): 457.

[70] Gigerenzer, "Decision Making," 3304.

[71] Gerd Gigerenzer, "The Adaptive Toolbox," in *Bounded Rationality: The Adaptive Toolbox*, ed. G Gigerenzer and R Selten (Cambridge, MA: The MIT Press, 2001), 38.

[72] Daniel Kahneman, *Thinking, Fast and Slow* (New York: Farrar, Straus and Giroux, 2011), Kindle Edition, location 271.

[73] Alain Samson and Benjamin G. Voyer, "Two Minds, Three Ways: Dual System and Dual Process Models in Consumer Psychology," *AMS Review* 2, no. 2 (2012): 54.

[74] Pelle Guldborg Hansen and Andreas Maaloe Jespersen, "Nudge and the Manipulation of Choice: A Framework for the Responsible Use of the Nudge Approach to Behaviour Change in Public Policy," *European Journal of Risk Regulation*, 2013, 13.

[75] Ibid., 14.

system 1.[76] System 2 tends to be activated by foul moods, decisions of high personal significance, and decisions that will elicit social judgments.[77] System 1 always has a significant influence on decisions and behaviors even when system 2 is activated, because system 2 is only able to operate on the perceptions that have been provided to it by system 1's intuitive responses to stimuli in the environment.[78] The inclusion of the automatic and involuntary system 1 in Dual System Theory is a significant departure from rational decision making theories and models of reasoned behavior, which assume that all human choices and behaviors are the product of deliberative thought processes.[79]

3. Disagreement within Behavioral Economics

Study of behavioral economics is divided into two camps, differentiated by their standard for rationality as well as their interpretation of heuristics.[80] The heuristics and biases research conducted by Tversky and Kahneman holds classical economics' selfish and maximizing rationality as the ideal norm, and views heuristics as error-prone shortcuts that prevent individuals from achieving rationality.[81] The fast and frugal heuristics program championed by Gigerenzer, on the other hand, eschews the maximizing standard asserted by classic rationality and instead considers heuristics to be value-neutral simplification strategies that help individuals succeed in tasks that are computationally impossible for humans to optimize.[82]

4. The Heuristics and Biases Program

Early research on behavioral economics conducted by the heuristics and biases program focused on establishing evidence to prove that the judgments and evaluations

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[76] Samson and Voyer, "Two Minds, Three Ways," 54.

[77] Ibid., 59.

[78] Hansen and Jespersen, "Nudge and the Manipulation of Choice," 14.

[79] Ibid., 27.

[80] Ralph Hertwig and Stefan Herzog, "Fast and Frugal Heuristics: Tools of Social Rationality," *Social Cognition* 27, no. 5 (2009): 668.

[81] Ibid.

[82] Gigerenzer, "The Adaptive Toolbox," 40–41.

that individuals make are the product of intuitive heuristics.[83] These studies demonstrated the existence of numerous situations where individual's judgments did not match classical economics' predictions of rational and reasoned judgments produced by optimizing calculations.[84] Instead, judgments were shown to be produced by simplified, intuitive heuristics that sometimes caused large, predictable errors.[85] Although Dual System Theory had yet to be formalized and integrated into the study of behavioral economics, these initial explanations of intuitive judgments aligned with the eventual development of Dual System Theory, which was ultimately integrated into these descriptions of judgmental heuristics.[86]

The heuristics and biases program views heuristics in a negative light, considering them to be biases that introduce errors.[87] This view preserves the normative perspective of classical rationality, considering any observed deviation from rational ideals to be an error.[88] According to this branch of psychology, heuristics occur only within the intuitive system 1.[89] It is these automatic heuristics of system 1 that are then responsible for producing inaccurate perceptions which then cause errors in judgment when the deliberate and rational-like system 2 makes decisions based on this flawed information.[90] Although the reflective system 2 is sometimes capable of monitoring and correcting for errors in system 1 intuitions, system 2 is not always successful.[91] The predictable errors

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[83] Thomas Gilovich and Dale Griffin, "Heuristics and Biases: Then and Now," in *Heuristics and Biases: The Psychology of Intuitive Judgment*, ed. Thomas Gilovich, Dale Griffin, and Daniel Kahneman (New York: Cambridge University Press, 2002), 1.

[84] Ibid., 4.

[85] Tversky and Kahneman, "Judgment under Uncertainty: Heuristics and Biases," 1124.

[86] Daniel Kahneman, "Maps of Bounded Rationality: Psychology for Behavioral Economics," *The American Economic Review* 93, no. 5 (2003): 1450.

[87] Tversky and Kahneman, "Judgment under Uncertainty: Heuristics and Biases," 1131.

[88] Hertwig and Herzog, "Fast and Frugal Heuristics: Tools of Social Rationality," 668.

[89] Daniel Kahneman and Shane Frederick, "Attribute Substitution in Intuitive Judgment," in *Models of a Man: Essays in Memory of Herbert A. Simon*, ed. Mie Augier and James March (Cambridge, MA: MIT Press, 2004), 413.

[90] Ibid.

[91] Ibid., 420.

introduced by intuitive heuristics prevent humans from achieving the optimal decisions prescribed by rational models.[92]

Several general, intuitive heuristics have been identified that purport to explain observed human behaviors. Representativeness, availability, and anchoring are three heuristics initially identified by the heuristics and biases program.[93] The representativeness heuristic describes how individuals typically judge the probability of an event or action belonging to a class by the degree to which the event or action under consideration resembles the class stereotype, despite the ready availability of information indicating actual probability.[94] Under the availability heuristic, events are considered to be more likely or weighted more heavily when examples come more readily to the individual's mind.[95] The ease at which an event or consideration comes to mind is determined by its salience, which can be influenced by temporal factors and personal relevance.[96] The anchoring heuristic explains how an individual's intuitive judgment of the value of an event or action is strongly affected by an unconsciously produced starting reference point.[97] Research on the framing effect demonstrated how an individual's intuitive judgments can be reliably influenced by manipulating the starting reference point that they will unconsciously use.[98] A manipulation as simple as asking study participants to write the last two digits of their social security number on a piece of paper produced a reference point anchor that then significantly affected the price they would be willing to pay for various products.[99] Priming is a term that can also be used to describe the framing effect caused by the anchoring heuristic.[100] The affect heuristic, another general heuristic defined subsequent to the heuristics and biases program, is responsible

[92] Ibid.

[93] Tversky and Kahneman, "Judgment under Uncertainty: Heuristics and Biases," 1131.

[94] Ibid., 1124.

[95] Ibid., 1127.

[96] Ibid.

[97] Ibid., 1128.

[98] Kahneman, "Maps of Bounded Rationality: Psychology for Behavioral Economics," 1458.

[99] Dan Ariely, *Predictably Irrational* (New York: HarperCollins, 2009), Kindle Edition, 30.

[100] Alain Samson, ed., "The Behavioral Economics Guide 2014 (With a Foreword by George Loewenstein and Rory Sutherland)," 2014, 30, http://www.behavioraleconomics.com/BEGuide2014.pdf.

for producing an automatic positive or negative feeling in response to stimuli in the environment.[101] Optimism bias is yet another heuristic that influences behavior by causing individuals to underestimate the likelihood that anything bad will happen to them or those that they know.[102]

While investigating these biases, the heuristics and biases program developed Prospect Theory, which provided an important insight into how real humans weight gains and losses.[103] According to prospect theory, individuals weight losses more heavily than gains.[104] This served to further discredit classical rationality, which would assume that rational humans would optimize for value, regardless of whether the value change was positive or negative relative to zero.[105]

Understanding of loss aversion described by Prospect Theory led to the discovery of the endowment effect and the status quo bias.[106] The endowment effect was proposed as an explanation for why individuals value items that they own more highly than items they do not, and is thought to be produced by an aversion to the loss produced by giving up the item or discontinuing the behavior, rather than an actual change in judged value of that object or behavior.[107] The status quo bias is also motivated by loss aversion, where individuals continue to perform the same action or acquiesce to defaults because the benefits lost by switching from a previous action or default are weighted more heavily than the potential gains of a new action or behavior.[108]

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[101] Ibid., 13.

[102] Neil D. Weinstein, "Why It Won't Happen to Me: Perceptions of Risk Factors and Susceptibility," *Health Psychology* 3, no. 5 (1984): 432–33.

[103] Daninel Kahneman and Amos Tversky, "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica* 47, no. 2 (1979): 263–92.

[104] Ibid., 280.

[105] Ibid., 263–75.

[106] Samson, "The Behavioral Economics Guide 2014 (With a Foreword by George Loewenstein and Rory Sutherland)," 20.

[107] Daniel Kahneman, Jack L. Knetsch, and Richard H. Thaler, "Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias," *The Journal of Economic Perspectives* 5, no. 1 (1991): 197.

[108] Ibid.

Social heuristics are also believed to exert a powerful influence on judgments. These intuitive heuristics occur in response to cues that are detected automatically from the observed behaviors of others. The ability of animals to intuitively detect predators and court mates is an example of an automatic social heuristic used to interpret and respond to the intentions of others.[109] Herding is a social heuristic that is seen in humans when individuals intuitively conform to what others are doing or are perceived to value.[110] Public commitment to an individual's self-image also exerts a powerful social force that influences individuals to maintain consistency with their self-characterizations.[111]

5. The Fast and Frugal Heuristics Program

The fast and frugal heuristics interpretation of behavioral economics describes heuristic decision making strategies that individuals use when selecting from a set of alternatives.[112] Heuristics are considered to be value-neutral simplifying methods that can be employed by both the intuitive and reflective systems of the mind.[113] Although proponents of the heuristics and biases program consider heuristics to be error-prone shortcuts of intuitive judgment that compromise the decisions of reflective thought, supporters of fast and frugal heuristics argue instead that humans elect to use heuristics as deliberate decision making strategies because they can save effort and produce better results than optimizing methods by taking advantage of the structure of the environment.[114] Under this view, the optimizing decision making prescribed by classical

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[109] Philip Blythe, Peter Todd, and Geoffrey Miller, "How Motion Reveals Intention: Categorizing Social Interactions," in *Simple Heuristic That Make Us Smart*, ed. Gerd Gigerenzer and Peter Todd (New York: Oxford University Press, 1999), 257–85.

[110] Samson, "The Behavioral Economics Guide 2014 (With a Foreword by George Loewenstein and Rory Sutherland)," 18.

[111] Barry Schlenker, David Dlugolecki, and Kevin Doherty, "The Impact of Self-Presentations on Self-Appraisals and Behavior: The Power of Public Commitment," *Personality and Social Psychology Bulletin* 20, no. 1 (1994): 32.

[112] Daniel G. Goldstein and Gerd Gigerenzer, "Fast and Frugal Forecasting," *International Journal of Forecasting* 25, no. 4 (2009): 760.

[113] Gerd Gigerenzer, "Why Heuristics Work," *Perspectives on Psychological Science* 3, no. 1 (2008): 23.

[114] Gigerenzer and Gaissmaier, "Heuristic Decision Making," 457.

rationality is disregarded as unachievable and irrelevant.[115] Heuristics here are not failures of rationality; rather, they are domain-specific, meaning that they will be reliable and accurate when used in an appropriate, ecologically rational context.[116]

A heuristic is considered to be ecologically rational if it is well adapted to the specific environment where it is used.[117] This notion of context-dependence is a significant component of Simon's original argument for bounded rationality, whereby both the cues that exist within an environment and the cognitive abilities of the humans who make decisions within these domains must be understood in order to comprehend human decisions.[118] Proponents of the neutral view of behavioral economics claim that ecologically appropriate heuristics are more realistic than rational theories and can produce results as good as or better than optimizing strategies.[119] Gigerenzer even opines that the term 'cognitive limitations' should not be used in describing bounded rationality, as it implies an inferiority relative to the perfect ideal presented by rationalism–rather, he suggests that the phrase cognitive abilities should be used instead to describe the realistic capabilities of humans without apology.[120]

Nonrational decision making heuristics can be described as a set of simplified search, stopping, and decision rules.[121] Search rules govern the order in which options are considered from a set of alternatives, and include such methods as random order, ordered search according to a particular attribute, and ordering prioritization by imitation of what other individuals do.[122] Stopping rules determine which alternatives enumerated by the search process should be evaluated for possible selection.[123] A simple stopping rule proposed by the satisficing heuristic stops search as soon as an alternative is found

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[115] Gigerenzer, "Why Heuristics Work," 20.

[116] Gigerenzer, "The Adaptive Toolbox," 47.

[117] Gigerenzer and Gaissmaier, "Heuristic Decision Making," 457.

[118] Simon, "Rational Choice and the Structure of the Environment," 130.

[119] Gigerenzer, "Decision Making," 3304–5.

[120] Gigerenzer, "The Adaptive Toolbox," 7.

[121] Gigerenzer and Gaissmaier, "Heuristic Decision Making," 456.

[122] Gigerenzer, "The Adaptive Toolbox," 44.

[123] Ibid.

that meets or exceeds a particular aspiration level.[124] More involved stopping rules continue to examine alternatives until two alternatives are found that can be differentiated based upon some common attribute cue.[125] Not all stopping decisions are conscious and reflective, however, as emotions such as love can also cause search to stop.[126] Decision rules are then used to decide if the alternative under consideration should be selected.[127] These three rules are used in two different classes of nonrational decision making heuristics described by the fast and frugal heuristics program: one class is used to parse through a large or infinite number of available alternatives until an acceptable choice is found, the other class of heuristics is used to decide between a limited and known set of alternatives on the basis of a large or infinite number of potential attributes.[128]

a. Aspiration-Level Theories for Large Sets of Alternatives

Aspiration-level theories describe how individuals make decisions when presented with a large or infinite set of possible alternatives. In these situations, individuals search through the available alternatives in some order, considering one option at a time.[129] The search order might be random, or it could be influenced by social imitation.[130] As soon as one option is found that meets or exceeds a pre-determined (though potentially variable) aspiration level, search is stopped and the aspiration-satisfying choice is selected.[131] This notion of satisficing upon reaching an aspiration level was presented by Herbert Simon alongside his initial argument for bounded rationality, to offer an alternate and far simpler explanation for decision making compared to the optimizing strategies described by rational choice models.[132]

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[124] Ibid.

[125] Ibid.

[126] Ibid., 45.

[127] Ibid.

[128] Gigerenzer, "Decision Making," 3306–7.

[129] Ibid.

[130] Gigerenzer, "The Adaptive Toolbox," 44.

[131] Gigerenzer, "Decision Making," 3306–7.

[132] Simon, "Rational Choice and the Structure of the Environment," 129.

b. Decision Making Heuristics for Limited and Known Alternatives

Four classes of decision making heuristics have been proposed to describe how individuals search through a limited and known set of alternatives to make a selection.[133] In these situations, search is conducted not over a set of alternatives, but over the attributes of those alternatives.[134] Search and stopping rules vary by heuristic, but generally involve searching through cues until there is sufficient information to discriminate between two alternatives, at which point the better option will be selected.[135] The four classes of heuristics that guide decision making when presented with a limited number of known alternatives are recognition-based decision making, one-reason decision making, compensatory decision making, and social decision making.[136]

Recognition-based decision making heuristics leverage the automatic recognition process that occurs prior to deliberate memory recall.[137] The recognition heuristic facilitates binary decisions when one alternative is recognized and the other is not by assuming the recognized alternative has a higher value and selects that option.[138] The fluency heuristic provides a solution for when both alternatives in a binary decision are recognized, by assuming that the alternative that was recognized faster must be more desirable, and will therefore be selected.[139] These heuristics are ecologically rational, and therefore can be relied upon to produce accurate results, in domains where recognition of an alternative is positively correlated with that alternative possessing desirable attributes.[140]

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[133] Gigerenzer and Gaissmaier, "Heuristic Decision Making," 459.

[134] Gigerenzer, "Decision Making," 3306–7.

[135] Gigerenzer and Gaissmaier, "Heuristic Decision Making," 460–73.

[136] Ibid.

[137] Ibid., 460.

[138] Ibid.

[139] Ibid., 462.

[140] Ibid., 460.

One-reason decision making methods rely upon the process of memory recall to guide selections.[141] One clever cue heuristics are highly domain-specific, using a single, pre-determined cue to guide decisions, such as the number of spots in peacock plumage for mating selection, or the angle of gaze for baseball players deciding whether to continue moving or stop where they are when tracking a fly ball.[142] The take-the-best heuristic searches through the attributes of two potential alternatives in order of attribute importance until a discriminating attribute is found, and then selects on the basis of this best, discriminating attribute.[143] The take-the-last heuristic simply searches through attributes not in order of attribute relevance, but by order of the most recently used, discriminating attributes.[144] Fast-and-frugal decision trees are commonly used in emergency medicine diagnoses or sentencing decisions, and only require a series of simple, binary choices that scale linearly with the number of possible attributes to consider in order to reach a decision, as opposed to rational choice models which would require evaluation of an exponential number of possible outcomes.[145] These heuristics are thought to be ecologically rational when cues are redundant and there is significant variability in cue values.[146]

Compensatory decision making heuristics ignore either the magnitude of cue weights, or even the overall desirability of alternatives, in order to facilitate the selection process. The tallying heuristic compares all attributes for two alternatives and selects the alternative that is positively discriminated on a greater number of attributes.[147] This heuristic is successful when there is no more than 10 times the number of alternatives as attributes under consideration, when it is difficult to predict the discriminating criterion,

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[141] Ibid., 463.

[142] Ibid.

[143] Gerd Gigerenzer and Daniel G. Goldstein, "Reasoning the Fast and Frugal Way: Models of Bounded Rationality," *Psychological Review* 103, no. 4 (1996): 653.

[144] Ibid., 660–61.

[145] Gigerenzer and Gaissmaier, "Heuristic Decision Making," 467.

[146] Ibid., 469.

[147] Ibid.

and there is high cue redundancy.[148] The 1/N heuristic, on the other hand, assumes that all alternatives are equally desirable and allocates resources equally to all alternatives.[149] Financial strategies that distribute money equally among investments can outperform many optimizing strategies in predicting future values.[150]

Social decision making heuristics for known sets of alternatives leverage information gained from other people to guide choice. Imitate-the-successful and imitate-the-majority are two heuristics that individuals use to quickly determine what attribute ordering to use when comparing several alternatives.[151] Beyond simply guiding the cue priority by which individuals compare alternatives, social heuristics can also influence choice directly. A series of experiments found that many individuals will suppress their own choices or judgments and decide instead to conform to a unanimous majority that settles on a different selection.[152] Another highly influential decision making heuristic guides individuals to comply with injunctive pressure received from perceived authority figures.[153] Social heuristics are ecologically rational and particularly beneficial in domains where the decision maker is very inexperienced or uncertain.[154]

6. Choice Architecture

Choice architecture is the practice of deliberately structuring environments to guide behavior and choice by taking advantage of nonrational heuristics.[155] This concept was introduced in the book *Nudge: Improving Decisions about Health, Wealth, and Happiness*, written by Thaler and Sunstein, which claims that change can be

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[148] Ibid.

