3-30-2022

Do Home Invasion Serial Killers Warrant a Distinct Classification from Other Serial Killer Location Types? A Retrospective Comparative Examination

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DO HOME INVASION SERIAL KILLERS WARRANT A DISTINCT CLASSIFICATION FROM OTHER SERIAL KILLER LOCATION TYPES? A RETROSPECTIVE COMPARATIVE EXAMINATION

A dissertation submitted in partial fulfillment of

the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

INTERNATIONAL CRIME AND JUSTICE

by

Caroline V. Comerford

2022

To: Dean John F. Stack
Steven J. Green School of International Public Affairs

This dissertation, written by Caroline V. Comerford, and entitled Do Home Invasion Serial Killers Warrant a Distinct Classification from Other Serial Killer Location Types? A Retrospective Comparative Examination, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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Jennifer Gebelein

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Tim Goddard

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Stephen F. Pires, Co-Major Professor

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Rob T. Guerette, Co-Major Professor

Date of Defense: March 30, 2022

The dissertation of Caroline V. Comerford is approved.

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Dean John F. Stack, Jr.
Steven J. Green School of International and Public Affairs

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Andrés G. Gil
Vice President for Research and Economic Development
and Dean of the University Graduate School

Florida International University, 2022

DEDICATION

To saving lives by hunting those that wish to take them.

ACKNOWLEDGMENTS

First and foremost, I want to express my most profound appreciation to my esteemed supervisor, mentor, and Chair of my dissertation committee, Dr. Rob Guerette. Thank you for your invaluable supervision, guidance, unwavering support, and belief in me throughout my Ph.D. journey. Not only have you played a pivotal role as my dissertation Chair, but you also took me under your wing and mentored me over the years; from being my assistantship advisor and supervised research professor, providing me invaluable opportunities in co-authored publications and presentations, and serving as the Chair for my comprehensive exam and dissertation proposal defense. Your infinite wisdom and expertise in environmental criminology, situational crime prevention, research methods, and advice on coping with the stresses of the Ph.D. process ("one bite at a time") have shaped me into the researcher that I am today.

I would also like to extend my deepest gratitude to the Co-Chair of my dissertation committee, Dr. Stephen Pires, for your consistent support, assistance, and profound belief in me. Thank you for being so diligent in keeping me on track with deadlines, instrumental feedback on each chapter submission that pushed me to sharpen my writing and brought my dissertation to a higher level, and your persistence as my Co-Chair afforded me the tools to complete my dissertation successfully. Additionally, thank you for teaching me everything I know about geospatial analysis. Your crime mapping class was my first course in the Ph.D. program, which facilitated my current specialization in geospatial analysis and served as a springboard for everlasting friendships with my fellow Ph.D. colleagues. My success and completion of the Ph.D. program and this dissertation would not have been possible without you and Dr. Guerette.

I am also incredibly grateful to my committee members, Dr. Tim Goddard and Dr. Jennifer Gebelein. Thank you both for your willingness to serve on my committee. Your insightful suggestions, guidance, and expertise helped shape and pave the way for my dissertation.

Special thanks to FIU's Department of Criminology and Criminal Justice (DCCJ) for providing me the opportunity to be a member of the first cohort of the International Crime and Justice (ICJ) Ph.D. program. I want to extend my sincere gratitude to the DCCJ Director, Dr. Rosa Chang, and Senior Program Coordinator, Carli Valdes. You have both developed the ICJ Ph.D. program into an incredible, well-oiled machine through your unrelenting efforts and assistance to my fellow Ph.D. colleagues and me. I cannot thank you enough for your endless patience, guidance, and unceasingly prompt responses to all of my inquiries. Additional thanks to our phenomenal DCCJ Chair, Dr. Lisa Stoltzenberg, and outstanding DCCJ Director of Research and Communications, Dr. Ryan Meldrum (thank you for facilitating one of my first peer-reviewed co-authored publications). To Dr. Besiki Kutateladze, thank you for teaching the Human Rights class and all there is to know regarding grant writing. To Dr. Stewart D'Alessio, thank you for teaching both data analysis and advanced data analysis courses. Thank you, Dr. Carleen Vincent-Robinson, for your Teaching Practicum course and instilling your invaluable expertise about being a great professor! To Dr. Ted Shields and Dr. Suman Kakar, thank you for being my advisors during my assistantship as a research/teaching assistant at FIU.

I want to thank FIU's Steven J. Green School of International and Public Affairs, particularly Dean John Stack, Dean Shlomi Dinar, Cheryl Johnson, Nelly Leon, and Stephanie Miller. Special thanks to the University Graduate School and faculty, Dean

Andrès Gil, Dr. Lidia Kos, Karla Ortega, Ashley Mendez, Brandie Course, and Claudia Balzan. Many thanks to FIU's Center for Excellence in Writing and Graduate Writing Mentorship Program (GWMP), especially Dr. Lidia Kos, Dr. Xuan Jiang, and Asafa Siddiqui, for coordinating the graduate writing workshops each semester. Particular thanks to Diana Rivero for being an incredible mentor and host of the Fall 2020 and Spring 2021 GWMP workshops to assist and support me each week regarding the progress and writing of my dissertation.

Thank you to the research specialists and organizations in serial homicide that contributed to this dissertation's research and data collection. Thank you to Dr. Mike Aamodt, founder and creator of the Radford University/Florida Gulf Coast University Serial Killer Database, for providing access to the primary data source and sample generated for this study. Many thanks for the correspondence regarding data for this dissertation from Dr. Kim Rossmo, the inventor of Geographic Profiling, renowned criminologist and expert in violent serial crime; Dr. David Canter, the creator of Investigative Psychology, forensic psychologist and geographic profiler; and the founder of the Murder Accountability Project (MAP), Thomas K. Hargrove. Special thanks to Enzo Yaksic, the Director of the Atypical Homicide Research Group and MAP, and creator of the Consolidated Serial Homicide Offender Database. Thank you for your serial homicide expertise, research collaboration and publication opportunities, and assistance in the data collection phase of my dissertation. Thanks also to the American Society of Criminology, Homicide Research Working Group, Atypical Homicide Research Group, Homicide Studies, and NJ Homicide Investigators Association.

I would also like to extend my sincere thanks to my former FIU ICJ Ph.D. supervisors and mentors, Dr. Harry Rhea and Dr. Brittany Gilmer. To Dr. Rhea, thank you for being my first supervisor in the ICJ program and for your unparalleled knowledge regarding international criminal justice and law, presentation and publication opportunities, as well as your tireless contributions and efforts regarding the formation and inception of FIU's ICJ Ph.D. program. I cannot begin to express my thanks to Dr. Gilmer, who was not only my supervisor during my second and third years of the Ph.D. program but was also a fantastic mentor, my fearless leader, role model, and biggest supporter who always had my back and still does to this day. From being an excellent professor/supervised research advisor (that led to my first peer-reviewed co-authored publication); to helping me realize that at heart, I am indeed a qualitative researcher; imparting your immeasurable knowledge and expertise on Somali piracy, and always checking in with me not just as a student but also about my life in general. Dr. Gilmer, my perseverance to continue this Ph.D. journey would not have been possible without your irrefutable support, encouragement, advice, and compassion; thank you from the bottom of my heart.

I would be remiss if I did not mention the numerous professional and academic mentors I was fortunate to have before my acceptance to this Ph.D. program, without whom I would've never evolved into the successful researcher, criminologist, and soon-to-be doctor I am today. To my high school teacher and mentor, Mr. McKenna, thank you for being one of the few teachers that always believed in me and pushed me to pursue my passion in this field and for always backing me (i.e., the underdog). To Retired FBI Special Agent Ed Petersen, thank you for taking the time to meet with me at the age of 15 regarding my interest in violent serial crime and inquiry about working for the FBI, and for your assistance 20 years later concerning your input about the data collection on serial killers for this dissertation.

I am deeply indebted to Louis Acevedo, Esq. and former Deputy Public Defender at the Office of the Public Defender Bergen County, New Jersey. Thank you for being a mentor to me during my college internship at the NJ Public Defenders office. As well as for your unwavering support, expertise, and guidance in the criminal justice field and your numerous recommendations that have allowed me to progress to this point in my academic career. I couldn't have gotten here without you! Special thanks to my Montclair State University professors that supported me during my Bachelor's degree in Justice Studies and applications to Master's degree programs: Dr. Cary Federman, Dr. Harold Ferguson, and Dr. Lisa Zilney. I would also like to thank my professors and mentors at John Jay College of Criminal Justice that supported me during my Master's degree in Criminal Justice and applications to Ph.D. programs: Professor John Laffey, Dr. Jon Shane, Dr. Rosemary Barberet, and Dr. Mangai Natarajan.

I am profoundly grateful to my former supervisors and colleagues during my employment as a purchasing and training manager at the Fort Lee Police Department: Retired Chief Thomas Ripoli, Chief Keith Bendul, Deputy Chief John Reuter, Captain Steve Hervey, Detective Shawn Hunt, Detective Rich Stanley, Melissa Ackerman, Melissa Cuello, Detective Nick Orta (my boxing coach and self-defense trainer), Captain Ronald Orso, Detective/Captain Thomas Ottina, Captain Camile Milo, and Detective/Lieutenant Kenneth Porrino. Thank you for training me on all that is law enforcement-related, encouraging me to follow my passion and higher education in this line of work, and shaping my aspirations to pursue the field I specialize in today.

I want to express my sincere gratitude to LJS Training and Consulting Group, LLC (Sexual Violence and Deviance Specialists) for the incredible experience as a research assistant, which allowed me to attend and present at numerous law enforcement training conferences throughout the US and opened the door for me in the field of violent serial crime. It was indeed an honor and a privilege to have the opportunity to be a part of your training and consulting group, which also led to the formation of my own violent serial crime research and consulting LLC. Special appreciation to the Founder and President of LJS Training and Consulting Group, Dr. Lawrence J. Simon and LJS consultant, Retired Detective/Sergeant Joe Matthews. Many thanks to Bergen Community College (BCC) for the teaching opportunity as a criminal justice professor, especially BCC's Department of Criminal Justice Chair, Professor Richard Kuiters.

To Barbara Bastek Comerford, Esq., my number one supporter who has always cheered me on my entire life and the most extraordinary woman in the world, my Mom. To a woman who has dedicated her life to helping individuals as a selfless yet formidable disability attorney and owner of one of the top disability law firms in New Jersey. Mom, you have taught me that no dream is unattainable, that women can achieve anything in life, and in the words of Eleanor Roosevelt, "no one can make you feel inferior without your consent." You are my ultimate role model, inspiration, guardian angel, and shaped me into the person I am today. No matter how many people have underestimated me, you have always believed in me and never ONCE allowed me to doubt myself or my ability to succeed. Your unlimited support has played the ultimate role in accomplishing my goals, especially through your words of wisdom and motivational phrases, such as: You are destined to save people's lives. Your outstanding leadership, positive affirmations, and encouragement have instilled in me the importance of self-confidence, perseverance, positive thinking, and that underestimation is the best motivational tool to succeed in life. Words cannot express how eternally grateful I am for all you have done over the years to help me achieve my dreams. From you proofreading my papers to your excellent advice, my rock and sounding board, your unconditional love, emotional, mental, professional, financial, and motherly support, and your endless patience and assistance during my academic and professional endeavors. You are the most amazing and influential person in my life, the best mother in the world, and I am the most blessed daughter to have you as my Mom. I love you with all my heart (and much much more). Love always, Scout.

I would like to extend my deepest gratitude to my Dad, Professor Richard Comerford. A man who is the embodiment of shaping individuals' lives through higher education, with his remarkable career as a college professor for over 45 years, Higher Education Consultant to the New Jersey Education Association, the Dark Knight, and who pushed me to seek my first job as a criminal justice professor. To a man of infinite wisdom that has continuously motivated me to follow my dreams, as well as change the world, and save lives. Dad, your unrelenting confidence in me, my goals, as well as your incessant motivational pep talks have always pressed me to persevere in my lengthy and challenging higher education journey. Your love, support, advice, and unforgettable, inspirational quotes are one of the primary mechanisms that motivated me to pursue a Ph.D. specializing in violent serial crime (to name a few): Focus on your education and career goals, and the rest will eventually fall into place; I don't want anchors in your life.

Stopping at a harbor somewhere and getting lost is not what I want for you. Quit stopping in the harbor and go out and conquer the sea; and my all-time favorite: you are meant to change the world and save lives, do not let any minor distractions or challenges prevent you from doing so. I love you dearly, Dad.

I am also profoundly grateful for the perpetual support of my stepmother, Suzanne Howe (Mommy Sue, love you like a circle!), my stepsisters Megan and Paige, future brother-in-law Sebastian and especially my sister Suzanne (Zannie) Comerford. To Zannie, my sister, best friend, and Bean, who has never stopped believing in me and is always there to support and encourage me. Zannie, you are a remarkable, amazing young woman that I am fortunate to have the privilege of calling you my sister. Thank you for always taking the time to talk and check-in, allowing me to vent, offering your insightful words of wisdom, and never allowing me to doubt or discourage myself in my academic and professional career or life. You are the best sister a girl could ask for, and I love you with all of my heart.

To my amazing boyfriend, the love of my life, the Rip to my Beth, and my best friend, Eddie Redmann, I am forever grateful for your endless patience, love, support, understanding, and encouragement throughout my Ph.D. journey. A few months before the pandemic, I was so focused on my Ph.D. that I had no interest in a relationship (other than my dissertation), and then I met you. The most incredible, kind, intelligent, loving, supportive, creative, and wonderful man I could ever ask or wish for. Meeting and falling in love with you truly was fate. From you bragging to everyone about me getting my Ph.D., dating soon-to-be Dr. Comerford and serial killer hunter, to us moving in together due to quarantine and surviving it with flying colors (couples that survive the quarantine together stay together!). Your astoundingly patient, caring, and relaxed demeanor concerning my dissertation process has been nothing short of magnificent. From your inquiries about my cases during the data collection stage and listening to the horrendous details, saving serial killer documentaries for me, asking questions regarding research jargon such as the formula for p-values and significance of my findings. From you making home-cooked or ordering takeout dinners and wine, or you taking up hobbies on the couch to sit next to me while I worked. You were always extremely understanding when I couldn't attend events with our family or friends due to impending deadlines. To you dealing with my stubbornness, tireless need to work, and constant tardiness regarding ETAs of when I'd be finished working for the night. Always reassuring me that I will get through it, I can do it, and cheered me on when I felt hopeless or wanted to give up. I am the most fortunate, lucky woman in the world to have you in my life. I cannot wait to see what the future holds and spend our lives together. Thank you for always loving me no matter what. I love you to infinities Booba!

To my beloved grandmother and namesake Caroline Bastek (Nonnie) and my Grandfather Adam Bastek (Pop). Thank you, Pop, for always loving and supporting me and being a wonderful grandfather that showed me no challenge in life is insurmountable. Thank you, Nonnie, for serving as the matriarchal rock of our family for 92 years. Not only were you an amazing mother, grandmother, sister, aunt, cousin, and friend, but a woman who touched the lives of so many people who knew you. As you always said: Caroline, you got my name; you better be good. Nonnie, I promise I will not disappoint you and make sure I live up to those words. I love you both with all my heart, and may you be at peace together in heaven.

To Aunt Di and Uncle John (UJ), my other set of parents, and fundamental pillars of support in my life. Aunt Di, thank you for being the best aunt ever and my other Mom, for your continuous prayers, love, encouragement, protectiveness, and compassion. Always thinking of me, saving Nonnie's items for me after she passed, the thoughtful and generous gifts from you and Uncle John every birthday and Christmas, and all of the help from you both with my Mom and I and the houses. Special shout-out to UJ, my Uncle/other Dad, and the law firm and LBI rental guru. From Yankees games to LBI trips, working at the law firm, our inside jokes (Aa-RON, what happens in LBI stays in LBI, UJ and Ca-Ca), your hilarious comments, and electrician jokes that Eddie and I treasure! I love you both with all of my heart!

Thank you to my cousins, Adam and Erika. To my future cousin Erika, our family is so blessed to have such a wonderful, sweet, and caring woman like you. To my cousin, Adam, who is like my brother, and the head paralegal of my Mom's law firm, thank you for all that you do for my Mom and me (watching the dogs, putting stuff together, being a phenomenal paralegal, cousin/brother, and person). From us being Nonnie and Pop's namesakes, our fabulous memories and endless laughs together, to your positive energy and charismatic personality that is contagious, thank you, and I love you both so much!

I am incredibly grateful to my cousins/siblings, Jill, Mike, and Cameron Bailey. Mike, thank you for being the best cousin/brother-in-law, husband, father, and fellow Taurus! To my Godson Cameron, you have made the last year-and-a-half of my life and this Ph.D. program AMAZING and are the most delightful addition to our family. You are the light of my life, a bundle of joy and love, and I am honored to be your Godmother. You are already a little virtuoso and genius, and I can't wait to teach and train you as you grow up. And since you have shown in your one and a half years in this world that you are a bookworm just like your Godmother, I will make sure to have a copy of this dissertation bound and ready for you to read (once you are of an appropriate age to read about serial killers, obviously!). Love you to the moon and back, my Godson. Finally, and most importantly, to my sister/cousin Jill (Jillibean), who always cheers me on and never ceases to make me laugh. The endless number of memories we have shared are PRICELESS. From us living together growing up, family functions and trips, LBI adventures, our sister ESP, Yankees Games, you constantly checking in and asking how the DISS is going and your motivational pep talks (How big of a celebration are we going to have once you're Dr. Comerford?!). Our limitless inside jokes, nicknames, and abbreviations (to name a few): bionic/pirate, club 454363, Yama drama, FAIL meter, banister sliding and the shovel, the chicken nugget bucket, Sharkys, heaters and juice bombs, PIVOT!, the shoulders incident, lodgers vs. slopers, El Cid, Mt. Fuji, and Park Ridge Steakhouse family dinners, and many more! From being the maid of honor at your wedding to making me Cam Cam's Godmother, and to you being my matron of honor and Godmother to my children in the future, thank you from the bottom of my heart. I love you more than words, sister.

Special thanks to my Uncle Mike and Aunt Denise. To my Uncle Mike, an honored and esteemed Retired Lieutenant Detective, who is responsible for my interest and specialization in the field of violent serial crime. Thank you for always supporting me and inquiring about my progress in academia and my career; providing your extensive insight and experience, teaching me about this line of work; consulting with me on your cold cases (don't worry, we will solve them!); asking for my assistance with material for your courses; and the like. You have trained me to think outside the box regarding homicide cases and all there is to know in this field, mainly through our lengthy serial murder-related conversations at family functions. Also, a big thank you to my Aunt Denise for putting up with Uncle Mike and me, always talking about serial killers and homicide cases at our family gatherings, and being such a supportive and loving Aunt to me throughout my life! Love you both dearly!

To my soon-to-be ‘honorary Ph.D.’ cousins, Michael and Amanda Pizza, thank you both for all of your help (always) but particularly when I moved down to Florida for the first three years of my Ph.D. program. Amanda, thank you for visiting and allowing Michael to be my transporter back and forth from Florida to New Jersey. Also, big thanks to you both for the research assistance during your trips! To Michael, my cousin/brother, transporter, future President of Security, and fellow head co-council member thank you for all of the above and your service as a police officer. You are my go-to, ride-or-die cousin/brother that is as relentless as I am about criminal justice and council consulting and training (survival prep, paintballing, just survive sHomehow). To our adventures on the long drives back and forth from Florida, me overpacking the car every time, traveling with my dogs (Montana and John Locke), our stays at shady hotels, car breakdowns, counting abandoned vehicles and estimates of serial killers at truck stops, and lengthy discussions regarding criminal justice, and everything in between; I can’t thank you enough and love you, Amanda, little Michael, and Jamison tons!

Special thanks to My Godmother, Aunt Maureen, and Uncle Jerry. To My Godmother, Aunt Maureen, who continuously cheers me on and never stops expressing how proud she is of me, thank you for your endless prayers, support, and love. I am so blessed to have you as my Godmother and Aunt and Uncle Jerry, who is always the life of our family parties! To Dr. James Bastek (Uncle Jimmy), my remarkable Uncle and one of the top retinal surgeon specialists, taken from our family far too soon. Thank you for always believing in me, saying how special, resilient, and strong I was growing up, and for insisting that I was meant to do great things. I know that you are with Nonnie and Pop, watching over our family as Guardian Angels. I miss you and love you with all of my heart. I am also profoundly grateful to Dr. Carol Bastek (Aunt Carol), who has always been highly supportive of me from being my math tutor growing up, my Confirmation sponsor, and especially regarding my Ph.D. as she knows the tremendous amount of work and dedication it takes to receive a doctorate. You are a phenomenal woman and aunt I will forever admire for your strength, courage, intelligence, and resilience. Thank you for all of your support, love, and wisdom. I love you and Uncle Jimmy so much!

Thank you to the rest of my cousins who have always been a driving force of support and love throughout my academic and professional efforts, which I love dearly and am so thankful to have in my life: Sean Callagy, Esq. (the first member of our cousin's crew and epitome of a warrior in every sense of the word), Dr. Jamie Bastek (a remarkable and successful doctor, just like her father/my Uncle Jimmy), Randi and Andrew Lennon (my awesome, successful, fun-loving cousins, and founders of Garry's Garage); Lauren and Dan Videon (outstanding parents and cousins!); Scott Bastek (a brilliant, successful and fabulous young man, just like your father/my Uncle Jimmy). Thank you also to my second cousins who are our family's bright future: Tyler, Courtney, Emma, and Selina; Michael and Jamison; Finn and Maddie; Caleb, Aaron, Josh, Jordan, and Naomi; Abigail, Andrew, and Aiden. Thank you also to the numerous

members of my extended family. I am also grateful to my Florida family, who helped and supported me during my move down there. Special thanks and endless gratitude to my Uncle Frankie (may you rest in peace, my dear Uncle) and Aunt Mary; Aunt Marianne, Uncle Joe, Joey (my hurricane partner and go-to FL cousin), Jenn, and Uncle Patti. All of you made Florida my second home with your unconditional love, support, and encouragement. I love you all!

My deepest thanks to my cousins, Carlissa and Rai. Especially Carlissa Prettyman, Esq., my incredibly amazing and supportive cousin/best friend that I have known my entire life; the Murdoch to my Riggs, the Marty to my Ruth, the Capricorn to my Taurus. Thank you for always being such a positive and powerful force in my life. Reflecting on our years ago, working as paralegals at my Mom's law firm, both of us pursuing our goals: you studying for the LSATs and me studying for my GREs, to you attending Rutgers Law School and me attending my Master's program at John Jay. Now, look where we are: you're an exceptionally successful disability lawyer, and I am on the brink of becoming a doctor! Thanks, Liss, for continually pushing me to prevail, especially when I doubted myself, felt discouraged, or thought the Ph.D. mountain was too hard to climb. You never allowed me to falter or stray from achieving the milestone of becoming Dr. Comerford, particularly with your motivational quotes to keep me on track: You got this! You are a WARRIOR and can do this! Love you and Rai tons!

Special appreciation and profound gratitude to my Mom's incredibly successful, powerhouse, female friends/family (i.e., My Aunts): Aunt Nan, Aunt Nancy, Aunt Pamela, Aunt Vivian, Aunt Donna, Aunt Sandra, Aunt Darlene, Aunt Michelene, Aunt Alain, Aunt Joyce, and the list goes on of the successful female role models and family/friends of my mother that I am honored to have in my life. Sincere thanks to Myra, Edgar, and the Quevedo family and all you do for my Mom and me and for being family to us. Additional shout-outs to friends who are our family: the fantastic staff at my Mom's disability law firm, Yemisi and Shymore Miller, Uncle Marshall, Judy, William and Candace, Megan, and Robbie Prettyman, Uncle Hank and Chrissy; Heidi and Rob, Danny and Lindsay Heller, Haley Rienzo, Agi, The Risinger Family; John, Sheila and Maddie Sterling, Dr. Hector Castillo, Dr. Sue Levine, Jill Shanker, Kenny Robinson, George Caceras, Lisa Manschell, Maria Prulello, John and Jimmy from Crestview, Uncle Murray, and all the other amazing people that have impacted my life, THANK YOU! Huge thanks to my furry dog family that has always kept me company and loved me unconditionally. To my dog daughter (dogter), Sawyer (AKA: Honeybear, Soy Soy, Hammy Hamhock), who I love more than life itself. You are the ultimate source of joy, love, and happiness in my life, and I am so happy that I found you! Special thanks to my Mom's dogs and Sawyer's siblings: John Locke, Desmond, Miles, and Marcie!

To all of the dearly missed loved ones that I have lost over the years, all of whom I know have guided me from above on this Ph.D. journey: Nonnie and Pop, Uncle Jimmy, Grandma Violet (also my namesake), Mama and Popa Howe, Uncle Frankie Bastek, Aunt Dolly, Aunt Gail, Aunt Maureen Auriema, Uncle Dave, Uncle Tim, Uncle Russ, Grandma Gloria, Shauna, Vincent and Christine Persico. One of my longest and closest best friends, Chris Noop Canavan, who passed away far too soon and I love like a brother; you will forever be in my heart Noop! Finally, my most missed furry companions, Montana and Rousseau (Roo), I miss you and love you both with all of my heart, but I know you are both together in Doggy heaven.

To Danielle, Chris, and Vin Coudray, thank you for being such a huge part of my life! Thank you to Danielle's husband and my close friend, Chris Coudray, for being an awesome husband to my best friend. To Danielle and Chris' son and my nephew, Vin, the sweetest, most intelligent, funniest 6-year-old I have ever known, thank you for being a source of light and happiness in my life. To the last member of the Coudray family, Danielle (Dee): my longest female best friend I met in acting class on the first day of high school. My ultimate ride-or-die best friend that has always been my rock, endlessly supportive, has my back without question, and never ceases to lend a patient ear to me venting about my Ph.D. struggles and life in general: your organized and detail-oriented Scorpio to the same traits as my Taurus. Our friendship over the past 20+ years truly means the world to me. From us in high school and our special agent glasses; crazy adventures in our teens, 20s, and now our 30s; living together; our girls' nights and trips; and being there for each other during the best of times, worst of times, and unforgettable milestones. Through our ups and downs, laughs and cries, thick and thin, and our everlasting memories together. Thank you for everything, bestie; I could not have made it through this life and Ph.D. journey without you. Love you with all my heart, Dee!

To Theresa Staine (My Lollipop and TNT bestie), who coined the term "serial killer hunter" to describe my career as a criminologist that specializes in violent serial crime, a phrase that is now always used by everyone who knows me. Thank you for your contagious positivity, never-ending support, encouragement, and always checking in and asking about my Ph.D. progress and life in general. You are genuinely a one-of-a-kind best friend. Thank you from the bottom of my heart for being you and my best friend. Love you dearly! To Gabrielle (Gaby) Piscatelli: there are some people that come into your life, and immediately upon meeting them, you know that they are your person. From meeting you when we were teenagers with me going off on the high school mean girl in your honor to us reconnecting 20 years later, I am so blessed to call you one of my best friends and have you in my life. Our friendship was fate. Thank you for always being there, supporting me, our long talks and hangout sessions, to our deep philosophical, academic, emotional, and mentally stimulating conversations, and as my Mom would say, essentially being my twin. Love you beyond words, Gabs (my SFS BFF).

To my criminal justice/law enforcement power couple and fellow members of the Fearsome Foursome, Karen Ruggiero and Officer Dave Perez. Thank you both for your service as law enforcement professionals and for being such a motivational and supportive source of strength in my life, especially as it relates to our line of work; I love you both! Honorable mentions and shout-outs to my other amazing friends: Joe and Sarah Sedo (especially our long talks/vent sessions of never-ending work), Chris and Molly Flannery (Cub & Pants, love ya both!), Randy and Kim Goode, Becky (Rook) and Brian Carle, Renny and Kate Mann, Carli and Jon Zafran, Rona Kornberg (thanks for being the reason I met Eddie!), Justyna, Jess DeStasi, my Ridgewood and St. John's boys (Fionda, Ralph, Lou, Tuc, Pete, Romero, JL, Davis, Gabe, Joey Noe, Danny/Hooch, Zam), Kristin Mingione and Samantha Rauch, my John Jay Master's Crew, and all my friends near and far that have been a special part of my life, THANK YOU!

A huge thank you to Eddie's friends/family, that has also become my family over the past 2+ years. I am incredibly grateful to Eddie's parents, Genevieve (my Bonus Mom) and Ed Redmann, Eddie's sisters Gen Kaplan and Erika Redmann, Eddie's brother-in-law and nephews, Alex, Dean, and Alec Kaplan. All of you have welcomed me to your family with open arms and have been nothing short of amazing to me over the past few years. I love all of you so much! Special shout-outs to Eddie's friends/family, whom I have become incredibly close with during the past few years. To the Jersey City Boys: Jeffrey, Eddie's brother (the Goose to my Maverick and the consigliere to my consigliera to Eddie); Devin (my survivalist partner whose wise words have taught me to always and unapologetically be myself); and Alex (for listening while I vented to you regarding my dissertation and analysis process). To Mike (Mikey) and Rachel (Ray), our former roommates, members of the Bonehouse, and ultimate quarantine partners. Thank you both for always being great roommates, friends, and a natural source of laughter, love, and support. Additional shout-outs to Phil (Philly Phil Phil), Dave, Dana and Andrew, Stefan and Nicole, Tommy and Sara, Robbie and Lauren, Vanessa and Eddie's adorable nieces and nephew, Bobbi Lynn, Ami, Eli, and all of the rest…THANK YOU!

Last but certainly not least, most profound thanks to my Grad School/Ph.D. Gladiators and the most extraordinary cohort that I had the privilege to travel alongside during my Ph.D. journey. We all have stuck together throughout the years in the Ph.D. program and always lift one another to succeed. The road to obtaining a Ph.D. is a long one; however, I cannot thank you all enough for the endless support, friendship, and strength you have provided to pursue my dreams of becoming Dr. Comerford. I could not think of a more fitting quote to describe our challenging yet meritorious Ph.D. journey together by Olivia Pope in Scandal: "We are all Gladiators. Gladiators don't run. They fight. They slay dragons. They wipe off the blood and stitch up their wounds, and they live to fight another day."

Special thanks to Chris Torres (The Statistics Slayer) for all of your help with anything related to quantitative analysis/statistics and for being one of my first friends at FIU through our collective confusion after the first night of crime mapping class. Your unwavering assistance, patience concerning my constant questions, and unhesitating support during the data analysis stage and throughout our Ph.D. journey together have been nothing short of epic. I can't thank you enough, my friend, and I am so excited to defend our dissertations and graduate together this semester! Additional shout-outs to my fellow Ph.D. Gladiators and other FIU Graduate School Friends: Ana Morales, Mohammed Alqahtani, Enrique Chavez, Dr. Erik Cruz, Marcy Diaz, Dr. Sinchul (Chuckie) Back, Melissa Ayazoz, Victoria Roque, Dr. Robert Archer, Juan Del Rio, Brittany Kane, George Connolly, Dr. Auzeen Shariati, Kimberly Przeszlowski, Dr. Olga Vega, Sadhika Soor, Natalie Sosa, Dr. Candice Aamons-Blanfort, Dylan Matthews, Doug Partin, and Dr. Peculiar (Mimi) Awa. All of you have made graduate school and my Ph.D. journey more endurable and enjoyable by meeting you and traveling this lengthy, arduous road with me. To my fellow Ph.D. Gladiators that have crossed the finish line, congratulations, DOCTORS! To my fellow Gladiators that continue traveling on this Ph.D. journey: Keep fighting the good fight, remain resolute in your quest, and DO NOT GIVE UP! All of you undoubtedly possess the strength, determination, and endurance to cross the finish line of this Ph.D. marathon!

Most importantly, I cannot begin to express my thanks and most profound appreciation for my Ph.D. Gladiators, best friends, and Circle of Trust members: Dr. Joelle Lee-Silcox (Alpha), Dr. Anna Leimberg, and Dr. Sara McFann. I am exceptionally fortunate and blessed to have you as my Ph.D. BFFs and legitimately couldn't have made

it through this journey without you. From our endless laughs, ASC reunions, large and growing Gladiator quotebook, from venting and research collaboration chats, and always being there to answer my incessant questions as the last member of our group to finish (No Gladiator left behind! - Joelle). I am so pleased to finally say the four of us finally met our Ph.D. group goal of a zero-attrition rate! To travel this journey with brilliant, remarkable, and successful women such as yourselves has indeed been an honor. I would gladly follow you Gladiators Over a Cliff every single time. I love you all dearly!

While there are still many individuals I would like to thank; I have excessively surpassed my limit in this section. Thank you to those who believed in me and those who doubted me, as it motivated me to succeed, paved the road to achieving my goals, and shaped the academic and professional I am today. I am forever grateful for your contribution to my life and Ph.D. journey.

Sincerely,

Caroline V. Comerford

ABSTRACT OF THE DISSERTATION

DO HOME INVASION SERIAL KILLERS WARRANT A DISTINCT CLASSIFICATION FROM OTHER SERIAL KILLER LOCATION TYPES? A RETROSPECTIVE COMPARATIVE EXAMINATION

by

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Florida International University, 2022

Miami, Florida

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This dissertation seeks to address the research gap in serial homicide regarding Home Invasion Serial Killers (HISKs) and add to existing policy by providing insight and approaches to assist in serial murder investigations of such killers. Data for the study was obtained from the 2019 Radford University/Florida Gulf Coast University Serial Killer Database (RU/FGCU SKD) and additional public information searches. A retrospective comparative design and proportionate stratified random sampling of 326 serial killers from the RU/FGCU SKD (2019) were used to examine the differences and classifications of HISKs and Non-Home Invasion Serial Killers (non-HISKs) in three investigations: (1) common characteristics; (2) geospatial patterns; and (3) criminal precipitators.

The study contributes to knowledge in three key ways. First, Study One revealed that HISKs warrant a distinct classification from non-HISKs regarding their modus operandi and crime scene actions (stalked attacks and single location crime scenes). These findings lend further evidence to support Routine Activity and Rational Choice

perspectives regarding the offense patterns of residential sex offenders. Such findings can also aid law enforcement in serial murder investigations by providing sets of characteristics for both groups that could lead to swifter apprehensions, prevent future murders in a series, and assist in cold cases.

Second, this dissertation raises public awareness of the problem of HISKs. Home invasion serial homicide is one of the most prevalent forms of serial murder, indicating that an individual's home does not unequivocally safeguard residents from serial killers. Public awareness of HISKs, and situational crime prevention measures can result in policy-relevant implications, leading to reactive and proactive strategies to reduce or prevent home invasion serial homicide.

Finally, this study addresses the research gap and advances our understanding of HISKs in the three analytical dimensions investigated in this dissertation. The findings also serve as a comparative baseline relevant to environmental criminology and developmental/life-course perspectives. Future research is recommended to bridge the gap in serial homicide literature concerning HISKs to provide a more comprehensive understanding and preventative approaches to deter such serial killers in the future.

TABLE OF CONTENTS

CHAPTER PAGE

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

American Psychiatric Association	APA
Aeronautical Reconnaissance Coverage Geographic Information Systems	ArcGIS
Bondage and Domination, Sadism and Masochism (or Sadomasochism)	BDSM
Crime Pattern Theory	CPT
Criminal Career Paradigm	CCP
Criminal Precipitator(s)	CP(s)
Dependent Variable(s)	DV(s)
Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition)	DSM-V
Federal Bureau of Investigation	FBI
Federal Bureau of Investigations Uniform Crime Report	FBI UCR
Florida International University	FIU
Geospatial Analysis	GSA
Hierarchical Generalized Linear Modeling	HGLM
Hierarchical Linear Modeling	HLM
Hierarchical Linear and Nonlinear Modeling Software (Version 8)	HLM 8
Home Invasion Serial Killer(s)	HISK(s)
Homicide Investigation and Tracking System	HITS
Independent Variable(s)	IV(s)
Institutional Review Board	IRB
Intraclass Correlation	ICC
Investigative Journalist/Expert Field Micro Task Force	IJ/EF MTF
Journey-to-Crime	JTC
Law Enforcement Agency(s)	LEA(s)
Life-Course Persistent (Offenders)	LCP

Mental Health Professional(s)	MHP(s)
Modus Operandi	MO
Murder Accountability Project	MAP
National Center for the Analysis of Violent Crime	NCVAC
National Institute of Justice	NIJ
Node-to-Crime	NTC
Non-Home Invasion Serial Killer(s)	Non-HISK(s)
Radford University/Florida Gulf Coast University Serial Killer Database	RU/FGCU SKD
Rational Choice Theory	RCT
Routine Activity Theory	RAT
Residence-to-Crime (Distance; see also RTC calculations)	RTC
Scientific Software International	SSI
Serial Killer(s)	SK(s)
Severity Continuum Index	SCI
Sexual Residential Burglary	SRB
Situational Crime Prevention	SCP
Smallest Space Analysis (of Crime Scene Behaviors)	SSA
Statistical Package for the Social Sciences (Version 27)	SPSS 27
Violent Criminal Apprehension Program	ViCAP

CHAPTER 1

I. INTRODUCTION

The phenomenon of serial homicide has been a fundamental problem for centuries. The existing literature reveals an abundance of research, typologies, and classifications proposed to categorize different serial killers and their offending styles. Serial murder is commonly viewed as a problem that primarily affects individuals who engage in high-risk lifestyles or at unsafe locations other than the victim's residence (FBI, 2014; Quinet, 2011; Rossmo, 1995; Warf & Waddell, 2002). However, serial killers that use *home invasion* to murder their victims is an area that remains relatively unexplored in the serial homicide literature.

Several studies have measured the prevalence of serial murder at various locations, and findings suggest that home invasion serial homicide is one of the most common forms of serial murder (Aamodt, 2015; Aamodt et al., 2016, 2020; FBI, 2014; Rossmo, 1995). Despite the magnitude of home invasion serial homicide, little is known about the common characteristics, geospatial patterns, and criminal histories of *Home Invasion Serial Killers* (HISKs).

Moreover, a closer examination of the research regarding serial homicide locations indicates it is unknown whether HISKs are inherently distinct from *Non-Home Invasion Serial Killers* (Non-HISKs). In light of these concerns, further investigation of HISKs is warranted concerning their common characteristics, geospatial patterns, and criminal precipitators. Therefore, HISKs are the primary focus of this dissertation.

1.1 Home Invasion Serial Killers Defined

HISKs are defined as serial killers that murder *one* or *more* victim(s) at the victim's *place of residence.* The victim's place of residence includes any location that is considered the victim's *temporary* or *permanent* residence (e.g., house, apartment, mobile home, family/friends/partners' residence). HISKs can gain access to the victim's residence through two methods: (1) *forced entry* (i.e., breaking into the victim's residence or using physical force to threaten the victim) and (2) *ruse entry* (i.e., coercion to gain access to the victim's residence).

1.2 Overview of the Problem: Home Invasion Serial Killers

Home invasion, particularly by serial killers, represents a significant violation of the sanctuary and protection that the home is supposed to symbolize. Home invasion serial homicide is a high-profile problem that constitutes one of the most prevalent forms of serial homicide. However, home invasion serial murder and HISKs have been largely overlooked in the field of serial homicide. Research has primarily analyzed serial murder locations, such as home invasion, as a descriptive variable (Aamodt, 2015, Aamodt et al., 2016, 2020; Dern et al., 2005; FBI, 2014; Rossmo, 1995).

For example, the *Federal Bureau of Investigation* (FBI) examined the locations of serial homicides in a sample of 92 serial killers (N = 92) and their victims (n = 480) and found that 22% of victims were murdered at their residences (2014). A subsample analysis of 16 serial killers (n = 16) responsible for killing 97 victims (n = 97) revealed that the victims' residence represented almost half of the locations where the killer approached (48.5%), assaulted (44.3%), and inevitably murdered their victims (44.3%) (FBI, 2014, p. 63). Moreover, the *Radford University/Florida Gulf Coast University*

Serial Killer Database (RU/FGCU SKD) contains more than 5,100 serial killers with 14,390 victims. According to the RU/FGCU SKD (2019), the victim's residence is the most frequently targeted location by serial killers, with more than 3,600 victims (25%).

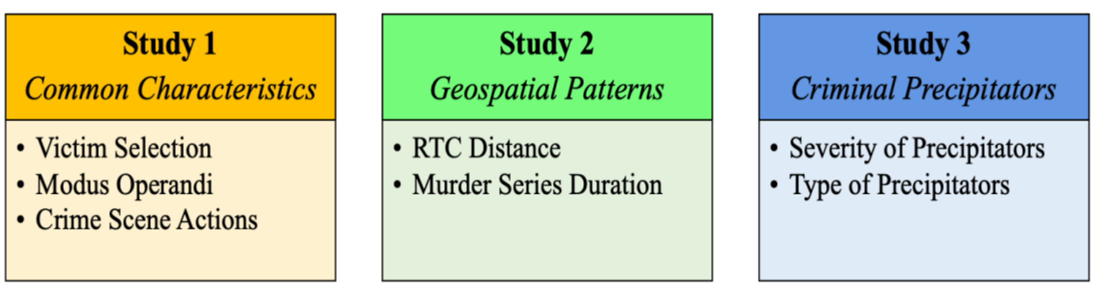
Descriptive research suggests that the problem of home invasion serial homicide constitutes one of the most prevalent forms of serial homicide; however, such killers have received minimal attention in the existing literature. Although several descriptive studies on serial murder locations, such as home invasions, have been documented in prior research, there is a critical gap in the literature that exclusively examines home invasion serial homicide. The author contends that home invasion serial homicide (HISKs) is prevalent enough to be studied both as a dependent variable (Study One and Study Three) and an independent variable (Study Two). A comprehensive examination of home invasion serial homicide in this capacity provides the ability to measure factors that may impact HISKs offense characteristics, geospatial patterns, and criminal precipitators.

While there is a considerable void that exists in research on HISKs, there are relevant studies on *non-fatal* home invasion sex offenders (Ensslen et al., 2018; Pedneault et al., 2012; Pedneault et al., 2015b; Schlesinger & Revitch, 1999; Vaughn et al., 2008). Ensslen et al. (2018) and Pedneault et al. (2015b) examined the offending patterns, decision-making, and situational context of "home intruder sex offenders" and "sexual burglars" substantiate offenders who use home invasion to target and attack their victims constitute a *distinct type* of sex offender. Both studies found that home invasion sex offenders and sexual burglars demonstrate similar decision-making processes regarding their crime sites, victim selection, and modus operandi (Ensslen et al., 2018, p. 4707; see also Pedneault et al., 2015b, p. 384). Furthermore, Ensslen et al. (2018) asserted that there is an inherent gap and need for further investigation concerning the location and "crime site selection" regarding offenses "other than burglary" (2018, p. 4695).

There is a need to investigate further the crime site selection of HISKs. The contention that home invasion sex offenders comprise a distinct type of sex offender based on their similar offending patterns provides the context and basis for the current study. Consequently, this dissertation addresses the need for a comprehensive examination of home invasion serial homicide and HISKs currently lacking in the existing literature. Similar to Ensslen et al. (2018) and Pedneault et al. (2015b), this dissertation seeks to address the research gap in the existing literature by exclusively examining home invasion serial homicide to (1) determine if HISKs are significantly different from non-HISKs and (2) whether HISKs warrant a distinct classification from non-HISKs. This dissertation consists of three comparative investigations in three fundamental dimensions: (1) *common characteristics*, (2) *geospatial patterns*, and (3) *criminal precipitators* (CPs) before the murder series (see Figure 1).

Figure 1

Three Comparative Investigations of HISKs and Non-HISKs



1.3 The Current Investigation

Through an environmental criminology approach using *Routine Activity* theory (RAT) and *Rational Choice* theory (RCT), the central inquiry for **Study One** is to investigate the common characteristics of HISKs and non-HISKs concerning their incident-level tactics used across the murder series to target and murder their victims (Cohen & Felson, 1979; Cornish & Clark, 1986). Previous descriptive research on home invasion sex offenders shows that they primarily target residents who are home alone at the time of the invasion (Campobasso et al., 2009; Rossmo, 1995). For example, Pedneault et al. (2015b) applied RAT and RCT perspectives to study the target selection and situational factors of sexual burglars. The findings revealed that such offenders targeted *occupied* and *easily accessible* residences when the victim was known to be alone in their residence, illustrating the rationality of such offenders (2015b). Similarly, Ensslen et al. (2018) adopted the approach of Pedneault et al. (2015b) to investigate the target selection and situational factors of home invasion sex offenders. The findings revealed that such offenders select *non-random adult* victims (frequently home alone) and use *structured premeditation* to commit their attacks (Ensslen et al., 2018, p. 4700).

Building on the findings of Pedneault et al. (2015b) and Ensslen et al. (2018) that home invasion sex offenders constitute a *distinct type* of *offender*, Study One applies RAT and RCT to investigate the common characteristics of HISKs and non-HISKs concerning *three* sets of *independent* variables: (1) *victim selection*; (2) *modus operandi*; and (3) *crime scene actions*. The primary goal of Study One is to determine if HISKs are different from non-HISKs and whether HISKs constitute a distinct type of serial killer than non-HISKs based on their common characteristics.

Through an environmental criminology approach using RAT, RCT, and *Crime Pattern* theory (CPT), the central inquiry for **Study Two** is to investigate the geospatial patterns of HISKs and non-HISKs concerning the distance traveled to each murder and the cumulative length of their murder series (Brantingham & Brantingham, 1981). Prior studies that have examined the journey-to-crime (JTC) patterns and crime scene locations suggest that serial killers who murder *and* dispose of their victims at a *single* location travel *shorter* JTC distances. Compared to serial killers with *multiple location* crime scenes (i.e., encounter site, murder site, and body disposal sites) (Canter, 2003; Martineau & Beauregard, 2016; Rossmo, 1995; Van Patten & Delhauer, 2007). Similarly, previous studies relevant to home invasion sex offenders also show that such offenders travel the *shortest* JTC distances, as they typically target, attack, and release their victims at a *single location* (i.e., the victim's home) (Beauregard et al., 2010; Dern et al., 2005). Lastly, regarding the duration of the murder series, existing research indicates that serial killers who travel *shorter* JTC distances are also *more likely* to be apprehended *faster.* As a result, they exhibit *shorter* murder series durations than serial killers who travel *longer* distances (Lammers & Bernasco, 2013; Martineau & Beauregard, 2016).

Building on the findings of prior JTC studies, using RAT, RCT, and CPT perspectives, Study Two investigates the geospatial patterns of HISKs and non-HISKs concerning *two dependent* variables: (1) *residence-to-crime (RTC) distance* and (2) *murder series duration* (i.e., the number of days from the *first* murder to the *last* murder). The primary goal of Study Two is to determine if HISKs are statistically different from non-HISKs and whether they warrant a distinct classification from non-HISKs based on their geospatial patterns.

Finally, using the *Career Criminal Paradigm* (CCP) and *Life-Course-Persistent offenders* (LCP) perspectives, the central inquiry for **Study Three** is to investigate the non-fatal criminal precipitators (CPs) of HISKs and non-HISKs concerning the severity and type of offenses committed before the murder series. Existing research shows that many serial murderers have extensive criminal histories of non-violent and violent offenses (Beauregard & Martineau, 2012; Brankley et al., 2014; DeLisi & Scherer, 2006; FBI, 2018; Hickey, 2019; Marono et al., 2020; Martin et al., 2020; Mesa, 2012; Miller, 2014b). One of the main ingredients in the criminal history of serial killers that use home invasion to target and murder their victims is sexual burglary (Brankley et al., 2014; Martin et al., 2020; Schlesinger & Revitch, 1999). Martin et al. (2020) note that prolific serial killers who used home invasion to target and murder their victims present "a three-part progression from burglary to sexual assault to murder" before the first murder in their killing series (p. 10; see also Brankley et al., 2014). Similarly, prior studies concerning the criminal histories of non-fatal home invasion sex offenders also indicate that such offenders typically exhibit *specialized* criminal careers involving property crimes and residential sex offenses (Brankley et al., 2014; DeLisi & Scherer; Greenall & West, 2007; Harris, 2013; Vaughn et al., 2008).

Building on the findings of the studies above, Study Three uses CCP and LCP perspectives to investigate the differences in non-fatal CPs committed by both serial killer groups regarding *two independent* variables: (1) *severity* of CPs and (2) *type* of CPs. The primary goal of Study Three is to establish if significant differences exist between both serial killer groups and if HISKs constitute a separate classification from non-HISKs based on their criminal histories before the murder series.

The following section outlines the significance of this dissertation and the potential implications of the findings of the three investigations. The findings' potential impact is also discussed through the lens of law enforcement, crime analysts, the public, and academia. The potential magnitude of the results of this dissertation is also reviewed from a preventive standpoint. Lastly, the future theoretical implications of the findings of each investigation and the contribution to existing serial homicide research are reviewed.

1.4 Significance of the Study

Since the existing serial homicide literature indicates that home invasion serial homicide is one of the most common forms of serial murder, the current dissertation is significant for several reasons. First, the potential implications of the findings will provide readers, law enforcement agencies (LEAs), and academia with an in-depth understanding of home invasion serial homicide. This dissertation will also raise public awareness of the prevalence and problem of home invasion serial homicide and HISKs. The findings of each of the three investigations may also yield various tactical, geospatial, and criminal offense patterns of HISKs and non-HISKs, and significant differences between both groups.

Second, assessing whether HISKs warrant a distinct classification is significant concerning LEAs and serial murder investigations. If such a distinct classification is warranted, the findings will provide LEAs with sets of characteristics for serial murder investigations based on the locations of murders in a series. Such characteristics can serve as an investigative blueprint in active and cold-case serial murder investigations.

From a *RAT* and *RCT standpoint*, the *common characteristics* and offending patterns of HISKs and non-HISKs can potentially assist in reactive and proactive measures implemented by LEAs. Reactively, LEAs can include the use of victim selection, modus operandi, and crime scene characteristics of both serial killer groups to establish whether the serial killer is a HISK or non-HISK. LEAs can proactively use this information to warn the public and recommend preventive measures for civilians based on the type of serial killer operating in the area (e.g., target removal or hardening, increased surveillance, reporting suspicious behavior, and implementing curfews or regulations) (Ensslen et al. 2018; Pedneault et al., 2015b).

From a *RAT*, *RCT*, and *CPT standpoint*, the *geospatial patterns* of home and non-home invading serial killers can also offer crime analysts invaluable information. Once a murder series is established, depending on the location, the findings can assist crime analysts in the prediction of the crime scene location and geographic regions where the killer might murder their next victim (Canter et al., 2000; Canter, 2003; Rossmo, 1995, 1995b, 2000, 2005; Snook et al., 2002, 2005). This information can also be used to alert the public of high-risk locations to avoid or use the predictions of crime analysts of the geographical region of the serial killer to alert civilians living in such areas. LEAs can also apply the results to cold cases, distinguish the type of serial killer (HISK or non-HISK), and use this classification to investigate the killer's travel patterns further to calculate the approximate geographic territory of the killer's residence.

From a *CCP* and *LCP standpoint*, the *criminal precipitators* (CPs) of HISKs and non-HISKs killers can offer vital information on the offender's behavior before their first murder, which is significant for several reasons. First, the findings will reveal the most prevalent crimes committed by HISKs and non-HISKs before their first murder. Second, from a preventive perspective, the results can potentially offer LEAs an investigative framework on the criminal offense patterns to look for in violent serial offenders and possible intervention efforts before such offenders' graduate to serial homicide (Pedneault et al., 2015b). Lastly, in unsolved serial murder cases, LEAs can apply the findings to search and potentially narrow suspect lists based on prior criminal records and suspects' offending patterns.

Third, from an *academic standpoint,* this dissertation is particularly novel as an inherent gap exists in the literature and reveals a need for further investigation on the incident tactics, hunting patterns, and criminal history of HISKs (Ensslen et al., 2018). Applying the environmental criminology perspectives of RAT, RCT, CPT, and the developmental-life-course perspectives of CCP and LCP to investigate these three analytical dimensions of HISKs and non-HISKs may yield significant theoretical implications within the field of serial homicide. Suppose the findings of this dissertation reveal significant differences between both serial killer groups. In that case, this will provide further evidence that home invasion serial offenders are inherently unique in their offending patterns (see Ensslen et al., 2018 "home invasion sex offender" and Pedneault et al., 2015b "sexual burglar").