[149] Ibid., 470.

[150] Ibid., 471.

[151] Rocio Garcia-Retamero, Masanori Takezawa, and Gerd Gigerenzer, "Does Imitation Benefit Cue Order Learning?," *Experimental Psychology* 56, no. 5 (2009): 310–11.

[152] Solomon Asch, "Opinions and Social Pressure," *Scientific American* 193, no. 5 (1955): 31–35.

[153] Stanley Milgram, "Behavioral Study of Obedience," *The Journal of Abnormal and Social Psychology* 67, no. 4 (1963): 371–78.

[154] Gigerenzer and Gaissmaier, "Heuristic Decision Making," 472.

[155] Richard H. Thaler and Cass R. Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness* (New York: Penguin Books, 2009).

accomplished through the use of a titular Nudge that "alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives."[156] These authors are careful to defend the practice of choice architecture by pointing out that there is no such thing as a neutral option–even a random presentation of alternatives, attributes and defaults will manipulate behavior; therefore, they claim that no harm is done by arranging these factors to encourage beneficial behaviors.[157] This review of choice architecture is organized in two parts: the first subsection presents numerous nudges and efforts by scholars to organize these methods, while the second subsection examines the role of Dual System Theory in classifying nudges as acting upon intuitive or reflective cognitive processes.

a. Describing and Organizing Nudges

Several teams of scholars have proposed frameworks that attempt to organize the many nudges enumerated by choice architects. Initially, the many nudges introduced alongside choice architecture were only loosely grouped according to the general area of desired change, such as money, health, or freedom.[158] In working to provide structure to choice architecture, most scholars have sought to organize nudges by the type of intervention technique employed.[159] A proposed synthesis of these intervention technique frameworks divides nudges into three categories: interventions that affect the information provided to decision makers, interventions that influence the decision structure itself, and interventions that provide decision assistance.[160]

The first class of interventions described by the synthesized nudge framework guide behavior and choice by changing the amount or nature of information that decision makers have about alternatives, as well as the social information that decision makers

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[156] Ibid., 6.

[157] Eric J. Johnson et al., "Beyond Nudges: Tools of a Choice Architecture," *Marketing Letters* 23, no. 2 (June 2012): 488.

[158] Thaler and Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*.

[159] Robert Münscher, Max Vetter, and Thomas Scheuerle, "A Review and Taxonomy of Choice Architecture Techniques," *Journal of Behavioral Decision Making*, 2015, 2, doi:DOI: 10.1002/bdm.1897.

[160] Ibid.

have about the behaviors and opinions of others regarding the behavior or choice in question.[161] The number of attributes visible for each alternative affects choice, as a large number of attributes can force decision makers to employ a simplifying heuristic that only considers a single attribute.[162]

To ensure that individuals base their decisions on the attribute that the choice architect desires, visible attributes should be kept to a small number or possibly even limited to just one cue.[163] An example of this nudge is Thaler and Sunstein's ice cream shop that controls information to influence decisions by only advertising the flavor of each ice cream choice, while concealing other attributes such as calories or ingredients.[164]

Modifying the appearance of an option's attributes through framing, or by simplification and reordering of the attributes can also influence decisions.[165] Framing effects are seen when the number of patients electing to undergo surgery is different when probabilities are presented in terms of survival rates rather than death rates.[166] Thaler and Sunstein also make a very simple reference to the influence of cue ordering and simplification in arguing for more informative "mappings" from attributes to value, suggesting that digital cameras should be listed first by the attribute of maximum print size rather than megapixels or cues.[167]

Social norms can also be used to shape the search process, either through descriptive norms whereby individuals use imitate-the-majority or imitate-the-successful heuristics to conform to the behavior of others, or through the injunctive norm of peer pressure.[168] Choice architects claim that individuals can be nudged to file their tax

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[161] Ibid., 4–6.

[162] Johnson et al., "Beyond Nudges," 495.

[163] Ibid.

[164] Thaler and Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*, 93.

[165] Johnson et al., "Beyond Nudges," 495–96.

[166] Thaler and Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*, 36.

[167] Ibid., 93.

[168] Münscher, Vetter, and Scheuerle, "A Review and Taxonomy of Choice Architecture Techniques," 6–8.

returns by reporting that most other citizens have already complied, students can be nudged to drink less alcohol by providing statistics on average drinking rate of their fellow students, and homeowners' energy use can be nudged towards convergence when average energy consumption within a community is revealed.[169]

The second class of interventions that choice architects adjust to direct an individual's search and choice process includes the number, nature, or presentation order of available options, the amount of time subjects have to make decisions, temporal landmarks, and the default outcome when no behavior is chosen.[170] When confronted with a large number of alternatives, individuals shift from a compensatory strategy that considers the various advantages of many attributes, to a simplified strategy that only evaluates a subset of attributes about each choice.[171] Thaler and Sunstein suggest that choice architects should either keep the number of alternatives small so individuals can weigh all pros and cons and make good decisions on their own, or provide nudges such as option groupings as paint stores do with color wheels, or use social conformity nudges as Netflix does in providing movie recommendations based on other users' preferences to guide decisions when the set of available options is very large.[172]

The nature of the available alternatives can also influence choice through framing and anchoring effects.[173] Framing a decision between physical and online newspaper subscription options by introducing a clearly inferior, dominated decoy option can nudge individuals to purchase more expensive subscriptions.[174] Suggested donation amounts on solicitation requests serve as anchors that nudge respondents' philanthropy.[175] The order and location of alternatives is another method that choice architects use to guide choice,

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[169] Thaler and Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*, 66–68.

[170] Münscher, Vetter, and Scheuerle, "A Review and Taxonomy of Choice Architecture Techniques," 2.

[171] Thaler and Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*, 96.

[172] Ibid., 97.

[173] Münscher, Vetter, and Scheuerle, "A Review and Taxonomy of Choice Architecture Techniques," 7.

[174] Ariely, *Predictably Irrational*, 4–6.

[175] Thaler and Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*, 24.

as seen in school cafeteria nudges that influence consumption of particular food items by adjusting the location and ordering of food choices.[176]

Limiting the amount of time available for individuals to implement behaviors that have delayed utility implications can make these actions appear more salient and increase performance of these behaviors, as seen in short windows for changing healthcare or retirement plans.[177] Temporal landmarks, which include birthdays, anniversaries, and the beginnings of weeks, months or years, can be exploited to seek changes in behavior, as individuals appear to be more willing to consider new alternatives when conducting search processes at these times.[178]

Finally, structuring environments so desired choices are presented as defaults that do not require a significant change in occupant behavior will produce an increase in these selections.[179] The power of nudging through defaults is seen clearly in organ donation rates, where 99 percent of Austrians accept their default choice to opt-in as organ donors, while only 12 percent of Germans deviated from their opt-out default to register as donors.[180]

The third class of nudges described in the synthesized intervention technique framework consists of decision aids that include reminders and commitments. Reminders influence behavior and choice by making certain previously known information more salient.[181] The image of a fly in a urinal is described in *Nudge: Improving Decisions about Health, Wealth, and Happiness* as a reminder that engages reflective system 2 cognitive processes to trigger a decision as to whether or not to aim at the fly, thereby

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[176] Ibid., 1.

[177] Johnson et al., "Beyond Nudges," 492.

[178] Hengchen Dai, Katherine Milkman, and Jason Riis, "The Fresh Start Effect: Temporal Landmarks Motivate Aspirational Behavior," in *Advances in Consumer Research*, ed. Simona Botti and Aparna Labroo, vol. 41 (Duluth, MN: Association for Consumer Research, 2013), 228–32.

[179] Thaler and Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*, 85.

[180] Ibid., 180.

[181] Münscher, Vetter, and Scheuerle, "A Review and Taxonomy of Choice Architecture Techniques," 9.

reducing spilled urine by 80 percent.[182] Public or private commitments also influence behavior, as individuals may be more likely to follow through with their intentions.[183] Stickk is an online commitment website that uses financial incentives and private or public commitments to help individuals achieve their goals by intentionally eliciting peer pressure to promote desired behaviors.[184] Beyond attempts to merely categorize nudges, there are also efforts underway to understand the underlying cognitive processes that are engaged by nudges.

b. Dual System Theory and Nudges

Little distinction is made between automatic behavior and deliberate choice in the initial introduction of choice architecture. In *Nudge: Improving Decisions about Health, Wealth, and Happiness*, Thaler and Sunstein explicitly reference Dual System Theory's automatic system 1 and reflective system 2 processes and adopt the heuristics and biases view of behavioral economics that considers heuristics of the intuitive system 1 to be the source of errors in judgment that compromise the reflective system 2's ability to make optimal decisions.[185] The authors then provide examples of nudges, such as a series of perpendicular lines painted on a road that are spaced closer together on the approach to a dangerous curve, thereby causing drivers to unconsciously slow down as the increased frequency of passing lines creates a false impression of increased speed.[186] Another nudge uses smaller dinner plate sizes to reduce caloric intake.[187] Mindless behavior, as in unintentional overeating, is explained by the authors two ways: as a choice between eating none, some, or all of the food in front of a person, and also as an automatic behavior performed by intuitive system 1 cognitive processes without reflection.[188] After describing the commonly accepted intuitive heuristics of anchoring, availability, and

[182] Thaler and Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*, 3.

[183] Münscher, Vetter, and Scheuerle, "A Review and Taxonomy of Choice Architecture Techniques," 7.

[184] Thaler and Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*, 233.

[185] Ibid., 19–22.

[186] Ibid., 37.

[187] Ibid., 43.

[188] Ibid., 40–43.

representativeness, along with Prospect Theory's loss aversion and intuitive social imitation herding heuristics, the authors then proceed to enumerate numerous decision making nudges without further exploration of the different cognitive processes engaged by these two types of interventions.[189]

Other scholars, however, draw more attention to the role of the intuitive and reflective cognitive processes in choice architecture. These authors assert that all nudges work by directly influencing the automatic system 1, as this is believed to be the source of all human perception and judgments that are the context upon which decisions are made.[190] But they differentiate between those nudges that remain within the realm of automatic thinking to influence intuitive judgments only, and another group of nudges that are designed to guide conscious, reflective system 2 decisions.[191] The narrowing road lines and smaller plate size nudges are categorized as type 1 nudges that only activate the intuitive system 1, while the fly in the urinal and the positive or negative framing of surgery results are defined as type 2 nudges that influence the reflective thinking of system 2's decision making process.[192]

D. SUMMARY

This chapter reviewed the literature on rational choice, reasoned behavior, and behavioral economics to present four explanations for individual action. Rational choice depicts human decisions as the direct outputs of Expected Utility Theory.[193] Reasoned behavior considers an individuals' observed behaviors to be direct products of their beliefs.[194] The heuristics and biases program of behavioral economics views individual actions to be influenced by the intuitive heuristics of system 1.[195] The fast and frugal heuristics program of behavioral economics asserts that individuals' choices result from

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189 Thaler and Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*.

190 Hansen and Jespersen, "Nudge and the Manipulation of Choice," 14.

191 Ibid.

192 Ibid., 15.

193 Edwards, "The Theory of Decision Making," 391.

194 Ajzen and Fishbein, "The Influence of Attitudes on Behavior," 195.

195 Kahneman and Frederick, "Attribute Substitution in Intuitive Judgment," 414.

deliberate use of heuristic decision making strategies.[196] These interpretations of individual action suggest four different models that may be used to analyze public health and safety interventions.

[196] Goldstein and Gigerenzer, "Fast and Frugal Forecasting," 760.

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III. METHODOLOGY

This thesis will perform a comparative case study across a number of individual-level public health and safety interventions. Each case will be analyzed using a four-model approach to detect the intervention methods that are correlated with the outcome of that case. Comparative analysis between these sets of intervention methods and associated case outcomes will permit identification of a refined set of methods that are correlated with success across the entire selection of cases examined by this thesis. The conclusions drawn from these findings may be applied and generalized beyond the confines of their original cases to design effective public health and safety interventions, including those in fire and life safety education. This chapter defines the four models of analysis that will be applied to each case, describes the comparative case study methodology, and provides a summary of the present research design.

A. MODELS

Models are used to facilitate understanding of events or phenomenon that occur in the real world. Models may be conceptual, mathematical, or physical, and provide a means of describing processes or relationships that are difficult to observe directly.[197] Models of decision making attempt to explain why an individual made certain choices, while models of behavior seek to describe why an individual performed a particular action.[198] These models may also be used in a predictive fashion by extrapolating a set of observed or hypothetical initial conditions using the assumptions and implications of a model to forecast future outcomes.[199]

[197] Kara Rogers, "Scientific Modeling," *Encyclopædia Britannica*, accessed June 21, 2016, http://www.britannica.com/science/scientific-modeling.

[198] Gigerenzer, "Why Heuristics Work," 21.

[199] Rogers, "Scientific Modeling."

1. Simplifications of Reality

All models are simplifications of reality that make certain assumptions regarding the factors that precipitate a decision or behavior.[200] In a noisy environment, there are many variables that do not influence a particular outcome.[201] The ultimate goal of scientific theory or modeling is to eliminate this noise and simplify the set of determinant factors to as small a number of variables as possible without losing any ability to explain or predict outcomes.[202] Due to the extremely large number of variables that may influence an outcome, however, most models are unable to incorporate every relevant variable and are instead forced to make simplifying assumptions that ignore some of these causal factors.[203]

Simplified models do not account for every causal factor in a process or outcome and therefore will contain some degree of error.[204] Several scholars who promote fast and frugal heuristics as neutral decision makings strategies acknowledge this and assert that, "All models are wrong."[205] Despite some unavoidable inaccuracy, however, appropriately designed models can still provide much benefit.[206] The validity of a model can be tested by referencing longitudinal studies to check if the model's predictions match the observed final results based on known starting conditions. A caveat, however, is that highly complicated models that fit existing data very accurately may be worse at forecasting future events than models with only a few free variables.[207] This can occur when the influence of noise within the data that does not contribute to the decision or behavior under study is amplified by an overly complicated model.[208] A model is

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[200] Ibid.

[201] Gigerenzer, "Decision Making," 3307–8.

[202] Albert Einstein, "On the Method of Theoretical Physics," *Philosophy of Science* 1, no. 2 (1934): 165.

[203] Rogers, "Scientific Modeling."

[204] Ibid.

[205] Gigerenzer and Gaissmaier, "Heuristic Decision Making," 459.

[206] Ibid.

[207] Goldstein and Gigerenzer, "Fast and Frugal Forecasting," 762.

[208] Gigerenzer, "Decision Making," 3307–8.

considered robust when it is able to explain existing data and forecast future outcomes accurately.[209]

Multiple models may exist that describe the same real world process or phenomenon in a variety of ways. By adopting a different set of simplifying assumptions, each model will provide an alternate explanation of the casual factors and relevant processes that are responsible for producing observed results.[210] Similarly, multiple models may offer differing predictions of the future based upon the same initial conditions. The varied explanations proffered by the various literatures on rational choice, reasoned behavior, and behavioral economics, as well as the interpretation of events as being either choice among alternatives or behaviors in isolation, demonstrates the very subjective nature of efforts to describe the real world processes of decision making and behavior.

2. Rational, Reasoned, or Nonrational? Choice or Behavior?

Decisions can be interpreted in very different ways depending on whether they are analyzed using a rational or nonrational decision making model. Classical economics' decision making models assume that individuals will always make rational selections, which according to this school of thought are defined as choices that are self-interested and optimal.[211] This implies that every choice observed in a longitudinal study must maximize expected utility for that individual. The fast and frugal heuristics branch of behavioral economics, however, makes no such assumptions, instead describing an individual's decision making process as ecologically rational if they select a heuristic that uses simplified search, stopping, and decision rules that take advantage of the structure of the current environment and produce accurate and reliable results within that domain.[212] By using a different set of assumptions, the nonrational decision making described by

[209] Goldstein and Gigerenzer, "Fast and Frugal Forecasting," 762.

[210] Rogers, "Scientific Modeling."

[211] Edwards, "The Theory of Decision Making," 381.

[212] Gigerenzer, "The Adaptive Toolbox," 43–47.

behavioral economics is free to consider a far wider range of decision making strategies that are not self-interested and optimal.

Similarly, identification of the causal factors that precipitate behavior and predictions of future behavior may vary greatly depending on whether a reasoned or nonrational model is used for analysis. Reasoned models of behavior assume that behavioral intentions and observed behaviors are always generated directly from an individual's pre-formed beliefs regarding those behaviors.[213] This causal relationship from reason to intention has been assumed to exist in many cross-sectional studies, despite failing to provide evidence demonstrating the direction of this relationship, or even proving that this relationship is anything more than correlation.[214] A very valid and contradictory view could assert instead that the behaviors that an individual performs or intends to perform are responsible for and produce conscious reasons.[215] This is the view espoused by Haidt, who argues that the conscious reasons that we often think direct our behavior are in fact post-hoc creations constructed to justify our intuitive, emotional responses to stimuli.[216] Haidt's view parallels that of behavioral economics, which considers many behaviors in isolation to be produced directly by heuristics of the intuitive system 1 without activation of deliberate, reflective system 2 processes.[217] Reasoned behavior asserts that a driver who slows down on approach to the curve described in the narrowing lines nudge would claim to have slowed down because they recognized they were going too fast, but Haidt would argue that the driver had first slowed down without conscious thought and then only afterwards constructed the conscious reasoning to justify their behavior.

Further subjectivity is introduced when an individual's actions are modeled either as decision making among alternatives or as single behaviors in isolation. This potential duality of interpretation is demonstrated (perhaps unintentionally) in *Nudge: Improving*

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213 Ajzen and Fishbein, "The Influence of Attitudes on Behavior," 193.

214 Webb and Sheeran, "Does Changing Behavioral Intentions Engender Behavior Change?," 251.

215 Ibid.

216 Jonathan Haidt, *The Righteous Mind: Why Good People Are Divided by Politics and Religion* (New York: Pantheon Books, 2012), Kindle Edition, 105.

217 Tversky and Kahneman, "Judgment under Uncertainty: Heuristics and Biases," 1130.

Decisions about Health, Wealth, and Happiness, when Thaler and Sunstein describe the continued eating of cocktail nuts before dinner in two different ways: as a decision making process whereby individuals must select between several alternatives, in this case eating none, some, or all of the nuts; and also as an act of mindless eating carried out by intuitive system 1 processes of the brain without conscious deliberation or consideration of other alternatives.[218] Thaler and Sunstein are inconsistent in highlighting the inherent subjectivity of interpreting actions as either behavior or choice, however, when they present the act of slowing an automobile when encountering narrowing road lines at a curve solely through the lens of isolated behavior without consideration for other alternatives.[219] As has been demonstrated, this same action could instead be interpreted as a decision between continuing the same speed, speeding up, or slowing down. Similarly, the influence of plate size on caloric intake can be viewed as either the mindless eating of an automatic behavior in isolation, or instead may be interpreted as a decision between continuing to eat or stopping.