Such findings will also provide further support for RAT, RCT, and CPT concerning the common characteristics and geospatial patterns of HISKs. In that HISKs exhibit rational decision-making processes based on their routine activities and the tactics used and distance traveled during the murder series (Brantingham & Brantingham, 1981; Canter, 2003; Cohen & Felson, 1979; Cornish & Clarke, 1986; Ensslen et al., 2018; Pedneault et al., 2015b; Rossmo, 1995). Lastly, the findings will also support CCP and LCP perspectives concerning the non-fatal CPs of HISKs. In that HISKs perpetrate more *severe* and *fewer types* of offenses before their murder series (e.g., home invasion sex offenses and property crimes) (Brankley et al., 2014; Blumstein et al., 1986; DeLisi & Scherer, 2006; Harris, 2013; Moffitt, 1993; Piquero et al., 2003; Vaughn et al., 2008).

In summary, this dissertation seeks to investigate each of these three analytical dimensions of HISKs and non-HISKs to: (1) proactively and reactively assist LEAs, and crime analysts in serial homicide investigations; (2) raise public awareness regarding the problem of HISKs to promote greater understanding and potential responses to this issue; (3) bridge the gap in the existing serial homicide literature concerning HISKs; and (4) reveal whether HISKs warrant a distinct classification from non-HISKs based on their common characteristics, geospatial patterns, and criminal precipitators.

1.5 Chapter 1 Summary and Overview of Chapters

Home invasion serial homicide is a high-profile problem that constitutes one of the most prevalent forms of serial homicide. Home invasion serial killers epitomize a significant violation of the sanctuary and protection that the home should represent. The prospect of becoming a victim of home invasion serial murder is disconcerting and triggers significant fear (Warf & Wardell, 2002). Existing research suggests that victims alone at their residence are the most vulnerable to HISKs (Aamodt, 2015; Campobasso et al., 2009; Rossmo, 1995; Warf & Waddell, 2002). Home invasion serial homicide is also a significant problem in serial murder investigations.

Despite being one of the most common forms of serial murder that substantially impacts the general public and law enforcement, home invasion serial murder is essentially an unexplored area in the field of serial homicide. Previous research relevant to home invasion serial homicide has been descriptive. Furthermore, no previous study has investigated HISKs as an independent or dependent variable or compared differences in offense tactics, hunting patterns, or criminal histories of HISKs and non-HISKs. This knowledge gap signifies a need to understand home invasion serial homicide on a comprehensive level to determine whether HISKs are inherently different from serial killers who murder victims in other locations. To further examine and address the gap in the existing serial homicide literature, this dissertation seeks to analyze the differences between HISKs and non-HISKs in three fundamental investigations: (1) common characteristics, (2) geospatial patterns, and (3) criminal precipitators.

Considering the points above, the remainder of this dissertation will be structured in the following order. First, Chapter 2 consists of an overview of the existing literature on the general problem of serial homicide. Second, the specific problem of HISKs will be reviewed. Third, the theoretical framework that formed the basis of the dissertation and the pertinent theories and research relevant to the hypotheses constructed for each of the three investigations will be comprehensively examined.

Following the literature review, Chapter 3 provides a general and orientational review of the research approach used for the dissertation and includes (1) the research questions and objectives; (2) the data and sampling method; and (3) an overview of the analytical plan for the three investigations. Subsequently, Chapters 4, 5, and 6 will include the following sections: (1) overview of the current investigation; (2) measures and analytical strategy of the investigation; (3) descriptive statistics; and (4) final results of the investigation. Finally, Chapter 7 will discuss the results from each of the three investigations, theoretical and policy implications, limitations of each study, and recommendations for future research.

CHAPTER 2

II. LITERATURE REVIEW

This chapter presents a review of the existing literature on the general problem of serial homicide, including the prevalence of serial homicide, the characteristics of serial killers and their victims, and the challenges of serial murder investigations. Second, the specific problem of HISKs and the gap in serial homicide research will also be reviewed. Third, the theoretical framework of the dissertation and the pertinent theories and research relevant to the hypotheses constructed for each investigation will be comprehensively examined. Finally, Chapter 2 will include a summary of the chapter and a methodological preview for Chapter 3.

2.1 Serial Homicide

Serial murder is a complex and often misunderstood phenomenon. One of the biggest challenges in the study of serial homicide is quantifying its prevalence (FBI, 2014; Hickey, 2016; Hodgkinson et al., 2016; LePard et al., 2015; Quinet, 2007; Yaksic, 2015, 2018; Yaksic et al., 2019a). The prevalence of serial homicide is challenging to estimate and is often dismissed as a rare occurrence. However, because serial murder is difficult to quantify and is subject to speculation, it is inaccurate to declare that serial homicide *rarely* occurs. Evidence suggests that serial murder may occur more frequently than people think. As Hickey (2016) noted, "we can never know for sure the actual number of serial killers" (p. 44).

Quinet (2007) asserts that the difficulty quantifying serial homicide is due to missing persons and unidentified bodies, which adds to the inaccurate underestimation of prevalent serial killers and their victims. This underlying problem is attributable to unsolved serial homicide cases and unidentified serial murderers operating domestically and abroad (Hickey, 2016; Quinet, 2007; Yaksic, 2018). Both Quinet (2007) and the *Murder Accountability Project* (MAP) emphasize the disconcerting reality associated with the dark figure of serial homicide in the US. MAP requests and obtains data from local, state, and federal governments regarding unresolved homicides within the US and publicly circulates these data to enhance overall awareness regarding issues associated with low clearance rates in homicide cases. Based on MAP's national data, findings show that approximately 5,000 murderers remain undetected in the US annually, and about one-third of homicide cases are unsolved. Since 1980, MAP estimates that unsolved homicides constitute over 250,000 US citizens (2019; see also Martin et al., 2020).[1]

Similarly, a recent report published in the *National Institute of Justice* (NIJ) *Journal* asserts a significant problem with unsolved homicides in the US (Martin et al., 2020). The FBI’s *Uniform Crime Report* (FBI UCR) indicates a significant decline in the clearance rates of US homicides over the past five decades (2018). In the 1960s, the clearance rates of US homicide cases were approximately 80%. However, the clearance rates of US homicide cases noticeably plummeted to less than 60%, resulting in approximately 250,000 unsolved murder cases in the US, with over 100,000 of these cases having been accrued over the past two decades (Martin et al., 2020, p. 1; see also FBI UCR, 2017). Martin et al. (2020) refer to this substantial decline in US homicide clearance rates as the “cold case crisis” (p. 1). They suggest that active serial killers in the US are a vital contributor to the existential cold case crisis (Martin et al., 2020, p. 1).

[1]*Note*. The Murder Accountability Project was founded in 2015 by retired law enforcement officials, investigative reporters, and crime experts in homicide patterns.

Quantification of the number of active serial killers currently operating in the US is one of the primary issues in studying the problem of serial homicide (FBI, 2014; Hickey, 2016; Hodgkinson et al., 2016; LePard et al., 2015; MAP, 2019; Martin et al., 2020; Quinet, 2007; Yaksic et al., 2019). Estimations of the number of serial killers currently operating in the US range from 200 to over 2,000 per year (Martin et al., 2020). This section reviewed the general problem of serial homicide and the challenges of quantifying its prevalence. The following section will review the general characteristics of the individuals responsible for the problem of serial homicide, serial killers.

Characteristics of Serial Killers

There is an overabundance of research on the demographics and common characteristics of serial killers (Arndt et al., 2004; Beasley, 2004; Bluemel, 2015; Chan et al., 2015; FBI, 2014; Hickey, 2010, 2016; Ressler et al., 1988; Yaksic et al., 2019a, 2020). Research indicates that serial killers are predominantly heterosexual males, with a large percentage being White, but many serial killers are Black, Hispanic, Asian, and other races (FBI, 2014; Hickey, 2016; Miller, 2014a). For example, the FBI (2014) examined 92 serial killers that killed 480 victims (n = 480); more than half of the sample were White, nearly 40% were Black, and the remainder of the sample was categorized as Hispanic or “other” (p. 13).

Other findings of the FBI’s study showed that approximately 80% of the murderers had prior criminal records. One-third of the sample was diagnosed with a psychiatric disorder, with more than 40% who had a personality disorder (2014). These findings also indicated that the hunting patterns of killers were relatively consistent and supported previous JTC research that most criminals offend close to home (Canter, 2003;

Rossmo, 1995; Lundrigan & Canter, 2001a, 2001b). More than 70% remained geographically stable and committed intrastate murders, and less than 30% committed interstate murders (FBI, 2014, p. 18). Geographically transient serial killers often resided close to other states and frequently assumed professions that required continuous travel (e.g., truck drivers) (FBI, 2009; FBI, 2014, p. 18; McClellan, 2008).

Although most serial killers consist of heterosexual males, other serial killers do not fall into this category. Female serial killers are the most underrepresented, mainly because they constitute a small portion of serial killers, ranging from 10 to 15% (Aamodt, 2015; FBI, 2014; Hickey, 2010; Vronsky, 2007). Team serial killers are also underrepresented; the RU/FGCU SKD contains approximately 700 team serial killers (less than 14%). According to Miller (2014a), team serial killers consist of several subtypes: (1) couple killers, (2) dominant-submissive serial killers, (3) equally dominant killers, and (4) family serial killers (p. 8).

Another common element of serial homicide is that most serial killers leave a "calling card" or personal signature at their crime scenes (Miller, 2014a, p. 5). A signature is defined as an action(s) exhibited at the crime scene that was unnecessary for the killer to complete the murder (FBI, 2014; Geberth, 2015; Keppel, 2005). Examples of a serial killer's signature can include (but is not limited to): rape, torture, biting, staging, marking, taking items, decapitation, insertion of foreign objects, notes left by the murderer, and other ritualistic behaviors (FBI, 2014; Geberth, 2015; Godwin, 2000; Hazelwood & Warren, 2003; Keppel, 2005; Koeppel et al., 2019; Miller, 2014a; Warren et al., 2013). The signature originates from the serial killer's long-standing fantasies that typically involve the fusion of sex and violence (Miller, 2014a, p. 5).

Finally, one of the most significant factors relevant to serial homicide is the concept of practice. Serial killers continuously evolve and improve with each murder throughout their killing series (Canter & Larkin, 1993; FBI, 2008; Hazelwood & Warren, 2003; Rossmo, 1995; Yaksic & Comerford, 2019). Each successful kill committed in the series constitutes additional practice and experience in honing their craft. The more murders the serial killer has achieved, the more experience they acquire. Throughout this experience, serial killers continuously adjust their murder methods to evade apprehension and successfully prey on more victims. The FBI refers to this process of practice and experience as the *serial killer learning curve* (2008, p. 6). Through this learning curve and self-training, many serial killers demonstrate increased forensic awareness at their crime scenes by removing any form of evidence that could lead to their apprehension (FBI, 2008; Miller, 2014a; Yaksic & Comerford, 2019).

Serial Homicide: The Victims

The ill-fated individuals who fall prey to serial killers include males and females, ranging from infants to older adults. All races and ethnicities are also at risk of falling victim to serial killers. According to Miller (2014a), most serial killers are intra-racial in their victim selection. However, interracial serial killers have become more prevalent (Miller, 2014a, p. 5). In addition, a large percentage of serial killers' victims are strangers, which directly contradicts the long-standing adage that murder victims usually know the killer (Block & Block, 2008; Chan et al., 2015; FBI, 2014; Keppel, 2005).

While no individual is protected from being murdered by a serial killer, women are the most frequently targeted victim group (Aamodt et al., 2020; FBI, 2014; Quinet, 2011, Vronsky, 2014). In an analysis of 15 serial killers (N = 15) who were responsible for killing 178 individuals (*n* = 178), Rossmo found that women represented nearly ¾ of the victims (72.5%) (1995). Similarly, Aamodt (2014) analyzed 2,624 serial killers operating in the US from 1930 to 2014, and females represented over half of the victims in the sample (53.8%). Other highly vulnerable and targeted groups by serial killers include children and older adults (Campobasso et al., 2009; Chopin & Beauregard, 2020).

Occupational and circumstantial variables also impact the probability of being murdered by a serial killer. For example, prostitution is one of the highest at-risk occupations targeted by serial killers (Godwin, 1998; Lee & Reid, 2018). In an analysis of US serial killer victims, Quinet (2011) found that the rates of female victims have marginally increased, especially women working in high-risk occupations such as prostitution. From 1970 to 2009, female prostitutes murdered by serial killers represented over 30% of all female serial homicide victims in the US (Quinet, 2011, p. 108).

Lastly, Bonn (2019) emphasizes that serial killers select their victims for three primary reasons: (1) *availability*, (2) *vulnerability*, and (3) *desirability* (see also FBI, 2008). The availability of the victim refers to the serial killer's use of victims' lifestyles and routine activities to gain access to them (e.g., single woman living alone) (Bonn, 2019; see also Cohn & Felson's Routine Activity theory, 1979). The *vulnerability* of potential victims is the susceptibility and degree of risk involved in killing the victim (e.g., an individual walking alone at night would be highly vulnerable to an attack by a serial killer) (Bonn, 2019). Lastly, the victim's *desirability* is subjective and depends on the serial killer's fantasies and other personal predilections (e.g., age, gender, ethnicity, hair color, body type) (FBI, 2008; Bonn, 2019).

Challenges of Serial Homicide Investigations

Finally, research on serial killers and their victims yields several critical factors relevant to serial homicide investigations. The apprehension of serial killers by law enforcement agencies (LEAs) is often problematic due to confounding variables such as the killer's signature, modus operandi (MO), victim selection, crime scene characteristics, and geospatial patterns (FBI, 2008, 2014; Geberth, 2015; Godwin, 2000, 2002; Hazelwood & Warren, 2003; Keppel, 2005). There are five fundamental challenges associated with serial homicide investigations: (1) preconceptions of LEAs regarding victim-offender relationships and deeming serial murder a rare phenomenon; (2) failing to connect the dots between cases; (3) lack of standard operating procedures for serial murder cases; (4) reliance on experience over evidence-based practice; and (5) the high-profile nature of serial homicide (Bennell et al., 2012; Canter & Wentink, 2004; Edelstein, 2016; Egger, 1990, 1999, 2005; FBI, 2008; Geberth, 2015; Godwin, 2000, 2002; Keppel, 2005; Rossmo, 2005; Scerra, 2011; Yaksic & Comerford, 2019).

One of the most significant disadvantages for LEAs in serial murder investigations is *linkage blindness*, defined as the inability to connect cases within the same serial killing series (Egger, 2005; Keppel, 2005; Hazelwood & Warren, 2003; O'Reilly-Fleming, 1992). Such investigations prove challenging for LEAs to swiftly connect cases to the same offender. According to the FBI (2008), identifying one or even multiple murders as a serial killer's work is the biggest challenge of serial murder investigations (2008). Moreover, Dr. Robert Keppel, who assisted in the investigation and apprehension of infamous serial killers Ted Bundy and Gary Ridgeway (i.e., the Green River Killer), suggests that linkage blindness is the central problem in 90% of all serial murder investigations (2005). Lack of cross-jurisdictional communication between LEAs can also result in unsolved serial homicide cases. Including many cases that remain unsolved to this day (i.e., the Zodiac Killer, Babysitter Killer, Axeman of New Orleans, Highway of Tears Murderer, Bible Belt Strangler, Freeway Phantom, West Mesa Bone Collector, Alphabet Killer, I-70 Killer, and the Long Island Serial Killer).

Second, the reliance on experience (i.e., criminal profiling) instead of evidence-based practices is also a significant challenge (Edelstein, 2016; Yaksic, 2020). Criminal profiling is an investigative concept based on law enforcement officers' experience, which establishes classifications of the killer's victim selection, MO, and crime scene actions to help catch serial killers (FBI 2008; Godwin, 2002; Keppel, 2005). Criminal profiling has been widely criticized in academia in that profiling is inherently based on the experience of law enforcement officers and lacks scientific data to validate it as a valuable investigative tool (Bennell et al., 2012; Canter & Wentink, 2004).

Although law enforcement experience is not impractical in serial homicide investigations, research suggests that LEAs should use evidence-based investigative tools in conjunction with police officers' expertise (Yaksic, 2020). For example, computer-based tools that construct profiles and link multiple cases together can be beneficial in such investigations (Egger, 1999; Godwin, 2000; Hazelwood & Warren, 2003). These computerized systems include: (1) ViCAP (*Violent Criminal Apprehension Program*); (2) NCAVC (*National Center for the Analysis of Violent Crime*); (3) HITS (*Homicide Investigation and Tracking System*); (4) geographic profiling (i.e., ArcGIS, Dragnet, Riegel); and (5) SSA-I (*Smallest Space Analysis* of crime scene behaviors) (Canter, 2003; FBI, 2014; Godwin, 2002; Hazelwood & Warren, 2003; O'Reilly-Fleming, 1992;

Rossmo, 1995, 2000, 2005). Multifaceted data-based approaches, such as the *Investigative Journalist/Expert Field Micro Task Force* (IJ/EF MTF) model, have also assisted in unsolved serial homicide cases (Yaksic, 2020).[2]

The literature reviewed so far has provided an overview of the prevalence of serial homicide, the characteristics of serial killers and their victims, and the various challenges of serial murder investigations. The following section discusses the specific problem of home invasion serial homicide and HISKs. The significant gap in the existing literature and little descriptive research on home invasion serial homicide is reviewed.

2.2 Home Invasion Serial Homicide

In general, serial homicide is a phenomenon that triggers high levels of public fear (Miller, 2014a; Warf & Waddell, 2002). More specifically, home invasion serial homicide is a high-profile problem that significantly affects LEAs, government officials, media outlets, the public, potential victims, families of the victims, and principally, individuals that fall victim to HISKs. According to Warf and Waddell, public fear related to serial murder is intensified by killers that murder victims within their residence (2002). The authors assert that home invasions by serial killers are highly feared by the public, particularly women living alone, which is predicated on the following perspective:

> Violation of the home adds to the terror of serial killers, indicating there is no clear physical boundary between safe and unsafe. The house is generally considered the most private, defensible place where the external world is held at bay, allowing the public self to give way to the informal, unrestrained backstage of private life. (Warf & Waddell, 2002, p. 340)

[2]*Note*. The IJ/EF MTF model consists of a joint effort of LEAs, crime analysts, and investigative journalists to clear unsolved serial homicide cases.

When communities face a public disaster or crisis such as a home invasion serial killer (HISK) operating within the area, social solidarity among community members is often deflated due to the public's growing paranoia, anxiety, distrust of outsiders, escalated levels of fear, and by extension, inadvertent moral panic within impacted areas (Warf & Waddell, 2002). Public fear is also exacerbated when the active serial killer continues to successfully evade apprehension, leading to a generalized skepticism by civilians about the protective capabilities of local LEAs (Gibson & Chavez, 2005; Hodgkinson et al., 2016; Warf & Waddell, 2002). Notorious HISKs such as Albert DeSalvo, Dennis Rader, Joseph DeAngelo, Russell Williams, Edward Surratt, Richard Ramirez, Israel Keyes, and the like are cases that highlight the magnitude of home invasion serial homicide (Brankley et al., 2014; Martin et al., 2020).

Despite being one of the most frequent forms of serial homicide, home invasion serial murder and HISKs have been marginally documented in prior research, mainly through descriptive studies. For example, Aamodt et al. (2016) reviewed findings from the *Radford University/Florida Golf Coast University Serial Killer Database* (RU/FGCU SKD), which at the time consisted of 4,274 US and international serial killers (N = 4,274) from 1950 to 2014. In their descriptive analysis of 8,058 US and Canadian victims (N = 8,058), the most frequent victim type was home invasion victims, with 1,371 victims being killed at their residence by serial killers (17%) (Aamodt et al., 2016). In the most recent annual RU/FGCU SKD report, Aamodt et al. (2020) found that in the US, the most frequent victim type of serial killers is home invasion (n = 1,788 or 16%).

Relatedly, in a clinical examination of sexual killers (N = 52) and their victims (n = 106), Schlesinger and Revitch (1999) found that more than 50% of the victims were murdered at their home and 75% of such killers had an extensive criminal history involving sexual burglary (Schlesinger & Revitch, 1999). Block and Block (2008) also identified a subgroup of 169 serial homicides in a study of 27,345 homicide victims, which indicated that the most frequent location of these murders was the victim's residence (25%), followed by "street, alley, or sidewalk" (23.7%) (p. 16).

As the marginal descriptive research indicates, the literature relevant to home invasion serial homicide is limited to measuring the occurrence of serial murder at various locations, including victims' residences. There is a significant gap in serial homicide research that has comprehensively and exclusively investigated home invasion serial homicide and HISKs as a dependent or independent variable. Due to this substantial gap, it is essential to exclusively examine HISKs as a dependent variable (Study One and Study Three) and independent variable (Study Two).

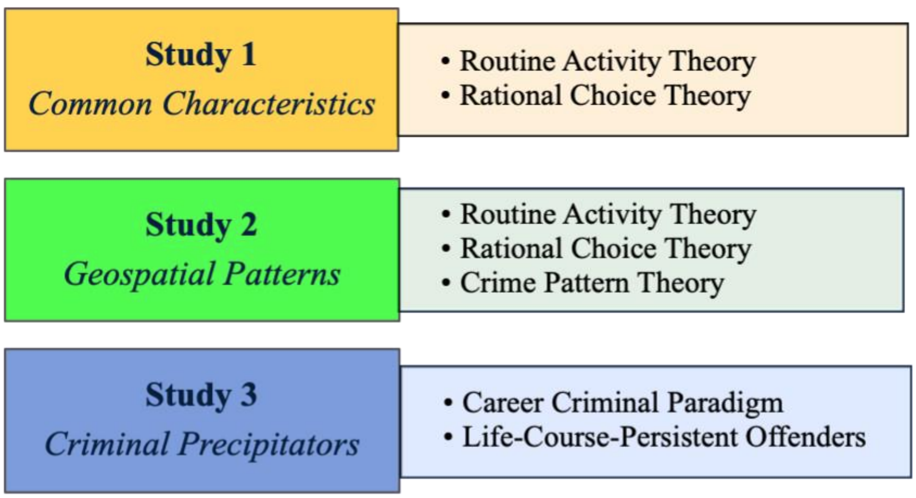
To comprehensively assess the problem of home invasion serial homicide, this dissertation aims to comparatively examine the differences between HISKs and non-HISKs in three fundamental investigations: (1) common characteristics, (2) geospatial patterns, and (3) criminal precipitators. The following section provides a comprehensive review of the theoretical framework that formed the basis of the dissertation and the pertinent theories and research relevant to the hypotheses of the three investigations.

2.3 Theoretical Framework

This section discusses the theoretical framework of the dissertation. Since this dissertation consists of three investigations and poses three research questions and various hypotheses, it encompasses several layers of theories concerning its design and framework. The structure of this section consists of several subsections for each of the three investigations: (1) theoretical background; (2) theoretical basis and application to the investigation; (3) review of the literature relevant to the hypotheses; and finally, (4) overview of the hypotheses. The theoretical framework of each of the three investigations is highlighted in Figure 2.

Figure 2

Theoretical Framework of Three Investigations of HISKs and Non-HISKS



Study One Theoretical Framework: Common Characteristics of HISKs and Non-HISKs (Routine Activity and Rational Choice Theories)

Theoretical Background

As illustrated in Figure 2, the first layer of the theoretical framework pertinent to Study One and the common characteristics of HISKs is grounded in environmental criminology. Environmental criminology is a well-established subdivision and crime-specific theory in *Positivist* criminology. The fundamental premise of environmental criminology is that crime is influenced by the environment in which it occurs (Jeffery, 1971). The underpinnings of environmental criminology are based on situational factors relevant to crime opportunity (Brantingham & Brantingham, 1981; Cohen & Felson, 1979; Cornish & Clarke, 1986).

Environmental criminology uses situational, spatial, and temporal analyses to identify crime opportunities to establish crime patterns and elements that impact the offending process (Brantingham & Brantingham, 1981; Cohen & Felson, 1979; Cornish & Clarke, 1986). The fundamental premise of environmental criminology is to pinpoint and alter the immediate and direct opportunities that lead to crime (e.g., lack of secure locks) (Coyne & Eck, 2015). Implementation of various *situational crime prevention* (SCP) measures (i.e., installing locks) is then employed to prevent crime opportunities presented to likely offenders (Clarke & Eck, 2005; Leclerc et al., 2016).

Two prominent environmental criminology theories are (1) *Routine Activity* theory (Cohen & Felson, 1979) and (2) *Rational Choice* theory (Cornish & Clarke, 1986). Routine activity theory (RAT), a *macro*-level criminology theory, is premised on the underlying concept that the routine activities of offenders and victims and other situational factors impact the crime commission process. The theory postulates that for a crime to occur, there must be an intersection of *time* and *space* involving three essential elements: (1) motivated offender(s); (2) suitable target/victim(s); and (3) lack of capable guardianship to prevent the crime (Cohen & Felson, 1979).

Rational choice theory (RCT), a *micro*-level criminology theory, posits that criminals engage in rational decision-making processes in their choice to commit a crime (Cornish & Clarke, 1986). The theory posits that the offender employs a cost-benefit analysis before the crime related to the risk (apprehension) versus the benefit (successful commission of the crime). RCT denotes that the primary objective of the rational criminal is maximizing the benefits associated with the crime while concurrently minimizing the risks (Cornish & Clarke, 1986).

Theoretical Basis and Application of RAT and RCT

As illustrated in Figure 2, the theoretical basis and framework for Study One integrated RAT and RCT since both environmental criminology theories highlight the importance of situational contexts and the decision-making processes of serial offenders (Cohen & Felson, 1979; Cornish & Clarke, 1986). Both RAT and RCT are frequently applied concomitantly to explain the offending process of serial offenders, particularly concerning the situational factors that impact such offenders' victim selection, modus operandi, and crime scene actions.

The first theory of Study One, RAT, was applied to examine the common characteristics of HISKs and non-HISKs. Previous research demonstrates that serial offenders frequently utilize the routine activities of victims and their daily lives to commit offenses over the crime series (Chopin & Beauregard, 2020; Pizarro et al., 2007). The findings of previous studies indicate that the routine activities of serial offenders and their victims can significantly impact the crime commission process regarding the type of victims, methods utilized, and crime locations in which such offenses occur (Chan et al., 2011; Ensslen et al., 2018; Pedneault et al., 2015b).

The second theory of Study One, RCT, was also applied to examine the common characteristics of HISKs and non-HISKs. The existing literature indicates that serial offenders exhibit rationality in their decision-making process regarding their victim selection, modus operandi, and crime site locations (Beauregard et al., 2007; Deslauriers-Varin & Beauregard, 2010; Ensslen et al., 2018; Pedneault et al., 2015b). Lastly, specifically pertinent to the hypotheses proposed in Study One, both RAT and RCT have been previously used to examine home invasion sex offenders (i.e., sexual burglars, home intruder sex offenders) (Ensslen et al., 2018; Pedneault et al., 2015b).

The theoretical foundation and scientific support of the perspectives of RAT and RCT are renowned and supported in environmental criminology. RAT and RCT also highlight the importance of assessing serial offenders' offending patterns and decision-making processes in the crime series. Consequently, both RAT and RCT formed the theoretical framework and were applied to Study One concerning the common characteristics of HISKs and non-HISKs to investigate three sets of independent variables: (1) victim selection; (2) modus operandi; and (3) crime scene actions. The existing literature relevant to each set of hypotheses posed for Study One is further discussed in the following section.

Study One: Literature Relevant to Hypotheses

A considerable amount of literature has been published on the offending patterns and common characteristics of serial killers (Beauregard & Martineau, 2012, 2016; Beasley, 2004; Bennell et al., 2012; DeLisi & Scherer, 2006; Godwin & Canter, 1997; Godwin, 2000; James & Proulx, 2016; Martin et al., 2020; Miller, 2014a; Pakkanen et al., 2015; Ressler et al., 1988; Salfati et al., 2015; Stein et al., 2010; Woster, 2020). Furthermore, relevant to HISKs, prior research has applied RAT and RCT perspectives to investigate the offending patterns of non-lethal sex offenders that use the victims' residence as the locus of their attacks (i.e., home invasion rapists, sexual burglars). Evidence suggests that such offenders illustrate differences in their decision-making process and offending patterns than non-residential sex offenders (Beauregard et al., 2010; Deslauriers-Varin & Beauregard, 2010; Ensslen et al., 2018; Pedneault et al., 2015b; Vaughn et al., 2008). The high-risk nature of the predilection of home invasion sex offenders for the victim's residence as the locus of their attacks is discussed below.

Why the Victim's Residence?

In 1628, English jurist Sir Edward Coke established eminent legal precedent regarding an individual's residence by proclaiming: "Every man's house is his castle and fortress, *et domus sua est tutiissimum refugium* [and each man's home is his safest refuge], as well as for his defence against injury and violence as for his repose" (p. 162). The residence is generally thought of as the most remote, defensible, and safe location to protect oneself from victimization (Warf and Waddell, 2002). Still, non-fatal home invasion sex offenders are ostensibly undeterred by the high-risk nature of targeting and attacking victims in their residence (Deslauriers-Varin & Beauregard, 2010).

The high-risk nature and dangerousness of home invasion sex offenders are well-documented in existing research. For example, Deslauriers-Varin and Beauregard (2010) identified three victim selection scripts of 72 serial sex offenders: (1) the *social script*, (2) the *outdoor script*, and (3) the *home script* (p. 329). Findings revealed that home script offenders exhibited the highest risk-taking levels by targeting victims within their homes. Such offenders are less likely to be familiar with the victim's house than a public location (Deslauriers-Varin & Beauregard, 2010, p. 329). Conversely, researchers claim that the appeal of the victim's residence is that it consists of an indoor location and consequently provides substantial privacy and a controlled environment to for such offenders to commit their attack (Deslauriers-Varin & Beauregard, 2010; Harbers et al., 2012; Pedneault et al., 2015b). Beauregard and Martineau (2012) also contend that home invasion sex offenders are further enticed by victims' residences when it is easily accessible, clearly visible (e.g., leaving the blinds open), and readily escapable.

Prior studies of home invasion sex offenders have primarily examined three sets of characteristics using RAT and RCT perspectives: (1) victim selection, (2) modus operandi, and (3) crime scene actions. For instance, through RAT and RCT approaches, Pedneault et al. (2015b) examined 104 sexual burglars and found that such offenders demonstrated profoundly distinct offense patterns than non-sexual burglars. Unlike the general burglar, sexual burglars were highly rational and premeditated regarding situational factors such as the home being easily accessible, lacking capable guardianship, and being occupied by victims (Pedneault et al., 2015b).

Ensslen et al. (2018) also examined serial sex offenders (N = 69). They asserted that the target selection, MO, and crime scene characteristics of home intruder sex offenders "constitute a specific type of sex offender, one that resembles the sexual burglar as discussed by Pedneault et al. (2015)" (Ensslen et al., 2018, p. 4695). All three characteristics were statistically significant in predicting whether encounter, attack, and release sites occurred at the victim's home or elsewhere (Ensslen et al., 2018, p. 4709).

Both types of home invasion sex offenders also considered the structural features and accessibility of the victims' residences. They mainly targeted single-story homes or ground-floor apartments (Pedneault et al., 2015b; Ensslen et al., 2018). The residences also lacked capable guardianship (e.g., security systems or another person present). Such findings further support RAT and RCT perspectives. As such residential sex offenders are inherently rational and use situational cues to target adult victims in easily accessible occupied dwellings, lacking guardianship, and use structured premeditation to gain access to and execute their offenses (Pedneault et al., 2015b; Ensslen et al., 2018).

The decision-making process and MO of home invasion sex offenders are often non-random and premeditated in their target and crime site selection, exemplifying such offenders' precision. Taking into account, the findings of Ensslen et al. (2018) and Pedneault et al. (2015b), the MO of home invasion sex offenders ostensibly resembles the “the stalker” outlined in Rossmo’s *attack method* typology (1995). According to this typology, three serial killer attack styles were delineated: (1) the *raptor,* (2) the *stalker*, and (3) the *ambusher* (1995). The raptor employs a blitz method and immediately attacks their victims; the stalker targets non-random victims and waits for an appropriate time to attack; the ambusher lures victims (via ruse) to an isolated location before the attack (Beauregard et al., 2010; see Rossmo, 1995).

Finally, the crime scene actions of home invasion sex offenders have also been investigated. Previous studies have reported that home invasion sex offenders exhibit consistent behavior in their crime site selection. Such offenders typically have *single location crime scenes* (i.e., encounter, attack, and release site are at the victim's residence) (Beauregard et al., 2010; Ensslen et al., 2018; Rebocho & Silva, 2014). Beauregard et al. (2010) examined 78 serial rapists and revealed that “home-intrusion track rapists” typically use the victim’s home as a <u>fixed base</u> as their “encounter, attack, crime, and victim-release sites <u>are the same</u>” (p. 142). Similarly, in a comprehensive review on the target selection process of rapists, Rebocho and Silva (2014) assert that home invasion rapists “will typically have <u>one crime scene location</u>” compared to non-residential rapists (p. 48; see also Beauregard et al., 2010).

The literature reviewed thus far provides evidence that non-fatal home invasion sex offenders exhibit distinct characteristics in their victim selection, MO, and crime scene actions compared to non-residential sex offenders. However, no previous investigation has examined home invasion serial killers' (HISKs) common characteristics and offense patterns. This gap in the existing literature indicates the need to understand the victim selection, MO, and crime scene actions of HISKs versus non-HISKs and formed the basis for the variables and hypotheses regarding the common characteristics of both serial killer groups in Study One.

Study One: Overview of Hypotheses

Based on the existing literature regarding home invasion sex offenders, RAT and RCT perspectives were used to form three sets of hypotheses and investigate the common characteristics of HISKs compared to non-HISKs in Study One. The hypotheses investigated in Study One posit that HISKs will exhibit differences in (1) victim selection, (2) modus operandi, and (3) crime scene actions compared to non-HISKs. These hypothesized differences are based on five independent variables constructed for Study One: (1) *non-random victims*; (2) *adult victims*; (3) *structured premeditation*; (4) *stalker attacks*; and (5) *single location crime scenes*.

The first hypothesis is relevant to *victim selection*; it is postulated that HISKs will be more likely to murder non-random victims that are primarily adults. This assumption is predicated on the findings of Ensslen et al. (2018) and Pedneault et al. (2015b) in that home invasion sex offenders primarily targeted non-random adult victims.

The second hypothesis is relevant to *modus operandi*; it is postulated that HISKs will primarily use structured premeditation and, as a result, employ a stalker attack method to gain access to the victims' residence(s). This assumption is also predicated on the findings of Ensslen et al. (2018), and Pedneault et al. (2015b) in that home invasion sex offenders employ structured premeditation in their offenses. Due to such offenders' non-random, premeditative nature, it is also anticipated that HISKs will employ a stalker attack method (Rossmo, 1995).

The third and final hypothesis is relevant to *crime scene actions*; it is postulated that HISKs will have single location crime scenes (i.e., the victim's residence). This assumption is predicated on previous studies that suggest home invasion sex offenders consistently use the victim's residence as the locus of their encounter, attack, and release sites (Beauregard et al., 2010; Rebocho & Silva, 2014; Warr, 1988).

Study One: Theoretical Framework Summary

The theoretical framework and literature reviewed in this section show that several researchers have applied RAT and RCT perspectives to examine the offending patterns of home invasion sex offenders. Conversely, there remains a gap in the existing literature regarding HISKs and applying these theoretical perspectives to investigate their common characteristics and offending patterns. Study One seeks to address this void in the existing literature by conducting a comparative analysis of the common characteristics of HISKs and non-HISKs. The hypotheses of Study One predict that HISKs will reveal significant differences in their victim selection, MO, and crime scene actions compared to non-HISKs.

Study Two Theoretical Framework: Geospatial Patterns of HISKs and Non-HISKs (Routine Activity, Rational Choice, and Crime Pattern Theories)

Theoretical Background

The second layer of the theoretical framework pertinent to Study Two and the geospatial patterns of HISKs and non-HISKs is predicated on the concept of journey-to-crime (JTC), which stems from environmental criminology. The function and application of JTC are to assess the geographic mobility patterns of serial offenders through geospatial analysis (GSA). The theoretical foundation of JTC and GSA originates from three environmental criminology theories: (1) routine activity theory (RAT), (2) rational choice theory (RCT), and (3) crime pattern theory (CPT) (Brantingham & Brantingham, 1981; Cohen & Felson, 1979; and Cornish & Clarke, 1986).

First, RAT posits that serial offenders' JTC patterns are impacted by the offenders' and victims' routine activities from a *macro*-level perspective. There must be an intersection in the time and space of the offender, a victim(s), and the lack of capable guardianship (Canter & Larkin, 1993; Cohen & Felson, 1979). The routines of the offender and victim play a crucial role in the location where the offender commits the crime. For example, targeting victims in the context of their daily routines, the familiarity with the area, and the accessibility of the victim are all critical factors in the crime commission process (Cohen & Felson, 1979).

Second, from a *micro*-level perspective, RCT proposes that criminals' JTC patterns are based on rational decisions through cost-benefit analysis prior to the crime (Canter, 2003; Cornish & Clarke; Rossmo, 1995). Such decisions are primarily associated with an offender’s spatial awareness and familiarity with an area to evade apprehension and commit crimes close to their home (Canter, 2004; Cornish & Clarke, 1986).

Third and finally, Brantingham and Brantingham’s Crime Pattern theory (CPT) is a *meso*-level environmental criminology theory that highlights offenders' spatial patterns *and* rationality. CPT posits that *rational* offenders, during their *routine activities*, select available targets based on the influence of the offender’s social and physical environments (Brantingham & Brantingham, 1981). CPT emphasizes that crime is not randomly dispersed in space or time but rather specific locations and time intervals that crime is more likely to occur (1981). Since RAT is a macro-level theory and RCT is a micro-level theory, at the meso-level, CPT effectively combines both RAT and RCT. Consequently, Study Two included CPT in the theoretical framework, as it connects the dots between RAT and RCT perspectives and the hypotheses delineated for Study Two.

Theoretical Basis and Application of RAT, RCT, and CPT

Figure 2 shows that the theoretical framework for Study Two integrated RAT, RCT, and CPT, as these perspectives highlight the importance of the situational and environmental context and the JTC decision-making processes of serial offenders (Brantingham & Brantingham, 1981; Cohen & Felson, 1979; Cornish & Clarke, 1986). RAT, RCT, and CPT theories are frequently applied concurrently to explain the serial offenders’ crime process, particularly concerning the geospatial factors impacting such offenders' decisions, and the distance traveled to each crime during the series.

The three environmental criminology theories provide the theoretical context in which journey-to-crime (JTC) and geospatial analysis (GSA) concepts were developed. The primary assumption of JTC is that criminals commit a crime near their residence or nodes (Canter & Larkin, 1993; Rossmo, 1995). The central focus of JTC is the distance traveled by serial offenders to commit a crime and uses the distribution of crimes to estimate the criminal's home or nodes (Canter, 2003; Kent et al., 2006; Rossmo, 1995). On the contrary, GSA includes a wide assortment of spatial tools to map the crime points to visualize and identify the geospatial patterns and trends related to the location of crimes in a series or specific regions (Ackerman & Rossmo, 2015; Faulkner et al., 2018; Lammers & Bernasco, 2013; Neldner, 2015; Rossmo, 2000, 2005).[3]

Pertinent to JTC and GSA is geographic profiling, a spatial technique developed by Rossmo (2000), which utilizes computer software algorithms to (1) analyze offenders' hunting patterns and (2) use such patterns to calculate probable locations of the offender's residence or nodes. Geographic profiling has also been used to study animals' foraging patterns (Johnson, 2014; Martin et al., 2009).

The theoretical foundation and scientific support of RAT, RCT, and CPT perspectives are robust and substantiated in environmental criminology. These theories highlight the importance of measuring serial offenders' spatial and temporal patterns during the series. Consequently, these environmental criminology theories were applied to examine the geospatial patterns of HISKs and non-HISKs. The existing literature relevant to each hypothesis posed for Study Two is further discussed below.

Study Two: Literature Relevant to Hypotheses

The geospatial patterns of criminals have been well-documented in the existing JTC literature. The literature indicates that most offenders commit crimes close to their

[3]*Note*. Nodes are locations routinely frequented by the killer other than their residence (e.g., occupation, school, hobbies).

residence or nodes (Amir, 1971; Beauregard et al., 2007; Canter, 2003; Canter & Larkin, 1993; Guerette et al., 2020; Lundrigan & Canter, 2001a, 200lb; Martineau & Beauregard, 2016; Rossmo, 1995, 2000, 2005; Santtila et al., 2008). Previous studies also suggest that criminals often make spatial decisions based on their familiarity with an area to avoid apprehension. Conversely, a small percentage of criminals travel longer distances to evade apprehension (Canter, 2003; Rossmo, 1995, 1995b, 2000; Synnott et al., 2019).

There are two key concepts relevant to the directionality of criminals' JTC patterns: (1) *distance decay* and (2) the *buffer zone hypothesis* (Canter & Larkin, 1993; Rossmo, 2000; Santtila et al., 2008). The concept of distance decay suggests that the frequency of the criminal's offenses *decreases* as the distance from the criminal's node(s) *increases* (Kent et al., 2006; Rossmo, 2000). In contrast, the buffer zone hypothesis suggests that criminals employ a buffer zone between their residence and crime site location(s) (Canter & Larkin, 1993; Santtila et al., 2008). Previous research suggests distance decay and buffer zones vary based on the offense type, geographic region, and jurisdiction in which the offenses are committed (Block & Bernasco, 2009; Canter & Larkin, 1993; LeBeau, 1987a, 1987b; 1992; Kent et al., 2006; Kocsis & Irwin, 1997; Synnott et al., 2019). These JTC concepts have also been denoted regarding serial criminals. Previous research suggests that serial criminals commonly exhibit similar JTC patterns and might apply to all forms of serial crime (e.g., serial arson, serial burglary, serial rape, and serial homicide) (Canter, 2003; Goodwill & Alison, 2005; Roh & Leipnik, 2005; Rossmo, 1995; Snook et al., 2002).

For example, Canter and Larkin's *Circle Theory of Environmental Range* (i.e., circle hypothesis) (1993) contends that if a circle is drawn around the series of connected crimes or body disposal sites, the serial offenders' residence will also be located in the outlined circle. In their well-known study of 45 serial sex predators, Canter and Larkin delineated two primary types: (1) *marauders* and (2) *commuters* (1993). Marauders are geographically static and usually offend near their residence, whereas commuters are geographically dynamic and tend to offend further away from their residence (Canter & Larkin, 1993; Canter, 2004; Deslauriers-Varin & Beauregard, 2013; Snook et al., 2005; Wartell & Gallagher, 2012). Several researchers have reported that marauders are much more prevalent than commuters, which coincides with RAT, RCT, and CPT, in that serial offenders tend to commit crimes closer to their home or other nodes (Brantingham & Brantingham, 1981; Canter, 2003; Cohen & Felson, 1979; Cornish & Clarke, 1986; Pizarro et al., 2007; Strangeland, 2005).

Similar typologies specifically relevant to the geographic mobility of serial killers have also been delineated, such as Holmes and DeBurger's geographically *stable*, *transient*, and *mixed* serial killers (1988) and Hickey's mobility typology of *traveling*, *local*, and *place-specific* killers (1991). The hunting style of serial killers has also been delineated. In a comprehensive micro and macro geospatial analysis of serial killers, Rossmo (1995) outlined four hunting styles: (1) the *hunter* (i.e., kills victims within the city the killer resides); (2) the *poacher* (i.e., kills victims outside their home city but in the vicinity of another node); (3) the *troller* (i.e., opportunist that kills during their routine activities); and (4) the *trapper* (i.e., uses their occupation to solicit victims where they have complete control) (1995).

All four serial murder geographic mobility typologies share similarities. For example, they all differentiate between geographically mobile and immobile serial offenders and the methods used to target victims. Canter and Rossmo's typologies share similar characteristics concerning Canter's marauder type and Rossmo's hunter type, as both types commit crimes close to their residence and target victims in the perpetrators' awareness space (Snook et al., 2005). Canter's commuter type is also similar to Rossmo's poacher type, as both types tend to travel outside their comfort zone to kill victims (Beauregard & Martineau, 2016). Similarities between Holmes and DeBurger's geographic and Hickey's mobility typology are also apparent since both consist of a three-fold typology, two of which discuss mobile and immobile killer types.

In a scoping review of the literature on geographic mobility of serial homicide (N = 43), Comerford (2021) examined these four associated typologies to determine the current status of the existing literature and provide avenues for future research in this domain. The review sample contained JTC and GSA sources relevant to serial homicide (N = 43), and a subsample of sources was also examined concerning the four typologies (n = 18). While the overall findings of the scoping review illustrate that JTC and GSA concepts have been recognized in serial murder investigations and prior research, there remains a considerable void in the literature regarding the geographic mobility of serial killers and these four typologies (Comerford, 2021).

For example, the typology most frequently examined was Canter and Larkin's marauder and commuter typology, representing less than 30% of the sources in the scoping review sub-sample (n = 18). The collective efficacy of the four typologies in the context of serial murder investigations has also not been systematically evaluated. Future research in this domain should conduct a meta-analysis to assess the predictive value of all four typologies to determine the most efficacious typology used in serial homicide investigations (Comerford, 2021). Table 1 below provides an overview of each typology, the results of the scoping review, and the limitations.

Table 1

Prominent Geographic Mobility Typologies Relevant to Serial Homicide

Author(s)	Sample	Typology	Strengths/Review Results	Limitations
Canter & Larkin (1993)	*N* = 45 serial offenders	Marauders Commuters	Most frequently examined/supported; JTC calculations to classify cases. *n* = 12: *Support* (= 9); *Partial* (= 3)	Dichotomous/lacks “mixed” category; does not account for other nodes.
Holmes & DeBurger (1988)	*N* = 110 SKs	Stable Transient Mixed	Includes mixed type; second most examined/supported. *n* = 6: *Supported* (= 3); *Partial* (= 2); *Unsupported* (= 1)	Lacks empirical framework to classify cases or account for other nodes; All 6 sources = gray literature.
Rossmo (1995)	*N* = 238 SKs *Macro* = 225 *Micro* = 13	Hunter Poacher Troller Trapper	The first hunting style typology; macro/micro samples; several sources examined/supported. *n* = 3: *Supported* (= 2); *Partial* (= 1)	Minimal empirical assessment; does not account for other nodes.
Hickey (1991)	*N* = 400+ SKs	Travelling Local Place-Specific	Includes place-specific category; several sources examined/supported. *n* = 3: *Supported* (= 2); *Unsupported* (= 1)	Does not use JTC calculations or account for nodes to classify cases; All 3 sources = gray literature.

Note. Overview of each sample, typologies, strengths/review results, and limitations served as the body and description of Table 1. Adapted from “A Scoping Review of Serial Homicide Geographic Mobility Literature and Four Typologies,” by C.V. Comerford (2021), *Homicide Studies*, OnlineFirst. https://doi.org/10.1177/1088767921993506. Copyright 2021 by SAGE Publications.

While little is known about the geospatial patterns of HISKs, there have been several studies on the JTC patterns of non-fatal home invasion sex offenders (Beauregard et al., 2010; LeBeau, 1987a, 1987b, 1987c). In particular, the *residence-to-crime* (RTC) distance and the *length* of the offending series of such offenders have also been examined using RAT, RCT, and CPT approaches. In the often-cited geospatial study of serial killers (*N* = 238), Rossmo found serial killers with *longer* JTC distances and *multiple location* crime sites are *more challenging* to solve than killers with *shorter* JTC distances and *single location* crime sites (1995). Likewise, Van Patten and Delhauer (2007) found that offenders with shorter JTC patterns and single location crime sites (i.e., "simplest geometry") are likely to be apprehended faster (p. 1140). Compared to offenders with longer JTC patterns and multiple location crime sites (i.e., "complex geometries") (Van Patten & Delhauer, 2007, p. 1140; see also Rossmo, 2000).

In the same way, Martineau and Beauregard investigated 'traveler' and 'non-traveler' sexual homicide offenders (*N* = 214) and the influence on *solved* versus *unsolved* sexual homicides; findings indicated a significant correlation between the travel patterns of sexual homicide offenders and the solvency of the case (2016, p. 76). "Traveler" sexual homicide offenders were more likely to remain *unsolved* compared to "non-traveler" offenders (i.e., single location crime sites) (Martineau & Beauregard, 2016, p. 76; see also Lundrigan & Canter, 2001a, 2001b). Lammers and Bernasco (2013) also found an inverse correlation between JTC distance traveled and apprehension of serial offenders: as the JTC distance of serial offenders *increased*, the likelihood of such offenders being apprehended *decreased*.

Similarly, previous research suggests that non-fatal home invasion sex offenders travel the *shortest* JTC distances than non-residential sex offenders (Beauregard et al., 2010; Dern et al., 2005). For example, in three geospatial examinations of serial sex offenders, LeBeau (1987a, 1987b, 1987c) found that home intruder serial sex offenders had the *shortest* JTC distances compared to non-home invasion sex offenders. Comparably, in an analysis of violent stranger sex offenses ($N = 544$), Dern et al. (2005) found that all illegal entry offenders (i.e., "break-in rapists") traveled *less than ten miles* to commit their offenses (p. 69). More than 80% of break-in rapists resided *less than five miles* from their victims' residences (Dern et al., 2005, p. 69). Martineau and Beauregard (2016) also contend that home invasion sex offenders typically travel shorter distances than non-residential sex offenders (see also LeBeau, 1987a, 1987b, 1987c).

The literature also suggests that home invasion sex offenders typically encounter, attack, and release victims at a *single location* and are more likely to be *apprehended faster* than serial offenders who encounter, attack, or release victims at multiple locations (Lammers & Bernasco, 2013; Martineau & Beauregard, 2016; Rebocho & Silva, 2014). Such findings indicate that due to swifter apprehension, home invasion sex offenders exhibit *shorter* crime *series durations* than non-residential sex offenders (Van Patten & Delhauer, 2007).

The research reviewed thus far provides evidence that serial killers and other serial offenders demonstrate similarities in their decision-making processes related to the JTC distance traveled to commit crime. Based on the existing literature that has applied RAT, RCT, CPT perspectives to examine serial killers' and home invasion sex offenders'

JTC distances, two hypotheses were tested regarding the geospatial patterns of HISKs versus non-HISKs in Study Two. An overview of these hypotheses are listed below.

Study Two: Overview of Hypotheses

Using RAT, RCT, and CPT perspectives, the relevant JTC literature regarding serial killers and home invasion sex offenders, the Study Two hypotheses posit that HISKs will reveal statistically significant differences in their geospatial patterns compared to non-HISKs. These hypothesized differences are based on two dependent variables constructed for Study Two: (1) *RTC distance* traveled (in miles) and (2) *murder series duration* (i.e., length of the murder series, in days, from the *first victim* to the *last victim* of the series).

The first hypothesis of Study Two tests the differences in the RTC distances traveled (in miles) by HISKs compared to non-HISKs. First, previous research on the JTC patterns of non-fatal home invasion sex offenders indicates that such offenders travel the shortest JTC distances to offense sites (i.e., victims' residences) (Dern et al., 2005; LeBeau, 1987a, 1992; Rebocho & Silva, 2014). Consistent with previous research, which indicates that home invasion sex offenders travel the shortest distance during the crime series, it is anticipated that HISKs will travel *shorter* RTC distances than non-HISKs.

The second hypothesis of Study Two tests the differences in murder series duration (in days) of HISKs compared to non-HISKs. Prior research illustrates that home invasion sex offenders are more likely to have single location crime sites than non-residential sex offenders (Dern et al., 2005; Martineau & Beauregard, 2016). Furthermore, serial offenders with single location crime sites are more likely to be apprehended faster than serial offenders with multiple crime site locations (Lammers &

Bernasco, 2013; Rebocho & Silva, 2014). Consistent with previous research, which has illustrated that home invasion sex offenders travel the shortest distances and often result in swifter apprehension during the series, it is anticipated that HISKs will also have *shorter* murder series durations than non-HISKs.

Study Two: Theoretical Framework Summary

The theoretical framework and literature reviewed in this section show a considerable amount of literature on applying RAT, RCT, and CPT perspectives to examine the geospatial patterns of serial killers and home invasion sex offenders. In contrast, there remains a substantial void in existing research on HISKs and applying these theoretical perspectives to investigate the decision-making process and situational factors that may impact their geospatial patterns during the murder series. Study Two seeks to address this gap in the literature by conducting a comparative analysis of the geospatial patterns of HISKs and non-HISKs. The hypotheses of Study Two predict that HISKs will reveal significant differences in their RTC distances and murder series durations compared to non-HISKs.