Even the aspiration-level satisficing heuristic introduced by Simon can be described as either decision making or behavior in isolation depending on the assumptions of the model used for analysis. Aspiration-level heuristics may appear to be decision making among alternatives because the search rule proceeds through available alternatives in some order until a satisficing option is found. On the other hand, aspiration-level theories might also be interpreted as behavior in isolation because they make no comparison between possible alternatives. Each available choice is considered serially in isolation and enacted if the alternative exceeds an individual's aspiration level, at which point the enumeration of further options is terminated. Do aspiration-level theories represent decisions among alternatives, or do they instead describe a series of isolated behavioral considerations? Neither view is wrong; both merely reflect the application of different models to understand the same action.

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[218] Thaler and Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*, Kindle Edition, 40–43.

[219] Ibid., 37.

3. Multiple Models to Improve Analysis

Conducting analysis using multiple models can aid understanding. Because all models are subjective simplifications of reality, the application of several different models may present additional perspectives on a particular process or action.[220] Viewing an event through multiple models may also increase the confidence of conclusions by corroborating results across several models. Conversely, if a model consistently underperforms the descriptive and predictive capabilities of other models, it may suggest that the assumptions of the poor-performing model should be reconsidered. Finally, the insights gained by comparing and contrasting the interpretations of multiple models may facilitate the synthesis and creation of new, more successful models.[221] The benefit of combining or integrating several models towards achieving a single goal has already been demonstrated in health and safety, where multi-model approaches have shown greater predictive accuracy and produced larger health improvements than single models on their own.[222]

Each health or safety intervention examined in the course of this comparative case study will be analyzed using a four-model approach to elicit multiple perspectives regarding the intervention methods that may have contributed to the program's success or failure. The four models of analysis can be described by a 2x2 matrix where the vertical axis divides rational and reasoned models on the left from nonrational models on the right, while the horizontal axis distinguishes between models that interpret an individual's actions as decision making among alternatives in the top two quadrants, and models that view actions as behaviors in isolation located in the bottom two quadrants (see Table 1).

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[220] Rogers, "Scientific Modeling."

[221] Ibid.

[222] Karen Glanz, Frances Lewis, and Barbara Rimer, "Moving Forward: Research and Evaluation Methods for Health Behavior and Health Education," in *Health Behavior and Health Education: Theory, Research, and Practice. The Jossey-Bass Health Series*, ed. Karen Glanz, Frances Lewis, and Barbara Rimer (San Francisco, CA: Jossey-Bass, 1990), 432.

Table 1. Four Models of Analysis

	Rational/Reasoned	Bounded Rationality
Decision making among Alternatives	**Model 1** Rational Decision Making using Expected Utility Theory (Classical Economics)	**Model 4** Nonrational Decision Making using Fast and Frugal Heuristics
Behavior in Isolation	**Model 2** Reasoned Behavior in Isolation using The Integrative Model of Behavioral Prediction	**Model 3** Nonrational Behavior in Isolation Resulting from Intuitive Heuristics

a. Model 1: Rational Decision Making with Expected Utility Theory

Model 1 represents rational decision making among alternatives using classical economics' Expected Utility Theory. This model assumes that individuals always behave in an economically rational manner meaning that they will act in their own self-interest and are always capable of identifying and selecting the optimal course of action. Model 1 describes a process of decision making among alternatives wherein individuals are omnisciently aware of all possible alternatives available to them, the outcomes that will occur for each possible choice, and the expected utility associated with every outcome.

The nature of Model 1's Expected Utility Theory suggests several inferences when analyzing an intervention. Integral to this model are the assumptions of selfish choice and maximization.[223] This implies that any choices observed in a longitudinal study must represent the optimal choice for that individual. Prediction using Model 1 is a simple matter of calculating the expected utility offered by every available alternative and then selecting the option that maximizes this value.

The inability of rational choice to permit non-optimizing choices is a shortcoming that has forced awkward explanations to justify seemingly suboptimal decisions made by individuals in experiments. When confronted with empirical laboratory findings that reveal subjects selecting non-optimizing alternatives, economists who support rational choice have claimed that the rewards offered in the offending studies must have been

[223] Edwards, "The Theory of Decision Making," 381.

insufficient to motivate the selfish and maximizing decisions that supposedly reign in the real world.[224] The validity of this model could be called into question if studies exist that reveal individuals selecting provably suboptimal choices.

b. Model 2: Reasoned Behavior using The Integrative Model of Behavioral Prediction

Model 2 uses the Integrative Model of Behavioral Prediction (IMBP) to represent the entire field of reasoned behavior. The IMBP asserts that behaviors are performed when individuals possess intent, necessary skills, and are not faced with environmental barriers that would prevent the behavior.[225] Intention is assumed to be the product of an individual's attitudes about the costs and benefits of the behavior, their perception regarding the opinions that others hold about the behavior, and the individual's confidence that they are capable of performing the behavior correctly.[226] According to the IMBP, every individual holds pre-formed, reasoned beliefs of varying strength about each of these three causal factors of intention.[227] The influence of each of the three determinant intentional factors is constant for every population-behavior pair.[228] The likelihood that an individual will intend to perform a behavior is determined by the combined strength of their beliefs about each of the three causal factors of attitudes, subjective norms, and self-efficacy, moderated by the influence of each factor for the population-behavior pair.[229] Barring a lack of skills or the presence of environmental barriers, the probability that an individual will perform a behavior is equivalent to their intentional probability.[230]

The IMBP assumes that the influence of each of the three intentional factors for a population-behavior pair can be determined by conducting cross-sectional surveys to

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[224] Hertwig and Herzog, "Fast and Frugal Heuristics: Tools of Social Rationality," 665–66.

[225] Ajzen and Fishbein, "The Influence of Attitudes on Behavior," 194.

[226] Ibid.

[227] Ibid., 195.

[228] Ibid.

[229] Ibid.

[230] Fishbein and Yzer, "Using Theory to Design Effective Health Behavior Interventions," 166.

identify correlations between individual's stated beliefs and their self-reported intentions and behaviors.[231] Because Model 2's IMBP assumes that reasoned beliefs precede and produce intention, and that intention precedes and produces behavior, these correlational relationships are assumed to be causal from belief to intention.[232] This assumption and the ready use of cross-sectional surveys introduces a weakness to Model 2, however, as it is possible that an individual's stated reasoning was actually a product of their intuitive intentions, a shortcoming that can be addressed through the use of longitudinal surveys.[233]

The IMBP used as Model 2 for this comparative case study provides its own set of implications that can aid in explaining, predicting, and changing health and safety behaviors. Following from the IMBP, if an intervention causes an individual to change their behavior, then the individual's reasoned beliefs regarding one or more of the relevant, causal factors of intention (attitudes, subjective norms, or self-efficacy) must have changed. If the changed belief or beliefs can be identified, then the IMBP asserts that the factor associated with those reasoned beliefs must have a meaningful impact on intent to perform this behavior for every member of the same population.[234] Also implied by the assumptions of the IMBP, if the strength of an individual's reasoned beliefs regarding a factor that is known to be relevant for the population-behavior pair can be changed, then a change in intention must follow, along with a change in actual behavior (barring a lack of skills or presence of environmental barriers). A lack of intention change in this situation would either invalidate the model, or would imply that the individual is not a member of the population described by the population-behavior pair. Behavioral prediction under Model 2 can be accomplished after the influence of each intentional factor is defined for the population-behavior pair by simply examining the strength of an individual's stated, reasoned beliefs regarding those factors.[235] Further, the IMBP of

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[231] Ibid., 169–71.

[232] Ajzen and Fishbein, "The Influence of Attitudes on Behavior," 195.

[233] Webb and Sheeran, "Does Changing Behavioral Intentions Engender Behavior Change?," 251.

[234] Fishbein et al., "The Role of Theory in Developing Effective Antidrug Public Service Announcements," 114.

[235] Fishbein and Yzer, "Using Theory to Design Effective Health Behavior Interventions," 167.

Model 2 suggests that behavioral change is best accomplished by designing interventions to alter individuals' beliefs regarding the most influential of the intentional factors for that population-behavior pair.[236]

c. Model 3: Nonrational Behavior Resulting from Intuitive Heuristics

Model 3 considers actions to be isolated behaviors that are produced by the simplified heuristics of behavioral economics. This model borrows heavily from the heuristics and biases branch of behavioral economics that views heuristics as simplified shortcuts employed by intuitive system 1 cognitive processes.[237] It also assumes that all individuals are typically influenced by the same heuristics when confronted with similar situations. In a departure from Tversky and Kahneman's program, however, this model dispenses with the normative aspect of classical economics' rationality that views heuristics to be error-prone shortcuts that prevent optimal behavior.

As a parallel to models of reasoned behavior, Model 3 only considers behaviors in isolation with no notion of alternatives or an optimal behavior. This model will also be confined to heuristics that operate solely within the domain of intuitive system 1 thought, as once an individual engages their reflective system 2 cognitive processes to deliberate between two available behaviors, or simply to choose between performing a behavior or not performing a behavior, they have left the realm of behavior in isolation and entered the realm of decision among alternatives.

Analyzing interventions using Model 3 will interpret observed actions as isolated behaviors that have been produced directly by intuitive heuristics. The heuristics that influence behavior include representativeness, availability, and anchoring as described by the initial heuristics and biases program, along with affect, optimism, loss aversion, and intuitive social heuristics. The representativeness, availability, and anchoring heuristics predispose individuals to perform behaviors that appear familiar or are similar to

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[236] Fishbein et al., "The Role of Theory in Developing Effective Antidrug Public Service Announcements," 114.

[237] Tversky and Kahneman, "Judgment under Uncertainty: Heuristics and Biases," 1130.

situations encountered previously.[238] Affect simply describes an automatic and uncontrollable positive or negative feeling in response to stimuli.[239] Optimism prevents individuals from properly assessing fear appeals or evaluating threats.[240] Loss aversion produces the status quo bias wherein the loss produced by abandoning the automatically assigned default condition is weighted more heavily than any potential gains that could be obtained by switching from the default option.[241] Social influences also affect behavior in isolation, either through descriptive norms whereby individuals imitate the observed behavior of groups or role models (herding), or through injunctive social norms that demonstrate approval or disapproval for an individual's behavior.[242] Public commitments produce an intuitive desire to maintain consistency between actual behavior and any stated self-characterizations of behavior in order to avoid dissonance.[243] These heuristics comprise Haidt's elephant, the mass of intuitions that direct behavior even as individuals believe that their reflectively stated reasons are in control.

Model 3 is fully capable of analyzing interventions that purport to study decision making among alternatives, despite the fact that this model only considers behaviors in isolation. This is because according to Model 3, individuals never actually engage in choosing among alternatives. Instead, Model 3 interprets an individual's behavior (in this case selecting one of the alternatives) to result directly from heuristics of the intuitive system 1 cognitive process with no deliberate, reflective consideration for other alternatives. Although the individual may be able to offer reasoned explanations for why they chose one alternative over the others after the act of choosing, Model 3 asserts that these reasons were actually post-hoc justifications created after the individual had already initiated the observed behavior.

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[238] Ibid.

[239] Samson, "The Behavioral Economics Guide 2014 (With a Foreword by George Loewenstein and Rory Sutherland)," 13.

[240] Weinstein, "Why It Won't Happen to Me," 432–33.

[241] Kahneman and Tversky, "Prospect Theory: An Analysis of Decision Under Risk," 279.

[242] Samson, "The Behavioral Economics Guide 2015 (with an Introduction by Dan Ariely)," 44.

[243] Schlenker, Dlugolecki, and Doherty, "The Impact of Self-Presentations on Self-Appraisals and Behavior: The Power of Public Commitment," 33.

Explanation, prediction, and change of behavior using Model 3 are purely a function of automatic heuristics. Any reasons explicitly stated by an individual to explain their own behaviors or actions are discarded, as Model 3 considers all behaviors to be automatically determined by intuitive heuristics. Explanation of behavior is instead accomplished by analyzing common behavioral themes across a number of subjects to propose an intuitive heuristic that could explain the observed behavioral trends of these individuals.[244] Prediction relies upon first identifying the heuristic engaged by a particular environment or stimulus, and then forecasting an individual's future behavior as a function of that heuristic. An important distinction from Model 2 is that behavioral change under Model 3 cannot be accomplished through appeals to reason or by changing beliefs–rather, behavior change under Model 3 will only be achieved by using choice architecture to design environmental stimuli that leverage the intuitive heuristics of automatic system 1 thought processes.

d. Model 4: Nonrational Decision Making with Fast and Frugal Heuristics

Model 4 interprets individuals' actions as the results of decision making processes that use the simplified heuristic strategies of behavioral economics. This model aligns closely with the fast and frugal heuristics branch of behavioral economics, in which individuals consciously and deliberately use simplified decision making heuristics that require less effort than optimizing methods and are able to produce more accurate results when ecologically rational.[245] Although this model accepts that the intuitive system 1 employs heuristics that may influence an individual's understanding of their environment, an individual's actions will always be viewed as conscious choices that are based on decision making heuristics controlled by the reflective system 2. These decision making strategies can be described as a set of search, stopping, and decision rules to simplify and aid choice when confronted with either a large number of alternatives, or

[244] Daniel Kahneman and Amos Tversky, "On the Psychology of Prediction," *Psychological Review* 80, no. 4 (1973): 237–51.

[245] Gigerenzer and Gaissmaier, "Heuristic Decision Making," 457.

when deciding between a limited and known set of alternatives on the basis of a large set of attributes.[246]

This model has greatly relaxed assumptions compared to the rational decision making model of Expected Utility Theory, and therefore provides far fewer implications for analysis. Model 4 makes no assumption that individuals will behave selfishly and optimally. In fact, it accepts that many individuals will use suboptimal decision making strategies in many situations. What Model 4 does assert, however, is that for many situations there exist simplified decision making heuristics that may produce satisfactory results within that domain.

Model 4 explains actions as choices resulting from nonrational decision making heuristics, an approach that implies a particular approach to predicting and influencing future decisions. Analysis using Model 4 attempts to identify the decision making heuristics and search, stopping, and decision rules influenced by interventions to encourage individuals to select beneficial health and safety choices. Individuals who choose unhealthy or unsafe options are assumed to have used different decision making heuristics which could either be a different strategy altogether, or a similar heuristic strategy but with different search, stopping, and decision rules based perhaps off of different cue orderings or attribute values.

Prediction according to Model 4 depends upon both the individual and the environment in which they make their decisions. An individual's experiences and knowledge, physical cues present in the environment, and social cues perceived from others all have a significant influence on the heuristic decision making strategies that individual will use to decide on a course of action.[247] According to Model 4, improvement in public health and safety can be accomplished either by conditioning individuals to use specific heuristic decision making strategies and search, stopping, and decision rules that are likely to produce beneficial individual-level choices, or by

[246] Gigerenzer, "The Adaptive Toolbox," 43–44.

[247] Gigerenzer and Gaissmaier, "Heuristic Decision Making," 456–57.

designing physical and social environments as in choice architecture in order to encourage the selection of these same strategies and rules.

B. COMPARATIVE CASE STUDY RESEARCH DESIGN

A comparative case study of individual-level interventions designed to influence seat belt, bicycle helmet, and alcohol use will benefit practitioners seeking to produce future health and safety programs. While numerous studies have been conducted in these fields, no validated models have been established to describe the factors that cause individuals to perform beneficial health and safety actions.[248] Without such models, it is difficult to determine which intervention methods are responsible for altering individuals' actions and generating effective programs. To address this issue, the present research will first analyze a set of interventions using a four-model approach to detect the methods used in each case, and then compare those sets of methods between cases to identify which methods are correlated with success across the selection of health and safety interventions examined in this thesis.

Comparison across cases may permit inference of intervention methods that produce successful programs in an assortment of health and safety fields. Searching a set of cases for patterns to generate hypotheses is an established use of the case study research design.[249] By considering the intervention methods and associated outcomes of multiple cases, it is hoped that a pattern of methods correlated with program success may be detected. This set of potentially influential methods could inform future interventions and serve as a basis for the eventual development of an established theory for changing public health and safety practices.

The cases within this study describe public health and safety interventions performed on a distinct population. Cases are merely data points, defined to suit the purposes of the study that uses them.[250] Within the present research, a case is defined as a

[248] Trifiletti et al., "Behavioral and Social Sciences Theories and Models," 298.

[249] Juliet Kaarbo and Ryan K. Beasley, "A Practical Guide to the Comparative Case Study Method in Political Psychology," *Political Psychology* 20, no. 2 (1999): 374–75.

[250] Ibid., 372–73.

set of intervention methods used on a population to produce a program outcome. A single study may yield multiple cases for analysis if different sets of methods were employed to influence two or more populations, or if a single set of intervention methods produced different outcomes when applied to two or more populations.

Like all research designs, the comparative case study requires a formal methodological description.[251] An explicit statement of the steps taken in conducting this study will guide implementation and allow for replication, thereby enhancing the credibility of its results and conclusions.[252]

1. Identify Research Question

The first step in conducting a comparative case study on individual-level health and safety interventions is to define the research question.[253] The question that this thesis seeks to answer is:

How can we design successful individual-level interventions to improve public health and safety?

2. Identify Variables to be Explored

A strength of the comparative case study is that it permits exploration of the relationships between independent and dependent variables through the use of multiple cases.[254] The goal of this thesis is to determine how to design successful individual-level health and safety interventions. To focus inquiry, this thesis hypothesizes that interventions work by employing some set of methods to influence the factors that determine how individuals act, thereby governing program outcome. The independent variables suggested by this hypothesis are the intervention's methods, and the dependent variable is program outcome.

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[251] Ibid., 377.

[252] Ibid., 378.

[253] Ibid.

[254] Ibid., 376.

To investigate the relationship between intervention methods and program outcome, it is first necessary to be capable of expressing all possible routes by which a method may have influenced an individual's actions within each case. The four models of analysis each define their own set of factors that determine individuals' actions, and each of these factors and the methods that influence them must be represented. To provide structure, these factors will be organized into four arrays. The elements contained within an array will correspond to the factors of behavior or decision making as defined by the associated model. Because each of the four models defines a different set of factors to explain an individual's actions, the four arrays will contain different sets of factors:

a. Model 1 Array: Expected Utility Theory

The only factor defined by this model is expected utility, and therefore the array for this model consists of only a single element representing this factor.

b. Model 2 Array: Integrative Model of Behavioral Prediction

The IMBP of Model 2 defines behavior to be caused by intent, which is comprised of attitudes based on perceived costs and benefits, subjective norms, and self-efficacy, along with necessary skills and a lack of environmental barriers.[255] The array of elements associated with Model 2 will contain five variables: attitudes, subjective norms, self-efficacy, skills, and absence of barriers.

c. Model 3 Array: Nonrational Behavior in Isolation

Behavior according to Model 3 is a direct result of the intuitive heuristics that occur within the automatic system 1 cognitive processes in response to stimuli in the environment. Accordingly, the array that corresponds to the factors defined by Model 3 will include seven elements to represent the intuitive heuristics that govern behavior under this model: representativeness, availability, anchoring, affect, optimism, loss aversion, and social pressure.

[255] Fishbein and Yzer, "Using Theory to Design Effective Health Behavior Interventions," 166.

d. Model 4 Array: Nonrational Decision Making

Model 4 asserts that individual's decisions are determined by the nature of the nonrational decision making heuristic that they use to make their selection. Therefore, the array for Model 4 will represent the five categories of decision making heuristics: aspiration-level satisficing strategies, recognition-based strategies, one-reason strategies, compensatory strategies, and strategies based upon social information. Intervention methods may influence any of these heuristics by altering their search, stopping, or decision processes.

e. Matrices of Individual Action Factor Arrays

Combining these four arrays will produce a matrix that can describe the results of a four-model analysis performed on a single case (see Table 2). The matrix generated from the multi-model analysis of each case will represent the methods employed by that intervention and the factors of individual action they may have leveraged to influence program outcome. It is important to emphasize, however, that the methods expressed by each relationship are merely correlated with the outcome of the associated case. Comparative analysis between cases will be required to infer a set of methods that are correlated with successful public health and safety interventions in general.

Table 2. Factors of Individual Action Defined by the Four Models of Analysis

Model 1	Expected Utility						
Model 2	Attitudes	Subjective Norm	Self-Efficacy	Skills	Barriers		
Model 3	Representative	Availability	Anchoring	Affect	Optimism	Loss Aversion	Social Pressure
Model 4	Aspiration-Level	Recognition	One-Reason	Compensatory	Social		

f. Arrays of Intervention Methods Correlated with Case Outcome

To facilitate comparative analysis between cases, the matrices describing intervention methods and activated factors of choice or behavior will be reduced to arrays that merely express the intervention methods employed in each case. Limiting the number of independent variables will permit greater opportunity for inference by increasing the probability that the influence of equivalent independent variables may be controlled.[256] Although some detail will be lost when transforming each matrix into an array of cells corresponding to the intervention methods encountered within the selection of cases examined by the present thesis, this mapping may facilitate identification of the intervention methods that are correlated with successful public health and safety interventions in general.

The independent variable arrays that represent the intervention methods used by each case contain one cell for every method encountered within this thesis (see Table 3). The array associated with each case therefore contains N elements, where N is equal to the number of unique intervention methods observed in the set of selected cases. As a consequence, these arrays cannot be constructed until every case has been analyzed and all intervention methods present in the selection are known. Once the set of intervention methods is defined, an independent variable array can be created for each case. A simple Boolean value assigned to each element indicates if the corresponding intervention method is present in the matrix generated by the four-model analysis of the associated case.

Table 3. Array of N Intervention Methods Correlated with Case Outcome

Intervention Method 1	Intervention Method 2	...	...	...	Intervention Method N-1	Intervention Method N

[256] Kaarbo and Beasley, "A Practical Guide to the Comparative Case Study Method in Political Psychology," 378.

3. Case Selection

Case selection is crucial in order to reveal the nature of the relationships present in health and safety interventions.[257] Cases will deliberately be chosen that represent both successful and failed interventions. This variability in the dependent variable will enable inferences regarding the intervention methods that produced these outcomes.[258] If a consistent relationship can be demonstrated between a set of methods that are correlated with effective interventions across a number of cases, this would suggest a set of generalizable methods that may be used to achieve success in other health and safety fields.

Use of the comparative case study method on a selection of cases that displays variability in the values of some of the independent "intervention method" variables should enable identification of those methods that are correlated with successful programs in general. By examining comparable cases which employed similar but not identical sets of methods, the influence of the equivalent methods on program outcome will be controlled for and any variability observed in program outcome may be attributed to the dissimilar methods.[259]

The studies selected for analysis describe interventions that attempted to increase seat belt usage, encourage bicycle helmet wearing, and discourage excessive alcohol consumption. Studies were deliberately selected from three different health and safety fields in order to encounter a greater range of potentially influential intervention methods and increase the likelihood of inferring a set of generalized methods correlated with program success that can be applied to other health and safety fields.[260] Identification of studies for possible inclusion was accomplished by searching Proquest and Google Scholar with an assortment of search strings based on the topic fields seat belt, bicycle helmet, and alcohol, along with the terms behavior or decision. Candidate studies were considered for analysis only if they contained longitudinal research designs that provided

[257] Ibid., 379.

[258] Ibid., 381.

[259] Ibid., 380.

[260] Ibid., 382.

both pre and post intervention data so that the dependent variable of program outcome could be coded, and if they provided a sufficiently detailed description of intervention methods so that the targeted factors of individual action could be coded.

4. Define Coding Guidelines for Assigning Values to Case Variables

Structured rules governing the coding of case variables are essential when conducting a comparative case study.[261] Clearly defined criteria for assigning values to variables facilitate consistent and reliable coding and analysis of cases, and provide credibility for conclusions reached by the comparative case study.[262] These rules constitute a case codebook that may be used to replicate the present study to test its conclusions, as well as enable the extension and refinement of these conclusions through the analysis and integration of additional cases.[263]

Evaluating the dependent variable of program outcome is fairly straightforward. A case will be deemed a Lasting Success if the intervention causes an intended improvement that persists beyond the withdrawal period of the study. Temporary Success describes cases where the intervention produces a temporary improvement that returns to the baseline during the withdrawal period of the case. No Effect will be coded when no change is observed in a single population study, or when no difference is observed between treatment and control groups. Temporary Unintended Consequences will describe interventions that produce a temporary effect that is opposite the intervention's intent, and any interventions that produce a persistent counterproductive outcome will be labeled Unintended Consequences. Dependence on the duration of withdrawal measurement performed by each intervention following termination of the treatment condition in categorizing a case as a temporary or lasting effect is an acknowledged limitation of this coding method. A lack of studies reporting either Unintended Consequences or Temporary Unintended Consequences may be due to publication bias

[261] Ibid., 385.

[262] Ibid.

[263] Ibid.

by which researchers whose interventions worsen public health and safety rather than improve it may not seek publicity for this achievement.

The matrices representing the factors of behavior or decision making that may have been influenced by each intervention must be produced before the independent variable arrays of intervention methods correlated with case outcome can be generated. Every case must be analyzed four times according to each of the models in order to interpret which intervention methods have targeted or acted upon the factors of that model. These interpretations are inherently subjective, an unavoidable aspect of a qualitative analysis. Remaining cognizant of the subjective nature of these analyses and adhering to the model definitions and coding methodology provided in this chapter should protect against bias.

Coding of the case matrices will capture the methods used by an intervention and the factors of behavior or choice that these methods may have activated. When a factor of a model has been deemed targeted or influenced by an intervention method, the cell that represents the factor of individual action within the corresponding model's array will be assigned a text value representing the influencing method. This indicates that the intervention method acting upon that factor is correlated with the program outcome. If it is possible to infer from a study that a factor did not influence the program outcome, then the associated cell will be assigned a value of zero. All other factors will remain as null values. The full set of intervention methods that may be assigned as values to the cells of the matrices will only be known after all cases within this thesis are analyzed. If future research analyzes other intervention cases and encounters additional intervention methods, these new methods would be added to this list of possible values, and the array of independent variables representing possible intervention methods would be expanded as well.

An array of independent variables representing the intervention methods employed by each case will be generated by mapping from the associated case matrix. The cell representing each intervention method will be coded with an X if that intervention was present in the matrix. Although the transformation from a matrix of qualitative intervention methods and activated factors of individual action to an array of

Boolean values representing intervention methods discards information, this lossy simplification will facilitate comparative analysis between cases. As previously noted, this mapping can only be performed after all cases are analyzed.

5. Analyze Cases to Code Variables and Identify Correlations

Analysis of a single case will reveal a correlation between the methods used by an intervention and the factors of behavior or choice that these methods may have activated to influence program outcome. Conducting this analysis involves interpreting cases through the lenses of the four models to identify relevant methods and activated factors of individual action according to the assumptions and implications of each model. Some methods may be identified by more than one model or associated with more than one factor within a model. The result of this analysis will be represented by the matrix described in Table 2. After all cases are analyzed and the full set of intervention methods is known, the matrix for each case will be reduced to a single array of independent variables that describes the set of intervention methods that are correlated with the associated case outcome.

6. Compare Correlations Across Cases and Make Inferences

The final step of the comparative case study will synthesize the correlational results obtained from each individual case in order to identify methods that are correlated with the success of public health and safety interventions in general. Cases will be considered in pairs to test the influence of their constituent methods on program outcomes. Similarities between each pair of cases will be leveraged to control for the influence of equivalent factors, permitting inference regarding the function or reasons for remaining differences.

The quantity of possible case pairings necessitates a structured approach when selecting interventions for comparison. Subjectivity in the selection of pairs for comparison threatens to introduce bias if not all combinations are analyzed. While this comparative analysis will not pedantically analyze all possible pairs of cases, an explicit methodology for locating potentially relevant combinations will be defined to protect against this bias.

A clear methodology is also needed to avoid bias when analyzing case pairings. The comparative analysis of two cases in this study is an unavoidably subjective interpretation that seeks to explain the similarities and differences observed between the outcomes and associated intervention methods of the cases under consideration. Consistency in analysis is further complicated because the elements subject to this comparative analysis are themselves the qualitative results of the four model analyses performed on each health and safety intervention included in this study. Awareness of the potential for subjectivity and adherence to the methodology provided below is intended to guard against this bias and allow for credible analysis.[264]

This comparative case study will consider three classes of case pairings that each enable different sets of inferences. These classes provide a logical guide for selecting comparisons that is replicable and thorough.

a. Identical Outcomes, Different Methods

The first class will compare cases with the same outcome and only a small number of intervention methods in common. While the pair's shared outcome might have been caused by varying combinations of each case's dissimilar methods, identification of those methods that are common among successful health and safety programs may suggest a direction for further investigation.

b. Similar Methods, Different Outcomes

The second class of pairings will compare cases with similar but non-equivalent sets of intervention methods. If the arrays of independent variables that represent cases within this study have been designed and coded correctly, then any equivalent methods within the pair will be controlled for and differences in program outcome may be attributed to the pair's dissimilar methods.[265] Inferences regarding the dissimilar methods in these comparisons will be inaccurate, however, if coding did not adhere to the methodology specified in Chapter IV, if the four models of analysis used to interpret each

[264] Ibid.

[265] Ibid., 386.

case were inadequate and missed an independent variable that explains the observed variation in program outcome, or if the mapping of intervention methods to the arrays of independent variables that were used for this comparative analysis lacks sufficient granularity to express the relevance of each factor.

c. Identical Methods

The third class of comparisons will only evaluate pairs of cases that employed identical sets of intervention methods. If the outcomes of the cases are the same, then this increases confidence that some subset of those methods are indeed correlated with the success of public health and safety interventions in general. If the cases have different outcomes, however, this will again suggest either a failure to adhere to the case codebook methodology, an inadequacy of the four models used to analyze each case, or an issue with mapping of the intervention methods used by each case to an array of correlated independent variables.

C. SUMMARY

This chapter described a methodology to seek out intervention methods that may be used to design successful public health and safety programs. Four models of analysis were developed from the fields of rational choice, reasoned behavior, and behavioral economics in order to detect a wide range of methods that may have influenced individuals and contributed to the outcome of an intervention program. Guidelines for a comparative case study were defined to analyze a selection of interventions and identify those methods that are correlated with program success in general, so that these findings may be applied to improve future public health and safety interventions.

IV. CASE ANALYSIS AND CODING

Many studies have evaluated intervention programs that aim to improve public health and safety in matters of seat belt use, bicycle helmet wearing, and moderation of alcohol consumption. This chapter analyzes a selection of these programs in order to identify the intervention methods and targeted factors of individual action that are associated with each case outcome. Seven cases have been deliberately drawn from three different fields in order to enumerate methods and factors that are correlated with the outcomes of health and safety intervention programs in general, rather than simply identifying associations for a particular field.

Interventions encouraging seat belt use have achieved significant success over the past several decades. Only 15 percent of vehicle occupants in the U.S. wore seat belts in 1984, even though these safety devices were known to reduce the probability of serious injury or death in an automobile accident by 55 percent.[266] By 2014, the seat belt compliance rate had increased to 87 percent.[267] While some of this increase was likely due to mandatory seat belt laws that have been passed in 49 states, interventions that were implemented prior to the passage of these laws did produce sizeable increases in seat belt use. To avoid any possible legislative influence, all of the seat belt interventions selected for this comparative case study were conducted prior to the passage of mandatory laws. Lessons learned from the analysis of these seat belt programs may aid in the development of other public health and safety interventions that encourage individuals to perform new safety practices.

Wearing a helmet when riding a bicycle is another important safety practice that has required intervention programs to encourage compliance. A properly worn bicycle

[266] James R. Rudd and E. Scott Geller, "A University-Based Incentive Program to Increase Safety Belt Use: Toward Cost-Effective Institutionalization," *Journal of Applied Behavior Analysis* 18, no. 3 (1985): 215.

[267] Timothy Pickrell, Eun-Ha Choi, and Shova KC, *Occupant Restraint Use in 2014: Results from the NOPUS Controlled Intersection Study* (Washington, DC: National Highway Traffic Safety Administration, 2016), 5.

helmet can reduce the number of reported head injuries by 85 to 88 percent.[268] Despite this benefit, only 18 percent of cyclists in 2005 wore helmets every time they rode, and 76 percent of bicyclists never used a helmet.[269] The factors that contribute to ownership and use of a bicycle helmet may be related to the determinants of smoke alarm compliance or other public health and safety activities that require the acquisition and proper use of a safety device to reduce the possibility of injury from a relatively unlikely event.

Numerous interventions have also been conducted to reduce alcohol consumption among college students. College students consume on average twice as many drinks per week than the general population.[270] Interventions to moderate alcohol consumption may prove informative because they are concerned with controlling rather than encouraging an action. Successful alcohol moderation programs discourage drinking, as smoke alarm interventions teach individuals to refrain from disconnecting smoke alarms due to nuisance activations, and other public health and safety interventions may similarly have to instill moderation or abstinence.

This chapter on case analysis and coding is organized into eight sections. The first seven sections correspond to the seven intervention studies examined by this thesis. Each intervention study section contains a description of the methods and findings of the study, followed by analysis of any cases generated by that intervention. Two of the studies included in this thesis applied intervention methods to separate populations and achieved two different program outcomes; therefore, this set of seven intervention studies yields a total of nine cases for analysis. Analysis of each case codes the dependent variable of program outcome, interprets the case using the four models defined in Table 1, and produces the matrix of intervention methods and activated factors of individual action that are correlated with the case outcome as described in Table 2. Also included in the

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[268] Michelle L. Cathorall, "Improving Bicycle Helmet Research: Examining Intervention Studies and Parental Experiences" (PhD diss., University of North Carolina, 2013), 2.

[269] Timothy Ludwig, Chris Buchholz, and Steven Clarke, "Using Social Marketing to Increase the Use of Helmets Among Bicyclists," *Journal of American College Health* 54, no. 1 (2005): 51.

[270] Scott T. Walters, Melanie E. Bennett, and Joseph H. Miller, "Reducing Alcohol Use in College Students: A Controlled Trial of Two Brief Interventions," *Journal of Drug Education* 30, no. 3 (2000): 361.

analysis subsection for each case is the array of independent variables representing the intervention methods associated with case outcome defined in Table 3. Although these independent variable arrays cannot be constructed until all cases have been analyzed and the full set of intervention methods is discovered, these arrays are presented within each case's analysis subsection to aid comprehension by providing an easily interpreted data structure that compiles the methods used by that case. Following the seven intervention study sections and their case analysis subsections, the eighth and final section of this chapter summarizes the current progress of the comparative case study.

A. GELLER ET AL.

1. Description

Geller et al. examined the effect of incentives on seat belt usage on the Virginia Tech University campus.[271] The study compared the observed rate of seat belt wearing at two different faculty/staff parking lots from 7:00 a.m. to 9:00 a.m. on 49 consecutive weekdays.[272] This period included 11 days to record baseline data, 24 days of intervention, and an additional 14 days of withdrawal following cessation of the intervention.[273]

A pair of observers were stationed at the entrances of two separate parking lots, each wearing an orange safety vest and holding a clipboard with a sign "Please Stop Again" written on the back that was used to signal drivers entering the lot to stop.[274] As a car approached, an available observer would display the clipboard, interact with the stopped driver in a manner dictated by the stage of the experiment, and record the driver's gender, seat belt usage, and license plate number.[275] If multiple cars approached

[271] E. Scott Geller, Lisa Paterson, and Elizabeth Talbott, "A Behavioral Analysis of Incentive Prompts for Motivating Seat Belt Use," *Journal of Applied Behavior Analysis* 15, no. 3 (1982): 403–15.

[272] Ibid., 405.

[273] Ibid., 405–7.

[274] Ibid., 405.

[275] Ibid.

at once the observers would only signal the last car in line.[276] If both observers were occupied no attempt would be made to stop incoming cars.[277]

Observers interacted with drivers according to the stage of the experiment.[278] During the baseline condition, observers at both lots would stop drivers to say, "Just checking to see you're wearing your seat belt," and then record driver information.[279] For the intervention period, observers stopped drivers to say, "Just checking to see you're wearing your seat belt and here's a description of how you can win valuable prizes."[280] Observers at the two lots then implemented different treatment conditions in order to study the impact of contingent and noncontingent incentives.[281] At the contingent lot, observers gave drivers who wore a seat belt a flier that promised modest incentive prizes for collecting multiple fliers with the same symbol printed on them, while non-wearers were given the same flier with no symbol and a message stating, "Next time wear your seat belt and receive a chance to win a valuable prize!"[282] At the noncontingent lot, all drivers were given a flier with a symbol regardless of their seat belt use.[283] When the treatment condition ended and the withdrawal period began, observers ceased distributing fliers and returned to the baseline interaction without explicitly stating that the reward period had ended.[284]

The study reported a significant increase in seat belt wearing in the contingent lot, with no change observed in the noncontingent lot.[285] Mean seat belt wearing rates for the contingent and noncontingent lots were 26.3 percent and 22.2 percent respectively during baseline, 45.7 percent and 24.1 percent during treatment, and 37.9 percent and 21.8

[276] Ibid.