Study Three Theoretical Framework: Criminal Precipitators of HISKs and Non-HISKs (Criminal Career Paradigm and Life-Course Persistent Perspectives)

Theoretical Background

The final layer of the theoretical framework for Study Three is based on two *developmental/life-course* perspectives of criminality: (1) *Criminal Career Paradigm* (CCP) and (2) *Life-Course-Persistent* offenders (LCP) perspectives (Blumstein et al.,1986; Moffitt, 1993; Piquero et al., 2003). The underlying premise of both theoretical perspectives is that most serial offenders begin their criminal careers with minor offenses but may progress to more severe offenses or various types of crimes during the series.

Theoretical Basis and Application of CCP and LCP Perspectives

Figure 2 shows that the theoretical framework for Study Three is premised on both CCP and LCP theoretical perspectives to investigate the non-fatal criminal precipitators (CPs) of HISKs and non-HISKs before their first murder of the series. Blumstein et al. (1986) devised the career criminal paradigm (CCP), which is defined as the classification of an extensive series of offenses carried out by a single criminal (p. 12). The concept of the career criminal involves the inception, repetition, and conclusion of the crime series by the offender, including the frequency and type of offenses in the series (Blumstein et al., 1986; Piquero et al., 2003).

The CCP also emphasizes crime severity. It suggests that serial offenders are more likely to have a criminal history of more serious offenses (e.g., violent crimes) (MacDonald et al., 2014). Moreover, CCP highlights two types of career criminals: (1) *specialist* career criminals and (2) *versatile* career criminals (Piquero et al., 2003). Specialist career criminals commit a specific type of crime repetitively and specialize in that type of crime throughout their criminal career (e.g., serial burglars, serial rapists). Conversely, versatile career criminals commit various types of crime throughout their criminal career (e.g., gang members) (Blumstein et al., 1986; Guerette et al., 2005; Piquero et al., 2003; Sullivan et al.,2009).

Similar to CCP, Moffitt (1993) generated the concept of life-course-persistent offenders (LCP). The concept of LCP is based on Moffitt's dual taxonomy of criminal offending: (1) *youth-limited* offenders; and (2) *life-course-persistent* offenders (LCPs)

(1993). Life-course-persistent offenders are the primary focus of Study Three, as Moffitt (1993) posited that such offenders frequently engage in antisocial and criminal behavior early during adolescence. As LCP offenders age, their behavior and CPs escalate in frequency, severity, and type (Moffitt, 1993). Prior research has found that even though LCPs constitute a small percentage of criminals, such offenders account for more than half of the most severe crimes committed (Boutwell et al., 2013). Such findings support Wolfgang's ground-breaking longitudinal study of juvenile males (N = 9,445), which revealed that only 6% of the juvenile cohort were responsible for 52% of all crimes committed in the sample (1972).

The theoretical foundation and scientific support of CCP and LCP perspectives are renowned and substantiated in developmental/life-course criminology. Both perspectives also highlight the importance of measuring the *severity* (i.e., crime seriousness) and *type* of serial offenses/offenders (i.e., specialized versus versatile criminals) throughout a criminal's career. Consequently, CCP and LCP perspectives were utilized to examine the non-fatal criminal precipitators (CPs) of HISKs and non-HISKs.

Study Three: Literature Relevant to Hypotheses

A considerable amount of literature exists on the developmental backgrounds and criminal histories of serial killers (Allely, 2020; Allely et al., 2014; FBI, 2014; Godwin, 2000; Hickey, 2016; Marono et al., 2020; Reid et al., 2019; Stone, 2001, 2007, 2009; Trojan & Salfati, 2010a; Wright et al., 2008). The criminal records of serial killers range from non-violent offenses (e.g., petty theft, voyeurism, exhibitionism, substance abuse) to violent offenses (e.g., aggravated robbery, burglary, sex offenses). While other serial killers engage in criminal activities but do not get caught until they are apprehended for serial homicide (Miller, 2014b, p. 13). However, the nature of serial killers CPs commonly evolves in frequency, *severity*, and *type* during the offense series before their first homicide (Brankley et al., 2014; Johnson & Becker, 1997; MacCulloch et al., 1983).

The *severity* of serial killers' criminal histories has been extensively documented in the existing literature (Gray et al., 2003; James & Proulx, 2014, 2016; Langevin, 2003; Malizia, 2017; Marono et al., 2020; Miller, 2014b; Prentky et al., 1989; Reid et al., 2019; Singer & Hensley, 2004; Trojan & Salfati, 2010a; White, 2007). Schlesinger (2000) outlined the developmental psychodynamics of serial killers and delineated three interrelated factors evident in every serial murder case: "1) sexual sadism, 2) intense fantasy, and 3) a compulsion to act out the fantasy" (p. 9).

Additionally, previous research suggests that serial killers frequently exhibit a *continuum of violence* involving a sequence of stages before graduating to serial homicide. Such stages involve *violent sexual fantasies* and *non-human rehearsals* (e.g., animal cruelty and fire setting). Which can progress to *non-contact offenses* and *test runs against humans*, and ultimately, their first murder (Malizia, 2017, p. 49; see also MacDonald's Homicidal Triad, 1963; Leary et al., 2017; Ressler et al., 1986).

To investigate this continuum of violence, MacCulloch et al. (1983) studied a group of sexually violent offenders (N = 16). They found that most of the sample reported compulsive masturbation to violent sexual fantasies, which escalated to behavioral "in vivo tryouts" on unsuspecting victims (i.e., stalking, violent sexual attacks, or murder) (MacCulloch et al., 1983, p. 20). Similarly, Johnson and Becker (1997) examined sexually violent juveniles (N = 9) and found that all offenders reported increasingly violent fantasies. Several offenders also progressed to non-human rehearsals or test runs against humans, and two of the juveniles committed murder (Johnson & Becker, 1997).

These findings have also been corroborated in the existing literature on offense escalation and the continuum of violence exhibited by serial killers prior to their murder series (Brankley et al., 2014; James & Proulx, 2014; Langevin, 2003; Marono et al., 2020; Prentky et al., 1989; Reid et al., 2019; Singer & Hensley, 2004; Trojan & Salfati, 2010a). For example, sexual burglary and rape are both associated with an escalation in the severity of offenses throughout the serial offender's criminal career. These offenses often serve as a gateway to *home invasion serial homicide* (Brankley et al., 2014; DeLisi & Scherer, 2006; James & Proulx, 2014; Martin et al., 2020; Miller, 2014b; Pedneault et al., 2015b; Schlesinger & Revitch, 1999). For example, Revitch (1978) posited that burglary could be a compulsive sexual offense, indicating sexually deviant behaviors (e.g., voyeurism, undergarment fetishes, destruction of female clothing, and habitual masturbatory fantasies) "may presage a murderous attack on women" (p. 283).

A large and growing body of literature has also investigated the severity of offenses by *non-fatal* home invasion sex offenders (DeLisi & Scherer, 2006; Greenall & West, 2007; Harris, 2013; Pedneault et al., 2012; Schlesinger & Revitch, 1999; Vaughn et al., 2008; Warr 1988). Home invasion sex offenders have been characterized as the most dangerous type of violent offender, as they exhibit high recidivism rates of committing similar offenses in the future (Davies et al., 1997; Greenall & West, 2007; Pedneault et al., 2012). Both Vaughn et al. (2008) and Pedneault et al. (2015b) devised distinct classifications relevant to home invasion sex offenders, as such offenders exemplify similarities through the physical invasion of both the victims' residence and body (see also Miller, 2014a). Vaughn et al. (2008) denote that the motivations underlying the predacious nature of such offenses stem from sexually deviant urges associated with the illegal entry into the victim's residence, often correlated with violent fantasies of victims they stalk beforehand (p. 1390).

In addition to the severity of CPs, previous studies have examined the *type*(s) of offenses committed by many serial killers. The majority of serial killers have previous criminal records containing non-violent, violent, or both types of crime (Beauregard & Martineau, 2012; Brankley et al., 2014; DeLisi & Scherer, 2006; FBI, 2018; Hickey, 2019; Marono et al., 2020; Martin et al., 2020; Miller, 2014b; Vronsky, 2004). While serial killers typically have criminal records, CCP distinguishes between specialized and versatile criminal careers. For example, serial killers with specialized careers commit the same type of crime habitually, whereas versatile criminals commit a hybrid of crimes over their careers (Piquero et al., 2003).

Another underlying assumption of CCP is that predatory offenders exhibit specialized criminal records involving sexual burglary and rape (Beauregard & Martineau, 2012; DeLisi & Scherer, 2006; Ensslen et al., 2018; Harris et al., 2013; Martin et al., 2020; Pedneault et al., 2015b; Schlesinger & Revitch, 1999; Vaughn et al., 2008). In particular, home invasion sex offenders have lengthy criminal records of *property* and *home invasion sex offenses* (Beauregard & Martineau, 2012; Ensslen et al., 2018; Harris et al., 2013; Pedneault et al., 2012; Pedneault et al., 2015b). Comparably, Vaughn et al. (2008) assert that *sexual predator burglars* exhibited *specialization* concerning their extensive criminal careers of rape and *residential sexual burglaries* (p. 1389). In a study of 41 stranger rapists of 67 victims, Greenall and West (2007) also found that nearly 40%

of rapes consisted of *home invasion rapes* and that such offenders have an increased probability of criminal records with similar offenses (p. 161; see also Davies et al., 1997).

More recently, Beauregard et al. (2018) interviewed incarcerated sex offenders, sexual and serial murderers (N = 616); findings showed that residential burglary was frequently committed during adolescence and more sexually driven than previously assumed. Regrettably, unless a physical attack or sexually deviant motivation is evident, burglaries are often misclassified categorized as property offenses, allowing such predators to evade apprehension (Beauregard et al., 2018).

Finally, the marginal descriptive research concerning HISKs reveals their criminal histories often include residential offenses such as general burglaries and home intrusion sex offenses such as sexual residential burglary (Beauregard et al., 2018; Schlesinger & Revitch, 1999). Sexual residential burglary can include (1) non-contact sex crimes (e.g., theft of underwear garments or voyeurism); (2) sexual contact in addition to material theft (i.e., a hybrid burglary offense); and (3) sexual contact offenses (e.g., assault of the victim sexually) (Pedneault et al., 2012, 2015a). These findings imply that such predatory offenders may exhibit *less versatile* and *more specialized* criminal careers in committing home invasion-related offenses, such as sexual residential burglary.

Examples of HISKs with a history of sexual residential burglary are Russell Williams and Joseph DeAngelo (i.e., the Golden State Killer). Before their first murder, both killers engaged in voyeurism into females' homes and soon progressed to breaking into such homes to steal females' undergarments (Brankley et al., 2014; McNamara et al., 2018). Both killers then escalated to home invasion rape, which inevitably culminated in home invasion serial murder (Brankley et al., 2014; McNamara et al., 2018).[4]

Based on the perspectives of CCP and LCP and the existing literature relevant to the criminal histories of serial killers and home invasion sex offenders, two hypotheses were constructed and tested regarding the criminal precipitators (CPs) of HISKs versus non-HISKs in Study Three. An overview of these hypotheses are summarized below.

Study Three: Overview of Hypotheses

The perspectives of CCP and LCP and the literature concerning the criminal backgrounds of serial killers and home invasion sex offenders were used to form the hypotheses for Study Three. The hypotheses of Study Three posit that HISKs will reveal statistically significant differences in their non-fatal CPs committed before the murder series compared to non-HISKs. These hypothesized differences are based on two IVs constructed for Study Three: (1) *severity* of CPs and (2) *type* of CPs.

First, previous research regarding the severity of criminal offenses by home invasion sex offenders indicates that such offenders commit *more severe* and predatory offenses compared to non-residential sex offenders (e.g., home invasion rape) (Beauregard et al., 2018; Brankley et al., 2014; Vaughn et al., 2008). Consequently, the first hypothesis of Study Three tests the differences in the severity of CPs of HISKs compared to non-HISKs. Consistent with prior research, which has illustrated that home invasion sex offenders commit more predatory offenses than non-residential sex offenders, it is anticipated that HISKs will perpetrate *more severe* CPs than non-HISKs.

[4]Before his killing series and notoriety as the Golden State Killer, DeAngelo was known as the East Area Rapist in Sacramento, CA, and committed 50+ rapes in the 1970s and 1980s (McNamara et al., 2018).

Second, previous research regarding the *type* of crimes committed by home invasion sex offenders suggests that they typically commit residential crimes such as *property offenses* and *home invasion sex offenses* (Harris et al., 2013; Pedneault et al., 2012, 2015a; Pedneault et al., 2015b). These findings imply that home invasion sex offenders are less versatile and *more specialized* in the *type* of offenses committed throughout their criminal careers (i.e., fewer crime categories). Accordingly, the second hypothesis of Study Three tests the differences in the *type* of CPs committed by both groups of killers. Consistent with previous research, which suggests that home invasion sex offenders typically commit residential offenses, it is anticipated that HISKs will commit *fewer types* of CPs than non-HISKs.

Study Three: Theoretical Framework Summary

The theoretical framework and literature reviewed in this section show a considerable body of research regarding the application of CCP and LCP perspectives to examine the criminal histories of serial killers and home invasion sex offenders. Conversely, there remains a significant gap in the existing literature regarding HISKs and applying both CCP and LCP perspectives to investigate the non-fatal criminal precipitators (CPs) committed by HISKs and non-HISKs before their first murder. Study Three seeks to address this gap in the literature by conducting a comparative analysis of the non-fatal CPs committed by HISKs and non-HISKs. The hypotheses of Study Three predict that HISKs will reveal significant differences in the *severity* of CPs and the *type* of CPs committed before the murder series compared to non-HISKs.

2.4 Chapter 2 Summary

This chapter began by providing a review of the literature on the general problem of serial homicide. The first portion of the chapter reviewed the prevalence of serial homicide, the characteristics of serial killers and their victims, and the challenges of serial homicide investigations. The second section reviewed the nominal descriptive literature on home invasion serial homicide. Third, the theoretical framework of the dissertation and the pertinent theories and research relevant to the hypotheses constructed for each of the three investigations were comprehensively reviewed.

This literature review established a considerable body of literature on serial homicide and home invasion sex offenders. However, the research on home invasion serial homicide and HISKs remains limited. To date, research has been descriptive and limited to measuring the rate of serial murder at various locations, indicating that home invasion serial homicide is one of the most common forms of serial murder. Despite this, previous studies have failed to address the problem of home invasion serial homicide or compare the differences between HISKs and non-HISKs. This dissertation seeks to comprehensively examine the problem of home invasion serial homicide and the differences between HISKs and non-HISKs in three comparative investigations: (1) common characteristics; (2) geospatial patterns; and (3) criminal precipitators.

The following chapter consists of the research approach used for all three investigations of the dissertation and includes the following sections: (1) research questions and objectives; (2) data and sampling method; (3) summary of the experimental (HISKs) and control (non-HISKs) groups; (4) overview of the analytic plan for each investigation; and (5) Chapter Three summary.

CHAPTER 3

III. RESEARCH APPROACH

The theoretical frameworks detailed in Chapter 2 were used to construct the research questions and objectives for each of the three investigations in this dissertation. This chapter consists of a general and orientational overview of the research approach employed for all three investigations and includes the following sections: (1) research questions and objectives; (2) data and sampling method; (3) overview of the experimental (HISKs) and control (non-HISKs) groups; (4) outline of the analytic plan for each investigation; and (5) Chapter Three summary.

This dissertation consists of a two-fold comparative research design through secondary data analyses (RU/FGCU SKD, 2019 and public information searches) to examine three analytical dimensions of HISKs and non-HISKs (common characteristics, geospatial patterns, and criminal precipitators). This dissertation employed two research approaches: (1) descriptive-comparative analyses and (2) deductive, exploratory working hypotheses. First, a descriptive-comparative approach was used to examine the differences and test hypotheses in the three investigations between HISKs and non-HISKs. Second, contingent on the results of each investigation, three working hypotheses were used to examine whether HISKs warrant a distinct classification from non-HISKs.

According to Casula et al. (2021), exploratory deductive research through working hypotheses is essential in quantitative studies to further understand complex or unidentified factors in existing research. The authors contend that such hypotheses provide the opportunity to perform exploratory supplemental analyses and are commonly utilized "as an evaluative criterion" (pp. 1708). Accordingly, the purpose of using a two-fold comparative design was to: (1) answer three research questions and test the hypotheses posed for each investigation regarding the differences between both serial killer groups; and (2) further investigate these differences through the working hypotheses and the classification determination of HISKs versus non-HISKs. The dissertation aims and the research questions and objectives of each investigation are reviewed in the following section.

3.1 Research Questions and Objectives

A review of the literature on home invasion serial homicide thus far reveals a significant gap in research concerning home invasion serial killers (HISKs), which draws attention to several primary aims of this dissertation. First, this dissertation seeks to reactively and proactively assist LEAs and crime analysts in current serial murder investigations and cold cases. Second, this study aims to raise public awareness of the prevalence of home invasion serial homicide and HISKs to promote greater understanding and potential responses regarding this issue. Third, since current knowledge concerning HISKs has been descriptive, this dissertation seeks to address this research gap by delivering the first comprehensive study to analyze HISKs as both a dependent variable (Study 1 and Study 3) and an independent variable (Study 2). The final aim of the dissertation is to examine the three working hypotheses posed for each investigation to determine if HISKs warrant a distinct classification from non-HISKs based on their common characteristics, geospatial patterns, and criminal precipitators.

Study One: Research Question and Objectives

The research approach of Study One consisted of descriptive-comparative analyses to investigate the common characteristics of HISKs and non-HISKs. The first research question was posed to examine the common characteristics of both killer groups:

Research Question 1

What are the differences between the common characteristics of HISKs and non-HISKs?

Study One: Objectives

The literature review in Chapter 2 shows that there is a large and growing body of literature on the offending patterns and common characteristics of serial killers (Beauregard et al., 2012; Chopin & Beauregard, 2020; FBI, 2014; Hickey, 2016; James & Proulx, 2016; Koeppel et al., 2019; Pakkanen et al., 2015; Salfati et al., 2015; Yaksic & Comerford, 2019). A considerable amount of research also exists on the application of RAT and RCT perspectives to examine the offending patterns of non-fatal home invasion sex offenders (Beauregard et al., 2007, 2010; Ensslen et al., 2018; Pedneault et al., 2012; Pedneault et al., 2015a, 2015b). However, prior literature relevant to HISKs has primarily consisted of descriptive research (Dern et al., 2005; FBI, 2018; Rossmo, 1995). To the author's knowledge, no present studies have investigated the common characteristics of HISKs (in general) or through the perspectives of RAT and RCT. Consequently, investigating the common characteristics of HISKs through the perspectives of RAT and RCT is a significantly neglected area in serial homicide.

Therefore, to address this void in research, there were three primary objectives of Study One: (1) investigate the common characteristics of HISKs and non-HISKs through a RAT and RCT framework; (2) examine the differences in the common characteristics of both serial killer groups to address the gap in existing research concerning HISKs; and (3) conclude whether HISKs constitute a unique type of serial killer from non-HISKs based on their common characteristics. The principles of RAT and RCT were used to formulate the research question and hypotheses for Study One relevant to the *victim selection*, *modus operandi*, and *crime scene actions* of both serial killer groups (see Chapter 4 for variables and hypotheses).

Study Two: Research Question and Objectives

The research approach of Study Two involved descriptive-comparative and geographic analyses to investigate the geospatial patterns of HISKs and non-HISKs. The second research question was proposed to examine the geospatial patterns of both groups:

Research Question 2

What are the differences between the geospatial patterns of HISKs and non-HISKs?

Study Two: Objectives

The literature review in Chapter 2 revealed a considerable body of research on the geospatial patterns of serial offenders and serial killers. The existing literature suggests that most serial offenders perpetrate offenses close to their residence (Beauregard et al., 2007; Canter & Larkin, 1993; Canter, 2003; Comerford, 2021; Lammers & Bernasco, 2013; Lundrigan & Canter, 2001a, 2001b; Martineau & Beauregard, 2016; Rossmo, 1995, 2000; Snook et al. 2005). The geospatial patterns of home invasion sex offenders have also been examined (Block & Bernasco, 2009; Dern et al., 2005; Deslauriers-Varin & Beauregard, 2010; LeBeau, 1987a, 1987b, 1992). However, existing serial homicide research fails to specifically study the geospatial patterns of HISKs or apply the perspectives of RAT, RCT, and CPT to do so.

Therefore, to address this void in research, there were three primary objectives of Study Two: (1) investigate the geospatial patterns of HISKs and non-HISKs through a RAT, RCT, and CPT framework; (2) examine the differences in geospatial patterns of both serial killer groups to address the gap in existing research concerning HISKs; and (3) conclude whether HISKs merit a separate classification from non-HISKs based on their geospatial patterns. The RAT, RCT, and CPT principles were used to formulate the research question and two hypotheses for Study Two relevant to both groups' *RTC distance* and *murder series duration* (see Chapter 5 for variables and hypotheses).

Study Three: Research Question and Objectives

Lastly, the research approach of Study Three consisted of descriptive-comparative analyses to examine the *non-fatal* criminal precipitators (CPs) committed before the murder series by HISKs and non-HISKs. The following research question was proposed to examine the non-fatal CPs committed by both groups in Study Three:

Research Question 3

What are the differences between the non-fatal CPs of HISKs and non-HISKs?

Study Three: Objectives

The literature review in Chapter 2 indicates that CCP and LCP perspectives have been used to study the criminal background of serial killers and other violent serial offenders. Previous studies suggest that such offenders often have a history of non-violent and violent crimes (Brankley et al., 2014; Ensslen et al., 2018; Godwin, 2000; Hewitt & Beauregard, 2014; Langevin, 2003; Marono et al., 2020; Martin et al., 2020; Reid et al., 2019; Trojan & Salfati, 2010a; Wright et al., 2008). The criminal histories of home invasion sex offenders have also been examined (Greenall & West, 2007; Harris et al., 2013; Pedneault et al., 2018; Schlesinger & Revitch, 1999; Vaughn et al., 2008; Warr, 1988). On the contrary, except for a retrospective case study of *one* home invasion serial killer (see Brankley et al., 2014), the *severity* and *type* of CPs of HISKs have been largely overlooked in the serial homicide literature.

Therefore, to address this void in research, there were three primary objectives of Study Three: (1) investigate the non-fatal CPs of HISKs and non-HISKs through a CCP and LCP theoretical framework; (2) examine the differences in CPs of both serial killer groups to address the gap in existing research concerning HISKs; and (3) conclude whether HISKs require a separate classification from non-HISKs based on their non-fatal CPs committed before the murder series. The principles of CCP and LCP were used to formulate the research question and hypotheses for Study Three concerning the *severity* and *type* of CPs by both groups (see Chapter 6 for variables and hypotheses).

3.2 Data and Sampling Method

Two primary sources of secondary data were used for the three investigations of this dissertation: (1) the *Radford University/Florida Gulf Coast University Serial Killer Database* (RU/FGCU SKD) and (2) *prerequisite* and *supplementary public information searches* conducted by the researcher. The following section summarizes the data and sampling method utilized for all three investigations in the dissertation.

The first stage pertinent to the data collected and analyzed for this dissertation was to receive official approval from the *Institutional Review Board* (IRB). The IRB application was completed by the principal investigator (PI) and supervisor of this dissertation, Dr. Rob T. Guerette, and the co-investigator (Ph.D. candidate, Caroline V. Comerford). The IRB application was approved under an *expedited* IRB application

(Social and Behavioral IRB, SB-IRB) to conduct the three investigations of this dissertation. All social and behavioral research guidelines were followed and adhered to by the PI and co-investigator (CI) per the agreements outlined in the IRB application.

Secondary Data Source 1: Radford University/Florida Gulf Coast University Serial Killer Database (RU/FGCU SKD)

The first data source utilized for this dissertation consists of secondary data of serial killer cases within an archival database, the RU/FGCU SKD, developed by Dr. Mike Aamodt in 1992. The RU/FGCU SKD (2019) contains secondary data on 5,148 serial killers and their victims (1950 to 2019), which Dr. Aamodt and his research team collect from publicly available sources (e.g., online searches, court and prison records, non-fiction serial murder books, media outlets). The RU/FGCU SKD is one of the world's largest and most extensive non-government serial killer databases (Martin et al., 2020). Data within the RU/FGCU SKD has been considered reliable and valid and is often updated and revised to reflect accurate information on serial killers and their victims (Aamodt et al., 2020; Woster, 2020). The database uses the FBI's definition of a serial killer to select cases for the database: "the unlawful killing of two or more victims by the same offender(s), in separate events" (2014, p. 4).[5]

Researchers can apply to use the database to gain access to the RU/FGCU SKD. Permission is generally granted to qualified researchers who are not trying to use the information for commercial or inappropriate purposes (RU/FGCU SKD, 2019). Membership to the RU/FGCU SKD is offered to those pursuing academic research.

[5]*Note*. The researcher's prerequisite and supplementary public information searches were cross-referenced with the RU/FGCU SKD (2019) to ensure the validity and reliability of the data for all serial killer cases.

Applicants must provide credentials from an accredited university or a law enforcement agency and state the reason for requesting access to the database. The request for access to the RU/FGCU SKD was completed through email correspondence with the creator of the database, Dr. Aamodt, in which he outlined three conditions to access the database:

> To use the database, we need you to agree to three conditions: 1) You will cite the source of your information as the Radford/FGCU Serial Killer Database; 2) you agree not to share or distribute the database to anyone other than your research advisor; 3) you will notify us of any errors you find in the database.[6]

The PI (Dr. Rob T. Guerette) and the CI (Caroline V. Comerford) agreed to these terms and obtained official consent and access to the RU/FGCU SKD by Dr. Aamodt.

Serial Homicide: Dissertation Definition

A widespread debate continues among researchers, LEAs, academics, and the like about the most accurate and inclusive definition of what constitutes serial homicide (Adjorlolo & Chan, 2014; Egger, 2005; FBI, 2008, 2014; Reid, 2016; Schlesinger, 2017). The literature has not recognized a universally accepted definition or taxonomy of serial homicide due to the debates about its classification. Due to the lack of a universal definition of serial homicide, several components were used to construct the definition of serial homicide delineated for this dissertation: (1) the number of offenders, (2) number of victims, (3) *cooling-off* period between murders, (4) repetition, and (5) motivation.

There were two reasons for including these elements in the definition of serial homicide outlined for this dissertation: (1) to differentiate between prevalent definitions and classifications of serial killer types; and (2) determine which RU/FGCU SKD cases were applied to the target population of the stratified random sampling procedure

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[6]Radford University/FGCU Serial Killer Database Website: http://skdb.fgcu.edu/info.asp

implemented for the final sample in the dissertation. The author merged various components of different definitions of serial homicide to generate a comprehensive definition for this dissertation (Adjorlolo & Chan, 2014; Egger, 2005; FBI, 2014; Hickey, 2016; Kerr et al., 2013; Osborne & Salfati, 2005; Reid, 2016; Schlesinger, 2000, 2017):

> ***Serial Homicide*: *One or more offenders* that murder *two or more victims* with an emotional *cooling-off period* between the murders, often resulting in a compulsive, *repetitive* cycle. The murders typically demonstrate *thrill-seeking behavioral patterns,* generally manifested in the form of *sexual gratification* exhibited at the crime scene. The cooling-off period between murders can consist of *days, weeks, months, or years*.[7]

Sampling Method

The researcher used *proportionate stratified random sampling*, a probability sampling technique. There were seven steps that the CI used to produce a stratified random sample. The seven steps were used to ensure that the final sample of the current investigation (N = 326) was generated randomly. First, the above-listed definition of serial homicide was used for the sampling criteria to determine the target population of serial killers from the RU/FGCU SKD (2019) pertinent to the dissertation (2,121 cases). Second, the *location* where each killer murdered their victims was the *relevant stratification characteristic* used to divide the target population of 2,121 cases into two *mutually exclusive*, *non-overlapping* groups of sample units (strata). The CI partitioned the 2,121 RU/FGCU SKD cases, resulting in 677 HISKs and 1,444 non-HISKs.[8]

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[7]*RU/FGCU SKD cases excluded from the serial homicide definition:* All victims were known to the killer (e.g., family, partners, acquaintances), financial gain was the sole motive, or any case that exclusively fell under certain criminal groups or related circumstances (e.g., cults, extremists, organized crime, contract killers, gangs, other criminal enterprises, war crimes, prison murders, or evasion murders).

[8]All 5,148 RU/FGCU SKD cases were individually vetted by the CI via online searches to ensure cases met the sampling criteria definition of *serial homicide,* resulting in 2,121 pertinent cases included in the target population of the dissertation (HISKs stratum = 677 cases; non-HISKs stratum = 1,444 cases).

Third, to calculate the sample size of the target population (2,121 cases), the CI used power analysis and a sample size calculator tool by *Raosoft.* Using the power analysis sample size calculator, the researcher selected the following sample size calculation options for the 2,121 RU/FGCU SKD cases pertinent to the current investigation: *Margin of error* (= 5%); *confidence level* (= 95%); *population size* (= 2,121); and *response distribution* (= 50%, "recommended"). The final sample *Raosoft* power analysis calculation of the 2,121 cases relevant to the dissertation was 326. The CI divided the 326 cases in half to generate the *same number* of primary and secondary strata cases. The final number of cases for each group in the dissertation was 163 HISK cases and 163 non-HISK cases.[9]

Fourth, the CI generated a *decision rule* to select cases based on the *number of victims murdered* by each serial killer for both strata. The decision rule consisted of *four victim count categories* (i.e., two victims, three victims, four victims, and five or more victims), and *proportion calculations* of the four victim count categories were computed for each stratum. Fifth, the CI generated a separate Excel file to reflect the *victim count category* with the number and percentages of cases for both the *primary* stratum (HISKs = 677) and *secondary* stratum (non-HISKs = 1,444), which was recorded in two separate Excel tabs (see Figure 3). The cases were then separated by victim count categories within each tab (i.e., two victims, three victims, four victims, and five or more victims). The cases in each stratum were numbered from *one* to the number of cases in each victim

[9]*Raosoft* is an online statistics database that uses web survey software to gather information and provides sampling tools to calculate sample sizes. Website: http://www.raosoft.com/samplesize.html

count category. For example, HISKs that only murdered two victims during the series consisted of 47 cases, and the CI numbered this set of cases from 1 to 47.

Sixth, the CI used a simple random sampling *randomizer application* to generate sets of random numbers for each victim count category for the primary stratum (HISKs = 163) and secondary stratum (non-HISKs = 163) based on the number of cases for each category (see Figure 4). The randomization procedure selected in the application was *simple random sampling without replacement* to avoid repeat numbers within each set. The randomized number sets were then added to their respective victim count categories in the Excel sheets. The CI removed the 326 cases randomly selected for the randomization procedure from the target population pool of 2,121 RU/FGCU SKD cases pertinent to the investigation (i.e., 163 cases were removed from the pool of 677 HISKs and 163 cases were removed from the pool of 1,444 non-HISKs). These cases were removed from the target population pool to maintain unselected cases from both strata that were not selected during the initial simple random sampling procedure. The unselected cases were also used to repeat the simple random sampling procedure for cases where the CI could not obtain the JTC data during the prerequisite Study Two searches on the 326 randomly selected cases. [10]

Subsequently, the CI used the simple random sampling procedure to replace the cases in each stratum where the JTC data could not be obtained. The CI conducted prerequisite JTC address and location searches of publicly available resources to acquire JTC data on each of the *initial* simple random sampling cases randomly assigned to both

[10]For an overview of the initial simple random sampling procedure per strata, see Appendices A and B. Randomizer application used: https://www.randomizer.org/

the HISK group (= 163) and the non-HISK group (= 163). The initial JTC searches for the *primary* sample cases (HISKs) resulted in the CI obtaining JTC data for 132 of the 163 cases, with *31 cases* in which JTC data *could not be obtained*. The initial JTC searches for the *secondary* sample cases (non-HISKs) resulted in the CI obtaining JTC data for 116 of the 163 cases, with *47 cases* in which JTC data *could not be obtained*. *Initial* JTC searches of the primary and secondary samples resulted in *78 cases removed* and *replaced* from the initial simple random sampling procedure.

The CI then repeated the simple random sampling procedure *three times* for the 31 *primary* cases that needed to be replaced and *four times* for the 47 *secondary* cases that needed to be replaced. Once the simple random sampling procedure was completed, the replacement cases were removed from the initial target population pool of HISK and non-HISK cases. During the supplementary simple random sampling rounds, there were *six* team serial killer cases (e.g., two serial killers that murdered victims together during the killing series) that *both partners* in the team were randomly selected. These six duplicate team serial killer cases resulted in an additional round of simple random sampling for both the primary and secondary strata, in addition to the *78 cases* that needed to be *removed* and *replaced* in the initial simple random sampling procedure.

In order to finalize the primary (HISK) and secondary (non-HISK) samples for each group, the simple random sampling procedure was repeated a total of *four* times for the primary sample cases (HISKs) and a total of *five* times for the secondary sample cases (non-HISKs). After repeating the simple random sampling procedure for both samples, the CI randomly replaced the 78 cases that were missing JTC data in the initial round of simple random sampling and the six cases that both partners in team serial killer cases were randomly drawn during the supplementary random sampling round. The total number of replacement cases of the overall sample size for the current investigation was *84 cases*, representing approximately 25% of the overall sample that needed to be removed and replaced with other randomly drawn cases.

The final sample size of 326 cases used for the three investigations (N = 326) contained both sufficient JTC data for Study Two and a correct total number of cases in each of the four victim count categories for the primary sample (n = 163 HISKs) and secondary sample (n = 163 non-HISKs). The *Target Population of Strata by Victim Count Category* (Figure 3) and the *Proportionate Stratified Random Sampling by Victim Count Category* (Figure 4) are presented below.

Figure 3

Target Population of Strata by Victim Count Category (N = 2,121)

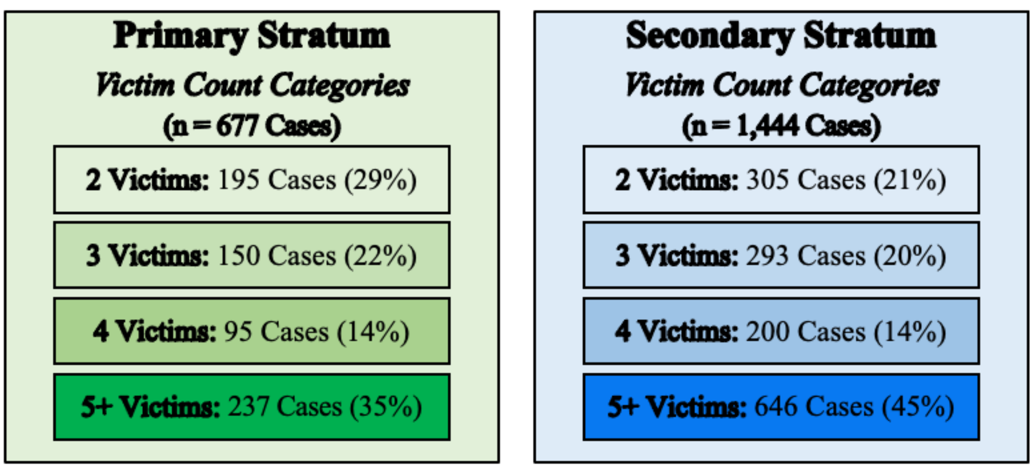
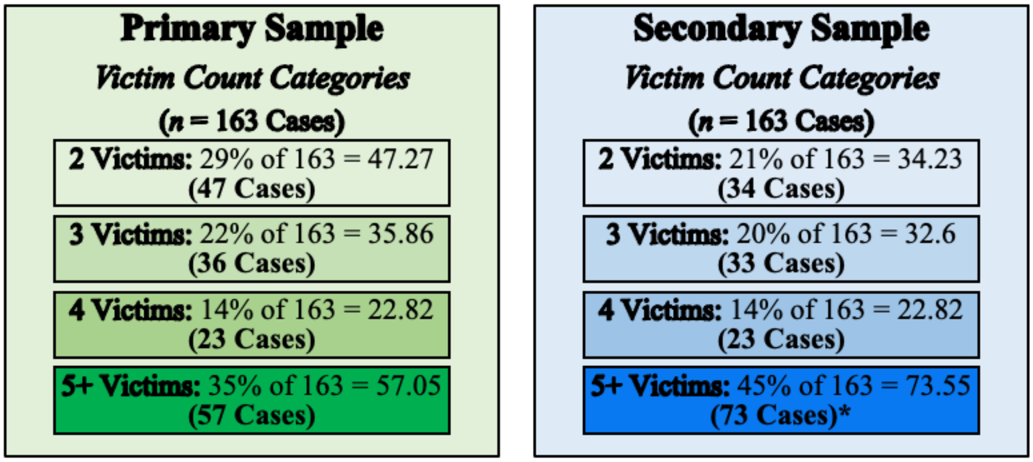


Figure 4

Proportionate Stratified Random Sampling by Victim Count Category (N = 326)



Note. 5+ Victim category of the secondary sample was rounded down to 73 cases.

Secondary Data Source 2: Prerequisite and Supplementary Public Searches

The second data source of this dissertation consisted of prerequisite and supplementary public information searches conducted by the CI. Discernibly, no data use agreement or official consent procedures were required for these searches. The CI adhered to all IRB ethical guidelines and agreements regarding secondary data collection and analysis outlined within the IRB expedited review application in these searches for the second stage of the data collection. The searches by the CI consisted of secondary public resources such as government and non-government websites, accredited legal software and public records websites, true crime books, newspapers, documentaries, and television/online interviews. The CI conducted these searches for several reasons, which are briefly discussed below and further detailed in each investigation chapter (see *Measures and Analytical Strategy* in Chapters 4, 5, and 6).

First, time and financial constraints prevented the CI from generating and sending individual *Freedom of Information Act* (FOIA) requests to the law enforcement agencies responsible for apprehending the 326 serial murderers in the sample. The CI conducted prerequisite and supplementary data collection public information searches in place of FOIA requests. The prerequisite searches by the CI were carried out for Study Two in an attempt to locate data on individual address and location points of the residences and other nodes of serial killers and the locations of each victim's murder. The CI conducted the prerequisite searches to collect JTC data, which assisted in the stratified random sampling procedure to generate the final sample for all three investigations. The CI cross-referenced the JTC data collected during the prerequisite searches with cases in an updated version of the RU/FGCU SKD (for cases the killer's residence or murder site location where available), as well as accredited software and websites to access legal, background, and public records to verify the serial killers' date of birth, address records, and data relevant to all three investigations.[11]

Second, as with most databases, some of the cases in the RU/FGCU SKD (2019) were missing data, which the CI conducted supplementary searches for missing information regarding Study One (common characteristics) and Study Three (criminal precipitators). Due to the extensive nature of Study Three and the criminal histories of each serial killer, the CI needed to collect additional information from various resources relevant to the non-fatal CPs of both groups (see Chapter 6, Section 6.3.1 for particulars).

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[11]*Note*. The updated version of the RU/FGCU SKD (2019), which the CI later received from Dr. Aamodt, contains a "Victim Data" tab of 65 columns of numeric and text data on many victims of the serial killers, including data on *some* geographic locations and addresses of the killers' residence and murder locations. However, the initial version of the RU/FGCU SKD did not contain this tab of victim data, which resulted in the CI conducting prerequisite data collection searches for Study Two to obtain the JTC data for each of the serial killers in the sample of all three investigations.

Accredited Legal Software and Public Records Websites: LexisNexis, WestLaw, Intelius.com, TruthFinder.com, Verified.com, and RecordsFinder.com.

Lastly, the CI used multiple resources to cross-reference and validate the RU/FGCU SKD and searches of public information and data collected in all three investigations.

3.3 Three Comparative Investigations of Two Groups: HISKs and Non-HISKs

Experimental Group of the Three Investigations: Home Invasion Serial Killers

HISKs were the *experimental group* (primary sample) and the key focus of all three investigations in this dissertation. The definition of HISKs is delineated below.

***Home Invasion Serial Killers*.** The *physical* entry into the victim(s) *place of residence* by a serial killer, ending in the killer(s) murdering the victim *within* their residence in *one* or *more* of the murders during the series. The victim's place of residence consists of any location considered the victim's *temporary* or *permanent* place of residence (e.g., house, apartment, mobile home, family/friends/partners' residence). There were two methods in which HISKs gained access to their victims' residences and are defined below. [12]

1. ***Forced Entry*.** Breaking into the victim's residence (e.g., picking locks, entering through unlocked doors or windows), or using physical force to threaten the victim and gain access to the victim's residence.
2. ***Ruse Entry*.** Using a ruse or false identity to unlawfully gain access to the victim's residence (e.g., service worker).[13]

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[12]*Exclusion Criteria.* Cases were *excluded* from the HISK group if the killer did not *physically invade* or *cross the threshold* of the *victim's residence* to murder the victim. Three examples of cases excluded from the HISKs group include: (1) killers who did not *physically* enter the victim's home but murdered the victim at home from a remote location (e.g., snipper shootings, mail bombings, exterior structural arson); (2) murders committed on the *victim's property* but not *within* the residence (e.g., outside or near the victim's home); and/or (3) killer and victim lived in the same residence (e.g., domestic homicide, familicide) (see FBI, 2014; Dern et al., 2005; Rossmo, 1995; Schlesinger & Revitch, 1999).

[13]*Note.* While HISKs could be delineated into multiple categories, such as HISKs that kill victims in several locations (i.e., victim's residence and other locations). However, categorization of the subtypes of HISKs falls outside the scope of the dissertation.

Control Group of the Three Investigations: Non-Home Invasion Serial Killers

Non-HISKs were the *control group* (secondary sample) to examine the differences of HISKs compared to non-HISKs in the three investigations of this dissertation. Additionally, the non-HISKs group was used to analyze whether HISKs warrant a distinct classification from non-HISKs. The definition used to conceptualize and operationalize non-HISKs is outlined below.

Non-Home Invasion Serial Killers. Serial killers who murdered victims at l*ocations other than the victim's residence*. There were four primary locations where non-HISKs murdered their victims, initially identified during the prerequisite data collection phase of the dissertation, which is defined below.

1. **Public.** Any location that is public or accessible to the public, including (but not limited to): Parks, streets, rest/truck stops, schools/universities, vehicles, woods, shelters, motels/hotels, vacant houses, houses of worship, public jails or prisons, warehouses, boats, beaches, or brothels.
2. **Killer's Workplace.** The killer's place of employment. The killer's workplace can include hospitals (angels of death), nursing homes, offices, and military bases.
3. **Killer's Residence.** Any location considered the killer's residence or constructed area under the killer's complete control (e.g., house, apartment, mobile home, torture chamber, dungeon).
4. **Other Locations.** Locations that were *not* encompassed by the above-listed categories were cases that were missing information on the murder location(s) that the researcher could not identify.

Serial Killer Group. This variable was used to distinguish between the *experimental group* (HISKs) and the *control group* (non-HISKs); dummy coding for both serial killer groups was used in all three investigations (HISK = 1; non-HISK = 0).

Lastly, two descriptive variables were included in the three investigations: (1) number of victims and (2) victim count category. Both variables were included in the investigations to incorporate the number of victims murdered by each killer and the victim count categories for both HISKs and non-HISKs. The descriptive variables for the number of victims and victim categories are defined and operationalized below.

The number of victims. The total number of victims the serial killer murdered during the series. These data were obtained from the RU/FGCU SKD, including the *number of victims* murdered by each serial killer (continuous variable). According to the RU/FGCU SKD serial killer definition, all killers murdered at least *two* or *more victims* (2019).

Victim Count Category. This descriptive variable was generated based on the decision rule to select cases based on the number of victims killed by each serial killer for both strata. The decision rule consisted of four victim count categories (i.e., two victims, three victims, four victims, and five or more victims), and proportion calculations of the victim count categories were computed for each stratum. This descriptive variable was included in each investigation to ensure that both groups included the correct proportion of victims per case within each victim count category, delineated for each stratum during the initial sampling procedure. This variable was ordinally coded as follows: *Two* victims (= 2); *three* victims (= 3); *four* victims (= 4); and *five or more* victims (= 5).

3.4 Analytic Plan for Three Investigations of HISKs and Non-HISKs

This section provides a brief overview of the analytic plan for the three investigations of HISKs and non-HISKs, followed by the analytic plan of each investigation presented in Figure 5. The supplementary analyses, classification criteria, and parameters contingent on the results of each investigation are also described, followed by an overview of these criteria presented in Table 2. The measures and analytical strategy will be discussed in further detail in the results chapters for Study One (Chapter 4), Study Two (Chapter 5), and Study Three (Chapter 6).

Study One: Analytic Plan

The analytic plan for Study One is to use IBM's *Statistical Package for Social Sciences Statistics* (SPSS 27) to examine the common characteristics of HISKs and non-HISKs. Several descriptive and comparative analyses will be performed to assess and compare the common characteristics of both groups. First, SPSS will be used to perform descriptive analyses of the three sets of *independent* variables (*victim selection*, *MO*, and *crime scene actions*) and other descriptive variables of HISKs and non-HISKs (*dependent* variable) (i.e., descriptives, frequencies, and crosstabulations). Second, to establish whether there are statistically significant differences in the common characteristics of both groups, *Chi-square* (χ^2) tests will be performed (see Figure 5). Finally, depending on the results of Study One, supplementary analyses will be performed to conclude whether HISKs warrant a distinct classification from non-HISKs (see *Supplementary Analyses* and Table 2 for classification criteria and parameters).

Study Two: Analytic Plan

The analytic plan for Study Two is to utilize SPSS 27 to examine the geospatial patterns of HISKs and non-HISKs (see Figure 5). Several descriptive and comparative analyses will be performed to assess and compare the geospatial patterns of both groups. First, SPSS will be used to perform descriptive analyses of the *dependent* variables (*RTC distance* and *murder series duration*) and other descriptive variables (number of victims, criminal range, victim count categories, node type, and crime site type) of HISKs and non-HISKs (*independent* variable). Second, *Mann-Whitney U* tests will be conducted to determine whether there are significant differences regarding the RTC distances and murder series durations of both groups (see Figure 5). Lastly, dependent on the results of Study Two, supplementary analyses will be performed for the classification determination of HISKs versus non-HISKs (see Table 2).

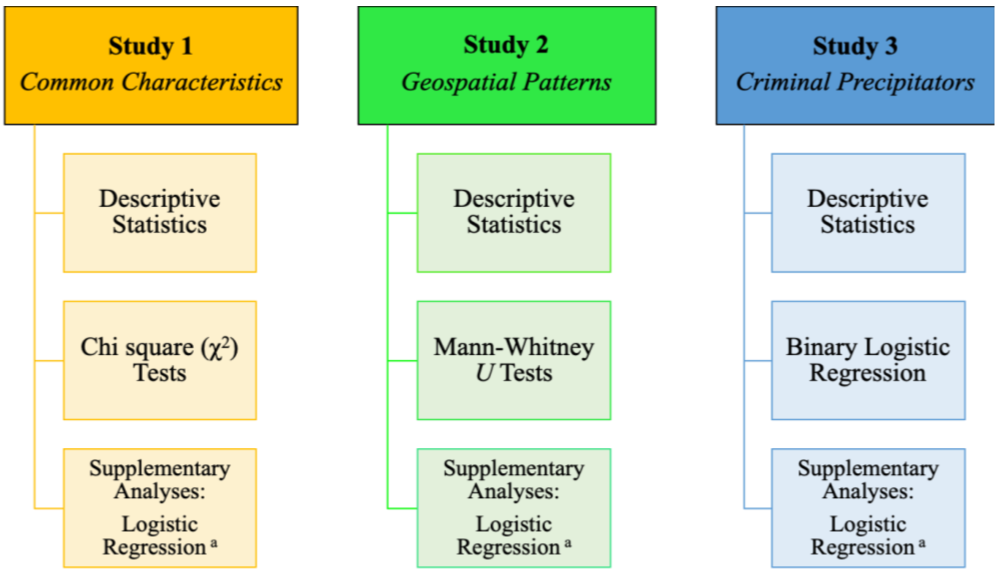
Study Three: Analytic Plan

The analytic plan for Study Three is to utilize SPSS 27 to examine the non-fatal criminal precipitators (CPs) committed prior to the murder series by HISKs and non-HISKs. Several descriptive and comparative analyses will be performed to assess and compare the non-fatal CPs of both groups. First, SPSS will be used to perform descriptive analyses of the *independent variables* (*severity* of CPs and *type* of CPs) and the other relevant descriptive variables (i.e., onset age group of first CP, age at first kill, previous arrests, prior jail/prison time, and sexual residential burglary) of HISKs and non-HISKs (*dependent* variable). Second, *binary logistic regression* models will be performed to determine statistically significant differences in the severity of CPs and the type of CPs committed by both groups of killers (see Figure 5). Finally, contingent on the results of

Study Three, supplementary analyses will be performed for the classification determination of HISKs versus non-HISKs (see Table 2). An overview of the analytic plan for the three investigations is presented in Figure 5 below.

Figure 5

Overview of Analytic Plan: Three Investigations of HISKs Versus Non-HISKs



[a] Contingent on 50% of hypotheses/variables being statistically significant (p = < .05).

Supplementary Analyses

Depending on the results of all three investigations, supplementary analyses may be performed, including binary and multilevel logistic regression models regarding the statistically significant hypotheses (if any) of the three investigations. Potential supplementary analyses will be conducted to determine the classification of HISKs versus non-HISKs. The criteria of the potential supplementary analyses and classification of HISKs versus non-HISKs for the three investigations are detailed below.

Criteria and Parameters for HISKs to Warrant a Distinct Classification

One of the primary goals of this dissertation is to determine whether HISKs warrant a distinct classification from non-HISKs based on their common characteristics (Study One), geospatial patterns (Study Two), and non-fatal criminal precipitators (Study Three). Therefore, it is imperative to outline and review the criteria and parameters used for the classification determination procedure of the investigations.

First, all three investigations contained descriptive statistics by serial killer group, which will be used to establish the differences (if any) between HISKs and non-HISKs (i.e., Research Questions 1, 2, and 3). Second, non-parametric hypothesis testing will be conducted for each investigation and the relevant hypotheses/variables to establish the significant differences (if any) between HISKs and non-HISKs. Third, to determine whether there are significant differences between both groups in each investigation, at least *50%* of the hypotheses/variables in the three investigations must be statistically significant ($p = < .05$). Fourth, once the hypothesis testing of each investigation is conducted, at least <u>two of the three</u> investigations are required to meet the 50% statistically significant hypotheses criteria to conduct the supplementary analyses and classification determination of both groups (i.e., working hypotheses of the dissertation).

Contingent on the results of each investigation, the supplemental analyses include two stages. First, binary logistic regression models will be performed on the significant hypotheses/variables from the investigations that met the criteria to determine significant predictors of HISK group membership. Second, a multilevel logistic regression model of all the significant variables from each eligible investigation to conclude whether HISKs warrant a distinct classification from non-HISKs. For HISKs to warrant such a classification in the investigations, it is required that at least *one* of the predictor variables (IVs) from each investigation be statistically significant (p = < .05) in the final multilevel logistic regression model (Corovic et al., 2012; Wolf, 2008).

In summary, several decision rules were generated for the supplementary analyses and classification of HISKs versus non-HISKs. First, the criteria to determine whether statistically significant differences exist between HISKs and non-HISKs in each investigation at least *50%* of the hypotheses/variables must be statistically significant (p = < .05). Second, at least *two of the three* investigations must meet the 50% statistically significant hypotheses criteria in order to perform the supplementary analyses. The final multilevel logistic regression model of the predictor variables from each investigation *included* in the supplemental analyses will be used to assess the classification and working hypotheses of HISKs compared to non-HISKs. To accept the working hypotheses that HISKs warrant a distinct classification from non-HISKs for the respective investigations in the supplemental analyses, at least *one* of the predictor variables (IVs) of each study must be statistically significant (p = < .05). The criteria and parameters of the supplemental analyses and the classification determination of HISKs versus non-HISKs are listed in Table 2 below.