[277] Ibid.

[278] Ibid.

[279] Ibid.

[280] Ibid.

[281] Ibid., 405–7.

[282] Ibid.

[283] Ibid., 407.

[284] Ibid.

[285] Ibid., 407–8.

percent during withdrawal.[286] Rate of seat belt use during withdrawal was also recorded as a function of the number of interactions each driver had with an observer, with seat belt use in the contingent lot remaining elevated until the fifth withdrawal intervention, at which point it returned to baseline.[287] Over the course of the experiment, 2,517 observations were recorded of 906 different vehicles at the first parking lot, and 2,808 observations of 980 different cars were recorded at the second lot.[288] Most drivers obeyed the observer's request to stop and participated fully with the study.[289] Only 0.01 percent of vehicles parked in both lots.[290] Any drivers who refused to participate or parked in both lots were excluded from the study.[291] The study concluded that only contingent incentives influenced seat belt use.[292]

2. Analysis of Case 1: Geller et al.

a. Outcome: Temporary Success

Although average seat belt use in the contingent lot remained elevated during the withdrawal period of the study, this program is coded as a Temporary Success because individual-level tracking of seat belt use revealed that wearing rates did return to baseline after five withdrawal interactions with observers.[293]

b. Model 1 Analysis

Seat belt usage is entirely determined by drivers' selfish and optimizing calculations of expected utility. Using a seat belt maximizes utility for those drivers who wear them, whereas the utility of non-wearers is maximized by non-usage. The results observed in the noncontingent parking lot are expected by Model 1 because the

[286] Ibid.

[287] Ibid., 409.

[288] Ibid., 407–8.

[289] Ibid.

[290] Ibid., 408.

[291] Ibid.

[292] Ibid., 411.

[293] Ibid., 409.

introduction of a noncontingent reward did not affect those drivers' calculations of expected utility achieved by the decision to wear a seat belt. In the contingent lot, the increase in seat belt use is explained by drivers who had previously calculated non-wearing to maximize utility, but with the added utility of flier rewards the choice of wearing a seat belt now became the optimal choice. For those drivers in the contingent lot who never wore their seat belts, this additional utility was insufficient to outperform the non-wearing option. The delayed return to baseline usage rates in the contingent lot during the withdrawal period occurred because individuals were not informed that the incentive period had ended, and therefore they continued to calculate seat belt wearing as the optimal choice until they had several interactions with observers and realized that the reward period had ended.

c. Model 2 Analysis

The IMBP asserts that seat belt behavior is a direct function of the individual's intent, as determined by attitudes, subjective norms, and self-efficacy.[294] Although drivers were not surveyed regarding the reasons that contributed to their seat belt behavior, the nature of this experiment makes it possible to identify attitudes resulting from a cost-benefit analysis as the only determinant factor of intent, with the other possible factors ruled out. Injunctive subjective norms from the fliers directing drivers to buckle up could not be responsible for elevated seat belt wearing in the contingent lot because no such change was observed in the noncontingent lot where the same fliers were distributed. Self-efficacy could also not have contributed to the increase in seat belt wearing, because if it had then usage rates would not have returned fully to baseline levels after the reward condition ended.

d. Model 3 Analysis

The contingent nature of the reward in the experimental lot caused an increase in seat belt wearing by activating the loss aversion heuristic of these drivers. The contingent lot presented a situation where drivers had an opportunity to win prizes, but would lose

[294] Fishbein and Yzer, "Using Theory to Design Effective Health Behavior Interventions," 166.

that chance if they did not wear their seat belt.[295] A desire to maintain the possibility of winning may be responsible for the increased usage rates. The heuristics of availability or anchoring due to the presence of known seat belt inspectors could not explain the increase in the contingent lot because the observers produced no increase in the noncontingent lot. As with the Model 2 analysis, change could not have been due to social pressure communicated by observers or through the flier because this change was not observed in the noncontingent lot. Affect similarly cannot explain the results observed in this study because otherwise the positive feelings associated with seat belt use would have maintained elevated usage rates after the reward condition had ended.

e. Model 4 Analysis

The possibility of receiving a reward in the contingent condition caused more drivers to buckle up by changing the nature of an attribute of the seat belt wearing alternative for either aspiration-level or one-reason decision making strategies. New seat belt wearing drivers may have used an aspiration-level strategy that had previously found the option of seat belt wearing unsatisfactory, but with the additional reward condition this choice now exceeded their aspiration threshold. Drivers using one-reason decision making strategies employed a simplified search heuristic to parse through the attributes of the seat belt or no seat belt options until they encountered a differentiating cue. Drivers who adopted seat belt wearing after the treatment period began encountered the new reward/no reward cue before any other differentiating attribute and accordingly chose to wear their seat belt. Those drivers in the contingent lot relying on one-reason decision making who did not adopt seat belt use must have used a different order for searching through the attributes associated with the two alternatives, leading them to encounter a different differentiating attribute that instead indicated the non-wearing decision.

f. Coding of Case 1 Data Structures

The matrix describing the intervention methods and activated factors of individual action that are correlated with the outcome of Case 1 is shown in Table 4. The reduced

[295] Geller, Paterson, and Talbott, "A Behavioral Analysis of Incentive Prompts for Motivating Seat Belt Use," 405.

array of independent variables representing the intervention methods correlated with the outcome of Case 1 is displayed in Table 5.

Table 4. Geller et al. Activated Factors of Individual Action

Model 1	Expected Utility Economic Incentives						
Model 2	Attitudes Economic Incentives	Subjective Norm 0	Self-Efficacy 0	Skills	Barriers		
Model 3	Representative	Availability 0	Anchoring 0	Affect 0	Optimism	Loss Aversion Economic Incentives	Social Pressure 0
Model 4	Aspiration-Level Economic Incentives	Recognition	One-Reason Economic Incentives	Compensatory	Social		

Table 5. Geller et al. Intervention Methods Correlated with Temporary Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
X						

B. ROBERTSON ET AL.

1. Description

Robertson et al. attempted to evaluate the efficacy of television commercial campaigns to encourage seat belt use.[296] This study was conducted in a community whose television cable system had been modified to permit controlled marketing studies.[297] All 13,800 homes in this cable district received the same regular programming, but roughly 6,400 households were given the treatment pro-seat belt commercials instead of the regularly scheduled commercials viewed by the remaining

[296] Leon S. Robertson et al., "A Controlled Study of the Effect of Television Messages on Safety Belt Use," *American Journal of Public Health* 64, no. 11 (1974): 1071–1080.

[297] Ibid., 1072.

7,400 homes.[298] Intervention commercials were displayed on the treatment cable loop from June 1971 through February 1972.[299] Observers were stationed according to schedule at 14 locations in the cable district and recorded driver seat belt use and associated license plate number daily from May 1971 through March 1972.[300] License plates were matched to treatment or control cable households through motor vehicle registration databases, allowing driver compliance/non-compliance to be coded to their experimental condition.[301]

Treatment commercials promoted the safety benefit of seat belts by threatening injury to viewers and their families for non-use.[302] The design of these messages was based on an analysis of preliminary driver interviews that purported to identify the causal factors associated with seat belt use.[303] Six such commercials were filmed, all featuring high-quality production values.[304] Three commercials threatened injury to boys and girls by featuring handicapped or scarred children who incurred their injuries because they were not wearing their seat belts.[305] Two commercials threatened male and female adults with injury.[306] The final commercial featured a physician to increase the credibility of injury threats for non-compliance with seat belt use.[307]

No difference in seat belt use was observed between drivers from the intervention and control cable loop households throughout the ten month study.[308] Both groups exhibited a significant decrease in rates of seat belt wearing throughout the duration of

[298] Ibid., 1076.

[299] Ibid., 1077.

[300] Ibid., 1078.

[301] Ibid., 1077.

[302] Ibid., 1072–76.

[303] Ibid., 1072.

[304] Ibid., 1075.

[305] Ibid., 1072–76.

[306] Ibid.

[307] Ibid.

[308] Ibid., 1077.

the program.[309] Researchers suggested that this downward trend may have been due to increased discomfort of seat belts when wearing bulkier winter clothes in the latter half of the study.[310]

2. Analysis of Case 2: Robertson et al.

a. Outcome: No Effect

No significant difference in driver seat belt use was observed between households on the intervention and control cable loops.[311]

b. Model 1 Analysis

Injury threats were intended to lower the expected utility of the decision to not wear a seat belt, thereby making buckling up the optimal choice. No effect on seat belt use was observed, however, and therefore the fear appeals of this intervention must have been insufficient to alter drivers' expected utility calculations.

c. Model 2 Analysis

Injury threats directed towards individuals and their dependents were intended to alter cost-benefit attitudes to make seat belt wearing appear more beneficial and therefore increase use. Several possible Model 2 factors may explain the inability of these fear appeals to increase seat belt use: the fear appeals may have been inadequate to change attitudes, drivers might have lacked the necessary skills to buckle their seat belts, or there may have been environmental barriers that prevented seat belt use. Unfortunately, there is insufficient information in the study to infer which of these factors were responsible for the lack success.

d. Model 3 Analysis

This intervention threatened individuals and their families with injury in an attempt to activate intuitive heuristics that would trigger seat belt wearing behavior. The

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[309] Ibid., 1078.

[310] Ibid.

[311] Ibid., 1077.

television commercials could have leveraged the availability or anchoring heuristics, but evidently failed to make seat belt wearing sufficiently salient to alter behavior. The fear appeals communicated through these commercials might also have encouraged belt use by instilling a positive affective response to buckling up or by stimulating loss aversion to protect against possible loss of health due to injury. These methods might have failed because the optimism heuristic caused individuals to discount the probability that they or their families would be involved in a car accident.

e. Model 4 Analysis

Seat belt commercials had the potential to change seat belt choices by altering either the search, stopping, or decision rules employed by aspiration-level and one-reason decision making strategies. Drivers employing aspiration-level strategies might have considered seat belt wearing prior to any other satisficing alternative due to salience generated from the commercials, or the fear appeals transmitted in these messages could have rendered the previously acceptable choice of driving without a seat belt unsatisfactory. One-reason decision makers might have encountered the differentiating safety cue earlier in their search either due to salience from publicity or an intentional higher prioritization in response to the injury threat. Additionally, the injury threats may have changed the weights of safety cue decisions for one-reason decision makers to increase seat belt use. Evidently the methods of this commercial campaign were unable to influence any of these factors.

f. Coding of Case 2 Data Structures

The matrix describing the intervention methods and activated factors of individual action that are correlated with the outcome of Case 2 is shown in Table 6. The reduced array of independent variables representing the intervention methods correlated with the outcome of Case 2 is displayed in Table 7.

Table 6. Robertson et al. Activated Factors of Individual Action

Model 1	Expected Utility Injury Threat						
Model 2	Attitudes Injury Threat	Subjective Norm	Self-Efficacy	Skills	Barriers		
Model 3	Representative	Availability Salience	Anchoring Salience	Affect Injury Threat	Optimism Injury Threat	Loss Aversion Injury Threat	Social
Model 4	Aspiration-Level Salience; Injury Threat	Recognition	One-Reason Salience; Injury Threat	Compensatory	Social		

Table 7. Robertson et al. Intervention Methods Correlated with No Effect

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
	X	**X**				

C. RUDD AND GELLER

1. Description

Rudd and Geller conducted another Virginia Tech-based study to evaluate the influence of incentives on seat belt use.[312] A series of sweepstakes periods was advertised during which time campus police recorded the license plates of drivers seen wearing their seat belts for entry into a rewards raffle.[313] Two unobtrusive observers rotated among 18 different campus locations to record the seat belt use data that was analyzed in this study.[314] The role of observing seat belt compliance was deliberately isolated from that of reward distribution in order to avoid a possible bias produced by drivers buckling up only when in proximity to campus police officers.[315]

The study evaluated campus seat belt use over the course of three sweepstakes periods that each lasted three weeks.[316] Observers recorded baseline, treatment, and

[312] Rudd and Geller, "A University-Based Incentive Program to Increase Safety Belt Use," 215.

[313] Ibid., 218.

[314] Ibid.

[315] Ibid., 216.

[316] Ibid.

withdrawal seat belt use rates for each period, with 31 days of baseline observations prior to the first sweepstakes, and 12 days of withdrawal measurements following the final sweepstakes. Posters, fliers, and news releases advertised the seat belt sweepstakes as a program of the Virginia Tech police.[317] Any driver observed by police on campus using a seat belt was entered into a raffle for rewards donated by local businesses.[318] The only drivers excluded from the reward incentive were the Virginia Tech campus police themselves.[319] A random sample of students at Virginia Tech and another nearby college were interviewed by telephone to ascertain awareness of the sweepstakes program, with 78.4 percent of respondents reporting familiarity during the first treatment, and 90 percent of students indicating knowledge of program details during the third reward period.[320]

The sweepstakes intervention program produced a lasting increase in student, faculty, and staff seat belt use, along with a temporary increase in seat belt use among campus police officers.[321] Student seat belt use increased 30.5 percent from the beginning of the first baseline to the final withdrawal observation following the third sweepstakes period.[322] Faculty and staff seat belt use increased 64.2 percent from initial baseline to final withdrawal.[323] This gain in seat belt use by students, faculty, and staff was maintained throughout the entirety of the study, remaining elevated during the withdrawal and baseline periods that followed the first two sweepstakes.[324] Seat belt use by campus police officers also increased significantly with the onset of the first treatment sweepstakes period, remained elevated through the third sweepstakes, and then returned to baseline during the withdrawal period following the third and final treatment.[325] The

[317] Ibid., 218.

[318] Ibid.

[319] Ibid.

[320] Ibid., 223.

[321] Ibid., 222.

[322] Ibid.

[323] Ibid.

[324] Ibid.

[325] Ibid.

difference between the intervention methods acting upon students, faculty, and staff, and the methods affecting campus police officers, as well as the different outcomes associated with these two populations, necessitates separate case analyses for these two groups.

2. Analysis of Case 3: Rudd and Geller Students, Faculty, and Staff

a. Outcome: Lasting Success

This program is coded as a Lasting Success for students, faculty, and staff because elevated seat belt use persisted for these groups throughout the withdrawal periods of each sweepstakes intervention.[326]

b. Model 1 Analysis

Expected Utility Theory is unable to explain the results observed in this study. Economic incentives from the sweepstakes rewards could have caused some drivers to select buckling up as the optimal decision, but their seat belt use should have returned to baseline when the incentive condition was removed.

c. Model 2 Analysis

Any of the determinant factors of intention may explain the lasting increase in seat belt behavior. Enduring positive attitudes towards seat belt use may have been instilled by the temporary economic incentives. The persistent change might also have been caused by injunctive social pressure, as students, faculty and staff were reminded that the campus police were constantly monitoring their seat belt behaviors at all times. Self-efficacy could also explain the maintenance of elevated seat belt wearing beyond the incentive period, as drivers who initially responded to economic rewards may have continued this behavior because they found buckling up easier after a period of regular use.

[326] Ibid.

d. Model 3 Analysis

Intuitive affective and social heuristics can explain the lasting improvement in seat belt behavior observed among students, faculty, and staff. Economic incentives may have produced a positive affective association with seat belt use that continued beyond the reward period. These drivers may also have increased seat belt behavior as an automatic response to the injunctive pressure they perceived from campus police.

e. Model 4 Analysis

This intervention may have increased student, faculty, and staff seat belt use by influencing the simplified aspiration-level, one-reason, or social decision making strategies employed by these drivers. Temporary economic incentives could have altered the search order of aspiration-level strategies so that the alternative of seat belt wearing was evaluated prior to other satisficing options, a condition that persisted because no other stimuli disrupted this search order during the withdrawal period. Temporary economic incentives may also have altered the outcome of one-reason decision making strategies by introducing a new reward/no reward cue that led decision makers to choose the seat belt wearing option for the duration of the sweepstakes period. During this time, however, drivers may have become more adept at wearing their seatbelts, therefore permanently changing the outcome of a “comfort” or “ease” cue comparison and producing the sustained increase in seat belt use that persisted beyond the reward period. Finally, injunctive social pressure from police officer authority figures might have caused some drivers to decide to wear their seat belts.

f. Coding of Case 3 Data Structures

The matrix describing the intervention methods and activated factors of individual action that are correlated with the outcome of Case 3 is shown in Table 8. The reduced array of independent variables representing the intervention methods correlated with the outcome of Case 3 is displayed in Table 9.

Table 8. Rudd and Geller Students/Faculty/Staff Activated Factors of Individual Action

Model 1	Expected Utility 0						
Model 2	Attitudes Economic Incentives	Subjective Norm Injunctive Pressure (Police)	Self-Efficacy Economic Incentives	Skills	Barriers		
Model 3	Representative	Availability	Anchoring	Affect Economic Incentives	Optimism	Loss Aversion	Social Injunctive Pressure (Police)
Model 4	Aspiration-Level Economic Incentives	Recognition	One-Reason Economic Incentives	Compensatory	Social Injunctive Pressure (Police)		

Table 9. Rudd and Geller Students/Faculty/Staff Intervention Methods Correlated with Lasting Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive norm	Public Commitment	Remove Barrier
X				**X**		

3. Analysis of Case 4: Rudd and Geller Police Officers

a. Outcome: Temporary Success

Virginia Tech police officers' seat belt use increased relative to the baseline during the three sweepstakes periods and the first two withdrawal periods, but then returned to baseline during the final withdrawal period.[327] Although police officers were not the intended subjects of this intervention, the significant yet temporary increase in seat belt use by police during this program allows for additional insights into the factors that cause individuals to buckle up.