Table 2

Supplemental Analyses: Criteria and Parameters for HISKs to Warrant a Distinct Classification from Non-HISKs

Investigation	Number of Variables/ Hypotheses	Non-Parametric Tests	50% Criteria Parameters	Multilevel Regression Model: Classification Determination
Study 1: Common Characteristics	5	χ^2 tests of Independence	*3 of 5* IVs/hypotheses	$\geq$1 statistically significant predictor variable(s) (p = < .05)
Study 2: Geospatial Patterns	2	Mann-Whitney U tests	*1 of 2* hypotheses	$\geq$ 1 statistically significant predictor variable(s) (p = < .05)
Study 3: Criminal Precipitators	2	Binary Logistic Regression	*1 of 2* hypotheses	$\geq$ 1 statistically significant predictor variable(s) (p = < .05)

Notes. Three scenarios and procedures are delineated for potential outcomes of the three studies and the use of supplementary logistic regression analyses to test the working hypotheses from each investigation that HISKs warrant a distinct classification:

(1) *All three* studies meet the 50% criteria: (1) single binary logistic regression models of the significant hypotheses/variables from each of the three studies to determine the significant predictors of HISK group membership; and (2) multilevel logistic regression model of all significant variables from the three studies to test which variables are significant in prediction of group membership and determine the classification of HISKs versus non-HISKs for each of the three studies.
(2) *Two of three* studies meet the 50% criteria: (1) single binary logistic regression models of the significant/hypotheses/variables from the two studies that met the criteria to determine the significant predictors of HISK group membership; and (2) multilevel logistic regression model of all significant variables from the two studies to test which predictor variables are significant in the prediction of group membership and determine the classification of HISKs vs. non-HISKs for the two studies.
(3) *Two of the three* studies or *all three* studies *do not* meet the 50% statistically significant hypotheses criteria, the working hypotheses for all three studies will be *rejected* and HISKs *will not* warrant a distinct classification.

3.5 Chapter 3 Summary

This chapter provided the research approach used to investigate the differences between HISKs and non-HISKs for Study One (common characteristics), Study Two (geospatial patterns), and Study Three (criminal precipitators). The research questions and objectives, data and sampling method, a summary of both groups (HISKs and non-HISKs), and an overview of the analytic plan for each investigation were discussed to provide the methodological blueprint for the subsequent results chapters of each investigation. The following three chapters will detail the measures and analytical strategy utilized and the results for each of the three investigations. The structure of Chapter 4 (Study One), Chapter 5 (Study Two), and Chapter 6 (Study Three) will consist of the following sections: (1) overview of the current investigation; (2) measures and analytical strategy of the investigation; (3) descriptive statistics; (4) final results of the investigation; and (5) summary of the chapter.

CHAPTER 4

IV. STUDY ONE: COMMON CHARACTERISTICS OF HOME INVASION SERIAL KILLERS VS. NON-HOME INVASION SERIAL KILLERS

4.1 Introduction

This chapter is the *first* of three investigations that examined the differences between home invasion serial killers (HISKs) and non-home invasion serial killers (non-HISKs). The focus of the current investigation is to determine the differences in the common characteristics between the two serial killer groups. This chapter will detail the analytical strategy and results of the current investigation (Study One). The structure of this chapter will consist of the following sections: (1) an overview of the current investigation; (2) measures and analytical strategy of the current investigation; (3) descriptive statistics; (4) final results; and (5) summary of Chapter 4.

4.2 The Current Investigation

The current investigation examined the differences of common characteristics between HISKs and non-HISKs. This chapter tests three hypotheses and five independent variables (IVs) relevant to the common characteristics of serial killers selected and analyzed to determine whether HISKs demonstrate statistically significant differences regarding their victim selection, modus operandi, and crime scene actions compared to non-HISKs. First, there were two IVs relevant to the victim selection of serial killers (i.e., *victim selection type* and *adult victims*). Second, there were two IVs relevant to the modus operandi of serial killers (i.e., *crime premeditation* and *attack method*). Lastly, one IV relevant to the killers' crime scene actions was examined: *crime scene location type*.

The following section details the measures (data collection, variables, and hypotheses) and analytical strategy employed for this investigation, followed by the descriptive statistics and results of this chapter (Study One).

4.3 Measures and Analytical Strategy of the Current Investigation

The following section details the measures and analytical strategy employed for the current investigation. The first section reviews the data collection measures used for the current investigation, followed by the variables and hypotheses of Study One. Finally, the analytical strategy used to examine the common characteristics of HISKs and non-HISKs is reviewed at the end of this section.

4.3.1 Data Collection Measures

Most of the data in the current investigation on the common characteristics of HISKs and non-HISKs was obtained from the RU/FGCU SKD (2019). For serial killer cases that had missing data in the RU/FGCU SKD, supplementary public information searches were conducted concerning the independent variables (i.e., victim selection, modus operandi, and crime scene actions), as well as the descriptive variables included in the current investigation. Additionally, the researcher used data from the RU/FGCU SKD and supplementary searches to construct several of the independent variables (i.e., victim selection type, crime premeditation, and attack method). Numerous resources were used to cross-reference both the RU/FGCU SKD and supplemental searches (i.e., legal software, public records websites, true crime books and documentaries, interviews, missing persons and serial murder websites, as well as official court records/transcripts and investigation reports [when available]).

All Study One data from the RU/FGCU SKD and supplementary searches were retained in a password-protected *Microsoft Excel* data collection spreadsheet file. The final Study One Excel spreadsheet used for the analysis consisted of 33 columns of data. The RU/FGCU SKD case ID; one column for the *dependent variable* (serial killer group); 14 columns of dummy coded data relevant to the *five independent variables* (i.e., victim selection type, adult victims, crime premeditation, attack method, and crime scene location type); and 15 columns of data pertinent to the *descriptive variables* of the current investigation. The variables, coding, and hypotheses are delineated and presented below.

4.3.2 Variables and Hypotheses

Dependent Variable and Independent Variables

The majority of data analyzed for the current investigation was categorical. Therefore, the current investigation's dependent variable (DV) and independent variables (IVs) were dummy coded variables and categories. The DV was serial killer group (HISK = 1; non-HISK = 0). Five IVs were constructed and utilized to investigate the differences between the common characteristics of both groups. Eight descriptive variables were also included in the analysis for the current investigation. The five IVs were divided into *three sets* relevant to the common characteristics of both serial killer groups: (1) *victim selection*, (2) *modus operandi,* and (3) *crime scene actions*. The definitions and operationalization of the IVs and descriptive variables of Study One are listed below.

Victim Selection

The researcher constructed two IVs relevant to the *victim selection* of HISKs and non-HISKs for Study One. The first IV, *victim selection type*, was adopted from the "victim selection type" delineated by Ensslen et al. (2018) regarding *home intruder sex* *offenders* (p. 4699). The researcher reconstructed the second IV, *adult victims*, using several columns of data from the RU/FGCU SKD concerning the age of victims in the database (2019). Both victim selection IVs are delineated and operationalized below.

***Victim Selection Type* (IV 1).** The researcher delineated three categories for this variable: (1) *random victims*, (2) *non-random victims*, and (3) *mixed victims*. First, the *random* and *non-random* victim selection types were adopted from Ensslen et al. (2018) and applied to this IV. Ensslen et al. (2018) defined *random* victim selection as a criminal who randomly selects the victim(s) "as a result of an opportunity to do so" (p. 4699). On the contrary, *non-random* victim selection was defined as a criminal "not choosing a victim at random, but rather *purposely selecting* a victim independent of the situation" (Ensslen et al., 2018, p. 4699). The researcher also included the *mixed victim* category to account for serial killers that targeted random *and* non-random victims during the murder series.

The researcher used columns of data from the RU/FGCU SKD (2019) relevant to the victim selection of serial killers during the murder series and supplementary searches to cross-reference, code, and enter data for each serial killer (N = 326). All three victim selection categories were dummy coded as to whether the serial killer selected random, non-random, or mixed victim types during the murder series (0 = no and 1 = yes).

***Adult Victims* (IV 2).** The researcher used the "VicAgeAdult" column of data from the RU/FGCU SKD, defined as victims over the age of 17 at the time of the murder (2019). The "VicAgeAdult" consisted of dummy coded data on whether the victims were adult(s) (0 = no and 1 = yes) (RU/FGCU SKD, 2019).[14]

[14]*Note.* RU/FGCU SKD (2019) cases coded as adult victims (Yes = 1) did not mean *all victims* murdered were solely adults. For example, if the killer murdered victims who were adults and teenagers, it was coded as adult victims. Teenagers (18+), older adults, and various groups (3+) were also coded as adult victims.

Modus Operandi (MO)

Two IVs relevant to the *modus operandi* (MO) of both serial groups were constructed for Study One: (1) *crime premeditation* and (2) *attack method* (see Ensslen et al., 2018; Rossmo, 1995). The first modus operandi IV was adopted from Ensslen et al.'s (2018) "crime premeditation" variable and the MO of home intruder sex offenders (pp. 4699-4700; see also Beauregard et al., 2010). The second IV was adopted from Rossmo's *Attack Method* typology (1995). Both IVs are delineated and operationalized below.

***Crime Premeditation* (IV 3).** The researcher defined three categories for this variable: (1) *no premeditation/unstructured*, (2) *structured premeditation,* and (3) *mixed premeditation*. The researcher adopted two categories from Ensslen et al. (2018): (1) *no premeditation/unstructured* and (2) *structured premeditation*. The no premeditation or unstructured category was defined as the serial killer's lack of elaborate planning or unstructured preparation to murder each victim during the series (Ensslen et al., 2018, p. 4700). Whereas, structured premeditation category was defined as elaborate planning and preparation by the serial killer prior to the murder of each victim during the series (e.g., particular type of victim targeted, specific MO, deliberate murder, and disposal locations) (Ensslen et al., 2018, p. 4700; see also Beauregard et al., 2010).

Lastly, the researcher also incorporated the *mixed premeditation* category to account for serial killers who used *both* types of premeditation during the murder series. The researcher used columns of data from the RU/FGCU SKD (2019) relevant to the MO and premeditation of serial killers during the murder series and supplementary searches to cross-reference, code, and enter data for each serial killer (N = 326). Three categories of premeditation were dummy coded as to whether the serial killer used: (1) no/unstructured premeditation, (2) structured premeditation, or (3) mixed types (0 = no and 1 = yes).

Attack Method **(IV 4).** This MO variable was adopted from Rossmo's attack method typology (1995), which was defined as the manner(s) used by the serial killer(s) to gain access to the victim before each murder. Rossmo's typology outlines three types: (1) the *raptor* (immediately blitzes the victim upon encounter); (2) the *stalker* (stalks the victim prior to striking); and (3) the *ambusher* (employs a ruse to lure the victim to isolated, controlled locations such as the killer's home, woods, place of employment) (1995; see also Beauregard et al., 2007, p. 1070). The researcher defined four categories for this variable relevant to serial killer attack methods: (1) blitzed ("Raptors"); (2) stalked ("Stalkers"); (3) ambushed ("Ambushers"); and (4) mixed methods.

The researcher incorporated the *mixed methods* category for serial killers who used more than one of these attack styles during the murder series (Beauregard et al., 2007, p. 1070). The researcher used columns of data from the RU/FGCU SKD (2019) relevant to the attack method of serial killers during the murder series and supplementary searches to cross-reference, code, and enter data for each serial killer (N = 326). The four categories were dummy coded as to whether the serial killer blitzed, stalked, ambushed, or used mixed methods to murder victims during the series (0 = no and 1 = yes).

Crime Scene Actions

Crime Scene Location Type **(IV 5).** The final IV consisted of three categories delineated by the researcher relevant to the crime scene locations of serial killers: (1) *single* crime scene locations, (2) *multiple* crime scene locations, and (3) *mixed* crime scene locations. This variable was defined as the location(s) where the killer *murdered* <u>and</u> *disposed* of their victims (see Synnott et al., 2019). The researcher constructed three categories to determine the type of crime scene locations of each serial killer(s) used to murder and dispose of each victim during the series: (1) *single* location crime scenes (i.e., murdered and left each victim's body at *single* locations); (2) *multiple* location crime scenes (i.e., separate murder and body disposal locations); or (3) *mixed* location crime scenes (i.e., *both* single and multiple location crime scenes).[15]

The researcher used columns of data from the RU/FGCU SKD (2019) relevant to the crime scene actions of serial killers regarding the murder and disposal location(s) of victims during the series, as well as supplemental searches to cross-reference, code, and enter data for each serial killer (N = 326). The three crime scene location categories were dummy coded (0 = no and 1 = yes) to determine whether the serial killer murdered and disposed of their victims in single, multiple, or mixed locations during the murder series.

Descriptive Variables

The researcher also incorporated and constructed several descriptive variables that were included in the data analysis of the current investigation on the demographics, victim selection, MO, and crime scene actions of serial killers in the sample. The descriptive variables are delineated and operationalized below.

***Serial Killer Gender*.** The gender of each serial killer. The researcher used the RU/FGCU SKD (2019) column of data for this variable. This variable needed to be re-coded by the researcher into two dummy coded categories from the RU/FGCU SKD data (originally

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[15]*Note*. The encounter or abduction location sites were not included in the definition of the crime scene location type due to unavailable or missing data relevant to the encounter or abduction location sites for many of the victims. The murder location and body disposal location were used to measure single, multiple, and mixed crime scene location types (RU/FGCU SKD, 2019).

coded in rank order "male = 1; female = 2") to decipher the gender of each serial killer: (1) male serial killer (0 = no; 1 = yes) and (2) female serial killer (0 = no; 1 = yes).

Serial Killer Race. The race of each serial killer in the sample. The researcher used the RU/FGCU SKD (2019) column of data for this variable. This variable needed to be re-coded by the researcher into four dummy coded categories from the RU/FGCU SKD data (originally coded in rank order) to decipher the race of each serial killer: White (0 = no; 1 = yes); Black (0 = no; 1 = yes); Hispanic (0 = no; 1 = yes); and Asian (0 = no; 1 = yes).

Solo or Team Serial Killer. The serial killer operated alone or as a team (i.e., murdered victims with one or more partners). The RU/FGCU SKD (2019) contains several columns of data on whether the serial killer was a solo serial killer or operated as part of a team of serial killers during the series: (1) "Type of Killer" (Text Data); (2) "Partner" (Yes = 1; No = 0); and (3) "Partner Name" (Text Data) (RU/FGCU SKD, 2019). The researcher used the three data columns from the RU/FGCU SKD to construct this variable and consisted of two dummy coded categories to decipher whether the serial killer operated alone or with a partner(s): (1) solo (0 = no; 1 = yes) and (2) team (0 = no; 1 = yes).

US Serial Killer. Whether the serial killer operated and murdered victims within the United States or not (RU/FGCU SKD, 2019). The researcher used the RU/FGCU SKD column of data "*Did the killer operate in the US*?" (2019) and was used to decipher whether the serial killers murdered victims in the US or internationally. The RU/FGCU SKD data were dummy coded: operated in the US (0 = no; 1 = yes).

Serial Killer Age (First Murder and Last Murder).The serial killer's age at their *first murder* and *last murder* of the series. The RU/FGCU SKD (2019) contains two columns of interval/ratio data of the exact age of the serial killer in both the first and last murders of the series (i.e., "Age1stKill" and "AgeLastKill"). Both columns of serial killer age data from the RU/FGCU SKD (2019) were included in their original form.

Age Group of Victims. The researcher included the "VicAge" column of data from the RU/FGCU SKD (2019), which was used to determine the primary age groups of the victims for each case. The RU/FGCU SKD (2019) "VicAge" column only consisted of text data from several age groups of victims. To numerically code the victim age groups, the researcher used the filter feature in the Excel RU/FGCU SKD (2019), which consisted of six victim age groups: (1) *children*; (2) *children and* teens; (3) *teens* (18+); (4) *adults*; (5) *older adults*; and (6) *various* (i.e., three or more age groups). The researcher used the RU/FGCU SKD data to construct the variable of the *primary victim age group* and ordinally coded the six age groups of the text data accordingly: children (= 1); children and teens (= 2); teens (= 3); adults (= 4); older adults (= 5); and various groups (3+ victim age groups) (= 6).

Victim Gender. The gender of all victims murdered by the serial killer throughout the murder series. The researcher used the RU/FGCU SKD column for this variable. This data column was originally coded as "*men*" (= 1); "*women*" (= 2); and "*both men and women*" (= 3) (RU/FGCU SKD, 2019)**.** The researcher needed to construct three dummy coded categories to decipher the gender of the victims murdered by each serial killer during the murder series. The three re-coded categories consisted of the following: (1) *male victims* (0 = no; 1 = yes); (2) *female victims* (0 = no; 1 = yes); and (3) *both male and female victims* (0 = no; 1 = yes).

Hypotheses of the Current Investigation

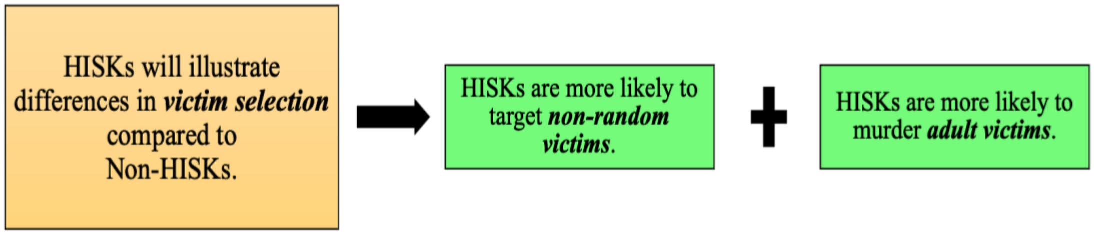
Based on the independent variables relevant to the common characteristics of HISKs and non-HISKs, three sets of hypotheses were tested regarding both groups' victim selection, MO, and crime scene actions. Anticipated differences in the common characteristics of HISKs and non-HISKs were predicated on five factors: (1) victim selection (*non-random* and *adult* victims); (2) modus operandi (*structured premeditation* and *stalked attacks*); and (3) crime scene actions (*single* location crime scenes). The three sets of hypotheses, their respective hypothesized models, and the working hypothesis of the current investigation are presented in the following sections below.

Hypothesis 1a

The first hypothesis tests the relationship and differences in *victim selection* of HISKs compared to non-HISKs. *Hypothesis 1a* consisted of two IVs relevant to the victim selection of both serial killer groups: (1) *victim selection type* (i.e., non-random, random, and mixed) and (2) *adult victims*. Two distinct victim selection characteristics of HISKs are anticipated to be: (1) *non-random* victims and (2) *adult* victims (see Figure 6). This assumption is predicated on the perspectives of RAT and RCT and existing research on home invasion sex offenders, indicating such offenders exhibit high levels of rationality in their victim selection (Beauregard et al., 2007; Deslauriers-Varin & Beauregard, 2010). In particular, Ensslen et al. (2018) and Pedneault et al. (2015b) established that both home invasion rapists and sexual burglars primarily targeted *non-random, adult* victims (frequently home alone at the time of the attack). Correspondingly, Hypothesis 1a predicts that HISKs will be more likely to target and murder *non-random, adult victims* compared to non-HISKs (Figure 6).

Figure 6

Hypothesis 1a: Hypothesized Model for the Victim Selection of HISKs and Non-HISKs

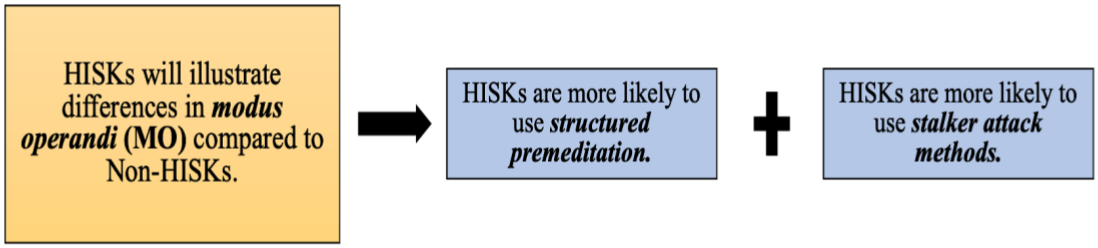


Hypothesis 1b

The second hypothesis tests the relationship and differences in *modus operandi* (MO) of HISKs compared to non-HISKs. *Hypothesis 1b* consisted of two IVs relevant to modus operandi: (1) *crime premeditation* (i.e., no/unstructured premeditation, structured premeditation, and mixed premeditation) and (2) *attack method* (raptor, stalker, ambusher, and mixed methods). Two distinct MO characteristics of HISKs are anticipated to be: (1) *structured premeditation* and (2) *stalker attacks* (Ensslen et al., 2018, p. 4700; see also Rossmo, 1995). This assumption is also grounded in RAT and RCT perspectives and prior research concerning non-fatal home invasion sex offenders. In particular, Pedneault et al. (2015b) and Ensslen et al. (2018) illustrate that both sexual burglars and home invasion sex offenders predominantly employ *structured premeditation* to execute their attacks. Due to such criminals' *non-random* and *premeditated* offending styles, it is also anticipated that HISKs will employ *stalker attacks* to murder their victims during the series (see Rossmo, 1995). Consequently, Hypothesis 1b predicts that HISKs will be more likely to use *structured premeditation* and *stalker attack methods* compared to non-HISKs (Figure 7).

Figure 7

Hypothesis 1b: Hypothesized Model for the Modus Operandi of HISKs and Non-HISKs

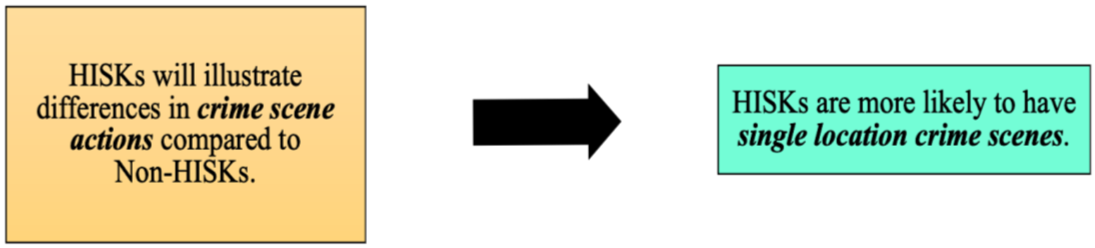


Hypothesis 1c

The final hypothesis of the current investigation tests the relationship and differences in *crime scene actions* of HISKs compared to non-HISKs. *Hypothesis 1c* consisted of one IV relevant to the crime scene actions of both serial killer groups: *crime scene location type* (i.e., single, multiple, or mixed crime scene location types). HISKs are expected to be more likely to murder *and* dispose of their victims at *single location crime scenes* (i.e., victim's residence) than non-HISKs. This assumption is also grounded in RAT and RCT perspectives and previous research concerning non-fatal home invasion sex offenders. Existing literature indicates that such offenders typically encounter, attack, and release victim(s) at a single location (Beauregard et al., 2010; Martineau & Beauregard, 2016; Rebocho & Silva, 2014). Accordingly, Hypothesis 1c predicts that HISKs will be more likely to murder *and* dispose of their victims at single location crime scenes during the series compared to non-HISKs (Figure 8).

Figure 8

Hypothesis 1c: Hypothesized Model for the Crime Scene Actions of HISKs and Non-HISKs

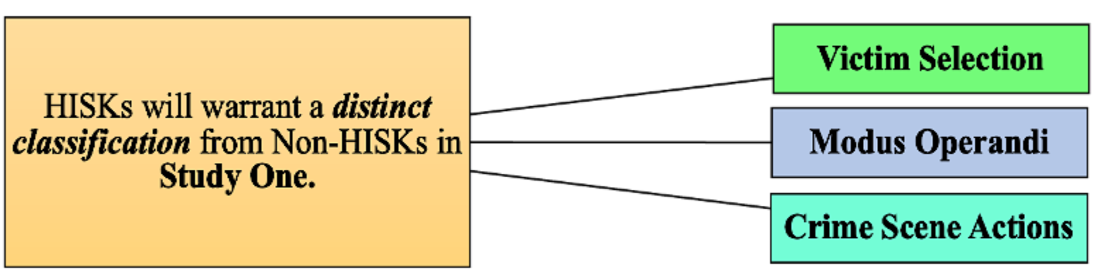


Study One Working Hypothesis

A working hypothesis of the current investigation concerning the common characteristics of HISKs and non-HISKs was also constructed. The working hypothesis was outlined as a provisional hypothesis, contingent on the current investigation results meeting the eligibility criteria for the supplementary analyses and classification determination of HISKs versus non-HISKs (i.e., *three* of *five* IVs/hypotheses must be statistically significant). Depending on *Hypothesis 1a* (non-random, adult victims), *Hypothesis 1b* (structured premeditation and stalked attacks), and *Hypothesis 1c* (single location crime scenes), it is predicted that HISKs will warrant a distinct classification from non-HISKs in Study One (Figure 9).

Figure 9

Study 1 Working Hypothesis: HISKs Warrant a Distinct Classification from Non-HISKs



4.3.3 Analytical Strategy

The current investigation consisted of descriptive statistics and *Chi-square* (χ^2) tests performed using SPSS 27. Proportionate stratified random sampling was used to produce the final sample of 326 serial killers (N = 326), which consisted of two groups: (1) the *experimental* group, HISKs (n = 163), and (2) the *control* group, non-HISKs (n = 163). Most of the data in the current investigation were categorical and not normally distributed. Consequently, non-parametric testing (χ^2 tests) needed to be performed in the analysis of the current investigation.

The analytical strategy of the current investigation consisted of several stages. First, most of the data and variables analyzed in the current investigation were nominal, descriptive statistics were run on all variables in the sample using the *frequency* function in SPSS (see Table 3). Second, to provide a descriptive overview of the variables by serial killer group, the *cross-tabulations* function in SPSS was utilized, which allows for the observation of similarities and differences between the two groups (see Table 4). Third, since the data of the sample of serial killers was not normally distributed, the current investigation utilized χ^2 tests to examine the differences in common characteristics between HISKs and non-HISKs. A *chi-square goodness-of-fit* test was performed to test the DV of the serial killer group to evaluate whether the observed frequencies differed from the expected frequencies in both groups (see Table 5).

Fourth, to examine the research question and the hypotheses of the current investigation and determine whether there were statistically significant differences in the common characteristics between both groups, five *χ^2 tests of independence* were conducted (see Tables 6, 7, 8, 9, and 10). The χ^2 test of independence is suitable to determine whether two nominal or categorical variables, serial killer group (DV) and each of the five categorical IVs, are independent (H_0 = the null hypothesis) or not independent (H_1 = the alternative hypothesis) (McHugh, 2013). While the χ^2 statistic and the test of independence measure the significance of two categorical variables, it does not measure the *strength* of the *relationship* between the variables. If any of the IVs tested were determined to be significant, Cramer's *V* was used to measure the strength of the relationship (see Table 11) (McHugh, 2013; Warmbrod, 2001).

Finally, according to the classification criteria delineated in Chapter 3, if 50% of the hypotheses (i.e., *three of five* IVs/hypotheses) in the χ^2 tests of independence are determined to be statistically significant (p = < .05), supplementary analyses of the significant variables in the current investigation will be performed and reported at the end of Chapter 6. Supplementary analyses will be used to determine whether HISKs warrant a distinct classification compared to non-HISKs based on their common characteristics. The descriptive statistics of the current investigation are presented below for each of the variables analyzed in this chapter. Subsequently, the analyses conducted to test the three sets of hypotheses and IVs concerning the differences between the common characteristics of HISKs and non-HISKs are presented.

4.4 Descriptive Statistics

Table 3 lists the descriptive statistics for all variables included in the current investigation. As reported in Table 3, the entire sample of serial killers (N = 326) was responsible for killing a total of 1,952 victims. Table 3 also shows that the average number of victims in the sample was 5.99 (SD = 12.78, SE_M = 0.71), with a *minimum* of two victims (see RU/FGCU SKD, 2019 definition) and a *maximum* of 215 victims during the murder series. Based on the sampling procedure and proportion of the victim count categories, the category most frequently observed was *five or more victims*, which constituted 40% (*n* = 130) of the overall sample, followed by two victims (*n* = 81 or 25%), three victims (*n* = 69 or 21%), and four victims (*n* = 46 or 14%) (see Table 3).

The first independent variable, *victim selection type*, consisted of three dummy coded categories: (1) *non-random*; (2) *random*; and (3) *mixed* victim types. As reported in Table 3, the most frequently observed category of victim selection type was *non-random victims*, with 150 serial killers (or 46%) that deliberately selected and murdered their victims regardless of the situation (Ensslen et al., p. 4699). The second most frequently observed victim selection category was *mixed* victim types, with 129 serial killers (or 40%) that murdered both random and non-random victims. The least observed victim selection type was *random* victims, with only 47 serial killers (roughly 14%) randomly murdering their victims based on opportunistic circumstances (see Ensslen et al., 2018 for victim selection types). Table 3 also illustrates that most serial killers murdered *adult victims* (IV 2) (*n* = 307 or 94%) during the murder series. However, only 19 serial killers (6%) exclusively murdered non-adult victims (i.e., only victims under the age of 18 at the time of the murder) (RU/FGCU SKD, 2019).

The third independent variable, *crime premeditation*, consisted of three dummy coded categories: (1) *no premeditation*/*unstructured* premeditation, (2) *structured* premeditation, and (3) *mixed* premeditation. As reported in Table 3, the most frequently observed category was *mixed premeditation* with 148 serial killers (approximately 45%) who used both types during the murder series. The second category most frequently observed was *structured premeditation*, with 136 serial killers (42%) who used calculated planning to target and kill their victims during the series. The least frequently observed category was *no premeditation/unstructured* premeditation, with only 42 serial killers (or 13%) who did not employ premeditation or if they did, it was unstructured (Ensslen et al., 2018; see also Beauregard et al., 2010).

The fourth independent variable, attack method, consisted of four dummy coded categories from Rossmo’s typology: (1) *blitzed*, (2) *stalked*, (3) *ambushed*, and (4) *mixed* methods (1995). As reported in Table 3, the most frequently observed category is *mixed methods* (N = 113), illustrating that 35% of serial killers used more than one attack method to gain access to and murder victims during the series. The second most frequently observed category was *stalked attacks*, with 95 serial killers (29%) who stalked and targeted non-random victims prior to each murder during the series. The third category of attack methods observed the most frequently was *ambushed attacks*, with 80 serial killers (approximately 24%) who used a ruse or lured victims to an isolated location to attack and kill victims during the series. Finally, *blitz* attacks (i.e., "Raptors") were the least observed category, with only 38 serial killers (12%) that immediately attacked their victims upon encountering them (Beauregard et al., 2010; Rossmo, 1995).

The final IV, *crime scene location type*, consisted of three dummy coded categories: (1) *single location,* (2) *multiple locations*, and (3) *mixed locations* crime scenes. Table 3 indicates the most frequently observed category was *single location crime scenes*, with 179 serial killers (55%) that murdered <u>and</u> left their victims' bodies at single location crime scenes during the series. The second category most frequently observed was *mixed location* crime scenes, with 78 serial killers (24%) who left *and* moved their victims' bodies during the murder series. Lastly, *multiple location crime scenes* were the least observed category, with 69 serial killers (roughly 21%) that exclusively murdered and disposed of their victims' bodies at multiple locations during the murder series (see Table 3).

Descriptive Variables

As Table 3 shows, the *gender* of serial killers in the sample primarily consisted of *men*, representing 97% (*n* = 315) of the sample, and *female* serial killers only represented 3% (*n* = 11) of the sample. Almost two-thirds consisted of *White* serial killers (*n* = 210 or 64%), followed by *Black* serial killers (*n* = 87 or approximately 27%), *Hispanic* serial killers (*n* = 20 or 6%), and the category least frequently observed was *Asian* serial killers (*n* = 9 or 3%). The sample consisted mainly of solo serial killers (*n* = 294), which made up approximately 90% of the sample, and only 32 cases were team serial killers (approximately 10%). In terms of the geographic operation region of serial killers, most operated in the *US*, representing almost 75% of the sample (*n* = 243). The remaining 25% of serial killers in the sample *did not* operate in the US (*n* = 83) (see Table 3).

The *age* of the serial killers' *first* and *last* murder of the series is also shown in Table 3. The average age of serial killers at their *first* murder was 27.70 (*SD* = 8.74, *SEM* = 0.48), with the *youngest* age at the *first* murder being 13 years old and the *oldest* age at the *first* murder being 64 years old. The average age of serial killers at the *last* murder was 32.94 (*SD* = 10.03, *SEM* = 0.56), the *youngest* age at the *last* murder was 15, and the *oldest* age at the *last* murder was 68 (RU/FGCU SKD, 2019).

Finally, two descriptive variables were also included in Table 3 on the victims of the serial killers: *primary age group* and *victims' gender* (RU/FGCU SKD, 2019). Table

3 shows adult victims, which includes the following age group categories: *teens* (18+) (*n* = 19 or 6%), *adults* (*n* = 220 or 68%), *older adults* (*n* = 19 or 6%), and *3+* age groups (50 or 15%), represented the majority of serial killer victims in the sample with 308 cases (roughly 96%). Lastly, *females* were the most frequently murdered victims by serial killers in the sample (*n* = 178 or 55%), followed by *both male* and *female* victims (*n* = 111 or approximately 34%), and only 37 serial killers exclusively murdered *male* victims during the series (11%) (RU/FGCU SKD, 2019). The descriptive statistics of the sample are listed in Table 3 below.

Table 3

Study 1: Descriptive Statistics (N = 326)

Variables	*n*	%	*M*	*SD*	Min	Max
Dependent Variable						
HISKs	163	50%	---	---	0	1
Non-HISKs	163	50%	---	---	0	0
Independent Variables						
Victim selection type [a]						
Non-random	150	46%	---	---	0	1
Random	47	14%	---	---	0	1
Mixed types	129	40%	---	---	0	1
Adult Victims [a b]						
Adult victims	307	94%	---	---	0	1
Non-adult victims	19	6%	---	---	0	0
Crime premeditation [a]						
None/Unstructured	42	13%	---	---	0	1
Structured	136	42%	---	---	0	1
Mixed types	148	45%	---	---	0	1
Attack method [a]						
Blitzed ("Raptors")	38	12%	---	---	0	1
Stalked ("Stalkers")	95	29%	---	---	0	1
Ambushed ("Ambushers")	80	24%	---	---	0	1
Mixed ("Mixed attackers")	113	35%	---	---	0	1
Crime scene location type [a]						
Single location	179	55%	---	---	0	1
Multiple locations	69	21%	---	---	0	1
Mixed locations	78	24%	---	---	0	1
Descriptive Variables						
Number of victims [c]	1,952	---	5.99	12.78	2	215

Variables	*n*	%	*M*	*SD*	Min	Max
Victim count category [c]						
2 victims	81	25%	---	---	2	2
3 victims	69	21%	---	---	3	3
4 victims	46	14%	---	---	4	4
5+ victims	130	40%	---	---	5	215
Serial killer gender [a]						
Male	315	97%	---	---	0	1
Female	11	3%	---	---	0	1
Serial killer race [a]						
White	210	64%	---	---	0	1
Black	87	27%	---	---	0	1
Hispanic	20	6%	---	---	0	1
Asian	9	3%	---	---	0	1
Serial killer type [a]						
Solo serial killer	294	90%	---	---	0	1
Team serial killers	32	10%	---	---	0	1
Geographic region of murders [a]						
US	243	75%	---	---	0	1
Non-US	83	25%	---	---	0	0
Serial killer's age at *first* murder	326	100%	27.70	8.74	13	64
Serial killer's age at *last* murder	326	100%	32.94	10.03	15	68
Age group of victims						
Children	12	4%	---	---	1	1
Children/teens	6	2%	---	---	2	2
Teens (18+)	19	6%	---	---	3	3
Adults	220	68%	---	---	4	4
Older adults	19	6%	---	---	5	5
Various (3+ groups)	50	15%	---	---	6	6
Gender of victims [a]						
Male	37	11%	---	---	0	1

Variables	*n*	%	*M*	*SD*	Min	Max
Female	178	55%	---	---	0	1
Male and female	111	34%	---	---	0	1

Notes. The DV is the serial killer group: HISKs (= 1); non-HISKs (= 0). The IVs are (1V1) Victim Selection Type; (IV2) Adult Victims; (IV3) Crime Premeditation; (IV4) Attack Method; and (IV5) Crime Scene Location Type. Due to rounding, percentages may not equal 100%.

[a] Reflects the number of serial killers coded as "yes" (= 1) for the variable or categories of the variable.

[b] Includes victims ages 18+, adults, older adults, and various age groups (3+) (e.g., teens < 17 years old and adult victims).

[c] The number of victims reflects the total number of victims (*n* = 1,952) murdered by all serial killers in the sample (*N* = 326), and the victim categories consist of the respective victim count categories for each serial killer.

Descriptive Statistics by Serial Killer Group

Table 4 lists the descriptive statistics of the independent and descriptive variables by *serial killer group* (HISK = 163; non-HISK = 163). As previously reported in Table 3, the 326 serial killers in the sample murdered a total of 1,952 victims, with 981 victims killed by non-HISKs (*n* = 163) and 971 victims murdered by HISKs (*n* = 163). The category of *five or more* victims constituted the majority of serial killers in both groups, with 73 non-HISKs (45%) and 57 HISKs (35%). *Two victims* were the second-highest and consisted of 34 non-HISKs (21%) and 47 HISKs (29%). *Three victims* were the third most frequent category, with 33 non-HISKs (20%) and 36 HISKs (22%). Table 4 shows that the least observed category was *four victims* with 23 cases in both serial killer groups (14%). The maximum number of victims killed by the non-HISKs group was 60, and the maximum number of victims killed by the HISKs group was 215.

Victim Selection by Serial Killer Group

Table 4 shows the differences and marginal similarities between both groups regarding the first IV (*victim selection* type). The most frequently observed category for non-HISKs was *mixed victim types* with 79 non-HISKs (49%) that murdered random and non-random victims during the murder series. The second most frequently observed category for non-HISKs was *non-random* victims, with 56 non-HISKs (34%) that purposely selected and murdered their victims. Conversely, the most frequently observed category for HISKs was *non-random victims*, with 94 HISKs (58%) that calculatingly selected and murdered their victims. The second most frequently observed category for HISKs was *mixed victim* types, with 50 HISKs (31%) that murdered both victim types during the series. The least observed category for both non-HISKs and HISKs were *random* victims, with only 28 non-HISKs (17%) and 19 HISKs (12%) randomly murdered victims based on opportunistic circumstances.

Adult Victims by Serial Killer Group

The second independent variable, *adult victims*, showed similarities between serial killer groups. Both non-HISKs (*n* = 147 or 90%) and HISKs (*n* = 160 or 98%) primarily murdered *adult victims* during their murder series. As reported in Table 4, non-HISKs murdered marginally more non-adult victims (i.e., exclusively victims less than 17 years old at the time of the murder) with 16 non-HISK cases (10%) and only three HISKs (2%) that murdered *non-adult* victims during the killing series.

Crime Premeditation by Serial Killer Group

Table 4 illustrates both groups' differences and minor similarities regarding *crime premeditation* (IV 3). The category most frequently observed for non-HISKs was *mixed types of premeditation* (*n* = 90 or 55%), while HISKs most frequently used *structured premeditation* (*n* = 86 or 53%) during the series. The second most frequently observed type of premeditation for non-HISKs was *structured* premeditation with 50 non-HISKs (31%). The second most frequently observed category for HISKs was *mixed types* of premeditation, with 58 HISKs (36%) that used both types during the series. Finally, the category that was observed least frequently for both groups was *no premeditation/ unstructured* with only 23 non-HISKs (14%) and 19 HISKs (12%) (Table 4).

Attack Method by Serial Killer Group

The fourth independent variable in Table 4, *attack method*, also shows differences and slight similarities between non-HISKs and HISKs. The most frequently used attack method by non-HISKs was *ambushed attacks* (*n* = 65 or 40%) compared to HISKs that most frequently used *stalked* attacks (n = 76 or 47%) to access and murder their victims. The second most frequently used attack method by both non-HISKs and HISKs was *mixed attacks* with 59 non-HISKs (36%) and 54 HISKs (33%). Lastly, the least frequently used method by both non-HISKs and HISKs was *blitz attacks* with only 20 non-HISKs (12%) and 18 HISKs (11%).

Crime Scene Location Type by Serial Killer Group

Finally, the last independent variable, *crime scene location type*, revealed similarities and differences between non-HISKs and HISKs. In general, the most frequently observed crime scene location category for both groups was *single location crime scenes* with 64 non-HISKs (39%) and 115 HISKs (71%) who murdered *and* left the victims' bodies at a single location during the series. The second most frequently observed category for non-HISKs was *multiple location crime scenes* with a marginal difference of two non-HISK cases (n = 62 or 38%). The least frequent category for non-HISKs was *mixed location crime scenes* with 37 non-HISKs (roughly 23%). In comparison, most HISKs murdered and disposed of their victims at *single location crime scenes* (n = 115 or 71%). The second most frequently observed for HISKs was *mixed location crime scenes* with 41 HISKs (25%). Lastly, only seven HISKs (4%) had *multiple location crime scenes* during the murder series (Table 4).

Descriptive Variables by Serial Killer Group

In the context of the descriptive variables included in Study One and as reported in Table 4, both non-HISKs and HISKs were somewhat similar in *gender*, *race*, *type*, *region of murders*, *age range*, and *victims*. For example, predictably, the *gender* of non-HISKs and HISKs consisted of male serial killers (non-HISKs = 155 or 95%; HISKs =

160 or 98%). Unsurprisingly, *female* serial killers were significantly underrepresented, with only eight non-HISKs (5%) and three HISKs (2%).

The *race* of serial killers in both groups was also comparatively similar, with the most frequently observed race category of *White* non-HISKs (n = 111 or 68%) and White HISKs (n = 99 or 61%). *Black* serial killers were less represented in the non-HISK group (n = 37 or 23%), while the HISK group had slightly more *Black* serial killers (n = 50 or 31%). As reported in Table 4, both groups were similar in terms of *Hispanic* and *Asian* serial killers, as both races were significantly underrepresented in the entire sample. Eight non-HISKs were *Hispanic* (5%), and seven non-HISKs were *Asian* (4%). The HISK group had slightly more *Hispanic* serial killers (n = 12 or approximately 7%), and two HISKs were *Asian* (1%) (see Table 4).

Table 4 shows that the majority of both groups consisted of *solo* serial killers with 141 solo non-HISKs (approximately 87%) and 153 solo HISKs (94%). Non-HISKs had a marginally higher *team serial* killers (n = 22 or 13%) than HISKs (n = 10 or 6%). Similarly, most of both groups consisted of serial killers that operated in the *US*, with 115 non-HISKs (71%) and 128 HISKs (79%). Regarding serial killers that *did not* operate in the US, there were marginally more *international* non-HISKs (n = 48 or 29%) than international HISKs (n = 35 or 21%).

The age range of the serial killers' *first* and *last* murder of the series by group was also included in Table 4. The average age at the *first* murder of non-HISKs was 28.86 (*SD* = 8.55, *SEM* = 0.67), with the *youngest* age for non-HISKs at the *first* murder being 13 years old and the *oldest* age at the *first* murder in the series was 63 years old. The average age of non-HISKs at their *last* murder was 33.82 (*SD* = 9.79, *SEM* = 0.77).

The *youngest* age for non-HISKs at the *last* murder was 18 years old, and the *oldest* age at the *last* murder in the series was 63 years old. In contrast, the average age of HISKs in the *first* murder was 26.55 (*SD* = 8.80, *SEM* = 0.69), the *youngest* age for HISKs in the *first* murder was 13 years old, and the *oldest* age for the *first* murder in the series was 64 years old. The average age of HISKs at their *last* murder of the series was 32.07 (*SD* = 10.22, *SEM* = 0.80), the *youngest* age of HISKs at the *last* murder was 15 years old, and the *oldest* age at the *last* murder in the series was 68 years old (Table 4).

As reported in Table 4, the variable for the primary age group of victims shows similarities between non-HISKs and HISKs for adult victims and minor differences between groups in other victim age categories. For example, *adult victims* were the most frequently murdered out of the six categories of victim age group, with 108 non-HISKs (66%) and 112 HISKs (69%). Non-HISKs murdered marginally more *children* (*n* = 8 or 5%) compared to HISKs (*n* = 4 or 2%). Furthermore, non-HISKs were the only group to murder victims in the *children and teens* group (*n* = 6 or 4%), whereas HISKs did not. Non-HISKs also murdered more victims in the category of *teenagers* (18+) (*n* = 15 or 10%) compared to HISKs (*n* = 4 or 2%). HISKs murdered slightly more victims in the *older* adult (*n* = 14 or 9%) and the *3+* age groups category (*n* = 29 or 18%). Compared to only five non-HISKs that murdered older adults (3%) and 21 non-HISKs that murdered victims in *3+* age groups (13%).

The moderately higher number of HISKs victims in older adults and 3+ age groups is somewhat fathomable. As HISKs may target older adult victims who live alone or invade homes where the entire family were all home at the time of the murders (i.e., 3+ age groups). For example, the first murders committed by Dennis Rader (BTK) consisted of a family of four as they were all home, even though Rader anticipated that only the mother and daughter would be home at the time of the murders (Douglas & Dodd, 2007).

As reported in Table 4, the overall *gender* of the victims of both groups was comparatively similar, with *females* being the most frequently murdered victims by 94 non-HISKs (58%) and 84 HISKs (52%). However, more HISKs murdered *both male* and *female* victims during their murder series (*n* = 66 or 40%). Compared to non-HISKs (*n* = 45 or 28%), which may be correlated with HISKs and the occupancy of residences at the time of the murders (e.g., husband and wife were home) (Ensslen et al., 2018; Pedneault et al., 2015b). Finally, *male* victims were the least frequently murdered gender of victims in both groups, with 24 non-HISKs (15%) and 13 HISKs (8%) that exclusively murdered males during the murder series. The descriptive statistics by serial killer group are reported in Table 4 below.

Table 4

Study 1: Descriptive Statistics by Serial Killer Group (N = 326)

Variables	Non-HISKs (*n* =163)						HISKs (*n* =163)						Total	
	n	%	*M*	*SD*	Min	Max	*n*	%	*M*	*SD*	Min	Max	*N*	%
Number of victims	981	50%	6.02	6.49	2	60	971	50%	5.96	16.9	2	215	1,952	100%
2 victims	34	21%	---	---	2	2	47	29%	---	---	2	2	81	25%
3 victims	33	20%	---	---	3	3	36	22%	---	---	3	3	69	21%
4 victims	23	14%	---	---	4	4	23	14%	---	---	4	4	46	14%
5+ victims	73	45%	---	---	5	60	57	35%	---	---	5	215	130	40%
Victim selection type [a]														
Non-random	56	34%	---	---	0	1	94	58%	---	---	0	1	150	46%
Random	28	17%	---	---	0	1	19	12%	---	---	0	1	47	14%
Mixed types	79	49%	---	---	0	1	50	31%	---	---	0	1	129	40%
Adult victims [a]														
Adult	147	90%	---	---	0	1	160	98%	---	---	0	1	307	94%
Non-adult	16	10%	---	---	0	0	3	2%	---	---	0	0	19	6%
Crime premeditation [a]														
None/Unstructured	23	14%	---	---	0	1	19	12%	---	---	0	1	42	13%
Structured	50	31%	---	---	0	1	86	53%	---	---	0	1	136	42%
Mixed types	90	55%	---	---	0	1	58	36%	---	---	0	1	148	45%
Attack method [a]														
Blitzed ("Raptors")	20	12%	---	---	0	1	18	11%	---	---	0	1	38	12%
Stalked ("Stalkers")	19	12%	---	---	0	1	76	47%	---	---	0	1	95	29%
Ambushed ("Ambushers")	65	40%	---	---	0	1	15	9%	---	---	0	1	80	25%
Mixed ("Mixed attackers")	59	36%	---	---	0	1	54	33%	---	---	0	1	113	35%
Crime scene location type [a]														
Single locations	64	39%	---	---	0	1	115	71%	---	---	0	1	179	55%
Multiple locations	62	38%	---	---	0	1	7	4%	---	---	0	1	69	21%
Mixed locations	37	23%	---	---	0	1	41	25%	---	---	0	1	78	24%
Serial killer gender [a]														
Male	155	95%	---	---	0	1	160	98%	---	---	0	1	315	97%
Female	8	5%	---	---	0	1	3	2%	---	---	0	1	11	3%

Variables	Non-HISKs (n =163)						HISKs (n =163)						Total	
	n	%	*M*	*SD*	Min	Max	*n*	%	*M*	*SD*	Min	Max	*N*	%
Serial killer race [a]														
White	111	68%	---	---	0	1	99	61%	---	---	0	1	210	64%
Black	37	23%	---	---	0	1	50	31%	---	---	0	1	87	27%
Hispanic	8	5%	---	---	0	1	12	7%	---	---	0	1	20	6%
Asian	7	4%	---	---	0	1	2	1%	---	---	0	1	9	3%
Serial killer type [a]														
Solo	141	87%	---	---	0	1	153	94%	---	---	0	1	294	90%
Team	22	13%	---	---	0	1	10	6%	---	---	0	1	32	10%
Geographic region [a]														
US	115	71%	---	---	0	1	128	79%	---	---	0	1	243	75%
Non-US	48	29%	---	---	0	0	35	21%	---	---	0	0	83	25%
Killer's age at *first* murder	163	50%	28.86	8.55	13	63	163	50%	26.55	8.80	13	64	326	100%
Killer's age at *last* murder	163	50%	33.82	9.79	18	63	163	50%	32.07	10.22	15	68	326	100%
Age group of victims														
Children	8	5%	---	---	1	1	4	2%	---	---	1	1	12	4%
Children/teens	6	4%	---	---	2	2	0	0%	---	---	2	2	6	2%
Teens (18+)	15	10%	---	---	3	3	4	2%	---	---	3	3	19	6%
Adults	108	66%	---	---	4	4	112	69%	---	---	4	4	220	67%
Older adults	5	3%	---	---	5	5	14	9%	---	---	5	5	19	6%
Various (3+ groups)	21	13%	---	---	6	6	29	18%	---	---	6	6	50	15%
Gender of victims [a]														
Male	24	15%	---	---	0	1	13	8%	---	---	0	1	37	11%
Female	94	58%	---	---	0	1	84	52%	---	---	0	1	178	55%
Male and female	45	28%	---	---	0	1	66	40%	---	---	0	1	111	34%

Notes. The DV is serial killer group: HISKs (= 1) and non-HISKs (= 0). The IVs are (1V1) Victim Selection Type; (IV2) Adult Victims; (IV3) Crime Premeditation; (IV4) Attack Method; and (IV5) Crime Scene Location Type. Due to rounding, percentages may not equal 100%.
[a] Reflects the number of serial killers coded as "yes" (= 1) for the variable or categories of the variable.

4.5 Results

A chi-square (χ^2) *goodness-of-fit* test was performed to determine whether the proportion of the serial killers in the sample (N = 326) was equal between both groups (i.e., HISKs and non-HISKs). The null hypothesis (H_0) of the χ^2 goodness-of-fit test was that the frequencies of the HISK and non-HISK cases in the sample are evenly distributed. The alternative hypothesis (H_1) of the χ^2 goodness-of-fit test was that the sample's frequencies of HISK and non-HISK cases are not evenly distributed. The significance of the χ^2 goodness-of-fit test is verified by calculating the χ^2 coefficient. The p-value is determined by using the χ^2 distribution and sample size (N = 326), with N - 1 degree of freedom and an alpha level of 0.05 (Intellectus Statistics, 2021; Louviere et al., 2000).[16] The formula for the χ^2 statistic is:

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Expectedly, the results of the χ^2 goodness-of-fit test were not significant based on an alpha value of 0.05, $\chi^2(1) = 0.00$, $p = 1.00$ and showed that there was no significant difference in the frequencies of HISKs and non-HISKs identified in the current sample (N = 326). The results also revealed that HISKs (n = 163) and non-HISKs (n = 163) were equally distributed between both groups in the sample, as the observed and expected frequencies were the same. Lastly, since the results were not significant, the null hypothesis (H_0) must be retained, as the frequencies of both serial killer groups are equally likely. The results of the χ^2 goodness-of-fit test are reported in Table 5 below.

[16]*Note*. c = degrees of freedom, O_i = observed frequency, and E_i = expected frequency.

Table 5

Chi-Square Goodness-of-Fit Test Results for Two Serial Killer Groups (N = 326)

Serial Killer Group	Observed Frequency	Expected Frequency	Residual
Non-HISKs	163	163.00 a	.0
HISKs	163	163.00 a	.0
Total	326	326	.0

Note. $\chi^2(1) = 0.00$, $p = 1.00$.
[a] 0 cells have expected frequencies < 5. The minimum expected cell frequency is 163.00.