[327] Ibid.

b. Model 1 Analysis

Police officers received no benefit from the sweepstakes program for wearing their own seat belts, and therefore Expected Utility Theory is unable to explain the results observed in this study.

c. Model 2 Analysis

The sweepstakes treatment period did not provide any economic or safety related benefit that might have altered police officers' attitudes regarding seat belt use. The increase in police officer seat belt wearing rates also cannot be explained by increased self-efficacy because seat belt use returned to baseline following the third treatment period. The only intentional factor of Model 2 remaining that can explain this temporary increase is subjective norms. Descriptive norms were not at work here, as the very nature of the intervention made officers aware that most individuals do not wear seat belts. Injunctive pressure from students faculty, or staff also cannot explain these results, because otherwise officer's seat belt use should have remained elevated beyond the end of the study. Injunctive pressure from the researchers running the study, who may have been perceived by police as authority figures, can explain both the increase in police seat belt use, and the abrupt return of police seat belt behavior to baseline levels upon completion of the final sweepstakes period.

d. Model 3 Analysis

Availability and social heuristics may explain the temporary increase in police officer seat belt use observed during the course of this study. Simple salience from the act of monitoring the public's seat belt use might have increased the availability of buckling up. Officers may have also felt an injunctive social pressure from researcher authority figures. Finally, police may have increased their seat belt use out of an intuitive desire to maintain consistency with the public commitment to buckle up that they implicitly made by encouraging others to do the same.

e. Model 4 Analysis

An increased number of campus police officers decided to wear their seat belts during the sweepstakes period because their aspiration-level or social decision making strategies were influenced by the methods of this intervention. Salience from campaign publicity or the act of monitoring the public's seat belt compliance might have caused officers to encounter the option of seat belt wearing before any other satisficing choices when employing aspiration-level heuristics. Additionally, injunctive social pressure from researchers may have guided officers to decide to buckle up for the duration of the study.

f. Coding of Case 4 Data Structures

The matrix describing the intervention methods and activated factors of individual action that are correlated with the outcome of Case 4 is shown in Table 10. The reduced array of independent variables representing the intervention methods correlated with the outcome of Case 4 is displayed in Table 11.

Table 10. Rudd and Geller Police Officers Activated Factors of Individual Action

Model 1	Expected Utility						
Model 2	Attitudes 0	Subjective Norm Injunctive Pressure (researchers)	Self-Efficacy 0	Skills	Barriers		
Model 3	Representative	Availability Salience	Anchoring	Affect	Optimism	Loss Aversion	Social Injunctive Pressure (researchers); Public Commitment
Model 4	Aspiration-Level Salience	Recognition	One-Reason	Compensatory	Social Injunctive Pressure (researchers)		

Table 11. Rudd and Geller Police Officers Intervention Methods Correlated with Temporary Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
		X		**X**	**X**	

D. PARKIN ET AL.

1. Description

Parkin et al. evaluated the effect of a school-based intervention on bicycle helmet use among 5–14 year old children at both high-income and low-income schools in East York, Canada.[328] Interventions were conducted at four of the 22 regional elementary schools, with two high-income and two low-income schools receiving the treatment condition.[329] The remaining 18 schools were considered as controls, with three matching the high-income criteria, and four qualifying as low-income.[330] Baseline observations were recorded in August and September 1990 by direct observation at school yards and specific observation sites selected throughout the neighborhoods surrounding each school.[331] Post-treatment observations were recorded at these same sites from June through October 1991.[332]

The treatment condition was a one-week, school-based intervention called "Be Bike Smart" that promoted the safety benefit of helmet use and the consequences that occur when they are not used.[333] Printed materials and oral presentations were delivered to students, while resources were provided to teachers for classroom exercises.[334] Students promoted helmet use to their peers during school assemblies and created posters advocating for helmet use.[335] An Olympic cyclist visited and spoke to students about the importance of wearing a helmet.[336] Parents received letters detailing the safety benefits of bicycle helmets along with presentations from the local hospital and a bicycle helmet

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328 Patricia Parkin et al., "Evaluation of a Promotional Strategy to Increase Bicycle Helmet Use by Children," *Pediatrics* 91, no. 4 (1993): 772–77.

329 Ibid., 773.

330 Ibid.

331 Ibid.

332 Ibid., 774.

333 Ibid., 773.

334 Ibid.

335 Ibid.

336 Ibid.

retailer.[337] Helmets were offered for purchase at a 20 percent discount, and a limited number of additional five dollar rebates available for children in low-income schools.[338]

Observers recorded group composition and location data along with basic helmet use statistics, enabling inference into the factors influencing helmet wearing.[339] Peer influence was strong, as 70 percent of high-income and 67 percent of low-income children wore a helmet when another child in their group was helmeted.[340] Parents also had an extremely significant effect, with 100 percent of high-income and 90 percent of low-income children wearing helmets when riding with a helmeted adult.[341] The influence of teachers on helmet use varied significantly by income group, with high-income schoolyard helmet use changing from 4 percent at baseline to 48 percent in intervention schools compared to control schools' 5 percent to 34 percent change, while low-income's intervention schools changed from 4 percent to 8 percent compared to control schools' 3 percent to 14 percent improvement.[342]

This intervention produced a lasting improvement in helmet use at the high-income schools, but had no effect at low-income schools.[343] Helmet use among students of the neighborhoods of high-income intervention schools increased from 4 percent at baseline to 36 percent post-treatment, a far greater improvement than the 4 percent to 15 percent change in helmet use recorded in areas near high-income control schools.[344] The "Be Bike Smart" intervention did not produce the same effect in low-income neighborhoods, however, where low-income treatment schools increased from 1 percent to 7 percent helmet use, and low-income control schools increased from 3 percent to 13 percent.[345] The disparity in outcome observed between children in high-income and low-

[337] Ibid.

[338] Ibid.

[339] Ibid., 774–75.

[340] Ibid.

[341] Ibid.

[342] Ibid.

[343] Ibid.

[344] Ibid.

[345] Ibid.

income schools identifies these two groups as two distinct populations requiring separate analyses.

2. Analysis of Case 5: Parkin et al. High-Income Children

a. Outcome: Lasting Success

A greater increase in bicycle helmet use was observed among high-income treatment schools relative to high-income control schools, a difference that persisted six months after the intervention.[346]

b. Model 1 Analysis

Injury threats and safety considerations altered the relative expected utilities of wearing a bicycle helmet and riding without, thereby causing helmeted wearing to become the optimal choice.

c. Model 2 Analysis

Model 2 interprets the Lasting Success of the "Be Bike Smart" program as a function of methods that increased children's' intentions to wear helmets when riding bicycles, in possible conjunction with methods that removed barriers to helmeted riding. Intent may have been cultivated by injury threats that influenced attitudes about helmet behavior, or by injunctive pressure to wear a helmet that students perceived from their peers who promoted helmets in school assemblies, from their parents, from teachers in school, or from the Olympian guest speaker. Barriers to helmet wearing behavior were removed by the discounted sale of helmets in school, which may have mitigated financial or convenience hurdles.

d. Model 3 Analysis

This intervention may have influenced affective, loss aversion, or social heuristics to achieve its Lasting Success. Explicit or implicit injury threats may have instilled an automatic, affective preference for helmeted riding behavior. The increase in bicycle

[346] Ibid.

helmet use may also have occurred in response to the injury threats communicated by this treatment. Social heuristics may also have caused children to wear their helmets, either by way of injunctive pressure from peers, parents, teachers, celebrity, or through an intuitive desire to maintain consistency with public statements made while performing in school assemblies or creating pro-helmet posters.

The presence of potential social explanations for the observed behavior change prevents inference regarding the status of optimism bias in this case. Without these social forces we could conclude that optimism bias had been successfully circumvented by this intervention in order to produce change through affect or loss aversion. With social heuristics available as vectors, however, we cannot know if program success was due to injury threats activating affect/loss aversion (with or without social heuristics in play), or if optimism bias did confound fear appeals, which would indicate that all change followed from social forces.

e. Model 4 Analysis

Aspiration-level, one-reason, and social decision making strategies may have been influenced by the "Be Bike Smart" intervention to produce a lasting increase in helmet use. Injury threats may have caused children employing aspiration-level strategies to consider the option of helmeted riding prior to other satisficing alternatives, or fear appeals may have altered aspiration-level evaluations to either render helmetless riding unsatisfactory, or to raise helmeted riding above the satisficing level. One-reason decision makers may have raised safety concerns to the top of their differentiating cue priority list in response to the injury threats communicated by this intervention, or these same injury threats may have altered the weights of existing cues about safety or social acceptability cues, leading more riders to decide to wear helmets. Finally, injunctive pressure from peers, parents, teachers, or the celebrity cyclist may have swayed children.

f. Coding of Case 5 Data Structures

The matrix describing the intervention methods and activated factors of individual action that are correlated with the outcome of Case 5 is shown in Table 12. The reduced

array of independent variables representing the intervention methods correlated with the outcome of Case 5 is displayed in Table 13.

Table 12. Parkin et al. High-Income Activated Factors of Individual Action

Model 1	Expected Utility Injury Threat						
Model 2	Attitudes Injury Threat	Subjective Norm Injunctive Pressure (peers, parents, teachers, celebrity)	Self-Efficacy	Skills	Barriers Remove Barrier (discount, convenience)		
Model 3	Representative	Availability	Anchoring	Affect Injury Threat	Optimism	Loss Aversion Injury Threat	Social Injunctive Pressure (peers, parents, teachers, celebrity); Public Commitment
Model 4	Aspiration-Level Injury Threat	Recognition	One-Reason Injury Threat	Compensatory	Social Injunctive Pressure (peers, parents, teachers, celebrity)		

Table 13. Parkin et al. High-Income Intervention Methods Correlated with Lasting Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
	X			**X**	**X**	**X**

3. Analysis of Case 6: Parkin et al. Low-Income Children

a. Outcome: No Effect

No significant difference in bicycle helmet use was detected between low-income treatment and control schools.[347]

[347] Ibid.

b. Model 1 Analysis

Expected Utility Theory explains that the intervention produced no effect in low-income schools because helmetless riding remained the optimal choice for these children.

c. Model 2 Analysis

The “Be Bike Smart” program attempted to increase helmet wearing behavior by enhancing intentions and removing environmental barriers. The lack of effect suggests that injury threats failed to instill positive attitudes about helmeted riding and the injunctive pressure from peers, parents, and the Olympian were ineffective, or the 20 percent discount and limited five dollar rebates were inadequate to remove the environmental barrier (lack of helmet) that prevented some children from engaging in this behavior.

d. Model 3 Analysis

The failure of this intervention to produce any effect may be understood through analysis of the intuitive heuristics that determine helmet behavior. Although the treatment attempted to leverage affect and loss aversion through injury threats, as well as social heuristics using injunctive pressure and public commitments, none of these factors produced behavior change. A possible explanation is that children’s optimism bias was activated in response to fear appeals, rendering these riders immune to influence.

e. Model 4 Analysis

Heuristic aspiration-level, one-reason, and social decision making strategies were targeted unsuccessfully by the treatment condition. Despite threat of injury, children in the low-income schools may have continued to encounter the option of helmetless riding and evaluate it as satisfactory when using aspiration-level strategies. Riders may also have decided to ride helmetless after using a one-reason decision strategy, as a differentiating cue besides safety may have been encountered, or evaluation of the safety cue for these children may not have indicated helmeted riding. Finally, the injunctive pressure received from peers, parents, or the celebrity must have either failed to convince children to wear helmets, or possibly even encouraged them to ride without a helmet.

f. Coding of Case 6 Data Structures

The matrix describing the intervention methods and activated factors of individual action that are correlated with the outcome of Case 6 is shown in Table 14. The reduced array of independent variables representing the intervention methods correlated with the outcome of Case 6 is displayed in Table 15.

Table 14. Parkin et al. Low-Income Activated Factors of Individual Action

Model 1	Expected Utility Injury Threat						
Model 2	Attitudes Injury Threat	Subjective Norm Injunctive Pressure (peers, parents, celebrity)	Self-Efficacy	Skills	Barriers Remove Barrier (discount safety device, convenience)		
Model 3	Representative	Availability	Anchoring	Affect Injury Threat	Optimism Injury Threat	Loss Aversion Injury Threat	Social Injunctive Pressure (peers, parents, celebrity); Public Commitment
Model 4	Aspiration-Level Injury Threat	Recognition	One-Reason Injury Threat	Compensatory	Social Injunctive Pressure (peers, parents, celebrity)		

Table 15. Parkin et al. Low-Income Intervention Methods Correlated with No Effect

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
	X			**X**	**X**	**X**

E. LUDWIG ET AL.

1. Description

Ludwig et al. studied the effect of fear appeals, peer influence, and public commitments on bicycle helmet use.[348] The intervention was performed on a U.S. college campus, with a similar college campus located several hours away serving as control.[349] Helmet use was recorded by direct observation for three weeks of baseline data prior to initiating the treatment, and monitoring continued throughout the five week intervention and three week withdrawal period at both the experimental and control campuses.[350] Additional follow-up helmet use data was obtained at the intervention campus only during weeks 32, 45, and 52.[351]

Resources and volunteers were prepared in advance for the implementation of this study.[352] A brochure featuring a colorful, student-designed logo was created prior to the study to describe the danger of head trauma and the ability of helmets to mitigate this risk.[353] Stickers bearing the same logo were also produced in order to identify riders who had agreed to wear helmets when cycling.[354] A group of 15 students who had been observed wearing helmets while riding were recruited as agents to deliver this intervention to their peers.[355]

The intervention employed several methods to encourage bicycle helmet use. Peer agents interacted with individuals on campus whom they observed either riding without a helmet, or riding with a helmet that did not bear the intervention sticker.[356] The volunteers provided a brochure, encouraged helmet safety, and asked subjects to commit

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[348] Ludwig, Buchholz, and Clarke, "Using Social Marketing to Increase the Use of Helmets Among Bicyclists," 51.

[349] Ibid., 53.

[350] Ibid.

[351] Ibid.

[352] Ibid., 53–54.

[353] Ibid., 54.

[354] Ibid.

[355] Ibid.

[356] Ibid.

to wearing a bicycle helmet by signing a pledge card and affixing the program sticker to their helmet.[357] Any individual who signed the pledge card was given a coupon for a free helmet at the local bicycle shop.[358] Upon redeeming a coupon for a free helmet, bicycle shop employees had been instructed to relate a personal story of injury to emphasize the importance of helmet wearing, and provide a free helmet bearing the program sticker.[359] As in Geller et al.'s 1985 study, the task of observation was segregated from that of reward distribution to avoid biased measurements.[360]

A lasting increase in helmet use was observed on the intervention campus.[361] Helmet use at the treatment school began at 26.1 percent during baseline, reaching 49.3 percent by the end of the intervention period, and remained at 44.4 percent at the end of the three week withdrawal period.[362] Students signed 379 pledge cards and redeemed 242 coupons for free helmets at the bicycle shop.[363] Long term follow-up revealed a 38.6 percent rate of helmet use at week 32, 52 percent at week 45, and 33.2 percent at week 58.[364] Helmet use at the control school did not change significantly, measuring 11.8 percent during baseline, 11.2 percent during intervention, and 14.2 percent during the withdrawal period.[365]

2. Analysis of Case 7: Ludwig et al.

a. Outcome: Lasting Success

This program is coded as a Lasting Success because elevated helmet use was not only maintained throughout the three week withdrawal immediately following treatment,

[357] Ibid., 54–55.

[358] Ibid., 55.

[359] Ibid.

[360] Ibid.

[361] Ibid., 55–56.

[362] Ibid.

[363] Ibid., 55.

[364] Ibid., 56.

[365] Ibid.

it was also observed 58 weeks later when one quarter of the student population had presumably been replaced by a new freshman class.[366]

b. Model 1 Analysis

Injury threats altered expected utility calculations for the options of cycling with and without a helmet such that helmeted riding was now the optimal choice.

c. Model 2 Analysis

The lasting behavior change observed in this study may have been produced by encouraging helmet-wearing intent, or by removing barriers to this behavior. Intention to wear a helmet when riding may have been increased by injury threats that instilled a positive attitude towards helmet use, or by injunctive pressure from peer volunteers. Provision of free bicycle helmets may have removed barriers inhibiting some riders from performing this behavior. Although 64 percent of pledge-signing riders redeemed a free helmet, there is no data to establish that these helmets accounted for the increased rate of helmeted riding, and therefore we cannot know if this improvement was caused by changing intentions or by removing barriers.[367]

d. Model 3 Analysis

Multiple intuitive heuristics may explain the results observed in this study. The increased salience of helmet-wearing produced by the program sticker borne on participants' helmets may have made helmeted riding behavior more available or primed riders to wear their helmets. Injury threats communicated by the brochure, the peer agent, or the bicycle shop employee may have instilled a positive affective response towards bicycle helmets, or these fear appeals might have activated a loss aversion response. Finally, social pressures from peer agents' injunctive requests for individuals to ride helmeted, or from subjects' intuitive desires to remain consistent with the public commitment to helmeted riding that they signed on the pledge card may have produced the increase in behavior. As in Parkin et al.'s high-income treatment condition, the

[366] Ibid., 55–56.

[367] Ibid., 55.

presence of availability/anchoring and social heuristics as alternatives to injury threats prevents any inference regarding the role of optimism bias in this case.

e. Model 4 Analysis

This intervention may have increased bicycle helmet use by influencing the simplified aspiration-level, one-reason, or social decision making strategies employed by riders. Aspiration-level strategies may have been altered either by salience from peer agents and program stickers altering search order to encounter the option of wearing a helmet prior to other satisficing options, or by injury threats that changed the nature of helmetless riding so that it no longer reached the rider's aspiration level. Injury threats may have also altered one-reason decision making strategies either by increasing the priority of safety cues for differentiation, or by altering the weight ascribed to the safety attribute for helmeted and helmetless riding to guide riders to choose helmeted riding. Finally, injunctive social pressure from peer agents, who as far as subjects knew were always present within the campus population, may have caused these riders to adopt helmet wearing.

f. Coding of Case 7 Data Structures

The matrix describing the intervention methods and activated factors of individual action that are correlated with the outcome of Case 7 is shown in Table 16. The reduced array of independent variables representing the intervention methods correlated with the outcome of Case 7 is displayed in Table 17.

Table 16. Ludwig et al. Activated Factors of Individual Action

Model 1	Expected Utility Injury Threat						
Model 2	Attitudes Injury Threat	Subjective Norm Injunctive Pressure (peers)	Self-Efficacy	Skills	Barriers Remove Barrier (free Safety Device)		
Model 3	Representative	Availability Salience	Anchoring Injury Threat	Affect Injury Threat	Optimism	Loss Aversion Injury Threat??	Social Injunctive Pressure (peers); Public Commitment
Model 4	Aspiration-Level Salience; Injury Threat	Recognition	One-Reason Injury Threat	Compensatory	Social Injunctive Pressure (peers)		

Table 17. Ludwig et al. Intervention Methods Correlated with Lasting Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
	X	**X**		**X**	**X**	**X**

F. WERCH ET AL.

1. Description

Werch et al. investigated the influence of descriptive and injunctive norms on student alcohol consumption.[368] A sample of 634 participants were recruited from the first year class of a U.S. college and randomly assigned to the treatment or control conditions.[369] Students in the treatment condition received a subjective norms-based intervention, while students in the control group were given the school's standard prevention program.[370] Baseline data on student alcohol use was obtained at the

[368] Chudley Werch et al., "Results of a Social Norm Intervention to Prevent Binge Drinking among First-Year Residential College Students," *Journal of American College Health* 49, no. 2 (2000): 85–92.

[369] Ibid., 86.

[370] Ibid.

beginning of the fall 1998 semester, and post-intervention use was recorded at the end of the spring 1999 semester.[371]

The intervention consisted of a series of three greetings cards mailed to treatment students during the fall semester, and telephone call made to these same students during the spring.[372] Greeting cards were sent shortly before Halloween, Thanksgiving, and winter break, holidays that are associated with increased drinking.[373] Each card featured images of attractive students, descriptive information about the actual prevalence of student drinking on campus, and injunctive statements indicating that most disapprove of heavy drinking by their peers.[374] Telephone calls placed by peers in the spring semester encouraged treatment subjects to avoid unhealthy drinking.[375]

No effect on alcohol consumption was observed during the course of this study.[376] Alcohol use indicators remained the same or worsened slightly from baseline to post-intervention for both the intervention and control groups.[377] Follow-up surveys of the treatment group found that 84 percent of students recalled at least two of the greeting cards, and 80 percent of students thought that the phone calls were very effective or effective.[378]

2. Analysis of Case 8: Werch et al.

a. Outcome: No Effect

No difference was observed between intervention and control groups.[379]

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[371] Ibid.

[372] Ibid., 86–87.

[373] Ibid.

[374] Ibid.

[375] Ibid., 87.

[376] Ibid., 88–89.

[377] Ibid.

[378] Ibid., 87.

[379] Ibid., 88–89.

b. Model 1 Analysis

Expected utility calculations were not influenced by this intervention, and therefore the treatment produced No Effect.

c. Model 2 Analysis

This intervention attempted to moderate student drinking behavior through social factors. Descriptive norms of average student drinking habits were meant to correct subject's misconceptions about the drinking behavior of their peers and inspire moderation through conformity. The spring semester telephone call from an unknown and anonymous peer was intended to exert an injunctive pressure to reduce alcohol consumption. Neither intervention method was successful.

d. Model 3 Analysis

Availability, anchoring and social heuristics were targeted by this intervention. Salience from the greeting cards and telephone call had aimed to moderate drinking through the availability or anchoring heuristics. The social heuristics of herding, whereby individuals conform to the descriptive norm, and injunctive norms from anonymous peers were also intended to change drinking behavior.

e. Model 4 Analysis

Simplified aspiration-level and social decision making heuristics might have been activated by the methods of this intervention. Salience from the greetings cards and telephone call could have altered the search order of aspiration-level strategies to encounter the option of not drinking prior to other satisficing alternatives. Descriptive norms encouraged students to adopt an imitate-the-majority decision making strategy, while injunctive pressure communicated by an anonymous peer over the telephone was intended to produce conformity to authoritative direction.

f. Coding of Case 8 Data Structures

The matrix describing the intervention methods and activated factors of individual action that are correlated with the outcome of Case 8 is shown in Table 18. The reduced

array of independent variables representing the intervention methods correlated with the outcome of Case 8 is displayed in Table 19.

Table 18. Werch et al. Activated Factors of Individual Action

Model 1	Expected Utility						
Model 2	Attitudes	Subjective Norm Descriptive norm; Injunctive pressure (anonymous peer)	Self-Efficacy	Skills	Barriers		
Model 3	Representative	Availability Salience	Anchoring Salience	Affect	Optimism	Loss Aversion	Social Descriptive norm (herding); Injunctive pressure (anonymous peer)
Model 4	Aspiration-Level Salience	Recognition	One-Reason	Compensatory	Social Descriptive norm (imitate the majority); Injunctive pressure (anonymous peer)		

Table 19. Werch et al. Intervention Methods Correlated with No Effect

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
		X	**X**	**X**		

G. COLLINS ET AL.

1. Description

Collins et al. evaluated the influence of descriptive norms and public commitment on the alcohol consumption of college students.[380] The study selected 100 participants from a psychology course who reported at least two occurrences of heavy drinking in the last month, and randomly assigned these subjects by gender to treatment or control

[380] Susan E. Collins, Kate B. Carey, and Martin J. Sliwinski, "Mailed Personalized Normative Feedback as a Brief Intervention for at-Risk College Drinkers," *Journal of Studies on Alcohol* 63, no. 5 (2002): 559–567.

groups.[381] Measures of alcohol use, attitudes, and alcohol-related consequences were obtained at a baseline screening session, as well as six weeks and six months post-intervention.[382]

The intervention provided personalized normative feedback to influence the drinking habits of the experimental group.[383] After completing baseline screening, members of the treatment group received a document describing the subject's self-reported alcohol use indicators, along with gender-specific descriptive norms of alcohol use on campus and nationwide.[384] Definitions of the alcohol use metrics were included, but no analysis of the subject's drinking habits relative to the norm were provided.[385] Students in the control condition received a brochure containing educational information about alcohol use.[386]

Only short-term effects were produced by the treatment condition.[387] Alcohol consumption by students receiving the treatment was reduced significantly relative to that of control students at a six week follow-up assessment, but after six months the alcohol use of both groups returned to levels near baseline.[388] Of the original 100 subjects, 95 participated in baseline screening, 94 provided six week alcohol use data, and 65 answered the six month follow-up.[389]

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[381] Ibid., 561–62.

[382] Ibid.

[383] Ibid., 562.

[384] Ibid.

[385] Ibid.

[386] Ibid.

[387] Ibid., 565.

[388] Ibid.

[389] Ibid., 563.

2. Analysis of Case 9: Collins et al.

a. Outcome: Temporary Success

The treatment group reported healthier alcohol use practices at six weeks post-intervention compared to the control group, but treatment alcohol use indicators returned to baseline at six month follow up.[390]

b. Model 1 Analysis

Some aspect of this intervention must have altered expected utility calculations temporarily to optimize the choice of drinking less in the short-term following treatment.

c. Model 2 Analysis

The IMBP explains the temporary reduction in alcohol use by the intervention group as an attempt to conform to descriptive norms of the alcohol use of a typical student.

d. Model 3 Analysis

This intervention used a single, brief instance of personalized normative feedback to influence drinking behavior by leveraging availability, anchoring, and social heuristics. The intervention was intended to be brief but highly salient so as to make moderate drinking behavior more available to students' minds, or to prime them to consider controlled alcohol use. Socially, this intervention could have altered behavior through descriptive norms to produce a herding effect, and by leveraging an individual's intuitive desire to maintain consistency with their perceived public image as a normal drinker. The disparity between the students' own heavy drinking behavior and that of the average student might have produced dissonance that motivated the student to change their behavior.

[390] Ibid., 565.

e. Model 4 Analysis

Simplified aspiration-level and social decision making heuristics explain the Temporary Success of this program. Salience from the brief yet significant intervention altered the search order of aspiration-level strategies to encounter the option of not drinking prior to other satisficing alternatives. Descriptive norms of average student alcohol use might also have moderated drinking by guiding students to adopt an imitate-the-majority strategy when making drinking decisions.

f. Coding of Case 9 Data Structures

The matrix describing the intervention methods and activated factors of individual action that are correlated with the outcome of Case 9 is shown in Table 20. The reduced array of independent variables representing the intervention methods correlated with the outcome of Case 9 is displayed in Table 21.

Table 20. Collins et al. Activated Factors of Individual Action

Model 1	Expected Utility						
Model 2	Attitudes	Subjective Norm Descriptive norm	Self-Efficacy	Skills	Barriers		
Model 3	Representative	Availability Salience	Anchoring Salience	Affect	Optimism	Loss Aversion	Social Descriptive norm (herding); Public commitment
Model 4	Aspiration-Level Salience	Recognition	One-Reason	Compensatory	Social Descriptive norm (imitate the majority)		

Table 21. Collins et al. Intervention Methods Correlated with Temporary Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
		X	**X**		**X**	

H. SUMMARY

This chapter analyzed nine cases that were derived from seven studies of public health and safety interventions. Each case was analyzed using a four-model approach to produce a matrix of intervention methods and activated factors of choice or behavior. The resulting matrices were then reduced to arrays of intervention methods that are correlated with the program outcome for each case. The elements of these arrays are independent variables that represent the intervention methods encountered during the nine case analyses: economic incentives, injury threats, salience, descriptive social norms, injunctive social norms, public commitments, and barrier removals. These independent variable arrays are the data that serve as input to the comparative analysis conducted in the following chapter. Table 22 displays the arrays of intervention methods correlated with program outcome for all cases on a single page, organized by outcome, to facilitate productive comparative analysis through visual recognition of patterns and detection of similar intervention method arrays that can control for the influence of identical variables.

Table 22. Intervention Methods Correlated with Program Outcome for all Cases

Rudd and Geller Students/Faculty/Staff Intervention Methods Correlated with Lasting Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive norm	Public Commitment	Remove Barrier
X				**X**		

Parkin et al. High-Income Intervention Methods Correlated with Lasting Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
	X			**X**	**X**	**X**

Ludwig et al. Intervention Methods Correlated with Lasting Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
	X	**X**		**X**	**X**	**X**

Geller et al. Intervention Methods Correlated with Temporary Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
X						

Rudd and Geller Police Officers Intervention Methods Correlated with Temporary Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
		X		**X**	**X**	

Collins et al. Intervention Methods Correlated with Temporary Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
		X	**X**		**X**	

Robertson et al. Intervention Methods Correlated with No Effect

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
	X	**X**				

Parkin et al. Low-Income Intervention Methods Correlated with No Effect

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
	X			**X**	**X**	**X**

Werch et al. Intervention Methods Correlated with No Effect

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
		X	**X**	**X**		

V. COMPARATIVE ANALYSIS

This chapter conducts a comparative analysis between the arrays of independent variables generated from each case in Chapter IV in order to identify methods that are correlated with the success of public health and safety interventions in general. Discovery of a set of methods correlated with program success could guide the design of new interventions and suggest future experimentally designed research studies to establish the causality of these methods. Before delving into the full comparative analysis, the first section of this chapter attempts a simplified, integrative approach to analyze the independent variable arrays. This initial technique proves inadequate, however, thereby demonstrating the necessity of the comparative analysis research design. The second section conducts the formal comparative analysis by examining the three classes of pairings defined in Chapter III. The comparative analysis process uses pairs of independent variable arrays that represent the nine cases to selectively control for the influence of certain variables, thereby permitting inference of those methods that are correlated with success across the entire selection of cases examined by this thesis. A summary section follows these two analysis techniques to review the progress of this thesis at the completion of the comparative analysis.

A. INTEGRATION OF CORRELATED INTERVENTION METHODS

A straightforward integration of potentially influential methods by program outcome constitutes a first attempt towards understanding the mechanisms behind the success or failure of health and safety interventions. The intervention method arrays generated from analysis of the individual cases are grouped according to outcome, and within each group the intervention method arrays are then combined to produce a new array that represents the methods that are correlated with that group outcome across all selected cases. The number of cases employing a particular method within each group are enumerated to obtain a possible indication of the correlational strength between that method and the group outcome. This integrative analysis weights all cases equally when tallying instances of method use, though an unequal case weighting based on sample size

or some other indicator of significance would represent another valid approach. The number of instances that each intervention method was correlated with Lasting Success are described by Table 23, the number of instances that each method was correlated with Temporary Success are represented by Table 24, and the number of instances that each method was correlated with No Effect are shown in Table 25.

Table 23. Instances of Intervention Methods Correlated with Lasting Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
1	**2**	**1**	**0**	**3**	**2**	**2**

Table 24. Instances of Intervention Methods Correlated with Temporary Success

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
1	**0**	**2**	**1**	**1**	**2**	**0**

Table 25. Instances of Intervention Methods Correlated with No Effect

Economic Incentive	Injury Threat	Salience	Descriptive norm	Injunctive pressure	Public Commitment	Remove Barrier
0	**2**	**2**	**1**	**2**	**1**	**1**

Analysis of the integrated sets of methods that are correlated with each outcome does not yield useful insights into the factors that contribute to program success. Cursory examination of these sets reveals that each intervention method is correlated with at least two different outcomes, and many methods are in fact associated with all three of the outcomes encountered in this thesis. The only inference that may be drawn from these results is that the factors that produce a successful health and safety intervention cannot be reduced down to the mere presence or absence of a universal method, but will instead require a more involved analysis to understand the reasons why change programs succeed or fail.

B. CONDUCTING THE COMPARATIVE ANALYSIS

A comparative analysis of the individual cases examined in this study will permit a more nuanced investigation of the methods that contribute to a successful health and safety intervention. This analysis will adhere to the methodology defined in Chapter III in order to produce reliable and credible results. Three classes of comparisons were defined in the methodology of this comparative case study, with each class guiding case pair selection and providing a detailed process by which to isolate variables from the sets of intervention methods correlated with each case outcome to infer a set of intervention methods that are correlated with successful public health and safety programs in general.

1. Identical Outcomes, Different Methods

Identifying common methods used by health and safety interventions to achieve Lasting Success cannot establish the causality of these shared methods, but may guide later analysis when pairs of cases that produce different outcomes are compared. Examination of the intervention methods acting upon Rudd and Geller's students alongside the methods influencing Parkin et al.'s high-income children reveals that both cases employed injunctive pressure as part of their recipes for Lasting Success. These injunctive forces were exerted by police towards Rudd and Geller's students, and by some combination of peers, teachers, parents, and celebrity towards Parkin et al.'s high-income children. Relating the factors influencing Rudd and Geller's students to those of Ludwig et al.'s study again finds that injunctive pressure may have played a role in producing Lasting Success through social forces originating from police in Rudd and Geller's case and from peers under the Ludwig et al. intervention. This finding of injunctive pressure as a common correlated factor in two pairings of successful health and safety interventions suggests that the role of this variable should be scrutinized in subsequent comparisons.

An examination of the cases resulting in Temporary Success suggests that economic incentives will only change behavior as long as individuals are rewarded. Drivers in the contingent lot of Geller et al.'s study wore seat belts at an increased rate

until they realized they would no longer be paid to do so.[391] Comparison among the three Temporary Success cases is unable to offer additional insights regarding singular methods associated with this outcome, however, because all pairings involve either two shared methods or none.

2. Similar Methods, Different Outcomes

Comparative analysis of cases with different outcomes may provide insight into the methods that determine program success. Synthesizing the inferences produced by this series of case comparisons may allow observations to build upon each other to gain further understanding of the mechanisms that drive change.

Analyzing Rudd and Geller's students in conjunction with Geller et al.'s contingent lot drivers reveals the power of injunctive pressure to produce lasting health and safety improvements. Both groups were exposed to economic incentives, suggesting that the influence of rewards on program outcome was controlled for in this comparison, and therefore could not have caused the difference between Rudd and Geller's Lasting Success and Geller et al.'s Temporary Success. This inference is further bolstered by the observation from Geller et al. that economic incentives are unable to produce Lasting Success.[392] With economic incentives controlled or discounted and only one other intervention remaining that could have influenced Rudd and Geller's students, we can infer that injunctive pressure from campus police must have been responsible for the lasting increase in student, faculty, and staff seat belt use.

Descriptive norms and salience were employed by both Werch et al. and Collins et al., suggesting that the variation in program outcome must have been caused instead by the methods on which these interventions differed. Werch et al. applied injunctive pressure via a single telephone call from an anonymous student but did not produce any effect on the treatment group.[393] Collins et al. achieved Temporary Success by leveraging

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[391] Geller, Paterson, and Talbott, "A Behavioral Analysis of Incentive Prompts for Motivating Seat Belt Use," 403.

[392] Ibid., 412.

[393] Werch et al., "Results of a Social Norm Intervention to Prevent Binge Drinking among First-Year Residential College Students," 87–89.

subjects' commitments to their perceived public images through dissonance-producing personalized normative feedback.[394] This comparison reveals that some sources of injunctive pressure are insufficient to effect any change, and that commitment to individuals' perceived public images can motivate at least a temporary change.

The set of possible methods that explain Ludwig et al.'s Lasting Success can be reduced to injunctive pressure from peers, public commitment, and barrier removal. Although Ludwig et al.'s intervention employed five methods, the role of injury threats and salience can be ruled out for two reasons. The first reason is that the Robertson et al. findings alone indicate that salient injury threats produce no effect.[395] Secondly, the influence of injury threats and salience on Ludwig et al.'s outcome are controlled by comparison to Robertson et al.'s array of independent variables, therefore indicating that the difference between Ludwig et al.'s Lasting Success and Robertson et al.'s No Effect must be due to variation on the uncontrolled variables.

Comparing Ludwig et al. with Rudd and Geller's campus police raises questions about the nature of the injunctive pressures and public commitments that are successful in improving health and safety. After comparing Ludgwig et al. to Robertson et al., the set of possible intervention methods that could explain the Lasting Success of Ludwig et al. were reduced to injunctive pressure from peers, public commitment from pledge cards and program stickers affixed on helmets, and barrier removal with free helmet coupons. When the intervention methods acting upon Rudd and Geller's police are compared to the reduced set of methods from Ludwig et al., the shared presence of injunctive pressure and public commitments in both cases should then control for the influence of these variables on program outcome. This would suggest that barrier removal, Ludwig et al.'s sole remaining uncontrolled method, must have been responsible for the Lasting Success achieved in this case as opposed to the Temporary Success produced with Rudd and Geller's police. Review of the Rudd and Geller study, however, indicates that there were

[394] Collins, Carey, and Sliwinski, "Mailed Personalized Normative Feedback as a Brief Intervention for at-Risk College Drinkers," 562–64.

[395] Robertson et al., "A Controlled Study of the Effect of Television Messages on Safety Belt Use," 1078.

no environmental barriers preventing police from buckling up.[396] This suggests that barrier removals could not be responsible for the difference between Ludwig et al.'s Lasting Success and Rudd and Geller's Temporary Success, a realization which casts doubt on the previous assumption that the influence of injunctive pressure and public commitments on program outcome were controlled for by the comparison of these two cases.

The injunctive pressures and public commitments applied to Ludwig et al.'s students must be different in some way from those experienced by Rudd and Geller's police if the comparison of these cases did not control for the influence of these methods on program outcome. The lasting increase in bicycle helmet use among students in Ludwig et al. was motivated by injunctive pressure from other peer cyclists and by participants' public commitments to maintain consistency with signed pledge cards and program stickers affixed to their helmets. Rudd and Geller's campus police temporarily increased their seat belt use in response to injunctive pressure from researchers and an implicit public commitment to buckle up when recording the license plate numbers of other belted drivers for entry in the sweepstakes raffle. While Ludwig et al. maintained a persistent influence by instilling participants with the perception that the population of helmeted bicycle riding peers on campus concealed peer agents who would judge helmetless riders negatively (especially if the participant were recognized as pledge-breakers), Geller et al.'s intervention ceased to exert any social influence on campus police once their interactions with researchers ended and police no longer monitored the public's seat belt use. This distinction implies that injunctive pressure and public commitments are powerful tools for change, but only while the sources exerting these social forces are perceived to be present.