Hypotheses and Chi-square χ^2 Tests of Independence

Five chi-square *tests of independence* were conducted to examine the research question and hypotheses of the current investigation. These tests were performed to test the *dependent* variable (DV) of *serial killer group* and the five *independent* variables (IVs) regarding their common characteristics (i.e., victim selection, adult victims, crime premeditation, attack method, and crime scene location type). The primary purpose of the χ^2 test of independence is to examine the association and differences between two categorical variables, which compares the observed frequencies within each category of variables with the expected frequencies (Pallant, 2020, p. 225). The χ^2 test of independence was used to compare the observed frequencies of both serial killer groups and the five IVs to determine if significant differences exist regarding the common characteristics between HISKs and non-HISKs.

There are several assumptions of the χ^2 test of independence: (1) the sample is random; (2) categories or groups are mutually exclusive and do not overlap; and (3) the number of expected observations within each level of both variables must have values greater than zero and 80% of cells must have expected values of at least five (McHugh, 2013, p. 135). Significance is determined by calculating the χ^2 statistic. The *p*-value is obtained from the χ^2 distribution with the following formula: $(r - 1) \times (c - 1)$ degrees of freedom (i.e., r = number of rows and c = number of columns within the contingency table), using an alpha of 0.05 to determine statistical significance (Intellectus Statistics, 2021). In addition to the χ^2 tests of independence, the *strength* of the association was also measured using Cramer's *V* for any of the IV categories that were significant (p = <.05).

Victim Selection Type (IV 1)

The first IV, *victim selection type*, consisted of three categories: (1) *non-random* victims, (2) *random* victims, and (3) *mixed* victims. This was the first IV of *Hypothesis 1a* relevant to *victim selection*. Three χ^2 tests of independence were conducted between the two groups and victim selection type. The primary category relevant to this hypothesis was *non-random* victims. The null hypothesis (H_0) regarding the victim selection types of HISKs and non-HISKs was that there would be no differences between both groups. The alternative hypothesis (H_1) predicts that HISKs will be more likely to murder *non-random* victims than non-HISKs. The first χ^2 test of independence (Table 6) was conducted to analyze whether HISKs and non-random victims were independent (H_0) or if HISKs and non-random victims were not independent (H_1).

Chi-square tests were run for the dependent variable (DV) of serial killer group and each of the three dummy coded victim selection categories as the independent variable (IV). The results of the cross-tabulations and three χ^2 tests were *combined* into *one table* (see Table 6). The first χ^2 test of independence assumption concerning the number of adequate cell size was met, and all cells in Table 6 had expected counts greater than zero. The second condition was also met as 100% of the cells in Table 6 contained expected counts of at least five (IBM SPSS, 2021; Intellectus Statistics, 2021).

The results of the χ^2 tests indicate that there was a statistically significant correlation between HISKs and *non-random victims*, $\chi^2(1) = 17.83$, $p < .001$ (Table 6). According to the Cramer's V strength of association results and index, there was a *moderate association* between HISKs and non-random victims, $V = 0.23$ (see Table 11). There was also a statistically significant relationship between non-HISKs and *mixed victims*, $\chi^2(1) = 10.79$, $p = .001$. However, the Cramer's V results suggested a *weak* association between non-HISKs and mixed victim types, $V = 0.18$ (see Table 11).

The results of the first portion of *Hypothesis 1a* denote the null hypothesis (H_0) that predicted no differences in the *victim type* between HISKs and non-HISKs can be *rejected*. The alternative hypothesis (H_1) can be *accepted,* as the p-value of the χ^2 test of HISKs and *non-random victims* are statistically significant at .000 ($p = < .001$). The results of the first portion of *Hypothesis 1a* are listed in Table 6 below.

Table 6

Chi-Square Tests of Independence for Victim Type by Serial Killer Group (N = 326)

Victim Type	Non-HISKs (n = 163)		HISKs (n = 163)		Total				
	n	%	n	%	N	%	χ^2	df	p
Non-random [a]	56	34%	94	58%	150	46%	17.83 [b]	1	.000**
Random [a]	28	17%	19	12%	47	14%	2.01 [c]	1	.156
Mixed types [a]	79	49%	50	31%	129	40%	10.79 [d]	1	.001*
Total	163	100%	163	100%	326	100%	---	---	---

Note. Due to rounding adjustments, percentages may not equal 100%.

[a] Reflects the number and percentage of serial killers coded as "yes" (= 1) for this category.

[b] 0 cells (0.0%) have expected count < 5. The minimum expected count is 75.00.

[c] 0 cells (0.0%) have expected count < 5. The minimum expected count is 23.50.

[d] 0 cells (0.0%) have expected count < 5. The minimum expected count is 64.50.

*p < .05, **p < .001

Adult Victims (IV 2)

One χ^2 test of independence was conducted between both serial killer groups and *adult victims*. This was the second IV of *Hypothesis 1a* relevant to *victim selection*. The null hypothesis (H_0) concerning adult victims of HISKs and non-HISKs was that there would be no differences between both groups. The alternative hypothesis (H_1) predicted that HISKs were more likely to murder *adult victims* than non-HISKs. The second χ^2 test (Table 7) was performed to analyze whether HISKs and adult victims were independent (H_0) or if HISKs and adult victims were not independent (H_1). A chi-square test was run for the DV of the serial killer group and the IV of adult victims. The results of the χ^2 test relevant to the second IV, adult victims of HISKs and non-HISKs are listed in Table 7. Both χ^2 test assumptions and conditions were met as all cells in Table 7 had expected counts higher than zero, and 100% of the cells contained expected counts of at least five (IBM SPSS, 2021; Intellectus Statistics, 2021).

The results reported in Table 7 reveal a statistically significant relationship between HISKs and *adult victims*, $\chi^2(1) = 9.45$, $p = .002$. According to the Cramer's V strength of association index (see Table 11), there was a relatively *weak* association between HISKs and adult victims, $V = 0.17$. Regardless of the strength of the association between HISKs and adult victims, the results of the second portion of *Hypothesis 1a* denote the null hypothesis (H_0) that predicted that there would be no differences in adult victims between HISKs and non-HISKs can be *rejected*. The alternative hypothesis (H_1) can be *accepted*, as the p-value of the χ^2 test of independence relevant to HISKs and adult victims were statistically significant at .002 ($p = < .005$). The results of the second portion of *Hypothesis 1a* are listed in Table 7 below.

Table 7

Chi-Square Test of Independence for Adult Victims by Serial Killer Group (N = 326)

Adult Victims	Non-HISKs (n = 163)		HISKs (n = 163)		Total				
	n	%	n	%	N	%	χ^2	df	p
Adult [a]	147	90%	160	98%	307	94%	9.45 [b]	1	.002*
Non-adult	16	10%	3	2%	19	6%	---	---	---
Total	163	100%	163	100%	326	100%	---	---	---

Note. Due to rounding adjustments, percentages may not equal 100%.
[a] Reflects the number and percentage of serial killers coded as “yes” (= 1) for this category.
[b] 0 cells (0.0%) have expected count < 5. The minimum expected count is 9.50.
*p < .05

Crime Premeditation (IV 3)

The third IV, *crime premeditation*, consisted of three dummy coded categories: (1) *no* premeditation/*unstructured* premeditation, (2) *structured* premeditation, and (3) *mixed* premeditation. Crime premeditation was the first IV of *Hypothesis 1b* relevant to *modus operandi*. Three χ^2 tests were conducted between serial killer group and the three premeditation categories. The primary category relevant to this hypothesis was *structured premeditation*. The null hypothesis (H_0) regarding the crime premeditation of HISKs and non-HISKs was that there would be no differences between both groups. The alternative hypothesis (H_1) predicted that HISKs were more likely to employ *structured premeditation* during the murders than non-HISKs. The third test was used to analyze whether HISKs and structured premeditation were independent (H_0) or not (H_1).

Chi-square tests were run for the DV of serial killer group and each of the three dummy coded premeditation categories as the IV. Both χ^2 test assumptions and conditions were met as all cells in Table 8 had expected counts higher than zero, and 100% of the cells contained expected counts of at least five (IBM SPSS, 2021; Intellectus Statistics, 2021). As reported in Table 8, the results of the χ^2 tests for the first portion of *Hypothesis 1b* illustrate a significant correlation between HISKs and *structured premeditation*, $\chi^2(1) = 16.35$, $p < .001$. According to Cramer's V strength of association results (see Table 11), there was a *moderate* association between HISKs and structured premeditation, $V = 0.22$. There was also a statistically significant relationship between non-HISKs and *mixed premeditation*, $\chi^2(1) = 12.67$, $p < .001$. The Cramer's V results indicated a *weak association* between non-HISKs and mixed premeditation, $V = 0.19$ (see Table 11).

The results of the first portion of *Hypothesis 1b* illustrate that the null hypothesis (H_0) that predicted that there would be no differences between HISKs and non-HISKs can be *rejected*. The alternative hypothesis (H_1) can be *accepted*, as the *p*-value of the χ^2 test of independence relevant to HISKs and structured premeditation is significant at .000 (p = < .001). The results of the first portion of *Hypothesis 1b* are listed in Table 8 below.

Table 8

Chi-Square Test of Independence for Premeditation by Serial Killer Group (N = 326)

Premeditation	Non-HISKs (n = 163)		HISKs (n = 163)		Total				
	n	%	n	%	N	%	χ^2	df	p
None/Unstructured [a]	23	14%	19	12%	42	13%	.437 [b]	1	.508
Structured [a]	50	31%	86	53%	136	42%	16.35 [c]	1	.000*
Mixed [a]	90	55%	58	36%	148	45%	12.67 [d]	1	.000*
Total	163	100%	163	100%	326	100%	---	---	---

Note. Due to rounding adjustments, percentages may not equal 100%.
[a] Reflects the number and percentage of serial killers coded as "yes" (= 1) for this category.
[b] 0 cells (0.0%) have expected count < 5. The minimum expected count is 21.00.
[c] 0 cells (0.0%) have expected count < 5. The minimum expected count is 68.00.
[d] 0 cells (0.0%) have expected count < 5. The minimum expected count is 74.00.
$*p < .001$

Attack Method (IV 4)

The fourth IV, *attack method*, consisted of four dummy coded categories: (1) *blitz* attacks, (2) *stalk* attacks, (3) *ambush* attacks, and (4) *mixed* methods. Attack method was the second IV of *Hypothesis 1b* relevant to *modus operandi*. Four χ^2 tests were performed between serial killer group and the four attack method categories. The primary category pertinent to this hypothesis was *stalked attacks*. The null hypothesis (H_0) regarding the attack methods of HISKs and non-HISKs was that there would be no differences between both groups. The alternative hypothesis (H_1) predicted that HISKs were more likely to engage in stalked attacks than non-HISKs. The fourth χ^2 test (Table 9) was conducted to analyze whether HISKs and stalked attacks were independent (H_0) or if HISKs and stalked attacks were not independent (H_1).

Chi-square tests were run for the DV of serial killer group, and each of the four dummy coded categories of attack methods as the IV. Both χ^2 test assumptions and the conditions were met as all cells in Table 9 had expected counts higher than zero, and 100% of the cells contained expected counts of at least five (IBM SPSS, 2021; Intellectus Statistics, 2021). As reported in Table 9, the results of the χ^2 tests for the second portion of *Hypothesis 1b* show a statistically significant correlation between HISKs and *stalked attacks*, $\chi^2(1) = 48.26$, $p < .001$.

According to Cramer's *V* strength of association results and index in Table 11, there was a *moderate association* between HISKs and stalked attacks, $V = 0.39$. There was also a statistically significant relationship between non-HISKs and *ambushed attacks*, $\chi^2(1) = 41.41$, $p < .001$. The results of Cramer's *V* also indicated a *moderate association* between non-HISKs and ambushed attacks, $V = 0.35$ (see Table 11).

The results of the second portion of *Hypothesis 1b* reveal that the null hypothesis (H_0) that predicted there would be no differences in attack methods between HISKs and non-HISKs can be *rejected*. The alternative hypothesis (H_1) can be *accepted* since the *p*-value of the χ^2 test relevant to HISKs, and *stalked attacks* are significant at .000 ($p = < .001$). The results of the second portion of *Hypothesis 1b* are listed in Table 9 below.

Table 9

Chi-Square Test of Independence for Attack Method by Serial Killer Group (N = 326)

Attack Method	Non-HISKs (n = 163)		HISKs (n = 163)		Total				
	n	%	n	%	N	%	χ^2	df	p
Blitz attacks [a]	20	12%	18	11%	38	12%	0.12 [b]	1	.730
Stalked attacks [a]	19	12%	76	47%	95	29%	48.26 [c]	1	.000*
Ambush attacks [a]	65	40%	15	9%	80	25%	41.41 [d]	1	.000*
Mixed attacks [a]	59	36%	54	33%	113	35%	0.34 [e]	1	.561
Total	163	100%	163	100%	326	100%	---	---	---

Note. Due to rounding adjustments, percentages may not equal 100%.

[a] Reflects the number and percentage of serial killers coded as "yes" (= 1) for this category.

[b] 0 cells (0.0%) have expected count < 5. The minimum expected count is 19.00.

[c] 0 cells (0.0%) have expected count < 5. The minimum expected count is 47.50.

[d] 0 cells (0.0%) have expected count < 5. The minimum expected count is 40.00.

[e] 0 cells (0.0%) have expected count < 5. The minimum expected count is 56.50.

*p < .001

Crime Scene Location (IV 5)

The fifth and final IV, *crime scene location*, consisted of three dummy coded categories: (1) *single location* crime scenes, (2) *multiple location* crime scenes, and (3) *mixed location* crime scenes. Crime scene location type was the IV of *Hypothesis 1c* relevant to *crime scene actions*. Three χ^2 tests were run between the serial killer group and the three crime scene location categories. The primary category relevant to this hypothesis was *single location crime scenes*. The null hypothesis (H_0) regarding crime scene location type of HISKs and non-HISKs was that there would be no differences between both groups. The alternative hypothesis (H_1) predicted that HISKs were more likely to have *single location crime scenes* than non-HISKs. The final χ^2 test (Table 10) was run to analyze whether HISKs and single location crime scenes were independent (H_0) or if HISKs and single location crime scenes were not independent (H_1).

Chi-square tests were run for the DV of serial killer group and each of the three dummy coded crime scene location categories as the IV. The χ^2 test assumptions and conditions were met, as all cells in Table 10 had expected counts higher than zero and 100% of the cells contained expected counts of at least five (IBM SPSS, 2021; Intellectus Statistics, 2021). As reported in Table 10, the results of the χ^2 tests for *Hypothesis 1c* show a statistically significant correlation between HISKs and *single location crime scenes*, $\chi^2(1) = 32.22$, $p < .001$. According to Cramer's V strength of association index and the results in Table 11, there was a *moderate association* between HISKs and *single location crime scenes*, $V = 0.31$. There was also a statistically significant relationship between non-HISKs and *multiple location crime scenes*, $\chi^2(1) = 55.61$, $p < .001$. The results of Cramer's *V* also signified a relatively *strong association* between non-HISKs and multiple crime scene locations, $V = 0.41$ (see Table 11).

The results of *Hypothesis 1c* show that the null hypothesis (H_0) that predicted there would be no differences in crime scene location between HISKs and non-HISKs can be *rejected*. The alternative hypothesis (H_1) can be *accepted*, as the *p*-value of the χ^2 test relevant to HISKs and *single location crime scenes* are statistically significant at .000 ($p = < .001$). The results of *Hypothesis 1c* are listed in Table 10 below.

Table 10

Chi-Square Test of Independence for Crime Scene Location by Serial Killer Group (N = 326)

Crime Scene Location	Non-HISKs (n = 163)		HISKs (n = 163)		Total				
	n	%	n	%	N	%	χ^2	df	p
Single location [a]	64	39%	115	71%	179	55%	32.22 [b]	1	.000*
Multiple locations [a]	62	38%	7	4%	69	21%	55.61 [c]	1	.000*
Mixed locations [a]	37	23%	41	25%	78	24%	0.27 [d]	1	.604
Total	163	100%	163	100%	326	100%	---	---	---

Note. Due to rounding adjustments, percentages may not equal 100%.

[a] Reflects the number and percentage of serial killers coded as “yes” (= 1) for this category.

[b] 0 cells (0.0%) have expected count < 5. The minimum expected count is 73.50.

[c] 0 cells (0.0%) have expected count < 5. The minimum expected count is 34.50.

[d] 0 cells (0.0%) have expected count < 5. The minimum expected count is 39.00.

*p < .001

Table 11

Study 1: Significant IVs and Cramer's Strength of Association by Serial Killer Group

Significant Variables	Non-HISKs (n = 163)		HISKs (n = 163)					
	n	%	n	%	χ^2	df	p	V
Non-random victims [a]	--	--	94	58%	17.83	1	<.001	0.23
Mixed victims	79	49%	--	--	10.79	1	.001	0.18
Adult victims [a]	--	--	160	98%	9.45	1	.002	0.17
Structured premeditation [a]	--	--	86	53%	16.35	1	<.001	0.22
Mixed premeditation	90	55%	--	--	12.67	1	<.001	0.19
Stalked attacks [a]	--	--	76	47%	48.26	1	<.001	0.39
Ambushed attacks	65	40%	--	--	41.41	1	<.001	0.35
Single location crime scenes [a]	--	--	115	71%	32.22	1	<.001	0.31
Multiple location crime scenes	62	38%	--	--	55.61	1	<.001	0.41

Notes. Cramer's *V* Strength of Association Index:
.00 and < .10 = Negligible association
.10 and < .20 = Weak association
.20 and < .40 = Moderate association
.40 and < .60 = Relatively strong association
.60 and < .80 = Strong association
.80 to 1.00 = Very strong association
[a] Denotes the significant IV categories relevant to HISKs.

4.6 Chapter 4 Summary

This chapter examined the differences in the common characteristics (i.e., victim selection, MO, and crime scene actions) between HISKs and non-HISKs. There were statistically significant differences between both groups concerning all five IVs and hypotheses analyzed in the current investigation. Conversely, the descriptive variables such as the gender, race, type, geographic region, and age range of both groups were relatively similar. The five IVs and hypotheses analyzed were all statistically significant ($p = < .05$), revealing that HISKs are more likely to select *non-random adult* victims, utilize *structured premeditation* and *stalked attacks*, and murder and dispose of their victims at *single location crime scenes* compared to non-HISKs.

Since all five IVs and hypotheses were significant, the current investigation (Study One) met the 50% criteria condition that at least *three out of five* IVs/hypotheses were statistically significant ($p = < .05$). Therefore, the five IVs and hypotheses analyzed in the current investigation will be included in the supplementary analyses, which will be presented after the analyses and results from each of the three investigations at the end of Chapter 6. The next chapter will examine the differences in the geospatial patterns between HISKs and non-HISKs (Study Two). Similar to this chapter, the next chapter will include an overview of the second investigation, the measures and analytical strategy, descriptive statistics, the final results, and a summary of Chapter 5.

CHAPTER 5

V. STUDY TWO: GEOSPATIAL PATTERNS OF HOME INVASION SERIAL KILLERS VS. NON-HOME INVASION SERIAL KILLERS

5.1 Introduction

This chapter is the *second* of three investigations that examined the differences between HISKs and non-HISKs. The current investigation focuses on determining the differences in geospatial patterns between both serial killer groups. This chapter will detail the analytical strategy and results of the current investigation (Study Two). The structure of this chapter will consist of the following sections: (1) overview of the current investigation; (2) measures and analytical strategy; (3) descriptive statistics; (4) final results; and (5) summary of Chapter 5.

5.2 The Current Investigation

The current investigation examined the differences in geospatial patterns between HISKs and non-HISKs. This chapter tests *two hypotheses* and *dependent* variables relevant to the geospatial patterns of serial killers that were selected and analyzed to determine whether HISKs demonstrate significant differences concerning (1) *residence-to-crime* (RTC) *distances* and (2) *murder series durations* compared to non-HISKs.

5.3 Measures and Analytical Strategy of the Current Investigation

The following section details the measures and analytical strategy employed for the current investigation (Study Two). First, the data collection measures used for the current investigation are summarized. Second, the variables and hypotheses of the current study are delineated and presented. Finally, the analytical strategy used to examine the geospatial patterns of HISKs and non-HISKs is reviewed.

5.3.1 Data Collection Measures

Proportionate stratified random sampling was used to generate the total sample of 326 serial killers consisting of 163 HISKs (experimental group) and 163 non-HISKs (control group). The researcher conducted prerequisite and supplemental public searches on the journey-to-crime (JTC) locations of each serial killer's residence, other nodes, and murder sites of each victim within each serial killer's murder series. These searches were conducted to collect JTC data for the current investigation and assist in the stratified random sampling procedure to generate the final sample for this dissertation. The data collection measures used before the coding of the Study Two variables are listed below.

Once the sets of stratified simple random sampling procedures were completed, and the replacement cases for each sample were finalized, the researcher collected three categories of address points for each case: (1) murder site; (2) serial killer's residence(s), and (3) nodes other than the serial killer's residence (if available). The CI conducted all of the supplementary JTC searches of public information for address points, street points, and JTC location estimations (i.e., dumpsites, abduction sites, and area estimation of murders were used as proxy points when the exact address or street points were unavailable). The JTC data from the searches for Study Two were retained in a password-protected Excel data collection spreadsheet. [17]

Subsequently, the JTC data was cleaned to prepare the Study Two Excel spreadsheet to be geocoded using *Aeronautical Reconnaissance Coverage Geographic Information System* (*ArcGIS*) software. After ArcGIS was used to geocode all the JTC

[17]*Note*. Other serial killer nodes were not available for every serial killer in the sample, and node-to-crime (NTC) distance calculations were not generated for all serial killers in the sample. If the exact address of the residence of the serial killer could not be obtained, other node locations were used (i.e., job location).

data, the exported ArcGIS Excel spreadsheet contained 70 columns relevant to the geocoded JTC points. The researcher included the address column and the latitude (Y) and longitude (X) coordinate columns for the killer's residence(s)/node(s) and murder sites from the ArcGIS geocoded export. These columns were added to the Study Two data collection spreadsheet.

Next, the CI cleaned the Study Two spreadsheet to prepare the data for the *residence-to-crime distance* (RTC) calculations (in *miles*). The cleaned Study Two spreadsheet prepared for the RTC calculations consisted of 15 columns: (1) *RUDB Code*; (2) *serial killer group*; (3) *number of victims; (4) victim count category*; (5) *murder series durati*on (in *days*); (6) *node type*; (7) *timeframe* that the serial killer lived at the residence; (8) *serial killer's full residence address*; (9) *latitude coordinate of the serial killer's residence*; (10) *longitude coordinate of the serial killer's residence*; (11) *date* of the *victim's murder*; (12) *full address of the murder location*; (13) *latitude coordinate of the murder location*; (14) *longitude coordinate of the murder location*; and (15) *RTC distance calculations* (in *miles*).

Two primary sources were used to calculate the RTC distances for each case: (1) *Bing Maps Excel Plugin* and (2) *Google Maps*. First, both sources were utilized by the CI to ensure the validity and reliability of the RTC distance calculations. Second, there were addresses or coordinates that either the Bing Maps plugin or Google Maps could not locate, particularly international JTC data points. Therefore, both RTC calculation sources were used to (1) cross-reference JTC distances for each case and (2) assist in cases where one RTC distance calculation source could not compute or locate the full address or coordinates in some instances.

Every RTC distance calculation required two points of data: (1) the serial killer's residence and (2) the murder site. As such, there should have been a total of 3,904 data points for all 326 serial killers and their 1,952 victims to compute the RTC distance calculations for the Study Two dataset. However, there were cases in the sample in which data points (murder sites) could not be obtained or approximated. As a result, 22 RTC distance calculations could not be computed (HISK = 3 cases, 16 points; non-HISK = 2 cases, 6 points). These missing data reduced the totals to <u>3,860 data points</u> and <u>1,930 RTC distance calculations</u> included in the final Study Two dataset. The current investigation's variables, coding, and hypotheses are presented in the following section.

5.3.2 Variables and Hypotheses

Independent and Dependent Variables

The researcher selected and constructed two dependent variables for the current investigation: (1) *RTC distance* and (2) *murder series duration.* Study Two's independent variable (grouping variable) was the serial killer group (HISKs and non-HISKs). The *two dependent* variables for this investigation consisted of continuous data calculations of the RTC distances (in miles) and the total number of days of the duration of each serial killer's murder series. The primary objective of this investigation was to compare the RTC distance and murder series duration between HISKs and non-HISKs. Both RTC distance (in miles) and murder series duration (in days) consisted of continuous data. To compare the differences between HISKs and non-HISKs, the DV(s) must be continuous, and the IV must consist of two dichotomous groups (Conover & Iman, 1981).

The researcher constructed the two dependent variables for this investigation based on the prerequisite and supplementary JTC searches. The researcher also used the

RU/FGCU SKD data (2019) to cross-reference cases. The following section includes the definitions and operationalization of the dependent variables and the descriptive variables selected and constructed for the current investigation.

Residence-to-Crime (RTC) Distance. The distance traveled from the serial killer's residence to each of the victim murder sites during the series. The *residence* was defined as the geographic location(s) of the temporary or permanent residence(s) of the serial killer during the murder series (e.g., house, apartment, mobile home, family/friend/ partners' residence). The RTC distance variable consists of ratio data of the distance traveled from the killer's residence to each murder location in the series (in miles). The researcher computed the RTC distance calculations for each serial killer and their victims in the sample using Bing Maps Excel Plugin and Google Maps. [18]

Murder Series Duration**.** The length of the serial killer's murder series is in *days*, from the *first murder* to the *last murder* in the killing series. The researcher constructed the *murder series duration* variable to determine the length of each serial killer's murder series and measure the amount of time (in *days*) between the *first murder* in the series and the *last murder* in the killing series (interval, continuous variable). The researcher utilized columns of data from the RU/FGCU SKD (2019) of the date of each victim's murder during the murder series and the prerequisite and supplementary searches to construct, code, and calculate the murder series duration for each serial killer.

[18] *Note*. During the data collection phase for Study Two, the CI collected geographic location points based on murder, body disposal, or abduction sites for each case. Most of the geographic location points collected were the murder sites for each case, but if murder sites could not be obtained, the body disposal or abduction site points were used as proxy JTC points.

The murder series duration variable was generated and coded using Excel formulas to subtract the *date* of the *first* victim from the *date* of the *last* victim in the series, which then calculated the *number of days* between the *first* and *last* murders of the killer's murder series. There were a few cases where the first or last murder of the series contained only the year of the victim's murder. If the CI could not locate the specific date of the first or last murder of the serial killer's series, the CI used a *years-to-days* calculator to estimate the number of days between the first and last murder in the series.[19]

Descriptive Variables

In addition to the dependent and independent variables, the researcher included several descriptive variables in the data analysis for the current investigation, which are delineated and operationalized below.

Criminal Range. The *criminal range* of the murder series was defined as the distance traveled from the *shortest* murder location to the *furthest* murder location (in *miles*) during the murder series. The researcher constructed the criminal range variable to determine the cumulative length of each serial killer's murder series by measuring the distance (in *miles*) between the shortest murder location and the furthest murder location in the killing series (interval, continuous variable). The researcher used the data from the JTC searches of each murder series (i.e., the home JTC points of the serial killers and the murder sites) to construct, code, and calculate the criminal range for each serial killer.

The criminal range variable was generated and coded using the SPSS case summary function to subtract the shortest distance traveled in the murder series from the

[19] *Years-to-Days Calculator* Tool: https://www.datecalculator.org/years-to-days

farthest distance traveled in the murder series, which then calculated the cumulative distance range (in miles) during the series. Once SPSS calculated the criminal range for each case, the results were constructed into a column of 326 data points (i.e., one criminal range calculation for each of the 326 serial killer cases in the sample).

Node Type. The *node type* was defined as the geographic location(s) routinely frequented by the serial killer other than the killer's residence(s) (e.g., occupation, school, recreational organizations). During the prerequisite and supplementary JTC searches, the researcher obtained JTC data for the serial killer's residence, murder site and also attempted to obtain data on nodes other than the serial killer's residence (e.g., work, school, jail or prison, recreation locations). The JTC points of other serial killer nodes could only be located for approximately 35% of the entire sample; as a result, other nodes could not be used in the RTC distance calculations for this investigation. If the serial killer had *more than one residence* during the murder series, the researcher used the *residence dates* at each residence to label cases that had more than one home during the series (i.e., the maximum number of residences a serial killer had during the murder series). The node type variable was not numerically coded but analyzed in SPSS as a "string" or text variable.[20]

Crime Site Type. The variable of crime site type was included as a descriptive variable to represent the type of JTC point of the crime site obtained for the RTC distance variable. Most of the data points collected and calculated consisted of murder sites. However,

[20]*Note*. In cases, the exact address point of the serial killer's residence could not be obtained, but the specific JTC point for the serial killer's other node(s) than their residence was available (i.e., work, school, family or significant other's home, and hotels [if the serial killer frequently traveled]), were used as a proxy JTC point for the serial killer's residence in several of the cases.

when the researcher could not obtain the murder site point, abduction or disposal sites were used as proxy data points. The crime site type was used as a descriptive variable and consisted of three crime sites: murder sites, abduction sites, and disposal sites. The descriptive variable of crime site type was not numerically coded but was analyzed in SPSS as a “string” or text variable.

Hypotheses of the Current Investigation

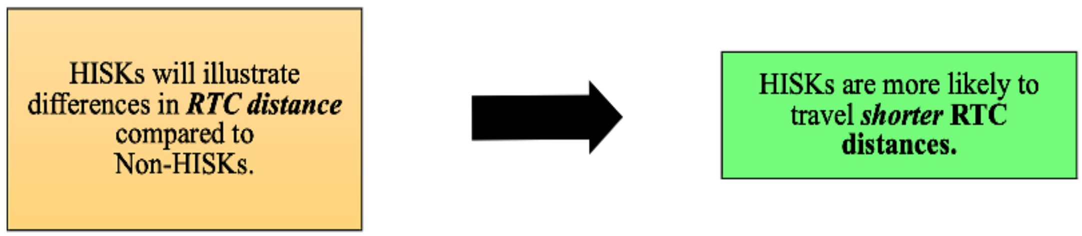
Based on the DVs relevant to the geospatial patterns of HISKs and non-HISKs, two hypotheses were constructed and tested regarding the RTC distance traveled and murder series durations of both serial killer groups. Anticipated differences in the geospatial patterns of HISKs versus non-HISKs were predicated on two primary factors: (1) *shorter* RTC distances and (2) *shorter* murder series durations. The two hypotheses, their respective hypothesized models, and the working hypothesis of the current investigation are summarized and presented in the following section.

Hypothesis 2a

The first hypothesis of Study Two (*hypothesis 2a*) tests the differences in the *RTC distances* of HISKs compared to non-HISKs. It was anticipated that HISKs would be more likely to travel *shorter* RTC distances than non-HISKs. This assumption is based on three environmental criminology theories relevant to the situational factors and geospatial decision-making process of serial offenders’ JTC patterns: routine activity, rational choice, and crime pattern theories (RAT, RCT, and CPT). Prior research highlights that home invasion sex offenders tend to travel the shortest JTC distances compared to sex offenders that attack their victims in other locations (Beauregard et al., 2010; Dern et al., 2005; Martineau & Beauregard, 2016). Therefore, *Hypothesis 2a* predicts that HISKs will be more likely to travel *shorter* RTC distances than non-HISKs (Figure 10).

Figure 10

Hypothesis 2a: Hypothesized Model for the RTC Distance of HISKs and Non-HISKs

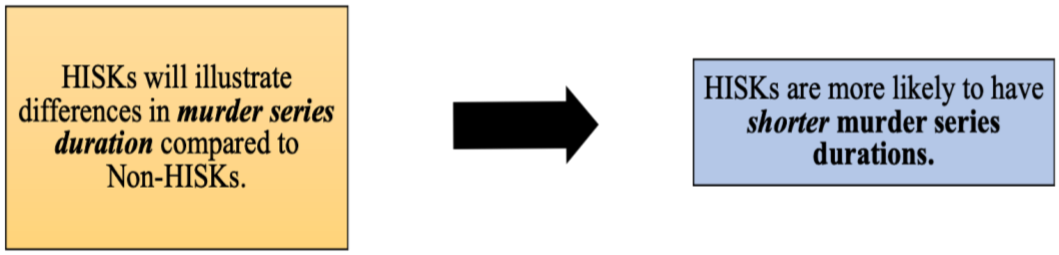


Hypothesis 2b

The second hypothesis of this investigation (*hypothesis 2b*) tests the differences in the murder series durations of HISKs compared to non-HISKs. It is anticipated that HISKs will be more likely to have *shorter* murder durations than non-HISKs. This assumption is also grounded in RAT, RCT, and CPT. Prior research has established that home invasion sex offenders are more likely to have *single location* crime sites than non-residential sex offenders, who are more likely to have *multiple location* crime sites (Lammers & Bernasco, 2013; Martineau & Beauregard, 2016). Additionally, serial offenders with *single location* crime scenes are more likely to be *apprehended faster* than serial offenders with *multiple location* crime scenes (Lammers & Bernasco, 2013). Therefore, due to the *swifter apprehension* of serial offenders who have *single location crime sites*, *Hypothesis 2b* predicts that HISKs will have shorter murder series durations than non-HISKs (Figure 11).

Figure 11

Hypothesis 2b: Hypothesized Model for the Murder Series Duration of HISKs and Non-HISKs

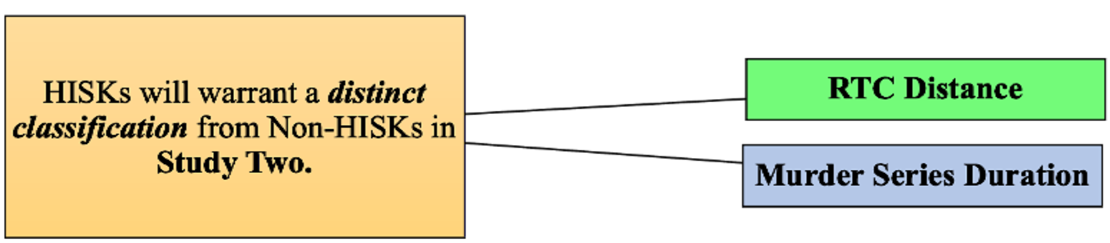


Study Two Working Hypothesis

A working hypothesis of the current investigation concerning the geospatial patterns of HISKs and non-HISKs was also constructed. The working hypothesis was outlined as a provisional hypothesis, contingent on the results of this investigation meeting the eligibility criteria of the supplementary analyses and classification determination of HISKs versus non-HISKs (i.e., *one* of *two* hypotheses = significant). Depending on *Hypotheses 2a* (RTC distances) and *Hypothesis 2b* (murder series durations), it is predicted that HISKs will warrant a distinct classification from non-HISKs in Study Two (Figure 12).

Figure 12

Study 2 Working Hypothesis: HISKs Warrant a Distinct Classification from Non-HISKs



5.3.3 Analytical Strategy

The data in the current investigation included both continuous and categorical variables that were analyzed using descriptive statistics and Mann-Whitney *U* tests, which were conducted using SPSS 27. Additionally, ArcGIS, Google Maps, Bing Maps (Excel plugin), and Microsoft Excel formulas were used to construct and calculate the two dependent variables of the current investigation. Although both dependent variables are continuous, the data in the current investigation were not normally distributed. Thus, non-parametric testing (Mann-Whitney *U* tests) were run for the current investigation.

The analytical strategy used for the current investigation consisted of several stages. First, the descriptive statistics of all variables of the entire sample (N = 326) were analyzed using both the *descriptives* function (continuous variables) and *frequencies* function (categorical variables) in SPSS (see Table 12). Second, *cross-tabulations* were performed to provide a descriptive overview of the variables by serial killer group (i.e., HISKs and non-HISKs) (see Table 13).

Third, two Mann-Whitney *U* tests were performed to examine the research question and two hypotheses of the current investigation and whether there were statistically significant differences in the geospatial patterns between HISKs and non-HISKs (see Tables 14 and 15). The two-tailed Mann-Whitney *U* test is the non-parametric equivalent of the independent-sample t-test and was conducted to examine the differences in the distribution and median scores of RTC distances (miles) and murder series durations (days) between HISKs and non-HISKs. The Mann-Whitney *U* test is suitable to determine whether the distribution and median scores of the DV(s) (continuous) are the same (H_0 = the null hypothesis) or different (H_1 = the alternative hypothesis) in the IV of the two groups.

The following section presents the descriptive statistics of the current investigation for each of the variables selected and analyzed in this chapter. Subsequently, the analyses conducted to test the two hypotheses concerning the geospatial patterns and differences between HISKs and non-HISKs are presented. Finally, if 50% of the hypotheses (i.e., *one of two* hypotheses) in the Mann-Whitney *U* tests are determined to be significant, supplementary analyses of the significant variable(s) will be performed and reported at the end of Chapter 6.

5.4 Descriptive Statistics

Table 12 lists the descriptive statistics for all the variables in the current investigation. The *two dependent* variables of the current investigation were (1) *RTC distance* (in miles) (N = 1,930) and (2) *murder series duration* (in days) (N = 326). The *independent* variable was HISKs (experimental group) and non-HISKs (control group). The sample consisted of 326 serial killers (n = 163 HISKs and n = 163 non-HISKs).

The serial killer sample (N = 326) murdered 1,952 victims. As reported in Table 12 under the descriptive variables, the average number of victims of the sample was 5.99 (SD = 12.78), with a minimum of two victims (according to the definition of RU/FGCU SKD, 2019) and a maximum of 215 victims during the murder series. For reference, the victim count categories are also listed in Table 12.

Table 12

Study 2: Descriptive Statistics (N = 326)

Variables	*N*	%	*M*	*SD*	Min	Max
Dependent Variables						
Residence-to-crime (RTC) distance (miles) [a]	1,930	99%	65.65	243.63	0	2,441
Murder series duration (days)	326	100%	1961.11	2805.97	2	15,753
Independent Variable						
HISKs	163	50%	---	---	0	1
Non-HISKs	163	50%	---	---	0	0
Descriptive Variables						
Number of victims	1,952	100%	5.99	12.78	2	215
2 victims	81	25%	---	---	2	2
3 victims	69	21%	---	---	3	3
4 victims	46	14%	---	---	4	4
5+ victims	130	40%	---	---	5	215
Criminal range [b]	326	100%	140.72	366.03	0	2,438
Node type [a]						
Home	1,554	80%	---	---	---	---
Home/Job	150	8%	---	---	---	---
Home 2	138	7%	---	---	---	---
Home 3	46	2%	---	---	---	---
Job	24	1%	---	---	---	---
Other node types [c]	18	1%	---	---	---	---
Crime site type [a]						
Murder site	1,785	91%	---	---	---	---
Disposal site	115	6%	---	---	---	---
Abduction site	30	2%	---	---	---	---

Notes. The IV is serial killer group: HISKs (= 1) and non-HISKs (= 0). Due to rounding, percentages may not equal 100%.
[a] There were 22 missing RTC distance calculations, which is reflected in the total for this variable (N = 1,930).
[b] The criminal range was calculated for the 326 serial killers to reflect the cumulative distance traveled (in miles) during the

murder series. There were 22 missing RTC points; all missing RTC points were excluded from the range calculations.
[c] *Other node types* were a combined category of the following: homeless shelter (*n* = 7 or 0.4%); home 4 (*n* = 4 or 0.2%); home 5 (*n* = 2 or 0.1%); hotel (*n* = 2 or 0.1%); family/significant other home (*n* = 2 or 0.1%); and school (*n* = 1 or 0.1%).

The first *dependent* variable (DV), *RTC distance* (in miles), contained ratio-level data on the distance traveled by each serial killer to murder each victim during the series. 22 RTC calculations could not be computed due to missing JTC data for 22 victims. Although the 326 killers murdered 1,952 victims in the sample, the adjusted total based on the 22 missing data points in the RTC distance calculations (n = 22 or 1%) was 1,930 RTC distance points (N = 1,930 or 99%), which is reflected in the descriptive statistics and the results of *Hypothesis 2a* (see Tables 12, 13, and 14). As reported in Table 12, the mean RTC distance (in miles) was 65.65 (SD = 243.63), with a minimum of zero miles traveled from the serial killer's residence to the murder and a maximum of 2,441 miles traveled from the serial killer's residence to the murder during the series.

The *second* DV, *murder series duration* (days), also contained ratio-level data calculated to reflect the total number of days of the murder series for each serial killer in the sample (N = 326). As reported in Table 12, the sample's average murder series duration (days) was 1961.11 (SD = 2805.97), with a minimum of two days and a maximum of 15,753 days between the *first* and *last* victim of the series. There were no missing data points for the murder series duration variable as all of the dates (or years) for each of the 1,952 victims were obtained from the RU/FGCU SKD (2019) or public information searches by the researcher.

Descriptive Variables

The first descriptive variable in Table 12, *criminal range*, consisted of continuous data calculated to reflect the cumulative distance (in miles) between the *shortest* murder location and the *furthest* murder location of each serial killer during the series. The sample's mean criminal range was 140.72 (*SD* = 366.03), with a minimum range of zero miles and a maximum of 2,438 miles traveled by the 326 serial killers during the series.

The second descriptive variable, *node type*, consists of six categories that the researcher labeled during the data collection phase of the current investigation. The 22 missing RTC calculations are reflected in the node type variable in Table 12. Overall, of the 1,930 RTC calculations, 1,554 (nearly 80%) of the serial killers' nodes consisted of Home 1. The second most frequent node type was Home/Job with 150 (or 8%), followed by Home 2 (138 or 7%), and Home 3 (46 or over 2%) of the serial killer nodes in the sample. Only 24 (or 1 %) of the node types consisted of the serial killer's Job, and only 18 (or 1%) consisted of Other Node categories (see Table 12).

The final descriptive variable, *crime site type*, includes three categories: (1) murder sites, (2) disposal sites, and (3) abduction sites (see Table 12). The 22 missing RTC calculations are also reflected in the crime site type variable. Of the 1,930 RTC distance points, there were a total of 1,785 murder sites (over 91%). The second most frequent type was the disposal site (*n* = 115 or 6%), and the least frequent type was the abduction site (*n* = 30 or 2%).

Descriptive Statistics by Serial Killer Group

Table 13 lists the descriptive statistics of the dependent, independent, and descriptive variables by serial killer group: non-HISKs and HISKs.

Residence-to-Crime (RTC) Distance (in Miles) by Serial Killer Group

The *first* DV, *RTC distance* (in miles), Table 13 shows that there was a total of 1,930 RTC distance calculations (*N* = 1,930 or 99%), with 22 missing RTC points (1%). There were six missing RTC calculations from the non-HISKs group and 16 missing

RTC calculations from the HISKs group. The non-HISK group had 975 RTC distance calculations (99%), with an average of 79.75 miles (*SD* = 290.45). The minimum RTC distance traveled by non-HISKs was zero miles, and the maximum distance traveled was 2,441 miles. The HISK group had 955 RTC distance calculations (98%), with an average of 51.26 miles (*SD* = 182.95). The minimum RTC distance traveled by HISKs was zero miles, and the maximum distance traveled was 1,944 miles.

Murder Series Duration (in Days) by Serial Killer Group

The *second* DV, *murder series duration* (days), Table 13 shows the average murder series duration of non-HISKs was 1895.96 days (*SD* = 2812.29), with a minimum of three days and a maximum of 14,851 days between the first and last victim of the series. Table 13 illustrates the average murder series duration of HISKs was 2026.26 days (*SD* = 2806.77), with a minimum of two days and a maximum of 15,753 days between the first and last victim of the series.

Descriptive Variables by Serial Killer Group

As reported in Table 13, the 326 serial killers in the sample murdered 1,952 victims, with 981 victims murdered by non-HISKs (*n* = 163) and 971 victims murdered by HISKs (*n* = 163). The average number of victims for non-HISKs was 6.02 (*SD* = 6.49), with a minimum of two victims and a maximum of 60 victims. The average number of victims for HISKs was 5.96 (*SD* = 16.90), with a minimum of two victims and a maximum of 215 victims (RU/FGCU SKD, 2019). For reference, the victim count categories by serial killer group are also listed in Table 13.

The descriptive variable of the criminal range in Table 13 shows that the average criminal range of non-HISKs was 176.61 (*SD* = 432.14), with a minimum of zero miles and a maximum of 2,438 miles traveled during the series. The average criminal range of HISKs was 104.82 (*SD* = 281.86), with a minimum of zero miles and a maximum criminal range of 1,943 miles traveled during the series (see Table 13).

The descriptive variable of node type consisted of 1,930 node points (*N* = 1,930 or 99%) with 975 points for non-HISKs (*N* = 975 or 99%) and 955 points for HISKs (*N* = 955 or 98%), both of which account for the missing RTC calculations for each serial killer group. The type of node most frequently observed for both non-HISKs (*n* = 850 or 87%) and HISKs (*n* = 704 or 74%) was Home 1 (see Table 13). Home/Job node type was not observed for non-HISKs (*n* = 0); however, this type of node was the second most frequently observed for HISKs (*n* = 150 or 16%). The third type of node observed most frequently for both non-HISKs (*n* = 68 or nearly 7%), and HISKs (*n* = 70 or 7%) was Home 2. The Home 3 node type contained non-HISKs (*n* = 35 or 4%) and HISKs (*n* = 11 or 1%). The Job node type consisted of non-HISKs (*n* = 13 or 1%) and HISKs (*n* = 11 or nearly 1%). The least frequent node type for both non-HISKs and HISKs was Other Node Types, in which both groups were tied (*n* = 9 or nearly 1%).

The final descriptive variable in Table 13, crime site type, consisted of 1,930 crime site points (non-HISKs = 975 and HISKs = 955). The *murder site* was the most frequently observed for both groups with non-HISKs (*n* = 888 or 91%) and HISKs (*n* = 897 or 94%) and represented a total of 1,785 crime site points (or 92%) of the sample. Disposal site was the second most frequently observed crime site type for both non-HISKs (*n* = 78 or 8%) and HISKs (*n* = 37 or 4%) and represented 115 crime site points (6%) of the sample. Abduction site was the least observed for both non-HISKs (*n* = 9 or

1%) and HISKs (*n* = 21 or 2%) and represented 30 crime site points of the sample (1%). The sample's descriptive statistics by serial killer group are listed in Table 13 below.

Table 13

Study 2: Descriptive Statistics by Serial Killer Group (N = 326)

Variables	Non-HISKs (n = 163)						HISKs (n = 163)						Total	
	n	%	*M*	*SD*	Min	Max	*n*	%	*M*	*SD*	Min	Max	*N*	%
RTC distance [a]	975	99%	79.75	290.45	0	2,441	955	98%	51.26	182.95	0	1,944	1,930	99%
Murder duration	163	50%	1895.96	2812.29	3	14,851	163	50%	2026.26	2806.77	2	15,753	326	100%
Victim count	981	50%	6.02	6.49	2	60	971	50%	5.96	16.90	2	215	1,952	100%
2 Victims	34	21%	---	---	2	2	47	29%	---	---	2	2	81	25%
3 Victims	33	20%	---	---	3	3	36	22%	---	---	3	3	69	21%
4 Victims	23	14%	---	---	4	4	23	14%	---	---	4	4	46	14%
5+ Victims	73	45%	---	---	5	60	57	35%	---	---	5	215	130	40%
Criminal range [b]	163	100%	176.61	432.14	0	2,438	163	100%	104.82	281.86	0	1,943	326	100%
Node type [a]	975	99%	---	---	---	---	955	98%	---	---	---	---	1,930	99%
Home	850	87%	---	---	---	---	704	74%	---	---	---	---	1,554	81%
Home/Job	0	0%	---	---	---	---	150	16%	---	---	---	---	150	8%
Home 2	68	7%	---	---	---	---	70	7%	---	---	---	---	138	7%
Home 3	35	4%	---	---	---	---	11	1%	---	---	---	---	46	2%
Job	13	1%	---	---	---	---	11	1%	---	---	---	---	24	1%
Other types [c]	9	1%	---	---	---	---	9	1%	---	---	---	---	18	1%
Crime site [a]	975	99%	---	---	---	---	955	98%	---	---	---	---	1,930	99%
Murder	888	91%	---	---	---	---	897	94%	---	---	---	---	1,785	92%
Disposal	78	8%	---	---	---	---	37	4%	---	---	---	---	115	6%
Abduction	9	1%	---	---	---	---	21	2%	---	---	---	---	30	1%

Notes. The IV is serial killer group: HISKs (= 1) and non-HISKs (= 0). Due to rounding adjustments, percentages may not equal 100%.

[a] There were 22 missing RTC distance calculations, which is reflected in the total for this variable (N = 1,930).

[b] The criminal range was calculated for the 326 serial killers to reflect the cumulative distance traveled (in miles) during the murder series by serial killer group. There were 2 non-HISK cases with 6 missing RTC points and 3 HISK cases with 16 missing RTC points. The 22 missing RTC points were excluded from the criminal range variable calculations.

5.5 Results

Two Mann-Whitney *U* tests were performed to examine the research question and two hypotheses of the current investigation: (1) *RTC distance* (DV 1) and (2) *murder series duration* (DV 2) by serial killer group (IV). As the data from the current investigation were not normally distributed, Mann-Whitney *U* two-sample rank-sum tests were utilized, which compare the *medians* of two groups rather than the means of two groups (Pallant, 2020). The Mann-Whitney *U* test is suitable to analyze and compare the differences of the medians between two independent groups from the sample population when the dependent variables(s) are continuous (Conover & Iman, 1981).

Mann-Whitney *U* tests are used when independent sample *t*-test assumptions (e.g., normality of the distribution) are not met and due its non-parametric nature, the assumptions are less stringent. The assumptions of the Mann-Whitney *U* test include the following: (1) random sample; (2) independent observations; (3) dependent variable(s) must be ordinal or continuous; and (4) the independent variable (grouping variable) must consist of two dichotomous mutually exclusive groups (Intellectus Statistics, 2019).

The primary purpose of the Mann-Whitney *U* test is to compare the number of times a dependent variable (DV) score from one group is ranked higher than a DV score from the other group. The test computes the scores on the continuous DV(s) to ranks between both groups and assesses whether the differences in the ranks of each group are statistically significant (Pallant, 2020). The scores of both groups are collectively ranked, with Rank 1 (R_1) being used for the lowest DV score, Rank 2 (R_2) for the next lowest DV score, and continues. If it is determined that there is a tie (i.e., scores have the same value), the tied scores are subsequently given the same ranking; these scores are ranked and then divided by the sum of scores. After ranking the data, calculations are computed on the ranks to establish the *U* statistic score, which is used to compute the *z*-score to obtain the *p*-value. To determine whether there are statistically significant differences in the DV between the two groups (IV), the level of significance of the *p*-value of 0.05 is used (Conover & Iman, 1981; Intellectus Statistics, 2019). The formulas for the Mann-Whitney *U* test are listed below.[21]

$$U_1 = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - R_1$$

$$U_2 = n_1 n_2 + \frac{n_2(n_2 + 1)}{2} - R_2$$

Two Hypotheses and Mann-Whitney *U* Tests

Two Mann-Whitney *U* tests were run to test the DVs (RTC distance and murder series duration) and if differences exist between the IV of HISKs and non-HISKs.

Hypothesis One: Residence-to-Crime (RTC) Distance (in Miles)

The first Mann-Whitney *U* test (Table 14) was performed to analyze whether the distribution and median scores of the RTC distances (DV) were statistically different between the two groups (IV) and whether HISKs travel *shorter* RTC distances compared to non-HISKs. The first DV and hypothesis of the current investigation, RTC distance (*hypothesis 2a*), consisted of ratio-level data that included 1,930 RTC distance calculations (in miles). The null hypothesis (H_0) regarding the RTC distances of non-HISKs and HISKs is that there will be no statistically significant differences between

[21]*Note.* n_1 = number of observations in sample one, n_2 = number of observations in sample two, R_1 = sum of the ranks assigned to sample one, and R_2 = sum of the ranks assigned to sample two.

both groups. The alternative hypothesis (H_1) predicted that there will be statistically significant differences in the RTC distances between both groups and that HISKs are more likely to have *shorter* RTC distances than non-HISKs.

Table 14 details the observations and results of the Mann-Whitney *U* test performed for *Hypothesis 2a* and the RTC distance traveled by both serial killer groups. There were 975 RTC distance observations in the non-HISKs group and 955 RTC distance observations in the HISKs group. Table 14 shows the results of the Mann-Whitney *U* test, which reveals statistically significant differences in the RTC distances between non-HISKs (Mdn = 6.63, n = 975) and HISKs (Mdn = 3.10, n = 955), U = 414540, z = -4.17, p = .000. The mean rank for non-HISKs was 1017.83, and the mean rank for HISKs was 912.07, which shows that the distribution of the RTC distance traveled by non-HISKs was *significantly different* from the distribution of RTC distance traveled by HISKs. The median of RTC distances for non-HISKs (Mdn = 6.63) was significantly greater than the median of RTC distances for HISKs (Mdn = 3.10), indicating that the RTC distance traveled by HISKs was *significantly shorter* than the RTC distance traveled by non-HISKs during the series (see Table 14).

The results of *Hypothesis 2a* determined that the null hypothesis (H_0) that predicted no differences in RTC distance between non-HISKs and HISKs can be *rejected*. The alternative hypothesis (H_1) can be *accepted*, as the p-value of the Mann-Whitney *U* test is statistically significant at .000 (p = < .001). The results of the Mann-Whitney *U* test of this hypothesis of the RTC distance traveled by serial killer group are presented in Table 14 below.

Table 14

Mann-Whitney U Test for RTC Distance Traveled by Serial Killer Group (N = 1,930)

RTC Distance (Miles)	Non-HISKs (n = 163)			HISKs (n = 163)						
	n	Mean Rank	*Mdn*	n	Mean Rank	*Mdn*	N	U	z	p
	975 [a]	1017.83	6.63	955 [a]	912.07	3.10	1,930 [a]	414540.00	-4.17	.000*

Notes. The IV is serial killer group: HISKs (= 1); non-HISKs (= 0). The DV is RTC distance (miles) calculated for each victim by serial killers in the sample to reflect the distance traveled from the killer's residence to the murder during the series.
[a] There were 22 missing RTC distance calculations, which is reflected in the total for this variable (N = 1,930).
*p < .001

Hypothesis Two: Murder Series Duration (in Days)

The second Mann-Whitney *U* test (Table 15) was performed to analyze whether the distribution and median scores of murder series durations (DV) were statistically different between the two groups (IV) and whether HISKs have *shorter* murder series durations than non-HISKs. The second dependent variable and hypothesis of the current investigation, murder series duration (*hypothesis 2b*), consisted of ratio-level data and was calculated to reflect the number of days between the *first* and *last* murders of each serial killer in the sample (N = 326). The null hypothesis (H_0) concerning the murder series durations of non-HISKs and HISKs was that there would be no statistically significant differences between both groups. The alternative hypothesis (H_1) predicted that there will be significant differences in the murder series durations between both groups and that HISKs are more likely to have *shorter* durations than non-HISKs.

Table 15 details the observations and results of the Mann-Whitney *U* test performed for the murder series durations of both serial killer groups. The results of the Mann-Whitney *U* test of *Hypothesis 2b* in Table 15 illustrate that there were no statistically significant differences in the murder series durations between non-HISKs (Mdn = 572.00, n = 163) and HISKs (Mdn = 722.00, n = 163), U = 13636.50, z = -0.41, p = .679. The mean rank for non-HISKs was 161.34. The mean rank for HISKs was 165.55, indicating that the distribution and median of the murder series durations for non-HISKs were *not significantly different* from the distribution and median of the murder series durations for HISKs.

The results of *Hypothesis 2b* revealed the null hypothesis (H_0) that predicted that there are no differences in the murder series durations between non-HISKs and HISKs must be *retained*. The alternative hypothesis (H_1) must be *rejected*, as the *p*-value of the Mann-Whitney *U* test was not statistically significant at .679 ($p = > .05$). The results of the Mann-Whitney *U* test of the second hypothesis of the murder series durations by serial killer group are presented in Table 15 below.

Table 15

Mann-Whitney U Test for Murder Series Duration by Serial Killer Group (N = 326)

Murder Series Duration (Days)	Non-HISKs (n = 163)			HISKs (n = 163)						
	n	Mean Rank	*Mdn*	n	Mean Rank	*Mdn*	N	U	z	p
	163	161.34	572.00	163	165.55	722.00	326	13636.50	-0.41	.679

Notes. The IV is serial killer group: HISKs (= 1); non-HISKs (= 0). The DV is murder series duration (days) calculated to reflect the number of days between the *first* and *last* murder of each serial killer's murder series.

5.6 Chapter 5 Summary

This chapter examined the differences in the geospatial patterns (i.e., RTC distance and murder series duration) between HISKs and non-HISKs. The first hypothesis on the RTC distance of non-HISKs and HISKs revealed statistically significant differences (p = .000) in the distances traveled by non-HISKs compared to HISKs, as HISKs traveled significantly *shorter* RTC distances during their murder series than non-HISKs. Consequently, *Hypothesis 2a* was *accepted*, and the null hypothesis was *rejected*. The second hypothesis on the murder series durations of non-HISKs compared to HISKs found no statistically significant differences between both groups (p = .679). As a result, *Hypothesis 2b* was *rejected*, and the null hypothesis was *retained*.

The descriptive variables such as criminal range, node types, and crime sites showed similarities and differences between HISKs and non-HISKs. For instance, the criminal range of both groups was relatively similar. In contrast, the node and crime site types showed slight differences between both groups, such as higher observations of the home/job node type for HISKs compared to zero observations of the home/job node type for non-HISKs. The descriptive variable of the crime site also showed differences between groups in that non-HISKs had higher observations of disposal sites than HISKs.

In summary, *Hypothesis 2a* and the dependent variable of *RTC distance* revealed significant differences in the RTC distances traveled by non-HISKs compared to HISKs, with HISKs traveling significantly *shorter* RTC distances throughout the murder series. However, *Hypothesis 2b* and the dependent variable of murder series duration did not show significant differences between the murder series durations of both groups. Since *one* of the *two* hypotheses was statistically significant, the current investigation (Study

Two) met the 50% criteria condition (i.e., *one* of the *two* hypotheses) that was statistically significant ($p = < .05$). Correspondingly, the current investigation's first hypothesis and dependent variable (RTC distance) will be included in the supplemental analyses performed and presented at the end of Chapter 6.

The next chapter will consist of two parts: (1) Study Three and (2) supplementary analyses of the investigations that met the 50% classification criteria condition. The first part of Chapter 6 will examine the differences of non-fatal *criminal precipitators* (CPs) prior to the murder series between non-HISKs and HISKs (Study Three). The second part of Chapter 6 will include the supplementary analyses of the investigations that met the 50% criteria condition to determine whether HISKs warrant a distinct classification from non-HISKs for the investigations included in the supplemental analyses.

CHAPTER 6

VI. STUDY THREE: CRIMINAL PRECIPITATORS OF HOME INVASION SERIAL KILLERS VERSUS NON-HOME INVASION SERIAL KILLERS AND SUPPLEMENTARY ANALYSES

6.1 Introduction

This chapter is the *third* and final investigation that examined the differences between home invasion serial killers (HISKs) and non-home invasion serial killers (non-HISKs). The focus of the current investigation was to determine the differences in the *non-fatal* criminal precipitators (CPs) committed prior to the murder series between both groups (Study Three). This chapter also includes the supplementary analyses conducted on the investigations that met the 50% classification criteria condition to determine whether HISKs warrant a distinct classification from non-HISKs.

This chapter consists of two parts: (1) Study Three and (2) supplementary analyses. The first part of Chapter 6 (Study Three) will be structured similarly to Chapters 4 and 5, with an overview of the third investigation, measures and analytical strategy, descriptive statistics, the final results, and a summary of the Study Three sections. The second part of Chapter 6 consists of supplementary analyses of the investigations that met the 50% criteria condition, which will include the following sections: (1) overview of the results of the three investigations; (2) analytical strategy of the supplementary analyses; (3) results of the supplementary analyses; and (4) summary of Chapter 6 and a preview of the final chapter of this dissertation (Chapter 7).

6.2 The Current Investigation

The current investigation examined the research question of Study Three to determine the differences (if any) in the *non-fatal* CPs committed prior to the murder series between HISKs and non-HISKs. This chapter tests *two hypotheses* and IVs relevant to the non-fatal CPs by both groups (DV) to determine whether HISKs demonstrate statistically significant differences regarding (1) the *severity* of CPs and (2) the *type* of CPs compared to non-HISKs.

6.3 Measures and Analytical Strategy of the Current Investigation

This section details the measures and analytical strategy used for the current investigation (Study Three). The following section includes the measures (data collection, variables, and hypotheses) and analytical strategy used for this investigation, followed by the descriptive statistics and results of this Chapter (Study Three).

6.3.1 Data Collection Measures

The data collected for Study Three consisted of two secondary data sources: (1) RU/FGCU SKD (2019) and (2) prerequisite and supplementary public information searches conducted by the researcher. Secondary public sources were used to collect data on the criminal histories of each serial killer (e.g., government and non-government archives; law libraries and legal software; investigation and arrest reports [when available]; public records and background check websites; and true crime sources).

One of the primary resources used by the researcher to collect data on the criminal backgrounds of serial killers was court documents such as transcripts, legal briefs, and appeals. Such documents were found through the use of the *Florida International University (FIU) Online Library*, accredited legal software (LexisNexis and Westlaw), and online searches of legal archive websites (e.g., Justia US Law, FindLaw, Oyez, and Legal Information Institute).

Court documents provide a wealth of information on serial killers' criminal histories and mental health backgrounds. For example, legal briefs and appeals in criminal cases include information on the defendant's mental capacity through testimony and evaluations by mental health professionals (MHPs). Assessments by MHPs frequently include antisocial behaviors and proclivities exhibited in the past (e.g., substance abuse, paraphilias, violent ideations, non-human rehearsals). Moreover, court documents also provide information regarding the defendant's official criminal record and offenses (i.e., non-contact and contact offenses, and test runs against humans).

Finally, to ensure the validity and reliability of the data, multiple supplemental searches of other public resources were also used to find, cross-reference, and confirm the information collected for each case (e.g., public records websites, newspaper articles; true crime books/websites/podcasts; missing persons and serial murder websites; serial murder documentaries). This information was used to code the cases for the two IVs (severity of CPs and type of CPs) and the descriptive variables of this investigation.

All the information pertinent to the criminal history of each serial killer, either from the RU/FGCU SKD (2019) or searches by the researcher, was retained in a password-protected Excel data collection spreadsheet file. Initially, the Study Three data collection spreadsheet included numerically coded columns of data from the RU/FGCU SKD (2019) and columns of *text data* from criminal history searches that would be numerically coded by the researcher. Subsequently, the researcher created a codebook tab in the Study Three spreadsheet with the descriptions of each column/category. The original codebook on the criminal history of each serial killer in the sample (N = 326) consisted of 68 columns of numeric RU/FGCU SKD data (23 columns) and text data (45 columns). The 23 numerically coded RU/FGCU SKD columns of data for each case remained unchanged in the Study Three data collection and codebook spreadsheet. If online criminal history searches by the CI yielded additional information to the RU/FGCU SKD columns, the researcher simply created new columns to preserve all original data from the RU/FGCU SKD (2019).[22]

Due to the extensive nature and broad columns of text data, the researcher had to code, re-code, and combine various columns within similar narrow categories (e.g., numerous types of offenses/CPs). To code the 45 columns of text data, the researcher generated an initial list of numeric codes in the Study Three data collection codebook sheet. Once the researcher combined the columns, the Study Three data collection spreadsheet was condensed from 68 to 25 columns.

To ensure intra-rater reliability, the researcher retained the original numeric and text data of the initial Study Three codebook in separate tabs to cross-reference the information with the final Study Three dataset. The researcher also cleaned and finalized the Study Three spreadsheet to ensure that it contained reliable codes and testable data for the analysis of the current investigation. The final Study Three dataset included five columns of cleaned and numerically coded data from the RU/FGCU SKD (2019). The remaining columns consisted of the information obtained from the supplemental public

[22]Examples of the initial columns of data and information added from the RU/FGCU SKD (2019) or collected by the CI included (but not limited to): randomization codes (sampling procedure); other kill locations (non-HISKs); age at first murder; number of victims; childhood and trauma(s); antisocial behaviors; psychological, biological, or neurological abnormalities; previous arrests and convictions; murder series data; SCI categories; type of CPs; miscellaneous background information.

searches that were numerically coded by the researcher relevant to the two independent variables (i.e., the severity and type of CPs) and seven descriptive variables of the current investigation. The current investigation's variables, coding, and hypotheses are delineated and presented in the following section.

6.3.2 Variables and Hypotheses

Dependent and Independent Variables

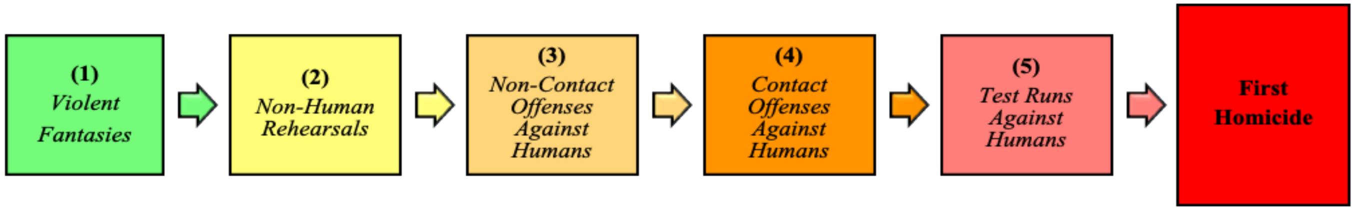
The dependent variable (DV) of the current investigation was serial killer group (1 = HISK and 0 = non-HISK) and two primary independent variables (IVs): (1) *severity* of CPs and (2) *type* of CPs. The two IVs are defined and operationalized below.

***The Severity of CPs* (IV 1).** The *severity* of the non-fatal offenses perpetrated by the serial killer prior to their first murder in the series. The researcher needed to further delineate and operationalize the severity of CPs by creating the *Severity Continuum Index* (SCI), which measures the severity of CPs by serial killers prior to their first murder. The SCI was constructed based on several factors: (1) previous research on the severity of offenses committed by serial killers/serial offenders; (2) RU/FGCU SKD data relevant to serial killers' criminal histories; and (3) public information searches (Liu et al., 2011).

The SCI contained five categories and was dummy coded (yes = 1, no = 0) to measure whether each serial killer engaged in any of the SCI categories, which were operationalized from the *least* to the *most* severe: (1) *violent fantasies*; (2) *non-human rehearsals*; (3) *non-contact offenses against humans*; (4) *contact offenses against humans*; and (5) *test runs against humans*. The SCI and the definitions of the five categories are presented in Figure 13 below.

Figure 13

Severity Continuum Index (SCI)



(1) *Violent Fantasies.* Any form of violent fantasies that are intense, repetitive, and persistent, including but not limited to violent daydreaming/drawings, sexually violent fantasies, compulsive masturbation.
(2) *Non-Human Rehearsals.* Any violent behavior(s) or action(s) against inanimate objects or non-humans (e.g., animals) indicative of rehearsing violent behavior to be performed on humans in the future (e.g., animal cruelty or torture, bestiality, *picquerism*).[23]
(3) *Non-Contact Offenses Against Humans.* Any *non-contact*, sexual or non-sexual, antisocial behavior, or criminal action(s) against human(s) (e.g., theft, fraud, property offenses, voyeurism, exhibitionism, stalking, fetish burglaries, pedophilia, *somnophilia*). A plan to commit a violent offense was not carried out (e.g., assembling a murder kit; external circumstances prevented the offense from occurring).[24]
(4) *Contact Offenses Against Humans.* General violence against human(s) *unrelated* to the serial killer's *fantasies*, *modus operandi*, or *signature* later *exhibited* during the murder series (e.g., domestic violence, bar fights, physical confrontations with others).
(5) *Test Runs Against Humans.* Any *non-fatal* sexual or violent action(s) against human(s) (unconsented) related to the serial killer's *sexual fantasies*, *modus operandi*, or si*gnature* later expressed or exhibited during the murder series. Test runs can include (but are not limited to): contact paraphilias (e.g., *frotteurism*, fondling, molestation, sadism, BDSM, *non-fatal* sexual attacks, kidnapping, false imprisonment, physical attacks through force or use of weapons, sexual assault/battery, rape, torture, non-homicidal necrophilia).[25]

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[23]*Picquerism*: Sexual arousal from penetrating the skin with sharp instruments, usually in a repetitive manner (DSM-V, 2013).
[24]*Somnophilia*: Sexual arousal from unconscious or sleeping individuals (i.e., home invasion to watch the victim sleep) (DSM-V, 2013).
[25]*Frotteurism*: Sexual arousal from rubbing one's body or genitals against non-consenting individuals (DSM-V, 2013).

The Type of CPs* (IV 2).** The second IV, *type* of CPs, was defined as any *non-fatal,** *criminal behavior* or actions committed by the serial killer before their first murder of the series. The preliminary categories of CP *types* were based on the numerically coded data in the RU/FGCU SKD (2019) and the text data retained from searches by the researcher. The original measurements of broad, overlapping CP types were condensed and reduced from 23 to 11 CP types, dummy coded by the researcher to determine whether each serial killer committed any CP types before the murder series (yes = 1; no = 0). The 11 CP types include: (1) substance; (2) auto; (3) fraud; (4) property; (5) robbery; (6) weapons; (7) animal cruelty; (8) assault; (9) *non-contact* sex CPs; (10) contact sex CPs; and (11) miscellaneous personal or non-personal CPs (see FBI UCR, 2020).

Descriptive Variables

In addition to the DV and IVs, the researcher incorporated seven descriptive variables in the data analysis for the current investigation. The first two descriptive variables, the number of victims and victim count category, were included as reference variables. The remaining descriptive variables are delineated below.

Onset Age Group of First CP. The *age group* of when the serial killer committed their *first* CP(s). Many cases did not have the exact ages of each serial killer's first CP. However, the researcher constructed an ordinal variable of the *onset age group* for each serial killer's first committed CP(s). The onset age group of first CP consisted of five categories and codes: (1) *no CPs reported* (= 0); (2) *childhood*, less than 13 years old (=

1); (3) *adolescent*, ages 13 to 17 (= 2); (4) *young adult*, ages 18 to 24 (= 3); and (5) *adulthood*, ages 25 and older (= 4) (see Tables 16 and 17).[26]

Age at First Kill. The age of the serial killer at their first murder in the series. Data for this variable were obtained from the RU/FGCU SKD (2019), which consists of the exact age of the serial killer when they murdered their *first victim* (continuous, interval/ratio). The age of the first kill was included to depict the approximate timeframe of each serial killer's *first CP* to their first murder. Discernibly, since the exact age of each serial killer's first CP could not be obtained, the age group of the first CP was used as a proxy variable (see Tables 16 and 17).

Previous Arrest(s). Whether the serial killer was arrested prior to their murder series (RU/FGCU SKD, 2019), this variable was included in the current investigation as a baseline to determine if the serial killer had an official criminal record that resulted in an arrest(s). The "Previous Arrest(s)?" column of data from the RU/FGCU SKD "Yes" the serial killer was previously arrested (= 1) or "no" the serial killer was not previously arrested (= 0) (see Tables 16 and 17).

Previous Jail/Prison Time. Whether the serial killer spent time in jail or prison prior to the murder series. The "Spent Time in Jail or Prison Prior to Killing" data column from the RU/FGCU SKD (2019) the following: "Yes" the serial killer previously spent time in jail or prison (= 1) or "no" the serial killer did not previously spend time in jail or prison (= 0). This variable was also included to establish whether the serial killer had an official prior criminal record that resulted in jail or prison time (see Tables 16 and 17).

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[26]For the descriptive variable of the *onset age group of first CP*, see age groups from Chan & Beauregard (2016) adopted by the researcher to generate the age categories for each group.

***Sexual Residential Burglary* (SRB).** The final descriptive variable, sexual residential burglary (SRB), was defined as the following: Any sexual CPs (attempted or completed) against a person(s) or residential property involving the unlawful entry, intrusion, or invasion into a person's residence (e.g., breaking in, use of force, or coercion/ruse). Sexual residential burglary can include (but is not limited to): (1) fetish burglaries (e.g., stealing female undergarments, somnophilia, exhibitionism, voyeurism); (2) non-contact and contact sex SRB offenses (see CP types 9 and 10 but within the victim's residence); (3) attempted murder during SRB; (4) opportunistic SRB; (5) theft or robbery SRB; (6) serial sexual burglary; (7) criminal confinement of a person(s) within their residence for sexual purposes; and (8) miscellaneous SRB offenses (Phenix & Hoberman, 2016; see also Ensslen et al., 2018 et al., 2018; Pedneault et al., 2015b; Schlesinger & Revitch, 1999; Warr, 1988). The sexual residential burglary variable was constructed and dummy coded (yes = 1; no = 0) to determine whether each serial killer committed SRB(s) before their first murder. The RU/FGCU SKD (2019) data columns relevant to previous arrests and jail/prison time and the researcher's searches were used to construct and code this variable.[27]

Hypotheses of the Current Investigation

Based on the IVs relevant to the non-fatal CPs of HISKs and non-HISKs, two hypotheses were tested regarding the (1) severity of CPs and (2) type of CPs committed before murder series by both serial killer groups. These hypotheses were tested based on

[27] *Note*. Initially, sexual residential burglary was the third IV of Study Three. However, the small percentage of serial killers who committed SRBs and low *events per variable* (EPV) by non-HISKs produced inflated odds ratios and confidence intervals in the regression models. Consequently, SRB was omitted as an IV from the models and included as a descriptive variable for this investigation (see Tables 16 and 17).

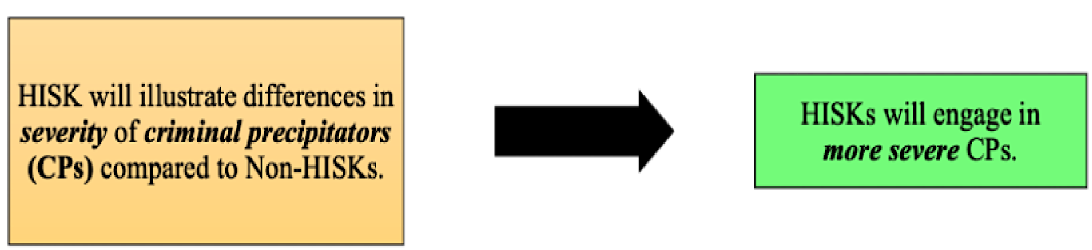
the theoretical perspectives of CCP and LCP and prior research on home invasion sex offenders. Previous studies indicate such offenders exhibit *more severe* and *specialized* offenses over their criminal careers (e.g., sexual burglary, home intruder rape). Anticipated differences in the non-fatal CPs of HISKs versus non-HISKs were predicated on two primary factors: (1) *more severe* CPs and (2) *fewer types* of CPs. The two hypotheses, their respective hypothesized models, and the working hypothesis of this investigation are summarized and presented below.

Hypothesis 3a

The first hypothesis and IV of the current investigation (*hypothesis 3a*) test the differences in the *severity* of CPs by HISKs compared to non-HISKs. It is anticipated that HISKs will engage in *more severe* CPs prior to their first murder than non-HISKs. This assumption is predicated on CCP and LCP perspectives and prior research regarding home invasion sex offenders, which indicates that such offenders perpetrate *more severe* offenses over their criminal careers (e.g., home invasion rape) than non-residential sex offenders (Deslauriers-Varin & Beauregard, 2010; Harris et al., 2013; Liu et al., 2011; Pedneault et al., 2012; Vaughn et al., 2008). Consequently, *Hypothesis 3a* predicts that HISKs will perpetrate *more severe* CPs compared to non-HISKs (Figure 14).

Figure 14

Hypothesis 3a: Hypothesized Model for the Severity of CPs by HISKs and Non-HISKs

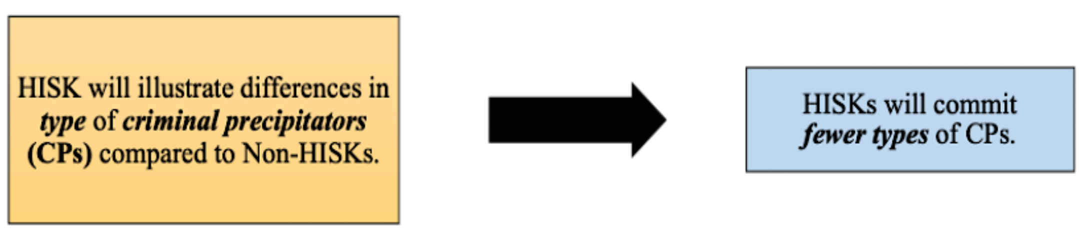


Hypothesis 3b

The second hypothesis and IV of the current investigation (*hypothesis 3b*) test the differences in the *type* of CPs committed by HISKs compared to non-HISKs. It is anticipated that HISKs will be *more likely* to commit *fewer types* of CPs prior to their first murder than non-HISKs. This assumption was predicated on CCP and LCP perspectives and previous research suggesting home invasion sex offenders are *less versatile* and *more specialized* in the *type* of offenses committed over their criminal careers (i.e., fewer crime categories). Such offenders commonly exhibit specialized criminal histories involving residential offenses, namely *property crimes* and home intrusion sex offenses (e.g., sexual residential burglary) (Brankley et al., 2014; DeLisi & Scherer, 2006; Harris, 2013; Vaughn et al., 2008). Consequently, *Hypothesis 3b* predicted that HISKs will commit *fewer types* of CPs compared to non-HISKs (Figure 15).

Figure 15

Hypothesis 3b: Hypothesized Model for the Type of CPs by HISKs and Non-HISKs



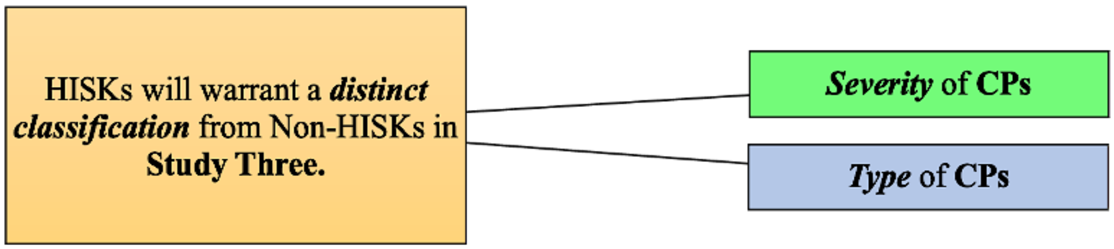
Study Three Working Hypothesis

A working hypothesis of the current investigation concerning the non-fatal CPs of HISKs and non-HISKs was also constructed. The working hypothesis was outlined as a provisional hypothesis, contingent on the results of this investigation meeting the eligibility criteria of the supplementary analyses and classification determination of

HISKs versus non-HISKs (i.e., *one* of *two* hypotheses must be significant). Depending on *Hypothesis 3a* (*severity* of CPs) and *Hypothesis 3b* (*type* of CPs), it is predicted that HISKs will warrant a distinct classification from non-HISKs in Study Three (Figure 16).

Figure 16

Study 3 Working Hypothesis: HISKs Warrant a Distinct Classification from Non-HISKs



6.3.3 Analytical Strategy of the Current Investigation (Study Three)

The data in the current investigation included categorical and continuous variables that were analyzed through descriptive statistics and *binary logistic regression* models, which were performed using SPSS 27. The data were not normally distributed, and thus logistic regression was used instead of linear regression (Pallant, 2020; Yin et al., 2006).

The analytical strategy used for the current investigation consisted of several stages. First, the descriptive statistics of all the variables in the sample were analyzed using both the descriptives function (continuous variables) and the frequency function (categorical variables) in SPSS (see Table 16). Second, cross-tabulations were performed to provide a descriptive overview of the variables by serial killer group (i.e., HISKs and non-HISKs) (see Table 17).

Third, binary logistic regression models were run to examine the research question and two IVs/hypotheses of this investigation (see Tables 18, 19, and 20). Logistic regression is the non-parametric equivalent of linear regression, and models must include a dichotomous outcome (DV) and categorical or continuous *predictor* variables (IVs). Such regression models are suitable to determine whether the IVs are statistically significant in predicting a dichotomous DV (H_1 = alternative hypothesis) or if the IVs do not significantly predict the DV (H_0 = null hypothesis).

Consequently, three binary logistic models were run for the current investigation. The initial two models were run to preliminarily examine the two IVs: (1) severity of CPs and (2) type of CPs (see Tables 18 and 19). The final model was performed to comprehensively test both IVs/hypotheses in the same model to determine if the *severity* of CPs (*Hypothesis 3a*) and the *type* of CPs (*Hypothesis 3b*) significantly affected the likelihood of observing the HISK group versus the non-HISK group (see Table 20).

The following section presents the descriptive statistics of the current investigation for each of the variables analyzed in this chapter. Subsequently, the analyses performed to test the two IVs and hypotheses regarding the differences between the non-fatal CPs and the predictive accuracy of the membership of the serial killer group (DV) are presented. Finally, according to the classification criteria, if 50% of the hypotheses (*one of* the *two* hypotheses) tested in the final model (Table 20) are significant (p = < .05), supplementary analyses of the significant variable(s) will be performed.

6.3 Descriptive Statistics

Table 16 lists the descriptive statistics for all the variables used in the current investigation. The DV was HISKs and non-HISKs, and the two IVs of the current investigation were the (1) *severity* of CPs (i.e., five SCI categories; yes = 1, no = 0) and (2) *type* of CPs (11 CP types; yes = 1, no = 0). The sample consisted of 326 serial killers (n = 163 HISKs and n = 163 non-HISKs). The serial killers (N = 326) murdered 1,952 victims. As reported in Table 16, the average number of victims was 5.99 (SD = 12.78), with a minimum of two victims and a maximum of 215 victims during the murder series. For reference, the victim count categories are also listed in Table 16 below.

Table 16

Study 3: Descriptive Statistics (N = 326)

Variables	*N*	%	*M*	*SD*	Min	Max
Dependent Variable						
HISKs	163	50%	---	---	0	1
Non-HISKs	163	50%	---	---	0	0
Independent Variables						
Severity Continuum Index (SCI) [a]						
SCI 1: Violent fantasies	66	20%	---	---	0	1
SCI 2: Non-human rehearsals	83	26%	---	---	0	1
SCI 3: Non-contact offenses	255	78%	---	---	0	1
SCI 4: Contact offenses	92	28%	---	---	0	1
SCI 5: Test runs	159	49%	---	---	0	1
Type of Criminal Precipitators (CPs) [a]						
CP 1: Substance CPs	211	65%	---	---	0	1
CP 2: Auto CPs	16	5%	---	---	0	1
CP 3: Fraud CPs	26	8%	---	---	0	1
CP 4: Property CPs	156	48%	---	---	0	1
CP 5: Robbery CPs	78	24%	---	---	0	1
CP 6: Weapon CPs	45	14%	---	---	0	1
CP 7: Animal cruelty CPs	44	14%	---	---	0	1
CP 8: Assault CPs	80	25%	---	---	0	1
CP 9: Non-contact sexual CPs	124	38%	---	---	0	1
CP 10: Contact sexual CPs	165	51%	---	---	0	1
CP 11: Miscellaneous CPs	160	49%	---	---	0	1
Descriptive Variables						
Number of victims	1,952	100%	5.99	12.78	2	215
2 victims	81	25%	---	---	2	2
3 victims	69	21%	---	---	3	3
4 victims	46	14%	---	---	4	4

Variables	N	%	M	SD	Min	Max
5+ victims	130	40%	---	---	5	215
Onset age group of 1st CP	326	100%	---	---	0	4
No CPs	9	3%	---	---	0	0
Child (< 13)	47	14%	---	---	1	1
Adolescent (13-17)	95	29%	---	---	2	2
Young adult (18-24)	120	37%	---	---	3	3
Adult (25+)	55	17%	---	---	4	4
Age at first kill	326	100%	27.70	8.74	13	64
Previous arrest(s) [a]	237	73%	---	---	0	1
Previous jail/prison time [a]	197	60%	---	---	0	1
Sexual residential burglary [a]	53	16%	---	---	0	1

Notes. The DV is serial killer group: HISKs (= 1) and non-HISKs (= 0). Two predictor variables: (1V1) *severity* of CPs (5 SCI categories) and (IV2) *type* of CPs (11 types). Due to rounding, percentages may not equal 100%.
[a] Reflects the number of serial killers coded as "yes" (= 1) for the variable or categories of the variable.

The first IV, the *severity* of CPs, contained dummy coded data (i.e., yes = 1, no = 0) for each of the five SCI categories (least to most severe), which was constructed to reflect whether the serial killer engaged in any of the five SCI categories before the first murder. As reported in Table 16, for SCI 1 (violent fantasies), there were a total of 66 serial killers (more than 20%) who reported having violent fantasies prior to their first murder. In the second SCI category, non-human rehearsals, 83 serial killers (nearly 26%) reported non-human rehearsal(s) prior to their first murder (see Table 16). The third category, non-contact offenses against humans, indicates that most serial killers (N = 255 or 78%) perpetrated non-contact offenses against humans prior to their first murder. The fourth SCI category, contact offenses against humans, shows 92 serial killers (28%) engaged in such offenses prior to their first murder. The final SCI category, test runs against humans, Table 16 reports nearly half of the serial killers (N = 159 or 49%) performed test runs against humans prior to their first murder.

The second and final IV, *type* of CPs, also contained dummy coded data (yes = 1, no = 0) for each of the 11 CP types, which was constructed to reflect whether the serial killer committed any of the CP types prior to their first murder (see Table 16). The first type of CP, substance CPs, Table 16 illustrates that nearly two-thirds of serial killers (N = 211 or 65%) engaged in substance use or abuse before their first murder in the series. Table 16 reports nominal observed frequencies in auto CPs (N =16 or less than 5%) and fraud CPs (N = 26 or 8%) committed by serial killers before the murder series.

As reported in Table 16, almost half of the serial killers (N = 156 or 48%) committed property offenses (CP 4). Surprisingly, serial killers did not commit robbery (CP 5), weapons (CP 6), animal cruelty (CP 7), or assault (CP 8) as frequently as expected, with no more than 25% of serial killers that committed these CP types. Both *non-contact* and *contact sexual* CPs had higher observed frequencies, with 124 serial killers (38%) that committed *non-contact* sexual CPs and 165 serial killers (51%) that committed *contact* sexual CPs (Table 16). Lastly, almost half of the sample committed miscellaneous personal and non-personal CPs (*N* = 160 or 49%) before the series.[28]

Descriptive Variables

The first descriptive variable in Table 16, the *age group of* the *first CP,* shows that only nine serial killers (less than 3%) had no history of CPs. Conversely, 47 serial killers (14%) committed their first CP during *childhood*, and nearly 30% of serial killers (*N* = 95) committed their first CP during *adolescence*. The most observed frequency was *young adults*, with 120 serial killers (37%) that committed their first CP between 18 and 24. Finally, 55 serial killers (17%) committed their first CP as an *adult* (see Table 16).

The second descriptive variable, *age* of the *first kill*, Table 16 shows that the average age of serial killers (*N* = 326) at their *first* murder was 27.70 (*SD* = 8.74), with the *youngest* serial killer age at the first murder being 13 years old. The *oldest* age is 64 years old (RU/FGCU SKD, 2019). The third and fourth descriptive variables, prior arrest(s) and jail or prison time, show that 237 serial killers (73%) had been previously arrested, and more than 60% of serial killers (*N* = 197) served time in jail or prison before their first murder. For the final descriptive variable, *sexual residential burglary* (SRB), Table 16 reports 53 serial killers (more than 16%) engaged in SRB before the series.

[28]*Examples of personal/non-personal miscellaneous CPs*: non-sexual human trafficking, hate crimes, probation/parole violations, vagrancy, delinquency, and other CPs against persons, society, or government.

Descriptive Statistics by Serial Killer Group

Table 17 lists the descriptive statistics of the DV, IVs, and descriptive variables by serial killer group: non-HISKs and HISKs.

The Severity of CPs (Five SCI Categories) by Serial Killer Group

As presented in Table 17, the *severity* of CPs (i.e., five SCI categories) shows that 49 non-HISKs (more than 30%) reported having *violent fantasies* prior to their first murder, compared to only 17 HISKs (approximately 10%). For SCI 2 (non-human rehearsals), SCI 3 (non-contact offenses against humans), and SCI 4 (contact offenses against humans), both non-HISKs and HISKs presented similarities in their observed frequencies for each category. For example, approximately 25% of both groups engaged in non-human rehearsals before their first murder (non-HISKs = 43 or 26% and HISKs = 40 or 24%). Almost 80% of both groups committed non-contact offenses against humans before their first murder (non-HISKs = 129 or 79% and HISKs = 126 or 77%), and both groups were tied at 28% for contact offenses against humans (non-HISKs = 46 and HISKs = 46) (see Table 17). In contrast, the final SCI category, test runs (SCI 5), reveals that non-HISKs committed considerably more test runs (n = 96 or 59%) compared to HISKs (n = 63 or 39%) prior to their first murder in the series (see Table 17).

***Type* of CPs (11 Types) by Serial Killer Group**

The second and final IV, *type* of CPs (11 types), Table 17 presents moderate differences for substance CPs, in that 97 non-HISKs (60%) engaged in substance use or abuse prior to their first murder, compared to 114 HISKs (more than 70%). Similarities between both groups for *auto* and *fraud* CPs are also reported in Table 17, as both groups were tied at 5% for auto CPs (non-HISKs = 8 and HISKs = 8) and 8% for fraud CPs (non-HISKs = 13 and HISKs = 13). Contrastingly, Table 17 presents moderate differences between the groups regarding *property* CPs, with only 37% of non-HISKs (*n* = 61) and approximately 60% of HISKs (*n* = 95). Comparative differences were also observed between the groups regarding robbery CPs, with less than 20% of non-HISKs (*n* = 32) and 30% of HISKs (*n* = 46) who committed robbery before their first murder.

Table 17 reports relative similarities between groups regarding weapons, animal cruelty, and assault CPs before their first murder. Table 17 also shows relative differences between groups regarding *non-contact* sex offenses (CP 9) and *contact* sex offenses (CP 10), with nearly 45% of non-HISKs who committed *non-contact* sex CPs (*n* = 71) compared to 33% of HISKs (*n* = 53). More than 60% of non-HISKs (*n* = 100) compared to less than 40% of HISKs (*n* = 65) committed *contact* sex CPs prior to their first murder. The final CP type, miscellaneous personal/non-personal CPs, Table 17 shows moderate differences between both groups with 92 non-HISKs (56%) and 68 HISKs (or 42%) that committed miscellaneous CPs before the series.

Descriptive Variables by Serial Killer Group

As reported in Table 17, the age group of first CP shows similarities between both serial killer groups that *did not* commit CPs (non-HISKs = 4 or 2% and HISKs = 5 or 3%) and in the child age group (non-HISKs = 25 or 15% and HISKs = 22 or 13%) who committed their first CP during childhood. The adolescent age group in Table 17 shows relative differences between 40 non-HISKs (or 25%) and 55 HISKs (34%) who committed their first CP during adolescence. The young adult age group was the most frequently observed for both groups, with 57 non-HISKs (35%) and 63 HISKs (39%)

who committed their first CP between 18 and 24. Lastly, Table 17 reports that more non-HISKs committed their first CP as adults (*n* = 37 or 23%) than only 18 HISKs (or 11%).

The descriptive variable of age at the first kill indicates that the average age of non-HISKs at their first kill of the series was 28.26 (*SD* = 8.54), with the *youngest* age for non-HISKs at the *first* murder being 13 years old and the *oldest* age for non-HISKs at the *first* murder being 63 years old (Table 17). The average age of HISKs at the first kill was slightly younger at 26.55 (*SD* = 8.80), the *youngest* age for HISKs at the *first* murder was 13 years old, and the *oldest* age for HISKs at the *first* murder was 64 years old. The descriptive variables (1) previous arrest(s) and (2) prior jail or prison show similarities between both groups (Table 17). With 122 non-HISKs (75%) and 115 HISKs (71%) who were previously arrested, and 97 non-HISKs (60%) and 100 HISKs (61%) who were officially convicted and served time in jail or prison before their first murder (RU/FGCU SKD, 2019). Lastly, Table 17 presents notable differences between both groups concerning sexual residential burglary. Only six non-HISKs (4%) compared to 47 HISKs (nearly 30%) that committed SRB offenses prior to their first murder. The sample's descriptive statistics by serial killer group are listed in Table 17.

Table 17

Study 3: Descriptive Statistics by Serial Killer Group (N = 326)

Variables	Non-HISKs (*n* =163)						HISKs (*n* =163)						Total	
	n	%	*M*	*SD*	Min	Max	*n*	%	*M*	*SD*	Min	Max	*N*	%
Severity of CPs (SCI) [a]														
SCI 1: Violent fantasies	49	30%	---	---	0	1	17	10%	---	---	0	1	66	20%
SCI 2: Non-human rehearsals	43	26%	---	---	0	1	40	24%	---	---	0	1	83	25%
SCI 3: Non-contact offenses	129	79%	---	---	0	1	126	77%	---	---	0	1	255	78%
SCI 4: Contact offenses	46	28%	---	---	0	1	46	28%	---	---	0	1	92	28%
SCI 5: Test runs	96	59%	---	---	0	1	63	39%	---	---	0	1	159	49%
Type of CPs [a]														
CP 1: Substance CPs	97	60%	---	---	0	1	114	70%	---	---	0	1	211	65%
CP 2: Auto CPs	8	5%	---	---	0	1	8	5%	---	---	0	1	16	5%
CP 3: Fraud CPs	13	8%	---	---	0	1	13	8%	---	---	0	1	26	8%
CP 4: Property CPs	61	37%	---	---	0	1	95	58%	---	---	0	1	156	48%
CP 5: Robbery CPs	32	20%	---	---	0	1	46	28%	---	---	0	1	78	24%
CP 6: Weapon CPs	24	15%	---	---	0	1	21	13%	---	---	0	1	45	14%
CP 7: Animal Cruelty CPs	26	16%	---	---	0	1	18	11%	---	---	0	1	44	13%
CP 8: Assault CPs	42	26%	---	---	0	1	38	23%	---	---	0	1	80	25%
CP 9: Non-contact sex CPs	71	44%	---	---	0	1	53	33%	---	---	0	1	124	38%
CP 10: Contact sex CPs	100	61%	---	---	0	1	65	40%	---	---	0	1	165	51%
CP 11: Miscellaneous CPs	92	56%	---	---	0	1	68	42%	---	---	0	1	160	49%
Descriptive Variables														
Number of victims	981	50%	6.02	6.49	2	60	971	50%	5.96	16.90	2	215	1,952	100%
2 Victims	34	21%	---	---	2	2	47	29%	---	---	2	2	81	25%
3 Victims	33	20%	---	---	3	3	36	22%	---	---	3	3	69	21%
4 Victims	23	14%	---	---	4	4	23	14%	---	---	4	4	46	14%
5+ Victims	73	45%	---	---	5	60	57	35%	---	---	5	215	130	40%
Onset age group of 1st CP														
No CPs	4	2%	---	---	0	0	5	3%	---	---	0	0	9	3%
Child (< 13)	25	15%	---	---	1	1	22	13%	---	---	1	1	47	14%
Adolescent (13-17)	40	25%	---	---	2	2	55	34%	---	---	2	2	95	29%

Variables	Non-HISKs (*n* =163)						HISKs (*n* =163)						Total	
	n	%	*M*	*SD*	Min	Max	*n*	%	*M*	*SD*	Min	Max	*N*	%
Young adult (18-24)	57	35%	---	---	3	3	63	39%	---	---	3	3	120	37%
Adult (25+)	37	23%	---	---	4	4	18	11%	---	---	4	4	55	17%
Age of first kill	163	50%	28.86	8.54	13	63	163	50%	26.55	8.80	13	64	326	100%
Previous arrest(s) [a]	122	75%	---	---	0	1	115	71%	---	---	0	1	237	73%
Previous jail/prison time [a]	97	60%	---	---	0	1	100	61%	---	---	0	1	197	60%
Sexual residential burglary [a]	6	4%	---	---	0	1	47	29%	---	---	0	1	53	16%

Notes. The DV is serial killer group: HISKs (= 1) and non-HISKs (= 0). Two predictor variables are (1V) the *severity* of CPs (5 SCI categories) and (IV2) *type* of CPs (11 types). Due to rounding adjustments, percentages may not equal 100%.

[a] Reflects the number of serial killers coded as “yes” (= 1) for the variable or categories of the variable.

6.5 Results

Three binary logistic regression models were performed to examine the research question and the two hypotheses of the current investigation. Due to the non-parametric nature of the data of the current investigation, logistic regression was utilized instead of linear regression, as the assumptions are less stringent (Yin et al., 2006). The assumptions of logistic regression consist of the following: (1) larger sample size for a higher number of predictor IVs; (2) minimal to no multicollinearity (i.e., variance inflation factor scores [VIFs] must be less than 10); and (3) identification and examination of residual outliers (Pallant, 2020, p. 189). Regression models are inherently sensitive to cases with low or high residual values, which requires the dataset to be screened for outlier cases. Outliers consist of cases with standardized residual values *greater than* 3.3 or *less than* -3.3 (Tabachnick & Fidell, 2013, p. 128).

Binary logistic regression consists of a logarithm of the likelihood of group membership in one of the two groups (Intellectus Statistics, 2019). Model results produce the fit, the significance of IVs, and the percentages of classification accuracy of the cases into the membership of each group. The χ^2 *Omnibus* test is used to determine the significance of the model, followed by *pseudo-*R^2 results (Cox & Snell R^2 and Nagelkerke R^2), which estimates the variance in the outcome attributed by the IVs. The coefficients in the model are interpreted by calculating the odds ratio or *Exp(B)* (Pallant, 2020). The formula used for binary logistic regression modeling is listed below.[29]

$$P = \frac{\exp(a + b_1x_1 + b_2x_2 + b_3x_3 + \dots)}{1 + \exp(a + b_1x_1 + b_2x_2 + b_3x_3 + \dots)}$$

[29]*Note.* P = Probability case is classified in the HISKs or non-HISKs group; *exp* = exponential function; a = constant; $b_{1,2,3}$ = slope coefficient of IVs in the equation (i.e., $x_{1,2,3}$..).

Two Predictor IVs and Hypotheses: Binary Logistic Regression Models

Three binary logistic models were run to assess the research question and two hypotheses/IVs of the current investigation to determine: (1) whether statistically significant differences exist between the IVs in both groups and (2) if the IVs significantly predicted the HISK and non-HISK groups (DV).

Severity of CPs (Five SCI Categories)

The first IV, the *severity* of CPs, consisted of the five SCI categories constructed to measure and assess whether the severity of CPs significantly predicted the membership of the serial killer group. The first model (Table 18) was run to preliminarily examine whether the severity of CPs was statistically different between both serial killer groups and whether HISKs perpetrated *more severe* CPs than non-HISKs before the series.

Collinearity diagnostics were performed to determine the presence or absence of multicollinearity between the SCI categories (VIF scores < 10) (Menard, 2009). The assumption of minimal multicollinearity was met since all five SCI categories in the model (Table 18) had VIF scores less than 10 (VIF range: 1.02 to 1.05). The first model also met the assumption of no outlier cases, as no cases had standardized residual values greater than 3.3 or less than -3.3 in Model 1 (Table 18) (Tabachnick & Fidell, 2013). Table 18 presents the observations and results of Model 1 regarding the severity of CPs (IV 1) and the prediction of both groups.

Table 18

Model 1: Binary Logistic Regression of Severity of CPs Predicting HISKs and Non-HISKs (N = 326)

Predictors	*B*	*SE*	χ^2	*p*	*OR*	95% *CI*	
						LL	*UL*
Constant	0.63	0.28	5.28	.022	1.88	---	---
SCI 1: Violent fantasies [a]	-1.34	0.32	17.96	.000*	0.26	0.14	0.49
SCI 2: Non-human rehearsals [a]	0.10	0.28	0.13	.718	1.10	0.64	1.90
SCI 3: Non-contact offenses [a]	-0.00	0.29	0.00	.987	1.00	0.57	1.75
SCI 4: Contact offenses [a]	0.07	0.26	0.07	.792	1.07	0.64	1.80
SCI 5: Test runs [a]	-0.86	0.24	13.19	.000*	0.42	0.27	0.67
-2 Log Likelihood	418.19						
Omnibus Tests	$\chi^2(5, N = 326) = 33.74$, p =.000						
Cox & Snell R^2	.098						
Nagelkerke R^2	.131						
Hosmer & Lemeshow Test	$\chi^2 = 2.83$, p = .901						
Classification Accuracy	HISKs = 55.8%						
	Non-HISKs = 73%						
	Overall Model = 64.4%						

Notes. The DV is serial killer group: HISKs (= 1); non-HISKs (= 0). Predictor IV 1 = severity of CPs (5 SCI categories) was dummy coded to determine if the serial killer engaged in any SCI categories (1 = yes; 0 = no). Method of logistic regression = Enter. *Reference group* = non-HISKs. *B* = unstandardized logistic regression coefficient; *SE* = standard error; *p* = significance; *OR* = odds ratio; *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit. The model estimates and confidence intervals were rounded to reflect two decimal points. Results of the *-2 Log Likelihood*, *Omnibus Tests*, *Cox & Snell* and *Nagelkerke* R^2, *Hosmer & Lemeshow Test*, and *Classification Accuracy* scores of HISKs, non-HISKs, and the *Overall Model* listed at the bottom of Table 18.

[a] Reflects the number of serial killers that were coded as "yes" (= 1) for this category.

* $p < .001$

The results reported in Table 18 show that the model containing all five SCI categories relevant to the *severity* of CPs (IV 1) was statistically significant, $\chi^2(5, N = 326) = 33.74$, $p < .001$, indicating that the model was able to distinguish between HISKs and non-HISKs. Overall, the model explained between 9.8% (Cox & Snell $R^{2\,=}$ .098) and 13.1% (Nagelkerke $R^{2\,=}$ .131) of the variance in serial killer group membership and correctly classified 64.4% of cases into HISK (55.8%) and non-HISK (73%) groups.

As shown in Table 18, *two* of the five SCI categories made a statistically significant contribution to the model: (1) *violent fantasies* (SCI 1) and (2) *test runs against humans* (SCI 5). The first significant category, violent fantasies, was statistically significant (B = -1.34, OR = 0.26, p < .001), which was less than 1, indicating serial killers who have violent fantasies, the odds of belonging to the HISK group are *74% lower* (OR = .26 - 1 = -0.74 * 100 = -74%). Compared to serial killers who do not have violent fantasies prior to the murder series, controlling for all SCI categories and constant included in the model (Table 18). The second most significant SCI category, test runs, was statistically significant (B = -0.86, OR = 0.42, p < .001), which was also less than 1, indicating serial killers that participated in test runs against humans, the odds of belonging to the HISK group are *58% lower* (OR = .42 - 1 = -0.58 * 100 = -58%). Compared to serial killers who did not participate in test runs before the series, controlling for all categories and constant included in the model (Table 18).

The remaining three SCI categories: (1) non-human rehearsals, (2) non-contact offenses, and (3) contact offenses did not make a statistically significant contribution to the model (Table 18). These results indicate that the commission of non-human rehearsals, non-contact, or contact offenses prior to the murder series, did not significantly affect the likelihood of observing the HISKs group (Pallant, 2020).

The two statistically significant SCI categories for the first IV of serial killer group membership, violent fantasies and test runs against humans, had *negative* predictive values, suggesting statistically significant differences regarding the severity of CPs by HISKs versus non-HISKs. The preliminary results of the first model reported in Table 18 indicate that HISKs did not appear to perpetrate *more severe* CPs than non-HISKs. Rather, non-HISKs perpetrated more severe CPs than HISKs. The third and final model tests both hypotheses to confirm these results (see Model 3, Table 20).

Type of CPs (11 CP Types)

The second IV, the *type* of CP, consisted of binary data of the 11 CP types constructed to measure and assess whether the type of CPs significantly predicted the membership of the serial killer group. The second model was performed to examine whether the types of CPs committed before the murder series (11 types) were statistically different between both serial killer groups and whether HISKs committed *fewer types* of CPs compared to non-HISKs prior to the murder series (Table 19).