Returning to Collins et al. with the newfound understanding that public commitments only produce change while an individual perceives dissonance in their actions allows for a satisfactory explanation of the temporary results achieved by this intervention. The earlier comparison of Collins et al. with Werch et al. established that a

[396] Rudd and Geller, "A University-Based Incentive Program to Increase Safety Belt Use."

subject's commitment to maintaining consistency with their perceived public image was wholly responsible for a temporary improvement in drinking habits. This result is now unsurprising and offers additional support for the finding that public commitments are effective methods achieving change in health and safety that will persist as long as subjects continue to perceive dissonance between their commitments and their actions.

The necessity of presence for the successful application of injunctive pressure is further demonstrated by comparing the different outcomes observed among Rudd and Geller's student, faculty, and staff population compared to that of the campus police in their study. As previously established, the lasting change in seat belt use among Rudd and Geller's student, faculty, and staff population was produced solely by injunctive pressure perceived from campus police monitoring of seat belt use. This result aligns with the findings of previous comparisons, as elevated seat belt compliance is expected to persist while the ever-present campus police continue to exert injunctive pressure. The failure of injunctive pressure originating from researchers to achieve lasting change in campus police seat belt use is explained by the close of the study and the end of scrutiny perceived by the police.

3. Identical Methods

Analyzing a pair of cases that employed identical sets of intervention methods can increase confidence in findings when both cases produce the same outcome, or can identify possible errors in coding or issues with research design when inconsistent outcomes are generated. The comparative analysis of Parkin et al.'s high-income and low-income children falls into the latter category, with the case codebook defined in Chapter IV guiding identical coding of the independent variables that represent the intervention methods used in each case, a problematic result given the different outcomes produced from these same inputs. A reassessment of the Parkin et al. intervention did not identify a failure to adhere to coding methodology, nor was this effort capable of locating additional factors of individual action missed by the four models of analysis, indicating a possible issue with research design.

The inconsistency detected in the comparative analysis of Parkin et al.'s high-income and low-income children reveals that the independent variables representing intervention methods in this thesis are unable to fully express the particulars of some cases. Parkin et al. found greater helmet use in high-income treatment schoolyards compared to high-income control schoolyards, but did not detect a difference in helmet use between treatment and control schoolyards in low-income areas.[397] These findings suggest that teachers in high-income areas exerted effective injunctive pressure that caused students more students to wear their helmets, while teachers in low-income schools did not influence children's helmet use. If injunctive pressure had been represented by an independent variable for each source, then the high-income and low-income children would differ only on the variable of injunctive pressure from teachers. A comparative analysis of these cases would control for the influence of all intervention methods except for injunctive pressure from teachers, thereby indicating that the success in Parkin et al.'s high-income schools was due to the addition of this influence.

This lack of granularity in the variables representing intervention methods may be unavoidable. If the independent variables were expanded to capture a greater degree of detail, then the ability to draw inferences from case comparisons would be reduced. With more specific intervention method variables, fewer shared methods would be present among case pairs, greatly limiting the ability to control for the influence of these methods on intervention outcomes. This would make identification of the intervention methods correlated with success across the selection of cases examined by this thesis more challenging, if not impossible. These conflicting needs for both specificity and generality in coding intervention methods demonstrate the strength of qualitative analysis to resolve inconsistencies, as well as the need to collect and retain sufficient data to permit such analysis.

Not only does the more detailed comparative analysis of Parkin et al. suggest that injunctive pressure contributed to success in the high-income case, it also raises further questions about the nature of effective injunctive pressure. Parkin et al. found that far

fewer children rode their bicycles to school in low-income areas compared to high-income neighborhoods.[398] Comparative analyses of previous cases have suggested that injunctive pressure is effective as long as a source is perceived to be present and exerting this force. It is unclear from these findings, however, if the failure to produce change in Parkin et al.'s low-income case was caused by a lack of presence due to the relatively low number of children who rode to school in low-income neighborhoods, or if there was something different about the nature of either the teachers or the children in the low-income case that prevented injunctive pressure from having an effect.

C. SUMMARY

This chapter conducted a comparative analysis between the intervention methods employed by each case in order to identify methods that are correlated with program success across the selection of cases examined in this thesis. The first section established the need for analyzing pairs of cases, while the second section conducted these comparisons and found a limited number of intervention methods correlated with success. Although these findings are correlational and not causal, they do permit conclusions and recommendations that may improve public health and safety.

[398] Parkin et al., "Evaluation of a Promotional Strategy to Increase Bicycle Helmet Use by Children," 774.

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VI. CONCLUSION

This thesis constitutes a search for methods that may be used to design and implement successful public health and safety interventions. This investigation was initially motivated by a desire to improve the smoke alarm interventions of fire and life safety education. While reviewing studies of smoke alarm programs, it became apparent that fire and life safety education practitioners did not adequately understand how to influence individuals to install and maintain these crucial lifesaving devices.[399] This problem was not limited to fire and life safety education, however, as other fields of unintentional injury prevention were found to be similarly uncertain of the determinant factors that cause individuals to perform recommended health and safety actions.[400] Further complicating this pursuit was a lack of reliable, longitudinal data describing fire and life safety education interventions.[401]

A comparative case study research design was employed to identify intervention methods that are correlated with successful public health and safety programs. Before any cases could be analyzed to identify potentially influential methods, however, this thesis first had to develop a model of individual action that was capable of capturing the factors that might cause individuals to perform health and safety practices. A review of the literature on rational choice, reasoned behavior, and behavioral economics suggested four models of individual action: rational decision making among alternatives, reasoned behavior in isolation, nonrational behavior in isolation, and nonrational decision making among alternatives. Armed with this multi-model approach, a selection of cases were analyzed to interpret which intervention methods might have acted upon individuals to produce the associated case outcome. Due to the lack of reliable data in fire and life safety education, these cases were drawn from interventions targeting seat belts, bicycle helmets, and alcohol consumption. Comparative analysis between the sets of methods

[399] Thompson, Waterman, and Sleet, "Using Behavioral Science to Improve Fire Escape Behaviors in Response to a Smoke Alarm," 185.

[400] Trifiletti et al., "Behavioral and Social Sciences Theories and Models," 298.

[401] Ta et al., "Evaluated Community Fire Safety Interventions in the United States: A Review of Current Literature," 195.

used in each case allowed for inference of the methods that were correlated with success across the entire selection of cases examined in this thesis. The findings of this comparative case study permit conclusions and support recommendations that may enhance public health and safety.

A. FINDINGS

1. Models of Individual Action

The literature on rational choice, reasoned behavior, and behavioral economics informed development of the four models of analysis that were used to detect the intervention methods employed by each case. The established field of rational choice featured Expected Utility Theory, which provided this thesis with a model of rational decision making among alternatives.[402] Reasoned behavior is a field moving towards convergence, with the Integrative Model of Behavioral Prediction purported to be a generalized model that represents reasoned behavior in isolation.[403] The emerging field of behavioral economics offered two perspectives from which to derive models of individual action. The first is the heuristics and biases program, which considers heuristics to be the source of errors which prevent humans from achieving optimal results.[404] The fast and frugal heuristics program, on the other hand, asserts that individuals intentionally use simplified, heuristic strategies to achieve satisfactory results with little effort.[405] Discussion within the behavioral economics literature was largely concerned with establishing definitions of rationality and classifying heuristics as products of either intuitive system 1 or reflective system 2 cognitive processes.[406] Although the interpretation of individual action as either behavior or choice was largely ignored by this literature, the heuristics and biases program implied a model of nonrational behavior in isolation, while the fast and frugal heuristics program suggested a model of nonrational decision making among alternatives. This four-model approach to

[402] Edwards, "The Theory of Decision Making," 391.

[403] Ajzen and Fishbein, "The Influence of Attitudes on Behavior," 195.

[404] Kahneman and Frederick, "Attribute Substitution in Intuitive Judgment," 414.

[405] Goldstein and Gigerenzer, "Fast and Frugal Forecasting," 760.

[406] Hertwig and Herzog, "Fast and Frugal Heuristics: Tools of Social Rationality," 668–69.

analysis was intentionally designed to detect a wide range of intervention methods correlated with each program outcome.

2. Strengths of the Comparative Case Study Research Design

The comparative case study proved to be a powerful research design. It permitted the discovery of a refined set of methods correlated with successful health and safety interventions across the selection of cases included in this thesis. Additionally, the comparative case study facilitated the development of hypotheses regarding the causality of relationships between the independent and dependent variables identified by this thesis.[407] The intervention methods found to be correlated with success in general can be used without definitive evidence to plan future health and safety interventions, and may also inform hypotheses of causality to be tested in experimentally designed research studies.

3. Insight through Qualitative Analysis

Qualitative analysis was revealed as a robust method capable of supporting multiple perspectives for increased insight. When the simplified mapping from matrices of intervention methods and activated factors of individual action to arrays of Boolean values representing intervention methods was stymied by the comparative analysis of Parkin et al.'s high-income and low-income cases, a return to the raw qualitative analysis data permitted a more nuanced inspection of the differences between the intervention methods acting upon these two population groups. Not only did reexamination of the details of the Parkin et al. study raise questions about the nature of effective injunctive pressure, the opportunity to reconsider the Boolean simplifications that were intended to facilitate control and isolation of independent variables demonstrated the importance of preserving qualitative data.

[407] Kaarbo and Beasley, "A Practical Guide to the Comparative Case Study Method in Political Psychology," 374–75.

4. Results

Finally, the intervention methods found to be correlated with successful health and safety programs across the selection of cases examined in this thesis provided evidence for the efficacy of several intervention methods to influence individuals, while other methods were shown to have limited or no effect. Injunctive pressure produced changes in individuals' actions that persisted while the sources of those pressures were perceived to be present, but ceased when those sources were removed. Public commitments combined with the continued presence of pledge reminders contributed to a lasting improvement in safety, while a single, brief introduction of dissonance in self-image caused individuals to temporarily engage in healthier actions to restore consistency with their perceived public image. Economic incentives did influence individuals to change their actions, but these changes persisted only as long as individuals were rewarded for their performance. Salient injury threats did not have any effect on subjects' actions.

B. CONCLUSIONS

1. Methods of Influence

The results of this study permit several informative conclusions regarding the methods that can be used to influence individuals. Injunctive pressure is a highly effective tool for producing change, provided that individuals believe they are liable to be judged negatively if they do not perform desired actions. Public commitments are also a viable means of achieving at least a temporary improvement in health and safety, but individuals may have to be occasionally reminded of these commitments to maintain compliance. The impact of these two methods reveals the power that social forces possess to guide the actions of individuals.

The findings of this comparative case study also inform conclusions about those methods that are not useful for improving individuals' health and safety actions. The use of economic incentives is not a sustainable method for producing widespread change, as the number of individuals who would have to be perpetually rewarded would render the costs impractical. This conclusion receives additional support from a review of multiple

bicycle helmet interventions, which also found that safety gains are lost when extrinsic rewards are removed.[408] Another conclusion of the present research is that salient injury threats are incapable of influencing individuals, possibly because the salience of these threats activates optimism bias, which then overrides any effects that might be produced by a change in attitudes and affect, or a reaction motivated by loss aversion. This conclusion only applies to the conjunction of salience with injury threats, however, as the findings of this research do not permit conclusions regarding the impact of salience or injury threats alone. It remains possible that non-salient injury threats might produce change, perhaps by subtly altering a subject's attitudes or activating an affective or loss averse response without triggering optimism bias.

2. Future Research

Future research could both hone and extend the conclusions reached in this study. Using the methodology defined in Chapter III, additional interventions may be analyzed and compared against this initial set of cases to test the conclusions reached herein and possibly reveal additional inferences regarding influential intervention methods. Such further analysis might discover if the power of injunctive pressure varies based on the identity of its source, or if injunctive pressure from any source is equally effective provided it is perceived as present. Analysis of additional cases could also explore if public commitments are capable of producing a lasting health and safety improvement without injunctive pressure. The effect of subtle, non-salient injury threats could also be determined if an appropriate intervention employing this method can be found. Finally, experimental research studies that employ treatment and control groups could evaluate the effect of the intervention methods found by this thesis to be correlated with success, thereby providing conclusive evidence that these methods are indeed causal factors of effective public health and safety interventions.

[408] Nancy J. Thompson, David Sleet, and Jeffrey J. Sacks, "Increasing the Use of Bicycle Helmets: Lessons from Behavioral Science," *Patient Education and Counseling* 46, no. 3 (2002): 193.

3. Ethical Considerations

Despite the potential to enhance public health and safety, the prospective use of public commitments and injunctive pressure to influence or nudge individuals does raise serious ethical questions. While some have argued that transparency regarding the intent and methods of a nudge renders it acceptable and non-manipulative, the classification of public commitments as transparent by these authors is not sufficiently reassuring.[409] A progression of public commitments was reportedly used in Chinese prison camps during the Korean War to subtly twist American prisoners of war to collaborate and inform on their compatriots.[410] This intervention worked by encouraging subjects to agree with seemingly innocuous statements criticizing the United States, sources of dissonance that then caused these individuals to alter their thoughts and actions to achieve consistency with these statements.[411] The use of injunctive pressure appears similarly troubling, as the motivation and means of influence behind this social force may not be readily apparent to its recipients. With public commitments used in prison camp conditioning, and the proposed campaign of injunctive pressure eerily reminiscent of a modern-day panopticon, health and safety practitioners must exercise the utmost caution to ensure that any use of these methods is responsible and controlled.

C. RECOMMENDATIONS

Achieving widespread change in individual-level health and safety is an ambitious and challenging goal. Obvious injury threats are ineffective even when they are made implicitly by promoting desired actions as a means of reducing health and safety risks. Rewarding every member of the public indefinitely in order to incentivize beneficial health and safety actions is not economically feasible. It is also not possible for health and safety practitioners to maintain a sufficient surveillance presence to exert the necessary injunctive pressure on the entire public to elicit widespread compliance with recommended practices, nor is it practical for these practitioners to secure commitment

409 Hansen and Jespersen, "Nudge and the Manipulation of Choice," 21.

410 Robert Cialdini, *Influence: Science and Practice*, vol. 5 (Boston: Pearson Education, 2009), Kindle Edition, location 1536.

411 Ibid.

pledges from every individual within the population. Through deliberate and targeted interventions, however, health and safety practitioners may be able to initiate a social reaction that spreads far beyond the limited reach of direct practitioner influence.

1. An Exponential Method of Influence

Practitioners should mount focused interventions that light a fire within the public for health and safety by crowd-sourcing injunctive pressure and public commitments. Limited, practitioner-implemented interventions could exert injunctive pressure and obtain public commitments from incentivized or volunteer peer agents, who would then be directed to pressure their neighbors, friends, and family to perform desired health or safety actions and secure pledges committing to those practices. Peer agents would pressure these individuals to encourage others to act in a healthy or safe manner, while also obtaining public commitments from these second-order subjects. To prevent the influence of public commitments from waning as in Collins et al., pledges should be constant fixtures that are advertised as widely as possible, perhaps by encouraging individuals to share these statements via social media.

2. Crowd-Sourcing Smoke Alarm Advocacy and Enforcement

Effective smoke alarm interventions might be designed by adhering to the preceding description of a public-driven health and safety campaign. Injunctive pressure and public commitments would be the core methods of this intervention, but practitioners should not attempt to exert these forces on the public at large. Rather, the extent of the practitioner's role in encouraging smoke alarm installation and maintenance would be to indoctrinate a limited number of peer agents dispersed throughout each community. It is these peer agents who would be responsible for applying injunctive pressure and obtaining public commitments from the majority in order to encourage widespread smoke alarm compliance. Members of local fire departments may be well positioned to fulfill the role of practitioners, as they are capable of reaching a diverse, distributed collection of peer agents throughout their jurisdictions.

Practitioners from local fire departments could cultivate a cadre of peer agents through public commitments and the judicious use of injunctive pressure to elicit

compliance with pledges. Public commitments are an ideal intervention method because they are a relatively cheap foot-in-the-door technique that can be applied to numerous potential peer agents without concern for wasted program resources should some of these individuals not respond as desired. Members of local fire departments could seek peer agents under the guise of door to door smoke alarm inspections. Occupants found to be in compliance with recommended smoke alarm standards should be considered for recruitment as peer agents. At no point should practitioners attempt to change attitudes or activate fear appeals through discussion about the safety benefits of smoke alarms or the repercussions for their absence, as these methods were previously found to be ineffective. Instead, practitioners should congratulate compliant residents on their responsible smoke alarm practices and ask these individuals to make a public commitment to maintain this level of smoke alarm protection in their own household, and to also pledge to help those around them accomplish the same. These commitments should be shared as widely as possible, using social media statements, signs displayed on lawns or front doors, and distribution of emails to family, friends, and coworkers. These seemingly innocuous pledges should cause peer agents to perceive injunctive pressure to uphold these vows from the fire department members who recruited them, as well as from family, friends, coworkers, and social media contacts who observed this public commitment.

Infrequent and seemingly random follow-up visits to peer agents should be performed to encourage consistency with public commitments, and to provide practitioners with an opportunity to launch the second phase of this intervention. The random nature of these visits should make the initial set of peer agents perceive injunctive pressure from the previously complimentary local fire department recruiters, who might appear at any time and judge these occupants poorly if their smoke alarm coverage is found to be inadequate on a follow up visit. This delay between initial recruitment and follow-up would also allow time for peer agents to influence other second-order subjects within their social circles to comply with recommended smoke alarm standards. During follow-up visits, practitioners should ask initial peer agents to make another public commitment, this time pledging to ask their second-order subjects to make their own public commitments to maintain adequate smoke alarm coverage and to

also agree to help others attain proper smoke alarm coverage. If successful, this second stage of the intervention would generate an explosive growth in the number of peer agents working towards achieving complete smoke alarm protection.

Practitioners should continue to perform follow-up visits that apply targeted pressure on the original set of peer agents in order to sustain the influence of this intervention. These visits should exert injunctive pressure on peer agents to remain consistent with their public commitment to maintain adequate smoke alarm coverage within their household, and to uphold their pledge to obtain similar public commitments from others. By engaging the public in smoke alarm advocacy, this intervention may succeed in achieving the goal of full compliance with smoke alarm protection recommendations.

3. Summary

The conclusions of this comparative case study indicate that a lasting improvement in smoke alarm compliance, or in any other public health and safety practice, may be attained provided that individuals remember their public commitments and perceive themselves to be recipients of injunctive pressure. If the intervention described above is successful in making the first and second-order subjects commit to and feel pressure to maintain adequate smoke alarm protection while eliciting the same from others, then this process should become self-sustaining. Admittedly, any intervention of this type would initially influence only a relatively small number of individuals. By kindling a flame of civic engagement, however, the resulting chain reaction could propagate an exponential, public-driven improvement in health and safety.

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