Collinearity diagnostics were also performed to determine the presence or absence of multicollinearity between each of the 11 CP types (Table 19). The assumption of minimal multicollinearity was met, as the 11 CP types in the model had VIF scores less than 10 (VIF range: 1.07 to 1.27). This model also met the assumption of no outlier cases, as there were no cases with standardized residual values greater than 3.3 or less than -3.3 (Tabachnick & Fidell, 2013). Table 19 presents the observations and results of Model 2 of the type of CPs (IV 2) and the prediction of serial killer group.

Table 19

Model 2: Binary Logistic Regression of Type of CPs Predicting HISKs and Non-HISKs (N = 326)

Predictors	*B*	*SE*	χ^2	*p*	*OR*	*95% CI*	
						LL	*UL*
Constant	0.28	0.27	1.02	.314	1.32	---	---
CP 1: Substance CPs [a]	0.12	0.26	0.21	.647	1.13	0.68	1.88
CP 2: Auto CPs [a]	-0.18	0.56	0.10	.752	0.84	0.28	2.49
CP 3: Fraud CPs [a]	-0.09	0.45	0.04	.838	0.91	0.37	2.22
CP 4: Property CPs [a]	1.22	0.27	20.31	.000**	3.39	1.99	5.75
CP 5: Robbery CPs [a]	0.38	0.30	1.59	.207	1.46	0.81	2.61
CP 6: Weapon CPs [a]	-0.17	0.38	0.20	.653	0.84	-0.17	1.76
CP 7: Animal cruelty CPs [a]	-0.32	0.37	0.77	.381	0.73	-0.32	1.49
CP 8: Assault CPs [a]	0.14	0.30	0.23	.635	1.15	0.64	2.07
CP 9: Non-contact sex CPs [a]	-0.19	0.27	0.51	.474	0.82	0.49	1.40
CP 10: Contact sex CPs [a]	-1.04	0.26	15.81	.000**	0.19	0.21	0.59
CP 11: Misc. CPs [a]	-0.76	0.26	8.72	.003*	0.47	0.28	0.77
-2 Log Likelihood	401.18						
Omnibus Tests	$\chi^2(11, N = 326) = 50.75, p = .000$						
Cox & Snell R^2	.144						
Nagelkerke R^2	.192						
Hosmer & Lemeshow Test	$\chi^2 = 10.69, p = .220$						
Classification Accuracy	HISKs = 65.0%						
	Non-HISKs = 64.4%						
	Overall Model = 64.7%						

Notes. The DV is serial killer group: HISKs (= 1); non-HISKs (= 0). Predictor IV 2: *type* of CPs (11 types) dummy coded to measure if the serial killer committed any of the 11 types (1 = yes; 0 = no). Method of logistic regression = Enter; *Reference group* = non-HISKs. *B* = unstandardized logistic regression coefficient; *SE* = standard error; *p* = significance; *OR* = odds ratio; *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit. Results of the *-2 Log Likelihood*, *Omnibus Tests*, *Cox* & *Snell* and *Nagelkerke* R^2, *Hosmer* & *Lemeshow Test*, and *Classification Accuracy* scores of HISKs, non-HISKs, and the *Overall Model* listed at the bottom of Table 19.

[a] Reflects the number of serial killers coded as "yes" (= 1) for this category. *$p < .05$, **$p < .001$

The results reported in Table 19 show that the model containing all 11 types relevant to the type of CP (IV 2) was statistically significant, $\chi^2(11) = 50.75$, $p < .001$, indicating that the model was able to distinguish between HISKs and non-HISKs. Overall, the model explained between 14.4% (Cox & Snell $R^2 = .144$) and 19.2% (Nagelkerke $R^2 = .192$) of the variance in serial killer group membership and correctly classified 64.7% of cases into HISK (65%) and non-HISK (64.4%) groups.

As shown in Table 19, *three* of the 11 CP types made a statistically significant contribution to the model: (1) *property* CPs, (2) *contact sex* CPs, and (3) *miscellaneous* CPs. The first type of CP, *property* CPs, was statistically significant ($B = 1.22$, OR = 3.39, $p < .001$), indicating serial killers who committed property CPs, the odds of HISK group membership are more than *three times higher* (239%) compared to non-HISKs, controlling for all types and constant included in the model (Table 19).[30]

The second significant type of CP in Model 2, *contact sex* CPs, was statistically significant ($B = -1.04$, $OR = 0.35$, $p < .001$), which was less than 1, indicating serial killers that committed contact sex CPs, the odds of belonging to the HISK group are *65% lower* ($OR = .35 - 1 = -0.65 * 100 = -65\%$). Compared to serial killers that do not commit contact sex CPs, controlling for all CP types and constant included in the model (Table 19). The final significant CP type in Model 2, miscellaneous CPs, was marginally significant ($B = -0.76$, $OR = 0.47$, $p = .003$), indicating serial killers that committed miscellaneous CPs, the odds of belonging to the HISK group are *53% lower* ($OR = .47 - 1 = -0.53 * 100 = -53\%$). Compared to serial killers that do not commit miscellaneous

[30]*Note*. The following equation was utilized to calculate the percentage of *positive* and *negative* odds of HISK group membership: (EXP)B - 1 * 100 = % of the odds ratio (Pallant, 2020).

CPs, controlling for all types and constant included in the model (Table 19). In contrast, the remaining eight CP types (i.e., substance, auto, fraud, robbery, weapons, animal cruelty, assault, and non-contact sex offenses CPs) did not significantly contribute to the model. These results indicate that the commission of these CP types before the series did not significantly affect the likelihood of observing the HISK group (see Table 19).

Two of the three statistically significant CP types, contact sex CPs and miscellaneous CPs, had *negative* predictive values, whereas property CPs had *positive* values, indicating significant differences regarding the type of CPs committed by HISKs versus non-HISKs. The preliminary results of Model 2 suggest that HISKs seem to commit *fewer types* of CPs (property CPs) versus non-HISKs (contact sex CPs and miscellaneous CPs). The final model tests both hypotheses to confirm these results and if HISKs categorically committed fewer types of CPs than non-HISKs (Model 3, Table 20).

Hypotheses One and Two: Severity of CPs and Type of CPs

Table 20 presents the third and final binary logistic regression model, which was run to comprehensively test both hypotheses and IVs in the same model to determine if the *severity* of CPs and *type* of CPs significantly affected the likelihood of observing both groups. Consequently, the null hypothesis (H_0) concerning the *severity* of CPs (*Hypothesis 3a*) is that the *severity* of CPs does not significantly predict the serial killer group. The alternative hypothesis (H_1) was that the *severity* of CPs (SCI) significantly predicts the serial killer group membership and that HISKs will commit *more severe* CPs than non-HISKs. The null hypothesis (H_0) regarding the *type* of CPs (*Hypothesis 3b*) is that the *type* of CPs does not significantly predict the serial killer group. The alternative hypothesis (H_1) is that the *type* of CP significantly predicts serial killer group membership and that HISKs will commit *fewer types* of CPs than non-HISKs.

Collinearity diagnostics were performed on all 16 predictors (i.e., five SCI categories and 11 CP types). The 16 predictor variables in Model 3 (Table 20) had VIF scores lower than 10 (VIF range: 1.10 to 7.39). Model 3 also met the assumption of no outlier cases higher or lower than the standardized residual threshold (> 3.3 to < -3.3).[31]

Table 20 reports the final regression results (Model 3) of the severity and the type of CPs, predicting HISKs and non-HISKs. The results of all three models are presented below in Table 20), followed by an overview of Hypotheses 3a, 3b, and the working hypothesis of Study Three and whether the current investigation met the eligibility criteria for the supplementary analyses of the dissertation.

[31]Two predictor categories with VIF scores > 5 = SCI 5: Test runs (VIF = 7.31) and CP 10: Contact sexual CPs (VIF = 7.31). Test runs against humans primarily consist of contact sexual offenses, which caused VIF scores > 5 for these categories.

Table 20

Model 3: Binary Logistic Regressions of Severity and Type of CPs Predicting HISKs and Non-HISKs (N = 326)

Predictors	Model 1: Severity of CPs				Model 2: Type of CPs				Model 3: Severity and Type of CPs			
	B	*SE*	*p*	*OR*	*B*	*SE*	*p*	*OR*	*B*	*SE*	*p*	*OR*
Constant	0.63	0.28	.022	1.88	0.27	0.28	.314	1.32	0.67	0.33	.039	1.96
Severity of CPs (SCI) [a]												
SCI 1: Violent Fantasies	-1.34	0.32	.000**	0.26	---	---	---	---	-1.13	0.40	.004*	0.32
SCI 2: Non-human rehearsals	*ns*	*ns*	*ns*	*ns*	---	---	---	---	*ns*	*ns*	*ns*	*ns*
SCI 3: Non-contact offenses	*ns*	*ns*	*ns*	*ns*	---	---	---	---	*ns*	*ns*	*ns*	*ns*
SCI 4: Contact offenses	*ns*	*ns*	*ns*	*ns*	---	---	---	---	*ns*	*ns*	*ns*	*ns*
SCI 5: Test runs	-0.86	0.24	.000**	0.42	---	---	---	---	*ns*	*ns*	*ns*	*ns*
Type of CPs [a]												
CP 1: Substance CPs	---	---	---	---	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
CP 2: Auto CPs	---	---	---	---	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
CP 3: Fraud CPs	---	---	---	---	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
CP 4: Property CPs	---	---	---	---	1.22	0.27	.000**	3.39	1.42	0.31	.000**	4.13
CP 5: Robbery CPs	---	---	---	---	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
CP 6: Weapon CPs	---	---	---	---	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
CP 7: Animal Cruelty CPs	---	---	---	---	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
CP 8: Assault CPs	---	---	---	---	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
CP 9: Non-contact sex CPs	---	---	---	---	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
CP 10: Contact sex CPs	---	---	---	---	-1.04	0.26	.000**	0.35	*ns*	*ns*	*ns*	*ns*
CP 11: Misc. CPs	---	---	---	---	-0.76	0.25	.003*	0.47	*ns*	*ns*	*ns*	*ns*
-2 Log Likelihood	418.19				401.18				389.16			
Omnibus Tests	$\chi^2(5, N = 326) = 33.74, p = .000$				$\chi^2(11, N = 326) = 50.75, p = .000$				$\chi^2(16, N = 326) = 62.77, p = .000$			
Cox & Snell R^2	.098				.144				.175			
Nagelkerke R^2	.131				.192				.234			
Hosmer & Lemeshow Test	$\chi^2 = 2.83, p = .901$				$\chi^2 = 10.69, p = .220$				$\chi^2 = 2.08, p = .979$			
Classification Accuracy	HISKs = 55.8% Non-HISKs = 73.0% *Overall Model* = 64.4%				HISKs = 65.0% Non-HISKs = 64.4% *Overall Model* = 64.7%				HISKs = 71.2% Non-HISKs = 63.8% *Overall Model* = 67.5%			

Notes. The DV is serial killer group: HISKs (= 1); non-HISKs (= 0). There are 16 predictor IV categories in Model 3: (1) *severity* of CPs (5 SCI categories), and (2) *type* of CP (11 types) was dummy coded (1 = yes; 0 = no). Method of logistic regression = Enter; *Reference group* = non-HISKs. *B* = unstandardized logistic regression coefficient; *SE* = standard error; *p* = significance; *OR* = odds ratio. The model estimates and confidence intervals were rounded to reflect two decimal points. Results of the *-2 Log Likelihood*, *Omnibus Tests*, *Cox* & *Snell* and *Nagelkerke* R^2, *Hosmer* & *Lemeshow Test*, and *Classification Accuracy* scores of HISKs, non-HISKs, and the *Overall Models* are listed at the bottom of Table 20.
[a] Reflects the number of serial killers coded as "yes" (= 1) for the categories of this variable.
*$p < .05$, **$p < .001$

The results reported in Table 20 show that *violent fantasies* and *property* CPs remain noteworthy in the final model (Model 3). The results show that the comprehensive Model 3 containing the five SCI categories and 11 CP types was statistically significant, $\chi^2(16) = 62.77$, $p < .001$, signifying that the model distinguished between HISKs and non-HISKs. Overall, the model (Table 20) explained between 17.5% (Cox & Snell $R^2 =$ .175) and 23.4% (Nagelkerke $R^2 =$ .234) of the variance in the membership of the serial killer group and correctly classified 67.5% of the serial killer cases into the HISK (71.2%) and non-HISK (63.8%) groups. As shown in Model 3 (Table 20), only *two* of the 16 predictor variables/categories made a significant contribution to the model: (1) violent fantasies (SCI 1) and (2) property CPs (CP 4).

The first significant predictor category, violent fantasies (SCI 1), remained statistically significant ($B = -1.13$, OR = 0.32, $p = .004$), which was less than 1, indicating serial killers who have violent fantasies, the odds of belonging to the HISK group are 68% *lower*. Compared to serial killers who do not have violent fantasies, controlling for all SCI categories, CP types, and constant included in Model 3 (Table 20). Property CPs also remained significant ($B = 1.42$, $OR = 4.13$, $p < .001$), indicating that serial killers that committed property CPs, the odds of HISK group membership are more than *four times higher* (313%) compared to non-HISKs, controlling for all SCI categories, CP types, and constant included in Model 3 (Table 20). In contrast, the results in Model 3 (Table 20) indicate that the remaining 14 predictor variables relevant to the *severity* of CPs (IV 1) and the *type* of CPs (IV 2) were not statistically significant in the membership prediction of the serial killer group, nor increased the odds of observing the HISK group (SCI categories 2-5; CP types 1-3 and 5-11).

Finally, the results in Model 3 (Table 20) were applied to both hypothesis 3a (severity of CPs) and hypothesis 3b (type of CPs) of the current investigation. *Hypothesis 3a* that predicted HISKs would commit *more severe* CPs prior to their murder series (H_1) must be *rejected*, and the null hypothesis (H_0) must be *retained*. *Hypothesis 3b* that predicted HISKs would commit *fewer types* of CPs compared to non-HISKs before the murder series (H_1) must also be *rejected*, and the null hypothesis (H_0) must be *retained*. The results in Model 3 (Table 20) indicate that HISKs did not engage in *more severe* CPs, but rather non-HISKs engaged in more severe CPs (violent sexual fantasies) than HISKs. Model 3 (Table 20) also indicates that HISKs *did not* commit *fewer* CP types than non-HISKs, but rather HISKs committed *more* CP types (property offenses) than non-HISKs before their first murder.

6.6 Summary of the Current Investigation

This investigation examined the differences in the non-fatal CPs between HISKs and non-HISKs committed before the murder series. The final regression model (Model 3) of both IVs/hypotheses regarding the *severity* (IV 1) and *type* of CPs (IV 2) revealed *inverse* findings. As HISKs did not engage in *more severe* CPs (hypothesis 3a), nor did they commit *fewer types* of CPs (hypothesis 3b). Contrastingly, non-HISKs engaged in *more severe* CPs (violent fantasies), and HISKs committed *more types* of CPs (property offenses) than non-HISKs. Based on the final model results, both the first and second hypotheses (H_1) of the current investigation were *rejected*, and the null hypotheses (H_0) were *retained*. As the results of Study Three suggest, HISKs do not seem to exhibit *more severe* or *specialized* criminal careers before their first murder than non-HISKs.

The five descriptive variables of both HISKs and non-HISKs: onset age of first CP, age at the first kill, previous arrests, previous jail/prison, and sexual residential burglary, presented similarities and differences. For example, young adults were the most frequently observed age group of first CP for HISKs and non-HISKs. Additionally, age at the first kill, previous arrests, and jail/prison time demonstrated that both serial killer groups shared similarities. The mean age at the first murder was the late 20s, more than 70% had prior arrests, and 60% of HISKs and non-HISKs spent time in jail or prison before their first murder. Contrastingly, the final descriptive variable, sexual residential burglary, illustrated that HISKs committed considerably more sexual residential burglaries (roughly 30%) than non-HISKs (4%) before their first murder.

This chapter's next and final part consists of the supplementary analyses of the *first* and *second* investigations that *met* the *50% criteria condition*. The supplementary analyses were performed to determine whether HISKs warrant a distinct classification from non-HISKs based on their common characteristics (Study One) and geospatial patterns (Study Two). Since the IVs/hypotheses in the current investigation *did not* meet the 50% criteria condition (i.e., *one* of *two* IVs/hypotheses) being statistically significant ($p = < .05$), both IVs from Study Three will be *excluded* from the supplementary analyses in the second part of this chapter.

6.7 Supplemental Analyses

The second part of this chapter consists of the supplemental analyses conducted for the investigations that met the 50% hypothesis criteria condition and includes the following sections: (1) overview of the three investigations and eligibility for the supplemental analyses; (2) analytical strategy of the supplemental analyses; (3) final results of the supplemental analyses; and (4) summary of Chapter 6 and preview of the final chapter of the dissertation (Chapter 7: Discussion and Conclusion).

6.7.1 Overview of the Three Investigations

Based on the existing literature regarding the common characteristics (Study One), geospatial patterns (Study Two), and criminal precipitators (Study Three) of serial killers and home invasion sex offenders, three investigations were conducted to examine the differences between HISKs and non-HISKs. The first investigation (Study One) used Chi-square (χ^2) tests to examine the differences in serial killers' *common characteristics* and tactics in the murder series between HISKs and non-HISKs. Three sets of IVs and hypotheses were tested regarding *victim selection* (i.e., victim type and adults), *modus operandi* (i.e., premeditation and attack method), and *crime scene actions* (i.e., crime scene location type). All five IVs and hypotheses were statistically significant in that HISKs revealed differences in the tactics used during the murder series compared to non-HISKs. HISKs primarily targeted *non-random adult* victims, employed *structured premeditation* and *stalked attacks*, and were more likely to murder *and* dispose of their victims at *single location crime scenes*. The results of Study One met the 50% criteria condition (*three* of *five* IVs/hypotheses) to be included in the supplemental analyses.

The second investigation (Study Two) used Mann-Whitney *U* tests to examine the differences in the geospatial patterns between HISKs and non-HISKs. *Two hypotheses* and *dependent* variables regarding the residence-to-crime (RTC) distance (in miles) and murder series duration (in days) were tested. *One* of the *two* hypotheses and DV was significant (RTC distance). HISKs revealed differences concerning distance traveled during the murder series compared to non-HISKs, as HISKs traveled significantly *shorter* RTC distances than non-HISKs. The results of Study Two also met the 50% criteria condition (*one* of the *two* hypotheses) to be included in the supplemental analyses.

The third and final investigation (Study Three) used binary logistic regression models to examine the differences in non-fatal CPs committed before the murder series between HISKs and non-HISKs. Two hypotheses and IVs relevant to the *severity* of CPs (five SCI categories) and the *type* of CPs (11 types) were tested. Study Three revealed inverse results, as HISKs did not engage in *more severe* CPs, nor did they commit *fewer types* of CPs than non-HISKs prior to their first murder. In contrast, non-HISKs engaged in *more severe* CPs (violent fantasies), and HISKs committed *more types* of CPs (property offenses) before the series. Based on these results, Study Three's first and second IVs/hypotheses were *rejected* and *did not* meet the 50% criteria condition (*one of two* hypotheses). Consequently, both IVs are *excluded* from the supplemental analyses.

In summary, the five IVs/hypotheses relevant to HISKs from Study One (i.e., non-random victim selection, adult victims, structured premeditation, stalked attacks, and single location crime site), as well as the DV/hypothesis from Study Two (i.e., RTC distance) showed statistically significant differences between HISKs compared to non-HISKs. Accordingly, Study One and Study Two met the eligibility criteria for the supplemental analysis as predictor IVs of HISK versus non-HISK group membership. The following section details the analytical strategy of the supplemental analyses.

6.7.2 Analytical Strategy

Binary and multilevel logistic regression (i.e., *hierarchical generalized linear modeling* or HGLM) was performed for the supplemental analyses of Study One and Study Two. Significant variables from Study One (*incident*-level tactics used across the series, $N = 326$) and Study Two (*individual*-level RTC distance traveled by the serial killer to each murder, $N = 1{,}930$) were analyzed as predictor IVs of serial killer group membership (HISK and non-HISK) (DV).

The Study One and Study Two datasets were not normally distributed and consisted of different units of analysis. The non-parametric nature and differences in the units of analysis in the Study One and Study Two datasets yielded several issues in the sole application of binary logistic regression modeling (i.e., overestimated alpha levels, multiple variable significance testing, and reliability and validity issues of merging two diverse level datasets). Therefore, to reduce these problems, several stages were required to perform the supplemental analyses (Corovic et al., 2012; Miyazaki et al., 2019).

First, to examine the significant variables from Study One and Study Two, separate binary logistic regression models were performed using SPSS 27. The binary logistic regression models were run to provide a preliminary assessment and overview of the significant IVs from Study One and Study Two and estimate the *influence* (if any) on the group membership of HISKs and non-HISKs (see Table 21). The first binary logistic regression model included the five significant IVs of Study One (non-random victims, adult victims, structured premeditation, stalked attacks, single location crime scenes) and the prediction of HISK and non-HISK group membership (DV) (see Table 21). The second binary logistic regression model included the *significant dependent* variable, RTC distance traveled (in miles), and the *non-significant* dependent variable, murder series duration, from Study Two. Since the DV in logistic regression must be dichotomous, the RTC distance and murder series duration variables from Study Two were tested as *independent* variables to assess the prediction of HISKs and non-HISKs (DV) (Table 22).

Second, to analyze the Study One and Study Two IVs in a *combined* analysis, a two-level logistic regression model was performed using HLM 8. This statistical software program performs *hierarchical linear* (HLM) and *generalized linear* models (HGLM). In general, multilevel modeling allows for analysis of the relationship between *two* levels or units of analysis: (1) *individual*-level unit of analysis (Level-1, lower level) and (2) contextual-level unit of analysis (Level-2, higher level). One of the critical components of multilevel modeling is to examine individuals *nested within* contextual units of analysis (Hox, 2010). Study One and Study Two datasets were not normally distributed; HGLM was used as it is the non-parametric equivalent to HLM (Raudenbush et al., 2019). HGLM tests the log odds of the individual (Level-1) and contextual (Level-2) IVs associating with two groups of the binary DV (Hox, 2010, see also Torres, 2020).[32]

The *initial* classification criteria and parameters outlined for determining whether HISKs warrant a distinct classification from non-HISKs were to perform a *combined* binary logistic regression model and classification accuracy assessment of all significant predictor IVs from Study One and Study Two. Due to the complexity and multilevel

[32]HLM 8 Software Program by *Scientific Software International* (SSI): https://ssicentral.com/.

nature of the datasets of the common characteristics in Study One (*N* = 326 incident-level tactics) and the geospatial patterns of each serial killer in Study Two (*N* = 1,930 individual-level RTC distances), a two-level logistic regression model (HGLM) was used to analyze the variables of both studies in the final supplemental analysis model.[33]

The final model contained the predictor IVs from Study One (five incident-level tactic IVs) and Study Two (two individual-level IVs of RTC distance traveled and murder series duration). The purpose of running the final HGLM was three-fold: (1) evaluate the *influence* (if any) the IVs from both studies had on HISK and non-HISK group membership; (2) establish if the IVs from both studies *increase* the odds of HISK group membership versus the non-HISK group; and (3) apply the results of the final model to the working hypotheses for each study and conclude whether HISKs merit a distinct classification from non-HISKs based on their common characteristics (Study One) and geospatial patterns (Study Two).

Finally, to determine whether the HISKs warrant a distinct classification from non-HISKs (i.e., working hypotheses for Study One and Study Two), at least *one* of the predictor variables (IVs) of each study had to be statistically significant ($p = < .05$) in the final HGLM model. The working hypotheses of Study One and Study Two determined by the results of the final HGLM model (see Table 23) are described below.

Study One's working hypothesis for the final model was that at least *one* of the *five* IVs (incident-level) significantly predicts the HISK group. As a result, HISKs warrant a distinct classification from non-HISKs based on their common characteristics

[33]HGLM does not generate R-squares or classification accuracy percentages, but it produces the variation percentage of the IVs, standard errors, chi-square statistic, odds ratio, and confidence intervals in the final HGLM outputs.

(H_1). The null hypothesis for Study One was that all five of the IVs *do not* significantly predict the HISKs group, and HISKs *do not* warrant a distinct classification from non-HISKs based on their common characteristics (H_0). Study Two's working hypothesis for the final model was that at least *one* of the *two* IVs (individual-level) significantly predicts the HISK group. As a result, HISKs warrant a distinct classification from non-HISKs based on their geospatial patterns (H_1). The null hypothesis for Study Two was that both IVs do not significantly predict the HISKs group, and HISKs *do not* warrant a distinct classification from non-HISKs based on their geospatial patterns (H_0).

The following section presents an overview of the supplemental analyses and the three regression models performed to assess the significant IVs from Study One and Study Two and the prediction of serial killer group membership (HISKs and non-HISKs). Subsequently, the results and interpretations of each model will be discussed. Finally, the application of the results of the final model (HGLM) to the working hypotheses and classification determination of HISKs for Study One and Study Two will be examined.

6.7.3 Results

The supplemental analyses consisted of three binary logistic regression models: two binary logistic regression models of Study One (see Table 21) and Study Two (see Table 22), and a two-level logistic regression model (HGLM) of the Study One and Study Two predictor IVs (see Table 23). The subsequent section presents the results for each of the three models and is structured in the following order under their respective sections below: (1) general overview; (2) model table; and (3) results and interpretations.

Study One: Binary Logistic Regression of Five Common Characteristics (Incident-Level Tactics) Variables

The first regression model was performed using SPSS to assess whether the five significant common characteristics IVs from Study One (non-random victims, adults, structured premeditation, stalked attacks, and single location crime scenes) significantly influenced the odds of HISK and non-HISK groups (DV). Collinearity diagnostics were performed on all five IVs in the Study One model to determine the presence or absence of multicollinearity (VIF scores should be no greater than 10) (Menard, 2009). The five Study One IVs in the model (Table 21) had VIF scores less than five (VIF range: 1.01 to 3.37). Study One also met the assumption that there were no outlier cases, as no cases had residual values greater than 3.3 or less than -3.3 (Tabachnick & Fidell, 2013).

Table 21 contains the supplemental analysis results of the Study One model performed for the five Study One IVs and the DV of serial killer group (HISKs and non-HISKs). The results of the Study One model are presented in Table 21 below.

Table 21

Study 1: Binary Logistic Regression of Five Incident-Level Tactic IVs Predicting HISKs and Non-HISKs (N = 326)

Predictors	*B*	*SE*	χ^2	*p*	*OR*	95% *CI*	
						LL	*UL*
Constant	-2.01	0.68	8.68	.003	0.13	---	---
IV 1: Non-random victims [a]	0.20	0.39	0.27	.604	1.22	0.57	2.61
IV 2: Adult victims [a]	1.20	0.69	3.02	.082	3.32	0.85	12.85
IV 3: Structured premeditation [a]	-0.42	0.42	0.99	.319	0.66	0.28	1.50
IV 4: Stalked attacks [a]	1.74	0.40	18.97	.000*	5.71	2.60	12.50
IV 5: Single location crime scenes [a]	0.88	0.25	12.53	.000*	2.40	1.48	3.89
-2 Log Likelihood	382.26						
Omnibus Tests	$\chi^2(5, N = 326) = 69.67, p = .000$						
Cox & Snell R^2	.192						
Nagelkerke R^2	.257						
Hosmer & Lemeshow Test	$\chi^2 = 7.38, p = .194$						
Classification Accuracy	HISKs = 74.8% Non-HISKs = 67.5% *Overall Model* = 71.2%						

Notes. The DV is serial killer group: HISKs (= 1); non-HISKs (= 0). The Study One IVs were dummy coded as to whether the serial killer engaged in any of the 5 IV categories (1 = yes; 0 = no). *Reference group* = non-HISKs. *Method* & *Estimation* = Enter, robust standard errors, and exponential parameters. *B* = unstandardized logistic regression coefficient; *SE* = standard error; *p* = significance; *OR* = odds ratio; *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit. The model estimates and confidence intervals were rounded to reflect two decimal points. Results of the *-2 Log Likelihood*, *Omnibus Tests*, *Cox* & *Snell* and *Nagelkerke* R^2, *Hosmer* & *Lemeshow Test*, and *Classification Accuracy* scores of HISKs, non-HISKs, and *Overall Model* are listed at the bottom of Table 21.

[a] Reflects the number of serial killers coded as "yes" (= 1) for this category.

* $p < .001$

The results reported in Table 21 illustrate that the model containing all five Study One IVs was statistically significant, $\chi^2(5) = 69.67$, $p < .001$, demonstrating that the model distinguished between HISKs and non-HISKs. Overall, the model explained between 19.2% (Cox & Snell $R^{2\,=}$ .192) and 25.7% (Nagelkerke $R^{2\,=}$ .257) of the variance in serial killer group membership and correctly classified 71.2% of all serial killer cases in the sample into HISK (74.8%) and non-HISK (67.5%) groups. As shown in Table 21, *two* of the five Study One IVs made a statistically significant contribution to the model: (1) *stalked attacks* and (2) *single location crime scenes*.

The first significant IV in the Study One model, *stalked attacks*, was statistically significant ($OR = 5.71$, $p < .001$), indicating serial killers that used stalked attacks in the murder series, the odds of HISK group membership are more than *five times higher* (471%) compared to non-HISKs, controlling for the IVs and constant included in the model (Table 21). The second significant IV, *single location crime scenes*, was statistically significant ($OR = 2.40$, $p < .001$), indicating serial killers who murdered *and* disposed of their victims at *single location crime scenes* in the murder series, the odds of HISK group membership are more than *two times higher* (140%) compared to non-HISKs, controlling for the IVs and constant included in the model (Table 21).

The remaining Study One IVs: non-random victims, adults, and structured premeditation, did not make a statistically significant contribution to the Study One model (Table 23), indicating that targeting *non-random, adult victims* and employing *structured premeditation* across all incidents in the series, did not have a significant effect on the odds of observing the HISKs group compared to the non-HISKs group.

Study Two: Binary Logistic Regression of Residence-to-Crime (RTC) Distance and Murder Series Duration as *Independent* Predictor Variables

The second regression model was also performed using SPSS to assess whether the significant geospatial patterns dependent variable from Study Two, *RTC distance*, significantly influenced the odds of the serial killer group membership of HISKs and non-HISKs. The three regression models used the serial killer group as the dichotomous DV. As a result, the RTC distance and murder series duration variables of Study Two were analyzed as *independent* predictor variables (see Tables 22 and 23). The dependent variables in Study Two were (1) RTC distance traveled and (2) murder series duration, with the independent variable of serial killer group. While only *one* of the *two* DVs in Study Two was statistically significant (RTC distance), for a logistic regression model to be meaningful, more than one predictor variable was needed to control for other factors in the single and multilevel models (see Tables 22 and 23). Therefore, the non-significant DV from Study Two, *murder series duration* (in days), was also included as a predictor IV in the supplemental analyses.

The regression model for Study Two tested (1) RTC distance and (2) murder series duration, which consisted of continuous *individual*-level data of the serial killer's RTC distance traveled (in miles) to kill each victim and the murder series duration (in days) (Table 22). Collinearity diagnostics were performed on the IVs in the Study Two model to determine the presence or absence of multicollinearity. Both IVs in the Study Two model had VIF scores less than 10 (VIF scores = 1.00). The Study Two model also met the assumption that there were no outlier cases, as no cases had residual values greater than 3.3 or less than -3.3 (Tabachnick & Fidell, 2013).

Table 22 contains the results of the Study Two model that was performed with the RTC distance traveled (in miles) and murder series duration (in days) as independent predictor variables and the DV of serial killer group (HISKs and non-HISKs). The results of the Study Two model are presented in Table 22 below.

Table 22

Study 2: Binary Logistic Regression of RTC Distance and Murder Series Duration as IVs Predicting HISKs and Non-HISKs (N = 1,930)

Predictors	*B*	*SE*	χ^2	*p*	*OR*	95% *CI*	
						LL	*UL*
Constant	.005	.048	.011	.915	1.00	---	---
RTC distance traveled (in miles) [a]	-.001	.000	6.42	.011	.999	.999	1.00
Murder series duration (in days)	.000	.000	.373	.541	1.00	1.00	1.00
-2 Log Likelihood	2668.19						
Omnibus Tests	χ^2(2, *N* = 1,930) = 7.15, *p* =.028						
Cox & Snell *R*^{2}	.004						
Nagelkerke *R*^{2}	.005						
Hosmer & Lemeshow Test	χ^2 = 250.42, *p* = .000						
Classification Accuracy	HISKs = 73.2%						
	Non-HISKs = 30.8%						
	Overall Model = 51.8%						

Notes. The DV is serial killer group: HISKs (= 1) and non-HISKs (= 0). Study Two IV of interest was RTC distance (in miles) calculations, and the control IV of Study Two was murder series duration (in days). *Reference group* = non-HISKs. *Method* & *Estimation* = Enter, robust standard errors, and exponential parameters. *B* = unstandardized logistic regression coefficient; *SE* = standard error; *p* = significance; *OR* = odds ratio; *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit. The model estimates and confidence intervals were rounded to reflect two decimal points. Results of the *-2 Log Likelihood, Omnibus Tests, Cox* & *Snell* and *Nagelkerke R^2, Hosmer* & *Lemeshow Test*, and *Classification Accuracy* scores of HISKs, non-HISKs, and *Overall Model* are listed at the bottom of Table 22.

[a] There were 22 missing RTC distance calculations, and listwise deletion was used.

The results in Table 22 indicate that the model containing the RTC distance traveled (in miles) and murder series duration as predictor IVs was not statistically significant, $\chi^2(2) = 7.15$, p = .028, denoting it was not significant in distinguishing between HISKs and non-HISKs. Overall, the model explained less than 1% (Cox & Snell $R^{2\,=}$ .004; Nagelkerke $R^{2\,=}$ .005) of the variance in the membership of serial killer groups and only correctly classified 51.8% of all cases in the sample. As shown in Table 22, the RTC distance traveled and murder series duration IVs did not make a statistically significant contribution to the Study Two model (Table 22).

Table 22 results show that the *individual*-level IVs of RTC distance traveled (in miles) and murder series duration *did not* significantly affect the odds of HISK and non-HISK group membership. While the model's overall fit was not statistically significant and only correctly classified 51.8% of the cases, both Study Two IVs were included in the final two-level HGLM model (see Table 23). Both Study Two IVs were included to assess the influence of the IVs from both studies on serial killer group membership and whether it increases the odds of HISK group membership compared to non-HISKs.

Study One and Study Two: Two-Level Regression Model of Incident-Level Tactics and Individual-Level Predictor Variables

The final regression model consisted of a two-level hierarchical generalized linear model (HGLM) using HLM 8. The final model contained the IVs from both Study One (five *incident*-level tactics IVs) and Study Two (two individual-level RTC distance traveled and murder series duration IVs) (see Table 23). Unlike the single binary logistic regression models for Study One and Study Two, additional assumptions and stages are involved in conducting HLM and HGLM, which are detailed below.

In addition to the assumptions of binary logistic regression (i.e., DV must be dichotomous, single direction causality, and odds ratio are calculated using exponentiated beta coefficients), there are other assumptions of HLM and its applicability to HGLM. First, HLM can be used for nonlinear distributions to calculate hierarchical generalized linear models (see Table 23). Second, the IVs included in both levels can consist of nominal, ordinal, and interval/ratio IVs. Third, the binary DV must always be included in Level 1 of the model (i.e., lower-level). Finally, to perform an HGLM, the HLM 8 software requires enough variability between both levels to generate both accurate and reliable parameter estimates: Level 1 must include a minimum of 30 observations, and Level 2 must include a minimum of 20 observations (Hox, 2010; see also Torres, 2020).[34]

As the SPSS datasets and IVs from Study One and Study Two consisted of different units of analysis, the IVs of both studies needed to be analyzed as two separate levels of analysis with the DV following a *Bernoulli distribution* of two serial killer groups. The DV in the final model was serial killer group (HISKs = 1 and non-HISKs = 0). The *individual-level* data and IVs (Level-1, Study Two) were the RTC distance traveled (significant DV) and murder series duration (non-significant DV) of the serial killer to murder each victim. The contextual-level data and IVs (Level-2, Study One) were the *incident-level tactics* used across all murders in the series by the serial killers (see Table 23). All the assumptions and conditions listed above for HGLM were satisfied in the final model of the supplemental analysis.

[34]HGLM is suitable for binary dependent variable(s) and uses a canonical logit link function (nonlinear transformation) of the expected average for binary outcomes and is utilized for each level of the model.

The type of model performed consisted of a *nested two-level* HGLM, and the data structure was set to *cross-sectional data* at *one point in time* of persons *within groups*. The unique identifier used to link the Study One and Study Two datasets was the serial killer group. Finally, because the data used from Study One and Study Two were multilevel and followed a Bernoulli distribution, a *penalized quasi-likelihood* (PQL) method was also utilized to generate the HGLM parameter estimates (Breslow & Clayton, 1993; see also Torres et al., 2021). There were several steps required to perform and produce the HGLM model. First, the *intercept-only* model was run as a baseline to determine the goodness-of-fit of the model and proportion variance concerning the grouping structure (HISKs and non-HISKs) and variation of the Level-1 (Study Two) and Level-2 (Study One) data (Hox, 2010, p. 15).

Next, the *intraclass correlation* (ICC) needed to be calculated to compute "the proportion of the variance explained by the grouping structure in the population" (Hox, 2010, p. 15; see also Torres, 2020). The ICC values are calculated for the Level-2 IVs and range from 0 to 1, with ICC values below 0.5 denoting marginal variation and higher values indicating a more significant variation. For multilevel logistic regression models, a *fixed* ICC formula is computed and is listed below (Torres, 2020).[35]

$$\textbf{ICC} = \frac{\textit{Level 2 Variance Component}\ (11.06)}{\text{Level 2 VC } (11.06) + 3.29}$$

The ICC for the intercept model was 11.06, which was divided by 11.06 + 3.29 (14.35) = .77 x 100 = 77%, indicating the Level-2 (Study One IVs) accounted for

[35]*Note*. The Level-1 variance in the ICC formula is permanently fixed at 3.29 as it is the standard distribution assumption used in the variance component for HGLM (Sommet & Morselli, 2017, p. 212).

approximately 77% of the variation in the model. Next, prior to specifying the IVs for the Level-1 and Level-2 models, *grand mean centering* was used to reduce multicollinearity and produce more reliable and accurate regression coefficient estimations. Lastly, to produce the final HGLM, the Level-1 (Study Two) and Level-2 (Study One) IVs were added, and three outputs were computed, which are delineated below.[36]

The Level-1 output included the DV and individual-level RTC distance traveled and murder series duration IVs (Study Two) and contained the following computations:

$$\textit{Sampling Equation}: \text{Prob}(SKGROUP_{ij}=1|\beta_j) = \phi_{ij}$$
$$\textit{Link Function}: \log[\phi_{ij}/(1 - \phi_{ij})] = \eta_{ij}$$
$$\textit{Structural Equation}: \eta_{ij} = \beta_{0j} + \beta_{1j}\, \textit{RTC Distance}_{ij} + \beta_{2j}\, \textit{Series Duration}_{ij},$$

where the sampling equation shows the binary DV of the serial killer group with a Bernoulli distribution (HISKs = 1, non-HISKs = 0) and ϕ_{ij} parameter; the probability of the individual serial killer RTC distance traveled (in miles) and murder series duration (in days) (i) based on incident-level tactics (j) will belong to the HISK group. The link function calculation shows the Bernoulli distribution as the logit link, with η_{ij} representing the logit transformation of the log-odds that a serial killer is a HISK or non-HISK, and coefficients for the incident-level tactics of Study One, Level-2 (β_{0j}), individual RTC distance (β_{1j}) and murder series duration (β_{2j}), in Study Two, Level-1 (Miyazaki et al., 2020; Srholec, 2011).

[36]The *grand mean centering function* converts the intercept (DV) into a critical value and provides further interpretational significance in the final model (Hox, 2010, p. 63; see also Torres, 2020).

The Level-2 model output of the HGLM consisted of the incident-level tactic IVs (Study One) and contained the following formula, which is delineated below.[37]

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\mathit{Adult\ Victims}_j + \gamma_{02}\mathit{Structured\ Premeditation}_j + \gamma_{03}\mathit{Stalked\ Attacks}_j + \gamma_{04}\mathit{Single\ Location\ Crime\ Scenes}_j + u_{0j},$$

where for each incident-level tactic (j), β_{0j} represents the intercept of the Level-1 model, Y_0 represents the incident-level IVs (Study 1), and u_{0j} represents the error term.

Lastly, the mixed model of both Level-1 (individual-level IVs, Study Two) and Level-2 (incident-level tactic IVs, Study One) formulas were calculated for the IVs in both levels and the prediction of HISKs and non-HISKs in the final HGLM formula below (see Table 23):

$$\eta_{ij} = \gamma_{00} + \gamma_{01}\mathit{Adult\ Victims}_j + \gamma_{02}\mathit{Structured\ Premeditation}_j + \gamma_{03}\mathit{Stalked\ Attacks}_j + \gamma_{04}\mathit{Single\ Location\ Crime\ Scene}_j + \gamma_{10}\mathit{RTC\ Distance}_{ij} + \gamma_{20}\mathit{Series\ Duration}_{ij} + u_{0j},$$

where η_{ij} is the log-odds of the serial killer group (HISKs and non-HISKs) based on the incident-level tactics ($\gamma_{01} \ldots \gamma_{04j}$), RTC distance and murder series duration of the individual serial killer (γ_{10} and γ_{20ij}), and u_{0j} is the error term (Miyazaki et al., 2020; Torres et al., 2021). Table 23 contains the supplemental analysis results of the final HGLM of the Study One and Study Two IVs and the prediction HISK and non-HISK groups, which is presented below.

[37]*Note*. The HLM 8 *Student Version* software limits the number of predictor IVs to four per level, which resulted in the first four Study One IVs being run in the Level-2 model: (1) non-random victims; (2) adult victims; (3) structured premeditation; and (4) stalked attacks. Since *stalked attacks* and *single location crime scenes* were the most significant IVs in the single binary logistic model (Table 21), the non-random victim IV was removed from the Level-2 IVs in the final HGLM.

Table 23

Study 1 and Study 2: Hierarchical Generalized Linear Model of Common Characteristics and Geospatial Patterns IVs Predicting HISKs and Non-HISKs

Variables	*Coefficient*	*SE*	*OR*	*p*
Intercept	0.011	0.119	1.011	0.928
Study 1 (Incident-Level IVs, Level-2)				
Non-random victims	0.179	0.362	1.201	0.611
Adult victims	0.999	0.586	2.717	0.089
Structured premeditation	-0.242	0.329	0.784	0.462
Stalked attacks	1.710*	0.360	5.529	< 0.001
Single location crime scenes	0.818*	0.238	2.266	< 0.001
Study 2 (Individual-Level IVs, Level-1) [a]				
RTC distance (in miles)	-0.000	0.000	0.999	0.774
Murder series duration (in days)	0.000*	0.000	1.000	< 0.001

Notes. DV is serial killer group: HISKs (= 1); non-HISKs (= 0). *Incident*-level tactic IVs: (Study 1, Level-2) = dummy coded (1 = yes; 0 = no) to reflect whether the serial killer engaged in any of the tactic IVs in the series (*N* = 326). *Individual*-level IVs (Study 2, Level-1) = RTC distance (in miles) traveled by an individual serial killer to murder each victim during the series (*N* = 1,930) and murder series duration (in days) as the control IV for Level 1. HGLM functions: *Bernoulli distribution*; *PQL parameter estimates*; Level 1 and 2 IVs = *fixed* effects with *grand mean centering*; intercept = *random* effects; and final estimation *with robust standard errors*. L1 Variance = *fixed* (3.29) and L2 Variance = 11.04/11.04 + 3.24 x 100 = 77%, denoting the Level 2 IVs account for 77% of the variation in the final model. *SE* = standard error; *OR* = odds ratio.
[a] There were 22 missing RTC distance calculations, and listwise deletion was used.
**p* < 0.001

Similar to the single regression models (Tables 21 and 22), the results in Table 23 show that the incident-level tactic IVs of *stalked attacks* and *single location crime scenes* remain noteworthy in the final model. Table 23 shows a consequential effect of serial killers that use stalked attacks and single location crime scenes across all incidents in the murder series on the probability of the HISK group membership compared to non-HISKs.

The first and *most* significant IV of Study 1 (Level-2), *stalked attacks,* was statistically significant (OR = 5.529, p = < .001), indicating serial killers that used stalked attacks in the murder series, the odds of HISK group membership are more than *five times higher* (452.9%) compared to non-HISKs, controlling for the intercept and the Study One and Study Two IVs included in the final model (Table 23). The second significant IV of Study 1 (Level-2), *single location crime scenes*, was statistically significant (OR = 2.226, p = < .001), indicating serial killers that murdered *and* disposed victims at single location crime scenes, the odds of HISK group membership are more than *two times higher* (122.6%) compared to non-HISKs, controlling for the intercept and the Study One and Study Two IVs included in the final model (Table 23).

In contrast, Table 23 shows that the remaining incident-level tactic IVs (Study One) of non-random, adult victims and structured premeditation did not significantly contribute to the final model. These results indicate that targeting non-random, adult victims and employing structured premeditation across all incidents in the murder series did not significantly affect the odds of HISK versus non-HISK groups (Table 23).

Finally, the effects of the individual-level RTC distance traveled, and murder series duration IVs (Study 2, Level-1) on the probability of the HISK group compared to non-HISKs are also reported in Table 23. When considering the exponentiated coefficients of the grand mean, serial killers' RTC distance traveled (in miles) *did not* significantly contribute to the final model (Table 23). The final model in Table 23 also shows that the RTC distance traveled IV *does not influence* the odds of HISK and non-HISK group membership, nor does it *increase* the odds of HISK group membership. This result denotes the RTC distance traveled (in miles) by an individual serial killer to murder each victim did not significantly affect the odds of HISK versus non-HISK groups.

The murder series duration (in days) IV that was included as a control IV in Level-1 (Study 2) was marginally significant (*OR* = 1.000, $p = < .001$), indicating a *minimal* contribution to the final model (Table 23). However, the odds ratio of the murder series duration IV is precisely 1. These results indicate that the duration of serial killers' murder series *did not* significantly affect the odds of HISK versus non-HISK group membership, controlling for the intercept and the Study One and Study Two IVs included in the final model (Table 23). The final portion of the supplemental analysis concerning the working hypotheses of Study One and Study Two and the determination of whether HISKs warrant a distinct classification from non-HISKs based on their common characteristics and geospatial patterns is detailed below.

Working Hypotheses of Study 1 and Study 2: Do HISKs Warrant a Distinct Classification from non-HISKs?

The final stage of the supplemental analysis was to apply the results of the final model to the working hypotheses for each study and conclude whether HISKs warrant a distinct classification from non-HISKs based on their common characteristics (Study 1) and geospatial patterns (Study 2). The classification criteria required at least *one* of the IVs from each study to be significant ($p = < .05$) in the HGLM (Table 23).

The final model results relevant to the *working hypothesis* of *Study One* revealed the null hypothesis (H_0) that predicted the five IVs would not significantly predict the HISK group and that HISKs would not warrant a distinct classification from non-HISKs based on their common characteristics can be *rejected*. The working hypothesis of Study One (H_1) can be *accepted*. The final model confirmed that *two* of the five IVs in Study One, *stalked attacks*, and *single location crime scenes*, significantly predicted the HISKs group. Therefore, HISKs *warrant a distinct classification* from non-HISKs based on their common characteristics for Study One (Table 23).

In contrast, the final model results for the *working hypothesis* of *Study Two* revealed the null hypothesis (H_0) that predicted both IVs would not significantly predict the HISK group and HISKs would not warrant a distinct classification from non-HISKs based on their geospatial patterns must be *retained*. The working hypothesis of Study Two (H_1) must be *rejected*. The final model showed that the RTC distance and murder series duration *did not* significantly predict the HISK group. Thus, HISKs *do not* warrant a distinct classification from non-HISKs based on their geospatial patterns for Study Two (Table 23). The final section of this chapter summarizes the results of Chapter 6 (Study Three and supplemental analyses) and a preview of the final chapter of this dissertation.

6.8 Chapter 6 Summary

This chapter consisted of two parts: (1) Study Three and (2) supplementary analyses of the investigations that met the 50% classification criteria condition and included in the supplemental analyses (Study One and Study Two). The first part of Chapter 6 (Study Three) examined the differences of *non-fatal criminal precipitators* (CPs) committed before the murder series between non-HISKs and HISKs. Two IVs and hypotheses relevant to the non-fatal CPs (*severity* of CPs and *type* of CPs) were analyzed using binary logistic regression to determine whether each of the IVs was significant in the prediction of HISK and non-HISK groups (DV).

The overall results of Study Three *did not meet* the 50% classification criteria condition (*one* of *two* hypotheses). The hypotheses of Study Three relevant to the non-fatal CPs of serial killers were *rejected* as both predictor IVs revealed *inverse* findings: HISKs did not engage in *more severe* CPs, nor did they commit *fewer types* of CPs. Contrastingly, non-HISKs engaged in *more severe* CPs (violent fantasies), and HISKs committed *more types* of CPs (property offenses) than non-HISKs. Therefore, both IVs of Study Three were *excluded* from the supplemental analyses portion of Chapter 6.

The second part of Chapter 6 included the supplemental analyses and logistic regression models of the two investigations that met the 50% classification criteria condition: Study One (*five* IVs/hypotheses) and Study Two (*one* of the *two* hypotheses). The five IVs and hypotheses relevant to HISKs from Study One (non-random, adult victims, structured premeditation, stalked attacks, and single location crime scenes) and the significant variable of RTC distance (i.e., HISKs traveled *shorter* RTC distances) from Study Two revealed statistically significant differences between HISKs compared to non-HISKs. The significant variables from both studies were eligible and included in the supplemental analyses as predictor IVs of serial killer group membership (DV).

Three binary logistic regression models were performed in the supplemental analyses: two binary logistic regression models for the Study One and Study Two IVs; and a two-level binary logistic regression model (HGLM). The results of the final HGLM were then applied to the working hypotheses for both investigations to conclude whether

HISKs warrant a distinct classification from non-HISKs based on their common characteristics (Study 1) and geospatial patterns (Study 2), requiring at least *one* of the IVs from each study in the HGLM to be statistically significant ($p = < .05$).

The final model in the supplemental analysis for Study One revealed that *two* of the five IVs (common characteristics) were statistically significant in the prediction of the HISK group compared to non-HISKs: stalked attacks (452.9% *higher*) and single location crime scenes (122.6% *higher*). Since *two* of the *five* IVs were statistically significant in predicting the membership of the HISK group, HISKs *warrant a distinct classification* from non-HISKs based on their common characteristics for Study One (Table 23). In contrast, the final model for Study Two showed that the RTC distance traveled and murder series duration IVs were *not* statistically significant in predicting the HISK group. Consequently, the results indicate that HISKs *do not* warrant a distinct classification from non-HISKs based on their geospatial patterns for Study Two (Table 23).

The subsequent and final chapter of this dissertation summarizes the results of all three investigations (Chapters 4, 5, and 6) and the supplemental analyses of Study One and Study Two related to the existing literature in the field of serial homicide. The theoretical and policy implications concerning the results of each of the three investigations and supplemental analyses be reviewed. An overview of the limitations will also be discussed. Lastly, Chapter 7 concludes with recommendations for future research specifically concerning home invasion serial homicide and future comparative studies between HISKs and non-HISKs.

CHAPTER 7

VII. DISCUSSION AND CONCLUSION

This dissertation aimed to address the substantial gap in serial homicide literature regarding HISKs and add to existing policy by providing insight and approaches to assist in serial murder investigations of such killers. A retrospective comparative research design and proportionate stratified random sampling of 326 serial killers were used to examine the differences between HISKs (*n* = 163) and non-HISKs (*n* = 163) in three investigations: (1) common characteristics; (2) geospatial patterns; and (3) non-fatal criminal precipitators. Examining the differences between HISKs and non-HISKs in these three analytical dimensions revealed noteworthy findings and implications. This chapter will summarize the results of Chapters 4 (Study One), 5 (Study Two), and 6 (Study Three). This dissertation's theoretical and policy implications will be discussed, followed by a review of the limitations of each investigation, and finally, recommendations for future research concerning home invasion serial homicide, HISKs, and comparative studies between both serial killer groups.

7.1 Study One: Common Characteristics of HISKs Versus Non-HISKs

In Chapter 4, two environmental criminology theories (1) Cohen and Felson’s routine activity theory (RAT) and (2) Cornish and Clarke’s rational choice theory (RCT), served as the theoretical framework to examine the common characteristics of HISKs and non-HISKs. Although there is limited research on the common characteristics of HISKs, the analyses conducted in Study One advance our understanding of these characteristics by establishing that HISKs exhibit notable differences in their victim selection, modus operandi, and crime scene actions compared to non-HISKs. The following section summarizes the results of Study One (Chapter 4) and the supplementary analyses of Study One (Chapter 6) relevant to the existing literature in the field of serial homicide. The theoretical and policy implications will also be discussed, followed by the limitations of Study One and avenues for future research.

7.1.1 Results from Chapter Four (Study One)

Chapter 4 (Study 1) investigated the *common characteristics* of HISKs and non-HISKs to address the considerable void in serial homicide research. *Victim selection*, *modus operandi*, and *crime scene actions* were examined to determine if differences exist between both serial killer groups. The results in Chapter 4 revealed that HISKs significantly differed in their common characteristics compared to non-HISKs. All of the IVs/hypotheses in Chapter 4 were statistically significant. As HISKs primarily targeted *non-random adult* victims, used *structured* premeditation and *stalked* attacks, and murdered and disposed of their victims at *single location crime scenes* during the murder series. In contrast, the results in Chapter 4 revealed that non-HISKs exhibited *mixed* victim selection and *premeditation* types, employed *ambushed* attacks and murdered, then disposed of their victims at *multiple location crime scenes*.

The initial results in Chapter 4 (Study 1) are consistent with prior research that has applied RAT and RCT perspectives to investigate the offending patterns of *non-fatal* home invasion sex offenders. Previous studies indicate such offenders exhibit differences in their offending patterns demonstrating highly rational decision-making processes before, during, and after offenses than non-residential sex offenders (Deslauriers-Varin & Beauregard, 2010; Ensslen et al., 2018; Pedneault et al., 2015b; Vaughn et al., 2008). In particular, home invasion sex offenders such as sexual burglars and rapists exhibit heightened levels of situational premeditation by targeting easily accessible residences, frequently occupied by victims who were alone (Pedneault et al., 2015b). Ensslen et al. (2018) also found that home intruder rapists commonly target *non-random adult* victims and employ *structured* premeditation. The initial findings of Chapter 4 show HISKs demonstrate similar offending patterns to home invasion sex offenders. As HISKs demonstrate heightened situational preparation in targeting specific victims within their residence, gaining access to such residences through structured premeditation and stalked methods, and murdered and left their victims at single locations during the murder series.

Results from Chapter Six (Supplementary Analyses of Study One)

Chapter 4 (Study One) results were further investigated in Chapter 6 (Supplementary Analyses) using binary and multilevel logistic regression models to determine whether HISKs warrant a distinct classification from non-HISKs. The final multilevel model in Chapter 6 (Study One) illustrated that HISKs exhibit significant differences in their modus operandi (*stalked attacks*) and crime scene actions (*single location crime scenes*) compared to non-HISKs. These results indicated that both stalked attacks and single location crime scenes remained noteworthy and were statistically significant in the prediction of the HISK group compared to non-HISKs. Lastly, the findings in Chapter 6 revealed that HISKs *warrant a distinct classification* from non-HISKs based on their common characteristics.

The Chapter 6 (Study One) findings seem to be consistent with previous studies relevant to serial killers, home invasion sex offenders, and other violent serial offenders in several ways. First, the results of the initial model in Chapter 6 of the five IVs of Study

One reported *pseudo-R^2* values that explained between 19.2% and 25.7% of the variance in serial killer group membership and correctly classified 71.2% of the serial killer cases into HISK (74.8%) and non-HISK (67.5%) groups. Preliminary results in Chapter 6 also indicate that two of the five IVs significantly contributed to the model: (1) *stalked attacks* and (2) *single location crime scenes*.

Various studies have used logistic regression models to examine the offense patterns of violent serial offenders (Cale et al., 2010; Chai et al., 2021; Corovic et al., 2012; DeLisi & Scherer, 2006; Leary et al., 2017; Pakkanen et al., 2015). The results of previous models reported *pseudo-R^2* values less than .1 to over .6 of the variance in serial versus non-serial offender group membership, with overall classification scores ranging from 65% to over 90% of both groups. Thus, Chapter six's initial Study One regression model suggests *average* results in model fit and classification prediction related to the larger literature in this field.

Second, the final multilevel model (HGLM) in Chapter 6 showed that the IVs of Study One accounted for 77% of the variation in the model, which is indicative of *above-average* results for multilevel logistic regression models (Hox, 2010). The final HGLM in Chapter 6 also revealed that *stalked attacks* and *single location crime scenes* remained noteworthy in the concluding stage of the supplemental analyses. Such results showed a consequential effect of serial killers that use stalked attacks and single location crime scenes across all incidents in the series on the probability of HISK group membership compared to non-HISKs. Serial killers that used *stalked attacks* throughout the murder series, the odds of HISK group membership are over *five times higher* (452.9%) than non-HISKs. Additionally, serial killers that both murdered *and* disposed of their victims at *single location crime scenes* during the series, the odds of HISK group membership are over *two times* higher (122.6%) than non-HISKs. The differences of the modus operandi and crime scene actions of HISKs are similar to previous research on the offense patterns of home invasion sex offenders (Deslauriers-Varin & Beauregard, 2010; Harris, 2013)

Finally, previous researchers have highlighted the differences in the offense patterns of home invasion sex offenders, asserting they constitute a distinct type of predatory criminal compared to non-residential sex offenders (Ensslen et al., 2018; Pedneault et al., 2015b; Vaughn et al., 2008). Both Pedneault et al. (2015b) and Vaughn et al. (2008) contend residential predatory offenders illustrate similarities in their offense styles and decision-making processes during the crime series (i.e., non-random victim selection, high levels of premeditation and forensic awareness, and crime site selection of the victim's residence). Similarly, Ensslen et al. (2018) investigated home intrusion sex offenders and asserted that such offenders constitute a unique class of criminal, comparable to *the sexual burglar* proposed by Pedneault et al. (2015b).

Consistent with previous research, the initial results and supplemental analyses of Study One indicate that HISKs warrant a distinct classification from non-HISKs based on their common characteristics. Therefore, Study One addresses the research gap concerning HISKs and also supports the contention that such residential predatory offenders are unique concerning their common characteristics compared to non-home invasion sex offenders (Ensslen et al., 2018; Pedneault et al., 2015b; Vaughn et al., 2008). The theoretical and policy implications of Study One are discussed below.

7.1.2 Implications

These findings reveal several noteworthy theoretical implications. First, Chapter 4 showed significant differences in the victim selection, MO, and crime scene actions of HISKs. These findings support RAT and RCT perspectives, as HISKs seem to demonstrate rational decision-making processes regarding their victim selection, MO, and crime scene actions throughout the murder series. RAT highlights the importance of routine activities of both victims and offenders and a suitable target, motivated offender, and lack of capable guardianship (Cohen & Felson 1979). Support for RAT is demonstrated in the initial findings in Chapter 4, as HISKs ostensibly targeted and murdered *non-random adult* victims using *structured premeditation*, *stalked attacks*, and murdered and disposed of victims at single location crime scenes (i.e., victim's residence) (Ensslen et al., 2018; Pedneault et al., 2015b; Vaughn et al., 2008).

Support for RCT is also illustrated in the initial results of Chapter 4 as HISKs exhibited rational decision-making processes by selecting non-random adult victims, highly methodical MO, and consistency in single crime scene locations (Cornish & Clarke, 1986). Similar to previous assertions, it appears that victims' residences attract HISKs as they provide an indoor, private, and controlled environment for serial killers to carry out the murders (e.g., less risk of witnesses, indoor location, and easily escapable) (Deslauriers-Varin & Beauregard, 2010; Ensslen et al., 2018; Pedneault et al., 2015b).

Second, when further investigating the five IVs from Study One and the prediction of serial killer group membership, Chapter 6 shows support for both RAT and RCT perspectives and previous research on home invasion sex offenders. Similar to the *home intruder sex offender* and the *sexual burglar*, the present study's findings reveal significant differences between both serial killer groups (see Ensslen et al., 2018; Pedneault et al., 2015b). As *stalked attacks* and *single location crime scenes* significantly predicted HISK group membership and revealed that HISKs warrant a distinct classification from non-HISKs. These findings lend further evidence to support that home invasion serial offenders are inherently unique in their offending patterns than non-residential serial offenders (Ensslen et al., 2018; Pedneault et al., 2015b).

Finally, sufficient attention has not been afforded to an in-depth investigation of the common characteristics of HISKs and whether such serial killers are distinct from non-residential serial killers. Therefore, the results of Study One offer the first comprehensive investigation of the common characteristics of HISKs to address the void in existing research regarding home invasion serial homicide. The present study also provides readers, academics, and law enforcement with a greater understanding of the common characteristics of HISKs. It also raises public awareness of the prevalence of home invasion serial homicide.

From a policy standpoint, these findings are essential for law enforcement agencies (LEAs) and crime analysts in serial murder investigations. First, since Chapter 4 revealed notable differences between both serial killer groups regarding their common characteristics, such findings can assist LEAs and serve as an investigative blueprint for the type of serial killer they are investigating. For instance, the initial results in Chapter 4 revealed HISKs were more likely to target non-random adult victims, employ structured premeditation and stalked attacks, and murder and dispose of their victims at single location crime scenes. In contrast, non-HISKs were more likely to target *random* and *non-random* victims, using *mixed premeditation* and *ambushed attacks*, and murder and dispose of their victims at *multiple locations* during the murder series.

Second, while the supplemental analyses in Chapter 6 revealed only stalked attacks and single location crime scenes were significant predictors of serial killer group membership, these results illustrated support for HISKs warranting a distinct classification from non-HISKs. Therefore, if an active serial killer uses the victim's residence as the locus of their murders, the findings of Study One can be applied to such cases. Third, the results of Study One can also offer assistance to crime analysts on the issue of *linkage blindness* (i.e., the inability to connect cases within the serial murder series). Crime analysts can cross-reference murder cases with similar victim selection, MO, and crime scene characteristics to decipher the type of serial killer (HISK or non-HISK) to link murders committed by the same serial killer.

Lastly, from *situational crime prevention* (SCP) perspective, LEAs should use the findings of Study One to increase awareness of the SCP measures that residents should implement to deter HISKs proactively. Examples of such SCP measures include (but are not limited to): locking all doors and windows; closing window blinds; increased capable guardianship by installing security systems and security cameras (e.g., conceivable entrances of the residence such as first floor doors, windows, garages); indoor and outdoor censored lighting systems; and easily accessible emergency calling or panic mechanisms in the home (see Ensslen et al., 2018, p. 4709).

7.1.3 Limitations and Suggestions for Future Research

Despite the significance and implications of the findings of Study One (Chapter 4) and supplemental analyses (Chapter 6), it is important to address the limitations of the current study, as it offers avenues for future research. First, the sampling method utilized for this dissertation was *proportionate stratified random sampling* and did not include all of the 2,121 serial killer cases from the RU/FGCU SKD (2019) pertinent to this dissertation (HISKs = 677; non-HISKs = 1,444). Power analysis was utilized to calculate an equal number of cases to be stratified for both groups (HISK = 163 cases; non-HISK = 163 cases). Simple random sampling was then used to randomly draw cases for each stratum and subsequently replace cases in each stratum where JTC data could not be obtained. As a result, a total of *84 cases* needed to be *removed* and *replaced* from the original random sample for each stratum (34 HISKs and 50 non-HISKs) by repeating the random sampling procedure several times, representing approximately *25%* of the *overall sample* that was removed and replaced with other randomly drawn cases.

Second, the RU/FGCU SKD (2019) and supplementary public information searches were used to construct three of the five IVs in Study One (i.e., victim selection type, crime premeditation, and attack method). Discernibly, there are limitations in using secondary data and publicly available resources, such as reliability and validity issues. However, RU/FGCU SKD (2019) data has been deemed reliable, valid, and frequently updated to reflect accurate information on serial killers and their victims (Aamodt et al., 2016, 2020; Woster, 2020). Additionally, any data collected during the supplementary searches for Study One and used to construct the IVs were cross-referenced through various resources such as court records, government/non-government reports, online and television interviews or documentaries, and additional true crime resources.

Third, since all of the IVs in Study One was categorical, the data were not normally distributed. Therefore, non-parametric testing (χ^2tests and logistic regression) needed to be performed for the present study. Recognizably, there are various limitations associated with non-parametric tests, such as fewer statistical assumptions, results are less powerful and less accurate due to the absence of a normal distribution, and less efficient than parametric tests (McHugh, 2013; Pallant, 2020). Consequently, future studies in this domain should use normally distributed data and parametric testing to provide more rigorous and definitive findings of the present study.

Fourth, due to the *student version* of the HLM 8 software restrictions, the supplemental analyses in Chapter 6 did not include the Study One IV categories significant for *non-HISKs* (i.e., mixed victim and premeditation types, ambushed attacks, and multiple location crime scenes). Thus, future studies in this area should perform comprehensive regression models of the five significant IVs for HISKs and four significant IVs for non-HISKs. Such models may increase the odds and classification accuracy of serial killer group membership.

Finally, since this dissertation was the first comprehensive examination of HISKs, it was limited to serial killers that murdered *one* or *more victims* at their residence (HISKs) and non-residential serial killers (non-HISKs). Consequently, this dissertation did not distinguish between *static* HISKs (serial killers that solely murdered victims in their residence) and *dynamic* HISKs (serial killers that murdered victim(s) at their home *and* other non-residential locations). The further delineation of the two HISK subtypes fell outside the scope of this dissertation. Thus, based on the present study's findings, future research is needed on the subtypes of HISKs (static and dynamic) and comparative research using both HISK subtypes versus non-HISKs.

In addition to the limitations outlined above, it is recommended that further research be undertaken in several key areas relevant to HISKs and home invasion serial homicide. First, based on the findings of Ensslen et al. (2018) and Pedneault et al. (2015b), future research should focus on the *situational characteristics* relevant to the victims of HISKs (e.g., whether the victim was home alone during the murder). Similarly, other situational factors of HISK victims should include the location of the victim(s) within the residence, if they were sleeping, and the type of entry methods used by HISKs to gain access to the victim's home.

Second, using the RAT and RCT perspectives, structural and environmental characteristics of victims' residences should also be considered. For example, if the victims lived in a one-story or two-story home, ground-level apartment, or the domicile was easily accessible to the HISK (Ensslen et al., 2018). Finally, from an SCP perspective, future research should examine whether the victims' residences displayed SCP measures such as locked windows and doors, closing window blinds, security systems or surveillance cameras, and censored lighting. Considering these factors would help identify whether or not victims used SCP measures and provide a comparative baseline of the preventive efficacy of such measures in HISK cases.

In summary, future research should utilize the perspectives of RAT and RCT to examine the situational and environmental characteristics of the murdered victims and the residences targeted by HISKs. This research may help implement preventive measures by residents. Such measures may also deter or prevent HISKs from targeting and murdering victims within their residences in the future.

7.2 Study Two: Geospatial Patterns of HISKs Versus Non-HISKs

In Chapter 5, three environmental criminology theories (1) routine activity theory (RAT), (2) rational choice theory (RCT), and (3) crime pattern theory (CPT), served as the theoretical framework for examining the geospatial patterns of HISKs and non-HISKs (Brantingham & Brantingham, 1981; Cohen & Felson, 1979; Cornish & Clarke; 1986). Until now, minimal attention has been given to the geospatial patterns of HISKs. Thus, Study Two appears to be the first comparative investigation regarding the geospatial patterns of HISKs and non-HISKs.

The analyses performed for Study Two enhance our understanding of the geospatial patterns of both serial killer groups by establishing that HISKs show *both differences* <u>and</u> *similarities* with non-HISKs in their residence-to-crime (RTC) distances traveled during the murder series. In comparison, no significant differences were found in the murder series durations of both serial killer groups. The following section summarizes the results of Study Two as it relates to the larger field of serial homicide literature. The theoretical and policy implications will also be discussed, followed by the limitations of Study Two and recommendations for future research.

7.2.1 Results from Chapter Five (Study Two)

Chapter 5 (Study 2) investigated the geospatial patterns of HISKs and non-HISKs to address the considerable gap in the existing serial homicide literature. The *residence-to-crime (RTC) distance* traveled, and *murder series duration* were examined to determine if differences exist between both serial killer groups. The results in Chapter 5 revealed that, as a *dependent* variable, the RTC distance traveled significantly varied between both groups. The initial results of Chapter 5 also showed evidence to support that HISKs traveled significantly *shorter* RTC distances than non-HISKs during the murder series. In contrast, the results in Chapter 5 showed that, as a *dependent* variable, the murder series durations did not significantly vary between both groups. Moreover, HISKs did not exhibit significantly shorter murder series durations than non-HISKs.

The initial results in Chapter 5 (Study 2) are both *consistent* and *inconsistent* with previous research concerning the geospatial patterns of home invasion sex offenders through RAT, RCT, and CPT perspectives. Previous studies indicate that such offenders seem to travel the *shortest* JTC distances compared to non-residential sex offenders (Beauregard et al., 2010; Dern et al., 2005; Rebocho & Silva, 2014). Relatedly, existing research suggests that shorter distances traveled by serial killers and home invasion sex offenders often result in *swifter* apprehensions and, in turn, *shorter* crime series durations than non-residential offenders (Beauregard et al., 2010; Lammer & Bernasco, 2013; Martineau & Beauregard, 2016; Rossmo, 1995; Van Patten & Delhauer, 2007).

Consistent with previous research findings, the initial results of Chapter 5 (Study Two) revealed that, as a *dependent* variable, the RTC distance traveled significantly varied between both groups of serial killers (IV). The results reported in Chapter 5 also showed evidence to support that HISKs traveled significantly *shorter* RTC distances than non-HISKs (Beauregard et al., 2010; Dern et al., 2005; Martineau & Beauregard, 2016). In contrast to previous studies, Chapter 5 showed that as a *dependent* variable, the murder series durations *did not* significantly vary between the two serial killer groups.

Results from Chapter Six (Supplemental Analyses of Study Two)

The results and dependent variables in Chapter 5 (Study Two) were further investigated as *independent* variables in Chapter 6 (Supplementary Analyses) to determine whether HISKs warrant a distinct classification from non-HISKs. Contrary to expectations, the findings of Chapter 6 *did not* show evidence to support that RTC distance *or* murder series duration were significant *independent* variables in the prediction of HISK or non-HISK groups. Furthermore, these findings *did not* show evidence to support the working hypothesis of Study Two that predicted HISKs would warrant a distinct classification from non-HISKs based on their geospatial patterns. Therefore, the overall findings in Chapter 6 are contradictory to previous studies concerning the geospatial patterns of home invasion sex offenders that have found such offenders travel shorter distances and exhibit shorter series durations than non-residential sex offenders (Beauregard et al., 2010; Dern et al., 2005; Rebocho & Silva, 2014).

However, the final results of the supplemental analyses and working hypothesis of Study Two must be *interpreted with caution* due to the different analytical methods and functions of the variables used in Chapter 5 compared to the supplemental analyses in Chapter 6. For instance, the RTC distance and murder series duration consisted of continuous data analyzed in Chapter 5 (Mann Whitney *U* tests) as *dependent* variables and serial killer group as the *independent* variable. In contrast, Chapter 6 analyzed RTC distance and murder series duration as *independent* variables (logistic regression) to predict the *dependent* variable of serial killer group. As a result, the reversal of the RTC distance and murder series duration from DVs to IVs may have impacted the results of the supplemental analyses and working hypothesis of Study 2. Thus, more research is needed to understand better the relationships and variance between both groups' RTC distances traveled and murder series durations.

While the final results of the present study did not show significant differences between the geospatial patterns of both serial killer groups, the findings deliver the first comparative investigation of HISKs and non-HISKs to address the considerable gap in existing serial homicide research. Furthermore, Study Two offers some insight into the RTC distances traveled by both groups as a *dependent* variable, in that HISKs traveled significantly *shorter* distances than non-HISKs during the series (Chapter 5). Conversely, as an *independent* variable, RTC distance traveled does not seem to significantly vary or predict either group of serial killers. Finally, the murder series durations of both serial killer groups did not differ substantially as a *dependent* variable or predict serial killer group as an *independent* variable. The theoretical and policy implications of the results of Study Two are discussed in the following section.

7.2.2 Implications

Despite the unexpected results of Study Two, several important theoretical and policy implications can be gleaned from the present study. From a <u>theoretical standpoint</u>, these findings raise important theoretical considerations regarding the geospatial patterns of both serial killer groups. Application of RAT, RCT, and CPT perspectives in previous research on geospatial patterns of home invasion sex offenders indicates that such offenders typically exhibit shorter JTC distances and crime series durations (Beauregard et al., 2010; Dern et al., 2005; Rebocho & Silva, 2014). However, the results of Chapter 6 are contradictory to previous research. RTC distance and murder series duration did not significantly predict serial killer group membership as *independent* variables. The present study's findings suggest that HISKs and non-HISKs *may not be as different in their geospatial patterns* as initially anticipated.

There are several possible explanations for these findings. First, this may be due to the number of victims murdered by each serial killer in the sample. For example, more prolific serial killers with higher victim counts may feel more comfortable traveling outside their comfort zone and have higher levels of forensic awareness than less prolific serial killers (Rossmo, 1995; Synnott et al., 2019). Second, node-to-crime (NTC) distance was not included in the analyses. Nodes such as occupational and recreational locations of serial killers in the sample could have affected the distance traveled by both groups to each murder. Initially, some node points were collected in the preliminary JTC data searches. However, due to the amount of missing data relevant to the node points of most serial killers in the sample, these data could not be analyzed in the present study. It is essential to note the considerable void in existing research regarding the impact of NTC distances traveled by serial killers and other serial offenders, which warrants a comprehensive investigation in future studies.

Third, many non-HISKs murder victims in their own homes or at the killer's occupation (i.e., angels of death) and, as a result, do not travel far or at all to kill their victims. Consequently, these murder locations may influence the RTC/NTC distances traveled, criminal range, and murder series durations of non-HISKs (Hickey, 2016). Future studies should consider these factors and their impact on the geospatial patterns of both HISKs and non-HISKs.

Lastly, adequate attention had not been afforded to a comprehensive investigation of the geospatial patterns of HISKs and whether such serial killers are distinct from non-HISKs. The present study also investigated the RTC distance traveled and murder series durations of HISKs and non-HISKs as both *dependent* and *independent* variables.

Therefore, Study Two serves as a comparative baseline for further understanding the geospatial patterns of both serial killer groups to address the gap in existing research on home invasion serial homicide. Taken together, the contradictory findings of this study relevant to environmental criminology (RAT, RCT, and CPT) and the geospatial patterns of both serial killer groups provide avenues for future research in this domain.

From a policy standpoint, these findings imply that in addition to murder locations, distance traveled, and series duration, LEAs and crime analysts should consider numerous geospatial factors in serial murder investigations. Such geospatial factors include (but are not limited to): the number of victims, NTC distances, geographic region(s) and range of the murders, and victim characteristics (Canter, 2003; Rossmo, 2005; Synnott et al., 2019). Temporal aspects of the murder series should also be considered (i.e., daytime versus nighttime, day of the week, the number of days between each murder, and lunar cycles). Exclusively investigating the murder location (HISKs versus non-HISKs), distance traveled, and series duration of serial killers may hinder, rather than help, serial murder investigations as the present study results suggest that RTC distance and murder series duration do not significantly predict the HISK and non-HISK groups. Therefore, more research is needed to thoroughly examine the geospatial patterns of both serial killer groups to bridge this gap in the existing literature.

7.2.3 Limitations and Suggestions for Future Research

Although the findings of this study serve as a comparative baseline for future research, there are several limitations in addition to the ones previously specified that warrant further discussion. First, time and financial constraints prevented the researcher from generating and sending individual FOIA requests to the LEAs responsible for apprehending the 326 serial killers to obtain JTC data. Consequently, in place of FOIA requests, prerequisite and supplementary searches of public sources were used to obtain the RTC points of the killers' residences and murder sites for Study Two.

Second, the prerequisite searches by the researcher were used to collect JTC data on the 2,121 RU/FGCU SKD (2019) serial killer cases pertinent to this dissertation. However, these initial searches were hindered due to unobtainable JTC data for many serial killer cases. As a result, *25%* of the original proportionate stratified random sample of 326 serial killers needed to be *removed* and *replaced* by repeating the random case replacement procedure several times. Subsequently, supplemental searches were conducted to obtain additional JTC data and calculate the RTC distances for each serial killer and their murder sites. Discernably, there are limitations associated with using secondary sources in Study Two, such as the reliability and validity of the data points collected to calculate the RTC distances. Due to these limitations, the reliability and validity of the JTC data were cross-referenced and verified using various sources (i.e., law libraries, government and non-government archive websites, accredited legal software, court documents, the RU/FGCU SKD [for cases that JTC data was available], and certified public records services).

Third, in cases where the locations of the murder site could not be obtained, the disposal site, abduction site, approximate geocodes, streets, and Google Maps/Bing Maps were used to estimate the RTC points for certain locations. There should have been a total of 3,904 RTC points for the 326 serial killers and their 1,952 victims to compute the RTC distance calculations for the present study. However, six of the serial killer cases in the sample had missing data, and the RTC distances could not be computed, reducing the total to 3,860 RTC points and 1,930 RTC distance calculations. Fortunately, the reduction in these totals represented *less than 2%* of the missing RTC data of the 326 serial killers and their 1,952 victims in the sample.

Fourth, the data collected for Study Two were not normally distributed. As a result, independent sample *t*-tests and linear regression models could not be used for the initial analyses in Chapter 5 and supplemental analyses in Chapter 6. Therefore, Mann-Whitney *U* two-sample rank-sum tests and logistic regression models were used, as the independent sample *t*-tests and linear regression assumptions were not met. Due to the non-parametric nature of Mann-Whitney *U* tests and logistic regression models, limitations are expected since the assumptions are less stringent. Finally, while the murder series duration DV in Chapter 5 was not significant, it was used in Chapter 6 for the supplemental analyses as a control IV for Study Two to make the binary and multilevel regression models more meaningful.

Notwithstanding these limitations, there are several suggestions for future research concerning the geospatial patterns of HISKs. First, it is recommended that FOIA requests be sent to LEAs to collect the node locations of each serial killer to calculate the NTC distances of both serial killer groups. Such calculations can be analyzed concurrently with RTC calculations to determine if the distances traveled by both serial killer groups increase or decrease. Furthermore, the occupation type of both serial killer groups should also be included to examine potential differences between occupations and distances traveled during the series. For example, prior research indicates that long-haul truckers frequently exhibit longer JTC distances during the murder series than other occupations that do not require continuous travel (FBI, 2009; McClellan, 2009).

Second, a comparative study of static versus dynamic HISKs and the RTC/NTC distances traveled by each group should be examined to determine differences between the subgroups. Analogously, the perspectives of RAT, RCT, and CPT should be used to comprehensively explore static and dynamic HISKs versus non-HISKs to reveal whether dynamic HISKs resemble the hunting patterns of static HISKs or non-HISKs.

Third, future research should examine the potential effects of three factors related to the geospatial patterns of the two serial killer groups: (1) victim count, (2) temporal data, and (3) the number of residences of serial killers. For example, it would be interesting to assess the effects of the *number of victims* murdered and the distance traveled by both serial killer groups to establish whether *more prolific* serial killers travel longer *RTC/NTC distances* during the murder series. Both groups' number of victims and murder series durations should also be considered. Previous studies indicate that *more prolific* serial offenders often exhibit a *spatial learning curve* throughout their crime series and travel further from their comfort zone than *less prolific* serial offenders (Canter, 2003; Rossmo, 1995). As a result of this spatial learning curve of more prolific serial killers, such cases are often more challenging to solve than less prolific killers (Canter, 2003; FBI, 2008; Miller, 2014a; Rossmo, 2005; Yaksic & Comerford, 2019).

More broadly, the use of *temporal* data such as day of the week and “cooling off” periods between each murder to establish whether these factors significantly influence both serial killer groups’ RTC/NTC distances. Lastly, a future study investigating the *number of residences* of each serial killer would be interesting (see Lundrigan & Canter, 2001a, 2001b; Synnott et al., 2019). Such an investigation can examine the potential impact of serial killers with one home compared to numerous homes to analyze if single versus multiple homes impacts RTC distances of both groups during the series.

In summary, comparative studies and the use of RAT, RCT, and CPT perspectives are recommended for future research relevant to the hunting patterns of HISKs (static versus dynamic) and non-HISKS. Data pertinent to the nodes, number of victims, temporal patterns, and number of residences(s) should be further investigated to establish if such factors impact the geospatial patterns of HISKs and non-HISKs. From a JTC perspective, such research may yield invaluable information for LEAs and crime analysts. Differences in these factors could also assist in predicting locations of future murders or estimating the residence(s)/node(s) of serial killers in both groups (Canter, 2003; Rossmo, 2005). Finally, further studies that take these factors into account will help bridge the gap in serial homicide research on the geospatial patterns of HISKs.

7.3 Study Three: Criminal Precipitators of HISKs Versus Non-HISKs

In Chapter 6, two *developmental/life-course* perspectives of criminality (1) criminal career paradigm (CCP) and (2) life-course-persistent offenders (LCP), served as the theoretical framework for examining the non-fatal *criminal precipitators* (CPs) committed before the murder series by HISKs and non-HISKs (Blumstein et al.,1986; Moffitt, 1993; Piquero et al., 2003). Until now, minimal attention has been paid to the non-fatal CPs of HISKs. Therefore, Study Three seems to be the first comparative investigation on the CPs of both serial killer groups. The analyses performed for Study Three enhance our knowledge of both serial killer groups' criminal histories by establishing that HISKs appear to illustrate differences in the severity and type of CPs than non-HISKs, but not in the direction as previously anticipated.

The following section summarizes the results of Study Three as they relate to the larger literature in this field. The theoretical and policy implications will be discussed, followed by the limitations of Study Three and recommendations for future research.

7.3.1 Results from Chapter Six (Study Three)

Chapter 6 (Study 3) investigated the non-fatal CPs committed before the murder series by HISKs and non-HISKs to address the notable gap in serial homicide research. The *severity* and *type* of CPs were examined to determine if differences exist between the two serial killer groups and group membership prediction. The *combined* model in Chapter 6 of both the severity and type of CPs seemed to illustrate *inverse* results as non-HISKs engaged in *more severe* CPs (*violent fantasies*), and HISKs committed *more types* of CPs (*property offenses*) compared to non-HISKs. The final model showed that the odds of HISK group membership were 68% *lower* for serial killers who had violent fantasies. In contrast, the odds of the HISK group were more than *four times higher* (313%) for serial killers who committed property offenses. The final model of Study Three reported *pseudo*-R^2 values that explained between 17.5% and 23.4% of the variance in serial killer group membership and correctly classified 67.5% of the serial killers into HISK (71.2%) and non-HISK (63.8%) groups.

Previous studies that have used logistic regression models to examine serial killers' criminal careers specifically are limited and have reported *pseudo*-R^2 values between 7% and over 10%, with overall classification scores ranging from less than 65% to over 70% (DeLisi & Scherer, 2006; Leary et al., 2017). The final model in Study Three indicates *average* results in model fit and classification prediction related to the existing literature in this field. Unfortunately, the *inverse* results of Study Three did not meet the

50% criteria condition (*one of two* hypotheses), and both IVs (severity and type of CPs) were consequently excluded from the supplementary analyses. Therefore, the working hypothesis of Study Three could not be further investigated, and as a result, the classification of HISKs versus non-HISKs remains undetermined.

The results of Study Three are both *consistent* and *inconsistent* with previous research on the criminal histories of serial killers and home invasion sex offenders using CCP and LCP perspectives. Previous studies have applied both perspectives to examine the severity and type of offenses in the criminal records of serial killers, which demonstrates that such killers typically engage in non-violent and violent crimes before the murder series (FBI, 2014; Godwin, 2000; Hickey, 2016; Langevin, 2003; Martin et al., 2020; Reid et al., 2019; Singer & Hensley, 2004; Wright et al., 2008).

Prior studies have also used these perspectives to investigate the criminal histories of home invasion sex offenders. These studies indicate such offenders frequently have lengthy offense records involving *property* offenses and *more severe* offenses involving *residential sex crimes* such as sexual burglary and home invasion rape (Beauregard & Martineau, 2012; DeLisi & Scherer, 2006; Greenall & West, 2007; Harris et al., 2013; Pedneault et al., 2012; Schlesinger & Revitch, 1999; Vaughn et al., 2008; Warr, 1988). These previous findings suggest that such offenders may exhibit *less versatile* and *more severe, specialized* criminal careers than non-residential sex offenders.

However, the overall results of Study Three revealed *inverse* findings, as HISKs and non-HISKs seem to differ in their criminal histories but not in the direction as previously anticipated. HISKs did not engage in *more severe* CPs, nor did they commit *fewer types* of CPs than non-HISKs prior to their first murder. In contrast, non-

HISKs engaged in *more severe* CPs (violent fantasies), and HISKs committed *more types* of CPs (property offenses) before the murder series. These findings, while preliminary, could not provide definitive evidence that HISKs exhibit *less versatile* and *more severe, specialized* criminal careers than non-HISKs.

Conversely, these preliminary results are broadly *consistent* with earlier studies that suggest home invasion sex offenders exhibit specialized criminal careers involving *property offenses* (DeLisi & Scherer, 2006; Harris et al., 2013). Moreover, the descriptive statistics concerning the commission of sexual residential burglary (SRB) illustrated that HISKs committed considerably more SRBs (30%) than non-HISKs (4%). In light of these results, future studies on the criminal histories of both groups should take into account specific crimes such as property offenses and sexual residential burglary.

It is important to note that the findings of Study Three were indeterminate and must be *interpreted with caution* for several reasons. First, a possible explanation for these results may be the multidimensional nature of the Study Three IVs/hypotheses examined in Chapter 6. Second, due to the lack of data on the *frequency* of CPs, this study was limited to dichotomously measuring whether serial killers engaged in the SCI categories and type of CPs before their first murder. Consequently, the dichotomous and restrictive nature of the two IVs/hypotheses was limited in their analytical capacity for the present study. Therefore, more comparative research is needed to understand better the variance between both groups' severity and type of CPs before the murder and provide more definitive evidence in the classification of HISKs versus non-HISKs.

Despite its indeterminate findings, Study Three delivers the first comparative investigation on the criminal histories of HISKs and non-HISKs to address the substantial gap in the existing serial homicide literature. Furthermore, the present study offers further insight into the non-fatal CPs of both groups before the murder series. For example, the frequency statistics of the descriptive variables showed that both groups primarily committed their first CP as young adults and the mean age at the first murder was in their late 20s. Similarly, most serial killers in both groups had prior criminal records. Over two-thirds of the sample had been previously arrested or served time in jail or prison before their first murder. In contrast, HISKs committed considerably more sexual residential burglaries than non-HISKs before their first murder. The theoretical and policy implications of the results of Study Three are discussed in the following section.

7.3.2 Implications

Notwithstanding the indeterminate results, important theoretical and policy implications are gleaned from the present study. From a theoretical standpoint, the results of this study suggest important implications to be considered for future research in this domain. Application of CCP and LCP perspectives in prior studies of home invasion sex offenders indicates such offenders exhibit more severe and specialized criminal careers than non-residential sex offenders (DeLisi & Scherer, 2006; Pedneault et al., 2012; Vaughn et al., 2008). Conversely, the results of Study Three are somewhat contradictory to prior research, as HISKs and non-HISKs seem to differ in their criminal histories but not in the direction as previously anticipated. Such results seem to suggest that CPs perpetrated by HISKs were not as severe as non-HISKs, but they committed more CP types (property CPs) than non-HISKs.

There are several potential explanations for these findings. First, the severity and type of CPs were multidimensional constructs. As a result, the SCI and CP types were used to determine if the serial killer engaged in any SCI categories or CP types. Second, the contradictory findings could also be attributed to the broad nature of both hypotheses proposed for Study Three. Initially, the analytical plan for this investigation was to conduct a longitudinal study on the offense escalation and the specialization versus the versatility of the CPs committed by both serial killer groups. However, the analytical plan of Study Three needed to be revised due to the lack of temporal and offense frequency data that could not be obtained through the prerequisite/supplemental searches. As a result, the escalation and the specialization versus versatility of the CPs of both serial killer groups could not be systematically assessed. Consequently, the scope of Study Three was limited as it only preliminary and dichotomously examined the differences between the number of serial killers in each group that committed more or less SCI categories and CP types. For this reason, further investigation of the criminal histories of both serial killer groups must be conducted to systematically assess the escalation and specialization versus the versatility of HISKs and non-HISKs.

Third, from a developmental/life-course perspective, the present study did not include information relevant to the upbringing of the serial killer (e.g., experienced abuse, psychological or personality disorders, biological or neurological impairments, and sociological factors) (Allely, 2020; Marono et al., 2020; Reid et al., 2019). Other factors relevant to the killer's background, such as relationships with family members, number of siblings, single-parent households, and poverty/living conditions, could also play a role in the current study results. Therefore, the association of these variables and the non-fatal CPs of both groups should be investigated in future studies. Such research could produce important theoretical implications relevant to CCP and LCP perspectives and the influence of developmental factors on the criminal careers of both serial killer groups.

The final theoretical implication of the present study is that far too little attention has been paid to the criminal history of HISKs and-HISKs. This study appears to be the first to examine both the severity and type of CPs committed before the murder series to determine the differences between both groups. Consequently, this study serves as a comparative baseline for further understanding the criminal histories of these groups to address the void in existing research on home invasion serial homicide. Overall, the results of this study pertinent to the developmental/life-course perspectives of criminality and the criminal histories of both groups offer avenues for future research in this area.

From a policy standpoint, two important implications emerge from the results of this study. From a *proactive* standpoint, these results indicate the need for a multifaceted approach to address antisocial or violent proclivities displayed by younger individuals (e.g., violent fantasies/drawings and ideations, animal cruelty, property offenses, violence against others). LEAs, MHPs, schools, and parents must make a cumulative effort to report these behaviors and assist such individuals. Addressing this issue would further raise public awareness of the seriousness of such propensities, which often serve as warning signs of the likely progression to more severe and violent behavior in the future. Reporting these warning signs could also help intervention and prevention of such individuals graduating to serial murder (Allely, 2020; Leary et al., 2017; Malizia, 2017).

Finally, while the present study's findings should be interpreted with caution, the results show that HISKs were over *four times* more likely to commit property offenses than non-HISKs. From a *reactive* standpoint, in unsolved HISK cases, LEAs should review the criminal records of suspects to determine if such suspects have a history of property offenses. This information could be used to search and potentially narrow suspect lists based on previous criminal records for property offenses.

7.3.3 Limitations and Suggestions for Future Research

While the findings of this study serve as a comparative baseline for future research, there are several limitations in addition to the ones previously specified that warrant further discussion. First, there are limitations and disadvantages of using secondary resources instead of FOIA requests for the data collection on serial killer criminal histories. Such limitations and disadvantages include (but are not limited to): missing frequency and temporal data, the exact age of serial killers' first CP, and unreported/unofficial criminal activities. Moreover, official criminal records and secondary data sources present limitations regarding serial killers' antisocial behaviors or criminal actions. Though the researcher's searches to collect all the data in the present study were cross-referenced with numerous sources, such sources may not have reflected the *full extent* of CPs or antisocial behaviors exhibited by serial killers before their first murder. In particular, serial killers who engage in such behaviors or actions are frequently not officially reported, or the serial killer was not arrested. As a result, such information is not officially or publicly available (Miller, 2014b).

On the contrary, this study has advantages in using secondary data sources such as the RU/FGCU SKD (2019) and public information searches. The primary benefit is that secondary data sources contain relevant information pertinent to the criminal background of serial killers that were never arrested or convicted and, in turn, did not have an official criminal record. Secondary resources such as true crime books, serial killer documentaries, online and television interviews, newspapers, missing persons and serial murder websites, and the like, afford an abundance of qualitative information relevant to the present study, a lot of which is absent in official records. Vaughn et al. (2008) assert that secondary sources and self-reports "can yield arrests and other criminal activities that do not appear on official records, arguably rendering them a more accurate reflection of an individual's true criminal past" (p. 1388).

Second, the present study initially included a third IV and hypothesis on the commission of sexual residential burglary (SRB) by both groups before the murder series. This variable was of particular interest, as prior research indicates that home invasion sex offenders commonly exhibit criminal histories of sexual residential burglary offenses (DeLisi & Scherer, 2006; Greenall & West, 2007; Harris, 2013; Pedneault et al., 2012; Vaughn et al., 2008). Unfortunately, only a limited number of serial killers committed SRBs. The low event per variable frequency of non-HISKs and SRBs caused inflated odds ratios and confidence intervals in the regression models. As a result, SRB was removed from the models and included as a descriptive variable in the present study. However, the descriptive statistics of the present study showed that HISKs committed considerably more SRB offenses than non-HISKs, suggesting that sexual residential burglary and HISKs should be examined in future research.

Third, the data analyzed in the current study were not normally distributed as they only contained dichotomous dependent and independent variables. As a result, binary logistic regression was used instead of linear regression. Therefore, it is recommended that future studies in this domain use normally distributed data to perform linear regression and other parametric tests.

Lastly, since Study Three did not meet the 50% criteria, both IVs from this investigation were consequently excluded from the supplemental analyses and classification determination of both serial killer groups. This limitation was unfortunate as further supplemental analyses and the working hypothesis of Study Three regarding the classification of HISKs versus non-HISKs could not be performed for this investigation. Conversely, the preliminary findings of this study provide opportunities for future research in this area.

The above limitations notwithstanding, there are several suggestions for <u>future research</u> regarding the non-fatal CPs of HISKs and non-HISKs. First, it is recommended that FOIA requests for both serial killer groups be sent to LEAs to obtain official dates, frequency, and other pertinent information regarding their official criminal history before the first murder. Such information would be invaluable for future research concerning the CPs of both serial killer groups (i.e., dates/order and frequency information, measurement of CP escalation, age of first official CP, verification of secondary data, and examination of specialized versus versatile serial killers).

Second, to build on the results of Study Three, longitudinal analysis and the measurement of offense escalation are highly recommended. Offense escalation is a crucial factor in both reactive and proactive responses to violent serial offenders, as well as younger individuals that exhibit violent ideations or behavior toward animals and humans (FBI, 2014; Leary et al., 2017; Johnson & Becker, 1997; Singer & Hensley, 2004; Wright & Hensley, 2003). Further examination of offense escalation could potentially produce an investigative framework regarding the offending patterns of violent serial offenders and conceivably intervene before such offenders' graduate to their first murder (MacCulloch et al., 1983; Pedneault et al., 2015b).

Third, as mentioned previously, HISKs should be further delineated into static and dynamic HISK subgroups to examine the CPs of both types of HISKs. Subsequently, the CPs of static and dynamic HISKs should be compared with those of non-HISKs. Such research would be helpful to compare the CP patterns of dynamic HISKs to non-HISKs and if such serial killers resemble static HISKs or non-HISKs in their criminal careers.

Finally, it is highly recommended that qualitative interviews be conducted with incarcerated serial killers in both HISK and non-HISK groups to further examine the extent of their criminal histories before the murder series. Such interviews would reveal an abundance of information on the severity and type of CPs committed before the escalation to serial murder. This information would also address the void of data not otherwise documented in official criminal records or secondary sources.

In summary, comparative studies and CCP and LCP perspectives are recommended for future research relevant to the non-fatal CPs of HISKs (static and dynamic) and non-HISKS. Furthermore, data pertinent to the dates, order, and frequency of CPs, offense escalation, sexual residential burglary, and other developmental factors should be further investigated to establish if such factors impact the CPs committed by both serial killer groups. From a developmental/life course perspective, such research may yield instrumental knowledge for LEAs, crime analysts, MHPs, parents, and schools. Differences in these factors could also assist in reactive and proactive measures to thwart future murders in a series or prevent ostensibly troubled or violent individuals from progressing to their first homicide.

7.4 Conclusion

This dissertation aimed to address the considerable gap in the existing serial murder literature regarding home invasion serial homicide and HISKs and add to existing policy by delivering new approaches to assist in serial murder investigations of such killers. The present research contributes to existing knowledge in *three* key ways.

First, Study One revealed that HISKs warrant a distinct classification from non-HISKs regarding their modus operandi and crime scene actions (stalked attacks and single location crime scenes). These results have several noteworthy theoretical and policy-relevant implications. First, the results contribute and lend further evidence to support RAT and RCT perspectives regarding the offense patterns and decision-making processes of home invasion sex offenders compared to non-residential sex offenders. Second, these findings can aid LEAs and crime analysts in current or cold cases by providing sets of common characteristics exhibited by both serial killer groups. Such knowledge and characteristics can lead to swifter apprehensions of active serial killers, prevent future murders in the series, and assist in cold cases. Lastly, the findings of Study One also offer various SCP measures relevant to target hardening that residents should implement to protect themselves from falling prey to a home invasion serial killer.

Second, this dissertation raises public awareness of the problem of home invasion serial homicide and HISKs. Serial murder is often viewed as a rare phenomenon that primarily impacts individuals who engage in high-risk lifestyles or occur at unsafe locations other than the victim's residence (FBI, 2014; Quinet, 2011; Rossmo, 1995; Warf & Waddell, 2002). However, home invasion serial homicide is the most prevalent form of serial murder, indicating that an individual's home does not unequivocally safeguard residents from serial killers (Aamodt et al., 2020; FBI, 2014; Rossmo, 1995). Public awareness of the prevalence, offense patterns of HISKs, and SCP measures regarding this problem can result in policy-relevant implications, leading to reactive and proactive strategies to reduce or prevent the occurrence of home invasion serial homicide.

Finally, this study addresses the substantial gap in existing serial homicide research concerning the common characteristics, geospatial patterns, and criminal precipitators of HISKs. The findings of all three investigations advance our understanding of these analytical dimensions of both HISKs and non-HISKs. The three investigations also provide theoretical implications, as the findings serve as a comparative baseline relevant to environmental criminology and developmental/life-course perspectives of both serial killer groups.

Although this dissertation increases our knowledge concerning these three areas and both serial killer groups, future comparative research is recommended to bridge the gap in serial homicide literature relevant to HISKs and non-HISKs. Moreover, the distinction between static versus dynamic HISKs and non-HISKs remains unexplored. Further investigation of HISKs and related areas will provide a more comprehensive understanding and preventative approaches to deter such serial killers in the future.

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APPENDICES

APPENDIX A

HISK Stratum: Initial Random Sampling Procedure of 163 Cases by Victim Count Category

Victim Categories	Cases per Category	%	Randomly Drawn	Range	Unique Number Sets
2 Victims	195	29%	47	1-195	61, 39, 47, 104, 177, 100, 170, 71, 179, 173, 110, 66, 147, 59, 161, 124, 52, 130, 184, 122, 21, 145, 85, 174, 1, 193, 113, 156, 171, 48, 11, 49, 46, 2, 132, 153, 186, 187, 149, 140, 134, 37, 114, 29, 13, 119, 125
3 Victims	150	22%	36	1-150	115, 27, 28, 4, 36, 7, 64, 108, 25, 26, 54, 30, 143, 132, 101, 95, 104, 52, 60, 42, 40, 11, 70, 99, 53, 88, 119, 78, 79, 83, 16, 77, 61, 50, 3, 9
4 Victims	95	14%	23	1-95	21, 46, 74, 68, 86, 55, 47, 16, 93, 31, 32, 89, 67, 62, 11, 58, 14, 28, 85, 26, 60, 52, 25
5+ Victims	237	35%	57	1-237	69, 166, 140, 111, 96, 17, 160, 192, 118, 194, 165, 180, 26, 170, 162, 27, 49, 214, 206, 25, 184, 230, 196, 152, 85, 235, 205, 108, 212, 185, 218, 65, 51, 211, 29, 207, 136, 12, 33, 102, 187, 209, 220, 11, 6, 113, 94, 138, 127, 177, 116, 224, 110, 131, 200, 119, 135

Notes. The proportionate stratified random sampling procedure involved several steps:

(1) *Serial homicide dissertation definition*: Criteria for the target population of serial killers from the RU/FGCU SKD (2019) (2,121 cases).

(2) *Relevant stratification characteristic* = The *location* where each killer murdered their victims was the used to stratify the target population of 2,121 cases into two mutually exclusive, non-overlapping strata. *Target population stratum of HISKs* = 677 cases.

(3) *Power analysis and sample calculation of target population* (2,121 cases) = 326 cases divided into HISKs (= 163) and non-HISKs (= 163).

(4) *Proportionate Decision rule* = Number of victims of each serial killer of the *victim count categories* (2 victims, 3 victims, 4 victims, 5+ victims), and *proportion calculations* of the victim count categories were computed for each stratum.

(5) *Simple random sampling procedure and randomizer application*: Used to replace the cases where the JTC data was unavailable and generate random number sets of each victim count category for the HISK strata based on the number of cases for each category.

(6) *34 HISK cases* = Removed/randomly replaced; the procedure was repeated *four* times to finalize the HISK sample (n = 163).

(7) *Final number of replacement cases of the final sample* = 84 cases (25%) were removed/replaced with other randomly drawn cases.

APPENDIX B

Non-HISK Stratum: Simple Random Sampling Procedure of 163 Cases by Victim Count Category

Victim Categories	Cases per Category	%	Randomly Drawn	Range	Unique Number Sets
2 Victims	305	21%	34	1-305	202, 34, 296, 208, 126, 31, 138, 207, 227, 242, 222, 136, 262, 179, 231, 130, 163, 61, 195, 251, 17, 93, 11, 67, 71, 276, 50, 286, 223, 243, 86, 275, 188, 15
3 Victims	293	20%	33	1-293	290, 133, 214, 184, 220, 187, 83, 91, 244, 281, 109, 54, 223, 70, 260, 115, 125, 117, 232, 173, 204, 85, 64, 33, 123, 227, 261, 75, 62, 41, 112, 159, 226
4 Victims	200	14%	23	1-200	55, 156, 137, 190, 170, 2, 147, 152, 104, 69, 165, 161, 72, 11, 87, 85, 123, 17, 109, 166, 167, 143, 191
5+ Victims	646	45%	73	1-646	514, 142, 9, 535, 445, 178, 471, 499, 575, 120, 147, 537, 330, 582, 113, 289, 539, 634, 124, 254, 410, 411, 314, 209, 213, 249, 16, 116, 352, 538, 237, 576, 275, 386, 515, 164, 479, 548, 585, 321, 300, 579, 135, 401, 577, 480, 295, 140, 278, 18, 418, 412, 454, 115, 569, 93, 604, 540, 497, 376, 446, 336, 417, 357, 598, 112, 133, 234, 433, 55, 230, 48, 494

Note. The proportionate stratified random sampling procedure involved several steps:

(1) *Serial homicide dissertation definition*: Criteria for the target population of serial killers from the RU/FGCU SKD (2019) (2,121 cases).

(2) *Relevant stratification characteristic* = The *location* where each killer murdered their victims was the used to stratify the target population of 2,121 cases into two mutually exclusive, non-overlapping strata. *Target population stratum of Non-HISKs* = 1,444 cases.

(3) *Power analysis and sample calculation of target population* (2,121 cases) = 326 cases divided into HISKs (= 163) and non-HISKs (= 163).

(4) *Proportionate Decision rule* = Number of victims of each serial killer of the *victim count categories* (2 victims, 3 victims, 4 victims, 5+ victims), and *proportion calculations* of the victim count categories were computed for each stratum.

(5) *Simple random sampling procedure and randomizer application*: Used to replace cases where the JTC data was unavailable and generate random number sets for each victim count category of the non-HISK strata on the number of cases for each category.

(6) *50 Non-HISK cases* = Removed/randomly replaced; procedure was repeated *five* times to finalize the non-HISK sample (n = 163).

(7) *Final number of replacement cases of the final sample* = 84 cases (25%) were removed/replaced with other randomly drawn cases.

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SELECTED PUBLICATIONS AND PRESENTATIONS

Comerford, C.V. (2021). A scoping review of serial homicide geographic mobility literature and four typologies. *Homicide Studies*, 1-28. https://doi.org/10.1177/1088767921993506

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